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Economic Determinants of Domestic Investment in an Oil-Based Economy: The Case of Iran (1965-2010)

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Hadis Khonsary-Atighi

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The PhD School of Economics and Management

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HÅNDELSHØJSKOLEN

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IN AN OIL-BASED ECONOMY: THE CASE OF IRAN (1965-2010)**

**BY
HADIS KHONSARY-ATIGHI
JANUARY 2016**

**SUPERVISORS
PROFESSOR ARI KOKKO; PROFESSOR KERRY PATTERSON**

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Hadis Khonsary-Atighi
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*Dedicated to my parents
to Stefan
and to the memory of my aunt*

ABSTRACT (IN ENGLISH)

The central focus of this thesis is the identification of theory-consistent economic determinants of aggregate and sectoral domestic investment in the context of the oil-rich and oil-based economy of Iran within the theoretical framework of modified neoclassical-accelerator type investment models. This thesis further attempts to extend this theoretically consistent framework by incorporating oil-driven financial constraint measures such as specified by cash flow models. The latter is justified on the basis of the presence of imperfect capital markets in Iran and the inherent uncertainty associated with the availability of oil-driven finance for investment due to the unpredictable nature of oil prices. A CVAR method is being employed to determine the theory-consistent long-run relationships between the variables of interest during 1974-2011.

Motivated by the existing gaps in the investment and natural resource curse literature, the main objectives of the thesis include investigating: (i) the extent to which the theoretical framework is able to explain investment in the Iranian context and the underlying reasons for the (expected) partial applicability of such a framework; (ii) the relation between oil and investment patterns; and (iii) sectoral shifts during the process of capital accumulation and the role of the state in this process. Hence, the findings of this thesis contribute to current debates in the literature on the economics of natural resources and on investment, as well as to the application of the investment literature in the context of oil-abundant and -dependent economies like Iran.

The empirical results, interestingly, showed that aggregate investment largely corresponds to factors which lie within the above theoretical framework. Notably, such a framework made it possible to make inferences and to draw policy implications based on the theoretically motivated long-run relationships between economic determinants of investment. It further allowed exploring how well such a framework, in the context of partial-market oil-driven economies like Iran, was applicable with some modifications that were needed to make the framework more appropriate for such economies.

Consistent with the predictions of the theory, at large, investment was strongly and positively related to output and the growth rate of capital in the long-run. Also, as expected by the theory, investment was negatively related to inflation, which was used as a proxy for the user cost of capital. However, investment and the user cost of capital were not associated in the long-run when the expected rates of return on facilities were used in the calculation of the user cost of

capital. This was explained on the grounds that the expected rates of return on facilities are centrally-set, making them quite non-responsive to changes in the economy's inflationary pressures. The empirical evidence further supported that the coefficients associated with the oil income variable carried a positive sign, suggestive of the importance of oil windfalls for investment spending in the Iranian economy. Employing impulse response functions (IRFs), the findings revealed that the effects of shocks to various measures of oil on investment and output were insignificant in most cases.

Contributory to the resource curse literature, the empirical findings based on the sector-level analysis revealed a pattern of structural shifts which only partly correspond to the Dutch Disease theory. This pattern was characterized by the expansion of investment and output in the sectors of services and manufacturing, yet by the contraction of output in the oil and gas sectors. This thesis refers to this phenomenon as the 'Iranian Disease', which was mainly developed through state-led oil-driven investment spillovers not only for services but also for manufacturing due to the promotion of industrialization in the country which began in the early 1950s and continued throughout the study period. Furthermore, the empirical evidence suggested an upward level shift in investment and output of the sectors of agriculture, manufacturing and mining as well as services associated with the end of the Iran-Iraq war in 1988. Remarkably, both at aggregate and at sectoral levels, the trivial long-run importance of the regime shift and various macroeconomic policies on investment signified the most characteristic feature of the Iranian economy in the pre- and post-revolutionary era, that is, its oil-dependency.

ABSTRACT (IN DANISH)

Det centrale fokus for denne afhandling er at identificere teorikonsistente økonomiske determinanter for samlede og sektorspecifikke indenlandske investeringer i kontekst af Irans olierige og oliebaserede økonomi inden for den teoretiske ramme bestående af tilpassede, neoklassiske accelerator-investeringsmodeller. Afhandlingen forsøger desuden at udvide denne teoretisk konsistente ramme ved at indarbejde finansielle begrænsninger forårsaget af oliemarkedet, f.eks. som angivet af cashflow-modeller. Denne fremgangsmåde retfærdiggøres af ufuldkomne kapitalmarkeder i Iran og den usikkerhed, der på grund af olieprisernes uforudsigelighed altid vil være forbundet med adgangen til oliedrevet finansiering af investeringer. Der anvendes en CVAR-metode til at bestemme de teorikonsistente, langsigtede forhold mellem de interessante variabler i perioden 1974-2011.

Som bidrag til afhjælpningen af nuværende mangler i litteraturen om investering og naturressourceforbandelse er hovedformålene med denne afhandling at undersøge: (i) i hvilken udstrækning den teoretiske ramme kan forklare investering i den iranske kontekst samt de underliggende årsager til denne rammes (forventede) delvise anvendelighed, (ii) relationen mellem olien og investeringsmønstrene og (iii) sektorspecifikke forskydninger under kapitalakkumuleringsprocessen og statens rolle i denne proces. Denne afhandlings resultater bidrager således til aktuelle debatter i litteraturen om naturressourceøkonomi og investering, samt om anvendelsen af investeringslitteraturen i konteksten af olierige og -afhængige økonomier som Iran.

De empiriske resultater viste nok så interessant, at de samlede investeringer i stor udstrækning afhænger af faktorer, som ligger inden for den ovennævnte teoretiske ramme. En sådan ramme gav navnlig mulighed for at drage slutninger og pege på politiske tiltag ud fra de teoretisk motiverede langsigtede relationer mellem økonomiske determinanter for investeringer. Det gav desuden mulighed for at undersøge, hvor anvendelig den teoretiske ramme var for oliedrevne, delvise markedsøkonomier som Iran, hvilket medførte nogle ændringer, som var nødvendige for at gøre rammen mere relevant for sådanne økonomier.

I overensstemmelse med teoriens forudsigelser var der generelt set et stærkt og positivt forhold mellem investeringer, produktion og kapitalens vækstrate på langt sigt. Samtidig var investeringerne, i overensstemmelse med de teoribaserede forventninger, negativt forbundet

med inflationen, hvilket blev brugt som en fuldmagt til brugernes kapitalomkostninger. Imidlertid var der ikke nogen langsigtet sammenhæng mellem investeringerne og brugernes kapitalomkostninger, når de forventede rentesatser blev brugt i beregningen af brugernes kapitalomkostninger. Dette blev forklaret med, at rentesatserne bestemmes fra centralt hold, hvilket gør, at de ikke påvirkes af ændringer i økonomiens inflationspres. De empiriske realiteter understøttede yderligere, at de med olieindtægten forbundne koefficienter havde positivt fortegn, hvilket tydede på, at de uventede oliegevinster havde betydning for investeringslysten i den iranske økonomi. Ved brug af IRF'er (impulse response functions) viste resultaterne, at oliechokkenes indvirkning på investeringer og produktion i varierende omfang var ikke-lineær.

Som et bidrag til litteraturen om ressourceforbandelse viste de empiriske resultater baseret på analysen på sektorniveau et mønster af strukturelle forandringer, som kun delvis stemte overens med teorien om hollandsk syge. Dette mønster var karakteriseret ved en udvidelse af investeringerne og produktionen i servicesektoren og forarbejdningsindustrien, dog med en tilbagegang inden for olie- og gasssektoren. I denne afhandling kaldes dette fænomen "den iranske syge", som primært blev skabt via statslige, oliedrevne investeringers afsmittende effekt, ikke blot på servicesektoren, men også på forarbejdningsindustrien som følge af de industrialiseringsfremmende foranstaltninger i landet, der blev påbegyndt tidligt i 1950'erne og fortsat i hele undersøgelsesperioden. Desuden viste erfaringerne, at investeringer og produktion var steget såvel inden for landbruget, forarbejdningsindustrien og minedriften som inden for servicesektoren efter afslutningen af krigen mellem Iran og Irak i 1988. Bemærkelsesværdigt var det, at på langt sigt var den ubetydelige indvirkning på investeringerne af regimeskiftet og de forskellige makroøkonomiske politikker, både samlet set og for de enkelte sektorer, kendetegnet ved olieafhængighed både før og efter revolutionen.

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LIST OF ABBREVIATIONS

BP	British Petroleum
CAI	Capital Accumulation Identity
CATS	Cointegration Analysis Of Time Series
CBI	Central Bank Of Iran
CD	Cobb Douglas
CES	Constant Elasticity Of Substitution
(C)VAR	(Cointegrated) Vector Autoregressive
DSGE	Dynamic Stochastic General Equilibrium
EIA	Energy Information Administration
FDI	Foreign Direct Investment
FOC	First Order Condition
FYDPs	Five-Year Development Plans
GARCH	Generalized Autoregressive Conditional Heteroscedasticity
GDP	Gross Domestic Product
GFCF	Gross Fixed Capital Formation
H-Q	Hannan-Quinn Criterion
ICOR	Incremental Capital-Output Ratio
IEA	International Energy Agency
IFS	International Financial Statistics
IMF	International Monetary Fund
IRFs	Impulse Response Functions
IRGC	Iranian Revolutionary Guard Corps
LM	Lagrange Multiplier
LNG	Liquefied Natural Gas
LR	Log-Likelihood Ratio
MCC	Money And Credit Council
MEK	Marginal Efficiency Of Capital
MPK	Marginal Productivity Of Capital
MPL	Marginal Productivity Of Labor
MPO	Management And Plan Organization
NDF	National Iranian Gas Company
NIGC	National Iranian Oil Company
NIOC	National Development Fund
NPC	National Petrochemical Company
NPLs	Non-Performing Loans
OPEC	Organization Of The Petroleum Exporting Countries
OSF	Oil Stabilization Fund
PIM	Perpetual Inventory Method
PO	Plan Organization
POGC	Pars Oil And Gas Company
RATS	Regression Analysis Of Time Series
SC	Schwarz Criterion
SCI	Statistical Centre Of Iran
SOEs	State-Owned Enterprises
TSE	Tehran Stock Exchange
US	United States Of America
(V)ECM	(Vector) Error Correction Model

1. INTRODUCTION

1.1. INTRODUCTION

The central focus of this thesis is the identification of aggregate and sectoral economic determinants of domestic investment in the context of the oil-rich and oil-based economy of Iran within the theoretical framework of modified neoclassical-accelerator type investment models. A cointegrated vector autoregressive (CVAR) method is employed to determine the theory-consistent long-run relationships between the variables of interest. The analysis is organized around three interconnected themes which underpin the development of investment patterns in the country during the years spanning from 1974-2011. These include: (i) the theory-based long-run macroeconomic determinants of investment; (ii) the impact of oil in financing investment; and (iii) the sectoral and structural shifts during the process of capital accumulation in the Iranian economy. With regards to the latter, the thesis refers to the problematic nature of these shifts as the ‘Iranian Disease’, a special case of the Dutch Disease. In particular, the use of sector-level data allows the recognition of sectoral heterogeneity in investment behavior in the presence of resource windfalls. An attempt is further made to go beyond the specifications of these themes by highlighting the interactions between economy- and sector-level investment, growth and institutional changes with an emphasis on the role of the state in this setting.

The standard (Jorgensonian-type) neoclassical model of investment assumes that the current level of investment is influenced by current and expected changes in the demand for output, taxation imposed on business income and relative factor prices. These are all important investment determinants of profit maximizing firms in competitive open-market economies. Therefore the neoclassical model of investment has been frequently used in empirical work. However, this model is based on some restrictive assumptions such as certainty about the future profitability and perfect capital markets. Hence, future expectations are expected not to affect the present since the stock of capital can be instantaneously and costlessly adjusted in the future. Yet, these assumptions do not fully hold if firms are uncertain or have different expectations regarding the future values of determining factors of investment. Particularly, in the context of partial-market and oil-rich exporting economies like Iran, uncertainty associated with the unpredictable nature of international oil prices and oil revenues could be expected to influence the availability of funds for investment activities in these economies.

In Iran, as in most developing economies, the state is involved in market regulation for instance through setting deposit and lending rates of return in the banking system, imposing protective tariffs or granting subsidies. Before the Islamic revolution in 1979, the government's direct investment in different productive sectors of the economy was noticeable. However, in the post-revolutionary era, direct investment by the government has been considerably reduced. This, for example, can be seen in Figure 2.3 (Chapter Two) illustrating the share of public investment compared to that of the private sector, or in Tables 6M3 and 6M4 (Appendix 6M) depicting government development expenditures in manufacturing and the share of credit facilities extended to public enterprises, respectively. Although, at the time of the revolution, a great share of the economy's large scale private sector was nationalized, these enterprises are independent of the central government and organized in large conglomerates called foundations. Moreover, since the early 2000s, due to the implementation of the privatization program, the government has divested of a large part of the public enterprises under its direct control.

The CBI is officially responsible for the supervision of all banks and credit institutions, and since the 1980s for the design and the conduct of monetary policies in the context of the Islamic Banking. Each year, after the government's approval of the annual budgets, the CBI presents its monetary and credit policy to the MCC for approval, and major elements of these policies are then incorporated in the development plans. The CBI implements monetary policies, both directly with no reliance on market conditions (through determining banking profit rates and credit ceilings) and indirectly or market-based (through deciding on reserve requirement ratios, issuing participation papers and regulating open deposit accounts). Appendix 2B provides the expected rates of profit on facilities by the specialized banks during 1973-2010.

Also, based on the Monetary and Banking Law, the CBI further intervenes in the monetary and banking affairs by restricting banks through setting sector-level ceilings for loans and credits. In this setting, the state-owned specialized banks provide loans and financial services to corporate sectors. They lend at subsidized rates, and their lending is rationed and concentrated on a small number of large companies or priority sectors. Although these banks take deposits, a greater part of their loanable funds comes from the commercial banks, other public sources including the central government and the CBI. Before the 4th FYDP, the MCC annually set the share of economic sectors from the outstanding loans and facilities extended by public banks to the non-public sector. Since the execution of the 4th FYDP, the sectoral allocation of the banking

facilities has been encouraged to be done through the use of cash subsidy and administered funds in the banking sector. Appendices 6L1, 6M4 and 6O8 report the extended facilities by banks and credit institutions to the sectors of agriculture, manufacturing and mining, and construction and housing, respectively.

Even though the Central Bank of Iran is formally an independent institution, its economic independence is in practice undermined due to its limited ability to control the quantity of credit it lends and to set the expected rates of return on facilities that is charged on (Jafari-Samimi, 2010). Also, rather than being dependent on the banks' profitability according to the Usury-Free Islamic Banking Law of Iran, deposit rates have become pre-set and the depositors have never gained higher returns than the pre-determined provisional rates or lost their savings (Hassani, 2010; Jafari-Samimi, 2010). Further, interestingly, the commercial risks of banks' are curtailed since the principal amount together with the late fees and the expected rates of return on facilities are collected by possessing and or selling of secured high value collateral items at the time of defaults (Hassani, 2010).

During the 1960s and the 1970s, the government pursued a policy of financial assistance to the private sector particularly through two banks, namely the Industrial and Mining Development Bank and Industrial Credit Bank (Karshenas, 1990). Following the revolution, however, substantial structural changes took place in the country's credit market and the banking system. For instance, in accordance with Article 44 of the Constitution, any fundamental market-oriented reforms such as privatization became highly constrained in the early 1980s and the Islamic Usury-Free Banking Law was introduced. Further, all the large-scale industries and commercial banks were nationalized. At large, during 1979-1988, the private sector activities were limited to small-scale mining and manufacturing, agriculture, and domestic trade and services (Jalali-Naini and Khalatbari, 2002). During the first plan, the Tehran Stock Exchange (TSE) was re-opened by the government. This, coupled with favorable oil prices, increased the financial resources of the banking sector and gradually relaxed the limits on sectoral credit allocations. Furthermore, participation shares were introduced as securities for medium-term investment financing of projects (Jalili-Naini and Toloo, 2001). During the implementation of the fourth plan, the government further imposed different rates and conditions on public banks to give high priority in their lending practices to technology-driven projects, small and medium enterprises, and to housing projects for low income earners (Amuzegar, 2010).

Therefore, the Iranian economy is characterized by a mixed-market economy nature. Nonetheless, it is not clear how and the extent to which a market-based theory would function in the context of a partial market economy since prices may provide incomplete signals to participants. In fact, it is reasonable to expect that the partial market economy of Iran could not fully perform like a neoclassical economy due to the peculiarities of the country, ranging from oil dependence to the Islamic revolution and state involvement in the economy of the country. The Jorgenson model, for instance, assumes perfect capital markets, constant returns to scale, price takers, which may not even be justified for Western economies.

Accordingly, the question is what might be relevant. The answer, in part, depends on how the allocation mechanism works. For instance, if outputs are fixed according to a plan, they cease to be endogenous and then firms may try to meet these targets in the most efficient way. This may motivate investment decision making as cost minimization rather than profit maximization. That is, firms minimize their production costs and the demand for capital becomes a derived function. Consequently, firms first specify the production function and then attempt to minimize costs of production so as to produce desired output. This will work provided that the prices of inputs provide (relatively) appropriate signals for substitution at the margin between, e.g., capital and labor, and these conditions will be of the same nature as if the firms were profit maximizing.

Against this background and given the desired properties of the neoclassical investment theory and its extensive use in the literature, it is of interest for this thesis to study how well such theoretical framework can explain investment in the context of the mixed-market economy of Iran.¹ In modelling domestic investment behavior, nevertheless, this thesis modifies the standard neoclassical-accelerator type investment models by augmenting them with oil-driven measures of financial constraints as specified by the principles of cash flow models. Also, it must be born in mind that although Jorgenson's investment model takes dynamics into account, it can be reduced to a static optimization problem as its optimality conditions only include variables in

¹ A complement to the analyses would have been to address the nature of investment decisions by separating private and public investment at the aggregate level so as to better justify the choice of the theoretical framework by shedding light on the extent to which the aggregate model could have performed better for the private investment data. However, even though the Central Bank of Iran and the Statistical Centre of Iran provide data on public and private investment, the data on private and public output is limited to the construction sector, and the data on capital stock is not available at disaggregate level for the public and private sectors. Therefore, it was not possible to conduct such a complementary analysis. See Chapter Three for the survey of the theoretical and empirical literature on investment.

the current period due to the absence of adjustment costs. Hence, it is important to employ a suitable methodology which could help examine the dynamic nature of the data. For that reason, a Vector Error Correction Model (VECM) is employed to capture dynamic adjustment processes to the long-run equilibrium.²

The rest of this introductory chapter is organized as follows. Section 1.2 outlines the rationale and objectives of this study. Section 1.3 provides an overview of the structure of the thesis. Section 1.4 specifies the methodology employed in this study. Section 1.5 identifies the contributions and the limitations of the thesis, and finally, Section 1.6 concludes the chapter.

1.2. RATIONAL AND OBJECTIVES OF THE THESIS

Iran owns about 11% of the global proven oil reserves and 15% of the world's natural gas reserves, and it is OPEC's second largest oil exporter (IEA, 2014). The country's economy is dominated by the oil sector, representing about 90% of total export earnings and over 50% of government revenues (CBI, 2014). The availability of oil revenues as the main source of financing Iran's economic development plans and investment is influenced by oil price volatility, hence oil shocks can influence the investment patterns of the country and its economic policy-making (Mehrara, et al., 2010). The paramount role of the oil sector within the Iranian economy is the outcome of state-led economic policies stretching back at least half a century.

While the state always played a major role within the modern Iranian economy, a relatively balanced share of activities between the public and the private sector had been gradually created by the 1960s. During that decade, the private sector became more active in services, finance,

² Several comments on earlier drafts of the thesis have in fact questioned the choice to apply a neo-classical model for the Iranian economy. Some of the very critical choices that I had to make with regards to the theoretical framework adopted in this thesis are as follows. The Iranian economy is a mixed market economy where both private and public actors drive investment spending. Undeniably, relative to market economies, it may not be easy to define the private sector in the context of the mixed market economy of Iran. Nevertheless, the semi-SOEs could still be categorized as private entities in investment analysis. This is because they are commercial entities producing for the market; hence follow the same logic as private businesses. Thus, a model of investment based on profit maximization may be relevant, but of course prices may not be as responsive as under less regulated market economies. Since the prices may provide incomplete signals to participants, it is not clear how and the extent to which a market-based theory would function in a mixed market economy. The answer, in part, depends on how the allocation mechanism works. For instance, if outputs are fixed according to a plan, then firms may try to meet these targets in the most efficient way. This could motivate investment decision-making as cost minimization rather than profit maximization. This will work provided that the prices of inputs offer (relatively) appropriate signals for substitution at the margin between, e.g., capital and labor, and these conditions will be of the same nature as if the firms were profit maximizing.

manufacturing, construction and trade. This, in return, provided the environment for the development of market forces in the country.³ During the last four decades, however, Iran experienced several important events in its economic and political system and underwent institutional changes that affected the balance of activities between the public and the private sector and hence the functioning of the market forces in the country. These included various oil shocks in 1973, 1979, and 1986; the Iranian revolution in 1979 followed by the state ownership of major economic sectors; the Iran-Iraq war (1980-1988); and a range of economic reforms which were implemented throughout the study period.

In the early 1970s, substantial windfalls of oil flooded the state's finance and gave rise to government (capital) spending. This was followed by sizeable amounts of foreign and local private investment in the country. After the revolution, however, the state sector's influence on the economy strengthened as the Islamic Constitution defined the role of the private sector only as complementary to the state sector and provided a legal basis for the dominance of the state in the Iranian economy. In addition, the war with Iraq increased more strict state controls on economic activities in general. As a result, during the 1980s, the role of the private sector and of market mechanisms weakened. After the war, the government gradually promoted privatization policies in order to strengthen domestic market forces by promoting investment activities of the private sector. Yet, due to the existence of semi state-owned enterprises (SOEs) in form of various foundations, the border between the public and the private sector became unclear.⁴ Therefore, although market forces existed in the country throughout the period under study, the private sector in the post-revolutionary era did not become fully vibrant because of institutional, political and economic setup of the country in that time.⁵

Similar to many other developing countries, Iran faced a combination of high and variable inflation, slow growth and severe balance of payment problems. In the post-revolutionary years, budget deficits were largely financed by printing money as external borrowing and bond financing were constrained, and tax income marginally contributed to government total

³ For instance, see Karshenas (1990) for an in depth analysis of the restructuring of industrial capital and capital accumulation during the pre-revolutionary years.

⁴ Some of these foundations owned about 20% of the assets in the country with a GDP contribution of about 10% (Khajehpour, 2000). See also Chapter Two Section 2.2 for a discussion on the role of the state and semi-SOEs.

⁵ See Chapter Two Section 2.3.2 for a discussion on public and private capital formation during the study period.

revenues. The conversion of foreign currency into the Iranian currency (Rials) coupled with the monetization of budget deficits brought about a close association between fiscal and monetary policies in the Iranian economy. In particular, increases in government expenditures due to the abundance of oil windfalls were often followed by the expansion of money supply and higher inflationary pressures in the country. These special characteristics of the Iranian economy had major implications for the process of economic growth and capital formation during the study years.

Several studies on the macroeconomic structure of Iran have been conducted. Among others, these include investigating the impact of oil revenues on economic activities (Amuzegar, 1997; Esfahani and Pesaran, 2009; Mehrara, et al., 2010) and the effects of oil price shocks on economic growth (Karshenas and Hakimian, 2005; Mehrara and Oskoui, 2007; Farzanegan and Markwardt, 2009). However, little is known about the institutional and macroeconomic consequences of the availability of oil for the process of capital accumulation, and particularly for aggregate and sector-level domestic investment determinants in the Iranian economy.

In fact, investment is a central issue in macroeconomic theory and plays an important role in economic growth of a country. Keynes (1936) first called attention to the existence of an independent investment function in the economy. In Keynesian theory, the rate of interest is considered as the price of investment, thus the cost of finance should be kept low to stimulate investment (Keynes, 1936). The accelerator theory, based on the assumption of a fixed capital-output ratio, implies that prices, wages, taxes and interest rates have no direct impact on capital spending, but they may have indirect impacts. The restrictive assumptions behind the accelerator theory, which are explained in detail in Chapter Three, led Jorgenson (1963) to formulate the neoclassical investment model. According to this theory, the cost of capital transforms the acquisition price of an asset into an appropriate rental price which depends on the rates of return and depreciation.

Some early neoclassical models argued that uncertainty has a positive impact on investment (Abel, 1983; Hartman, 1972). However, the focus of the more recent investment literature following the work of Dixit and Pindyck (1994) is on the negative effects of uncertainty on investment. Some empirical contributions investigate the role of macroeconomic variables such as exchange rate distortions, the cost of capital, debt and inflation in depressing private

investment (Hadjimichael and Ghura, 1995), the associations between income distribution, political instability and investment (Perotti, 1994; Campos and Nugent, 2005) and the role of political and financial institutions in shaping investment behavior (Poirson, 1998). At large, however, the link between uncertainty and investment is subject to debate. Also, the literature on investment has largely ignored the question as to what role a country's deeper characteristics such as endowments or its institutional political system may play in shaping investment patterns in resource-rich and -dependent economies (Bond and Malik, 2007). There has been little research investigating how investment behavior and policies in such countries actually respond to oil price shocks or oil income fluctuations.

The latter is particularly important because, surprisingly, resource-rich economies like Iran often underperform in comparison to resource-poor economies in terms of economic growth. Numerous studies have shown a link between natural resource abundance and poor economic performance (e.g., Sachs and Warner, 1997). Many resource-dependent countries are in fact affected by 'the natural resource curse' which is also known as 'the paradox of plenty'. The resource curse thesis, introduced by Auty in 1993, attempts to explain the paradox that countries with an abundance of natural resources, specifically non-renewable ones such as minerals and fuels, tend to do worse in terms of economic growth and development outcomes than resource-poor countries (Auty, 1993).

This negative relationship between resource abundance and economic growth undoubtedly creates a theoretical dilemma as natural resources are expected to raise wealth and purchasing power of resource-rich economies, hence enabling them to invest and grow. Resource wealth can move economic growth forward, if combined with innovation, significant levels of human capital, industrial development, institutional reforms and open trade policies (Mehlum, Moene and Torvik, 2006; Blomstrom and Kokko, 2007; Lederman and Maloney; 2007; van der Ploeg and Poelhekke, 2010). Higher oil revenues may facilitate the import of capital and intermediate goods needed by industries, increase the entry of new technology and thus induce economic growth (Mehrra, et al., 2010).

A body of literature focuses on the 'Dutch Disease' theory to provide an explanation for the resource curse thesis. This theory attempts to describe the association between the exploitation of natural resources and a decline in the manufacturing sector. The term Dutch Disease

originally refers to the decline of the Dutch manufacturing sector due to the discovery of large natural gas fields in 1959, which subsequently led to the appreciation of the Dutch real exchange rate (Humphreys, et al., 2007). In the Dutch Disease model, there is a non-tradable good sector (e.g., services), a booming tradable sector (e.g., oil or natural gas) and a lagging tradable sector (e.g., manufacturing). An existence of a boom in a large natural resource sector will lead to the ‘resource movement effect’ and the ‘spending effect’ (Cordon and Neary, 1982). The former happens when the resource boom leads to an increase in the demand for labor in the booming sector, which will shift the direction of the production away from the lagging sector and toward the booming sector. This effect is also called ‘direct de-industrialization’. The latter takes place due to excessive revenues created by the resource boom, which results in a higher demand for labor in the non-tradable sector and takes the labor away from the lagging sector. This is also called ‘indirect de-industrialization’.

A further approach in line with the concept of the natural resource curse lies in the area of political economy. In resource-independent economies, governments tax citizens in order to be efficient and responsive. This bargain establishes a political relationship between rulers and citizens. However, in resource-dependent economies, governments do not need to tax their citizens as the source of income is guaranteed from natural resource rents. As a result, the relationship between governments and citizens collapses, citizens are often poorly served by their rulers and these countries are prone to be more repressive and corrupt (Moore and Unsworth, 2007). This is known as ‘the paradigm of the rentier state’. Economists differentiate profit-seeking from rent-seeking. The former leads to the creation of wealth, whilst the latter explains the use of the state’s power to redistribute wealth in the society. In fact, rentier states do not need to tax or may tax lightly as their primary function is the distribution of resources accruing from abroad. These resources enter domestic circulation and have an impact on their domestic economies only to the extent that they are domestically spent by the state. Spending is therefore the essential function of the rentier state and generosity the essential virtue of their rulers (Mahdavy, 1970).

Early empirical studies explained the inverse linear relationship between oil price increases and aggregate economic activities in oil-importing economies (Darby, 1982; Gisser and Goodwin, 1986). The oil price collapse of the early 1980s spurred research efforts to derive new specifications that could produce a more responsive oil-GDP relationship, one of which was the

notion of asymmetry in the economy's responses to positive and negative oil price changes (Mork, 1989; Lee, et al., 1995; Hamilton, 1996). In this picture, in oil-exporting economies, oil price increases can have greater positive impact on economic growth than the adverse effects of oil price decreases. As a result of oil price increases, government revenues increase which in turn can lead to faster growth in government spending (El-Anshasy and Bradly, 2009). An additional line of argument is associated with the volatility impact of natural resources. Resource-producing countries may gain massive influence and strength when prices of natural resources increase, whereas they can undergo major economic agony when prices fall. Countries that specialize in commodities with unstable prices are more volatile in their terms of trade, benefit less from foreign direct investment and will have lower growth rates in comparison with countries that are industrial leaders or those that specialize in commodities with more stable prices (see, for instance, van der Ploeg (2011a)).

The above discussion indicates that while many scholars attempt to explain the link between natural resource wealth and economic performance, this relationship remains open to disputes. Although some scholars find evidence in support of the natural resource curse thesis, others try to establish that the curse can be converted into a blessing if the quality of institutions is high enough to exploit the natural resource boom, for example through savings, investment, and the use of rents in innovation, knowledge and human capital development (Mehlum, et al., 2006). Some scholars argue that natural resources are 'neither curse nor destiny' (Lederman and Maloney, 2007) and that resource abundance is not the only determinant of growth (Caselli and Cunningham, 2009). This thesis thus attempts to answer a number of relevant research questions in the context of the oil-rich and oil-reliant economy of Iran as follows:

1. What are the economic determinants of aggregate and sector-level domestic investment in Iran?
2. To what degree is the modified neoclassical-accelerator type model of investment, augmented with oil-based financial constraint measures, applicable and effective in its empirical implementations to unravel the determinants of investment in the Iranian context?
3. What are the underlying explanations for (probable) partial applicability of such theoretical framework for the case of Iran if the empirical results do not provide a consistent degree of support for these models?

4. Does a long-run relationship exist between sector-level investment and the availability of oil windfalls? (ii) Are there sectoral differences? (iii) Do the empirical findings suggest the presence of a mechanism, in line with the Dutch Disease theory, through resource movement and in particular spending effects?
5. (i) What has been the role of the state in the process of economic development and capital accumulation in the pre- and post-revolutionary Iran? (ii) How has the presence of oil altered the institutional structure of the economy of Iran and how has it affected sectoral capital formation and balances in the country?

Accordingly, the main objectives of this thesis are to:

- i. examine the theory-driven economic determinants of aggregate and sector-level domestic investment over the years under consideration and the significance of oil-driven uncertainty in shaping investment behavior in Iran;
- ii. investigate the extent to which the modified neoclassical-accelerator type model of investment, augmented with oil-based constraint measures, can explain investment determinants in the Iranian context;
- iii. study the underlying reasons for (likely) partial applicability of the theoretical framework for the case of Iran;
- iv. explore if a mechanism, in line with the Dutch Disease theory, exists through resource movement and spending effects in the Iranian economy;
- v. study the role of the Iranian state in the process of growth, capital accumulation and structural shifts during the study period; and research how and the extent to which the presence of oil has altered the path of institutional structure in the Iranian economy during the years under investigation.

1.3. THE STRUCTURE OF THE THESIS

This thesis is divided into seven chapters. After this introduction, the second chapter investigates different stages of economic development, capital formation and institutional changes in the Iranian economy. Particular emphasis is given to the role of the state and oil income, and on how over-reliance on oil revenues has structured Iran's economic policy-making and capital accumulation process. What at first appears as the use of oil income for development and capital

spending may in the final examination turn out to be the utilization of oil chiefly for financing government current expenditures. Also, the availability of oil income could significantly affect monetary and fiscal policies with bearing on the allocation of resources at economy- and sector-levels. Hence, the role of the state in utilization of oil income for formulating revenue and expenditure policies along with the special characteristics of the Iranian economy have to be investigated. This, in depth, is done in Chapter Two.

Chapter Three surveys the literature on the concept of the resource curse and the Dutch Disease theory. Further, this chapter discusses theories which try to explain investment determinants in market, partial-market and resource-rich economies and studies their associated methods and empirical findings. Although investment is a major determinant of growth in the long-run, a general agreement on its determinants does not exist. In the presence of market imperfections, investment funds may only be available in external capital markets or may not be available at all, which in turn could constrain the availability of credit in financing investment. Not only has the post-revolutionary Iran's ability to borrow from international capital markets been constrained, but the availability of oil income as a key source of financing investment has also been subject to uncertainty and affected by the volatility of oil prices throughout the study period. Chapter Four, hence, provides an overview of major issues related to the modeling of investment behavior, particularly in the context of the oil-based partial-market economy of Iran. It then theorizes the model of investment related to this study based on the neoclassical-accelerator type investment models. Finally, it describes the empirical methodology used in this study in detail.

Chapters Five and Six investigate theory-consistent economic determinants of aggregate and sector-level domestic investment in Iran, respectively, and the extent to which the modified neoclassical-accelerator type model of investment provide an explanation for investment patterns in the Iranian economy. Furthermore, measures of oil-driven uncertainty are incorporated into the investment modelling to examine the role of oil in shaping investment patterns in the country. Subsequently, the chapters identify long-run economic determinants of aggregate and sectoral investment and shed light on how well the theoretical framework could explain investment behavior in the Iranian context. The economic sectors under study in Chapter Six are the resource sectors of oil and gas, the non-resource tradable sectors of agriculture and manufacturing, and the non-tradable sector of services. This is in line with the sectoral

classification of the Dutch Disease theory and allows to study whether the persistent accessibility of oil windfalls by the government results in structural shifts in the Iranian economy over the study period. Chapter Seven presents an overview of the main findings and contributions of the thesis, and concludes with a discussion on a set of policy implications motivated by the empirical findings.

1.4. METHODOLOGY

This thesis is a macroeconomic rather than a microeconomic study, and a country-specific rather than a cross-country study. It is situated within the theoretical frameworks of investment and natural resource economics. It is a conceptual rather than a policy-oriented study as the emphasis is on theoretical concepts and their empirical applications rather than an examination of policy-oriented variables. However, this study is useful in drawing policy implications and therefore various policies are recommended and discussed in the last chapter of this thesis. The period of study is limited by the availability of data. From Chapter Two, the year 1965 may be considered as the initial year of this study and the study period is extended to 2011 since the latter is the most recent year for which the relevant data are available. However, the empirical analyses of investment, presented in Chapters Five and Six, cover the years between 1974 and 2011. Data are collected from Iranian official databases such as the Central Bank of Iran (CBI), the Statistical Centre of Iran (SCI) and the National Iranian Oil Company (NIOC). The data are further cross-checked with international databases such as the International Monetary Fund (IMF), the International Financial Statistics (IFS), the World Bank, the International Energy Agency (IEA) and British Petroleum (BP). The variables and their data sources for Chapters Five and Six are detailed in Appendices 5A and 6A, respectively.

Chapter Two takes a narrative approach to carefully describe different phases of economic development, capital formation and institutional changes with an emphasis on the role of the state and oil in (re-)structuring economic policy-making, investment and sectoral balances in the country. This narrative approach is then complemented by employing an econometric approach for the analysis of time-series macroeconomic data in Chapters Five and Six, the theoretical basis for which is outlined in Chapter Four. This is because, in comparison to the narrative approach, the econometric approach involves less subjective judgement by the researcher, hence lowering the likelihood of biased conclusion and increasing the verifiability of the findings. One

of the weaknesses of the econometric approach, however, is its reliance on identifying assumptions that are commonly open to dispute. More recently, a body of literature advocated analyzing time-series data by allowing ‘the data to speak for itself freely’ and assessing theoretically consistent relationships through employing general-to-specific modelling techniques (for instance, see Juselius, 2006).

Several econometric modelling methods have been alternatively used in the literature to estimate the determinants of and the effects of uncertainty on investment. The most commonly used approaches include unrestricted Vector Autoregressive (VARs), structural VARs, Dynamic Stochastic General Equilibrium (DSGE) and Cointegrated VARs (CVARs). The unrestricted VAR methodology models a relatively small set of stationary macroeconomic variables with a main focus on the statistical fit of the model to the data. To achieve stationarity, this approach requires a careful transformation of data so that statistically significant and economically justifiable relationships are not excluded from the analysis. A VAR model in first differences of the I(1) variables, however, is misspecified if there exists cointegrating relations between two or more of the I(1) variables (Garratt, et al., 2006). The structural VAR approach aims at providing some economic rationale through imposing theory-based restrictions on the covariance structure of various types of shocks. Thus, it avoids the arbitrary or implicit identification of orthogonalized impulse responses as it is the case in unrestricted VARs. Such restrictions, however, do not allow identifying long-run relationships between the variables (Garratt, et al., 2006). The CVAR approach developed by Johansen (1996) and Juselius (2006) makes minimal use of economic prior knowledge and is based on the view that economic theory is more informative on the long-run relations than it is on the short-run dynamics (Garratt, et al., 2006).

Based on optimizing decisions made by households and firms, the DSGE methodology provides an explicit intertemporal general equilibrium model of the economy using stochastic intertemporal optimization techniques. As argued by Garratt, et al., (2006), the main difference between the DSGE and the CVAR approaches is their treatment of short-run dynamics and their empirical validation of the long-run relations. The DSGE methodology emphasizes the use of theory in the modelling of both short- and long-run relations. Concerning the long-run relations, the CVAR approach is in line with the DSGE model, but it is silent on short-run dynamics. Both methodologies combine theory and evidence to obtain models which are useful and relevant for policy-making decisions. However, the advantage of the CVAR methodology is that the

identification and validation of long-run relations are tested and therefore supported by the evidence rather than by imposing them as *a priori*. Therefore, the present study follows the CVAR approach developed by Johansen and Juselius to identify theory-consistent long-run relationships between the variables of interest. Further, the CVAR model as the empirical methodology is a rather flexible approach to the empirical investigation as it allows producing new insights based on the available data through examining economic phenomena and testing of more than one economic theory.

1.5. CONTRIBUTIONS AND LIMITATIONS

This thesis examines the theory-consistent economic determinants of aggregate and sectoral domestic investment in the context of the oil-rich and -based Iranian economy within the modified neoclassical-accelerator type investment model, into which uncertainty-driven oil measures are incorporated. The thesis thus adds new sets of data and knowledge to these fields particularly based on the empirical analyses conducted in Chapters Five and Six. To the author's knowledge, long-run economic determinants of domestic aggregate and sector-level investment have not been estimated for Iran and therefore the findings of the thesis may be of interest for scholars in Iranian Studies and policy-makers in Iran. Furthermore, the findings of this study contribute to current debates on the economics of natural resources and on investment as well as the application of the investment literature in the context of partial-market, oil-abundant, and exporting economies like Iran.

The thesis further studies the role of the Iranian state in the process of capital formation and structural shifts, and the means through which these have been affected by the availability of oil income during the pre- and post-revolutionary years. Hence, this thesis provides an analytical basis for studying how economic and political institutions as well as the role of the state have evolved in an oil-based economy context. From a policy-making perspective, therefore, it guides policy-makers in their decision-making processes which can lead to greater long-run and sustainable growth and stability. To be contributory to policy studies that go beyond short-term forecasting requirements, particular attention is given to long-run equilibrium properties and stability of the models.

Importantly, the neoclassical-accelerator type theories of investment, such as the ones employed in this thesis, proved relevant and important as a tool to assess the effectiveness of economic determinants of domestic investment in semi-market oil-dependent economies and the underlying reasons for their partial applicability for such economies. This was despite the restrictive assumptions inherent in the standard investment models which are (partly) at variance with the structure of the financial systems and markets of these economies. In addition, a theory-consistent neoclassical-accelerator type identification of a CVAR model, such as the one applied here, was found useful to investigate the theoretically motivated long-run relationships between market-based economic determinants of investment in such economies, its outcome depends on the peculiarities of individual countries under study.

Contributing to the natural resource curse literature, this thesis identified the presence of the ‘Iranian Disease’, as a special case of the Dutch Disease, based on the empirical results related to the sector-level analysis presented in Chapter Six. According to the Dutch Disease theory, it was expected that the relation between investment and oil windfalls in sectors of manufacturing and agriculture to be negative, and that relation in oil and services sectors to be positive. However, the Iranian-type Dutch Disease was characterized by the expansion of investment and output in the sectors of services and manufacturing, yet by the contraction of output in the oil and gas sectors. The findings suggested that, primarily through state-directed investment for the promotion of industrialization in the country, oil income was continuously invested in the manufacturing sector during the pre- and post-revolutionary era. Therefore, it is plausible to believe that, in a mixed-market economy like Iran, the state’s ambitions to achieve industrial development could dominate the Dutch Disease effects.

One of the limitations of this study concerns the reliability of macroeconomic and oil data. Since most of the world’s natural resources are state-owned, there is considerable evidence that nationally reported statistics may be politically biased (Davis, 2006). Thus, data necessary to examine the described hypotheses are collected from several national and international sources and cross-checking is conducted.

Another constraint is the modest extension of the research sample, since the analysis in this study focuses on Iran because of the unique institutional set-up of its economic and political system. An extension, however, could take into consideration other oil-based and oil-rich

countries at a regional level (e.g., the Gulf region or the Caspian region), or a cross-country analysis framework which includes a large number of countries endowed with (various) natural resources (e.g., as classified by Collier and Goderis, 2007) to test the generalizability of the results at regional and cross-country levels. This study does not focus on actual versus optimal investment and saving rates. Such an approach may require a more general model which is beyond the scope of this study. Even though the current study concerns an oil-rich and oil-dependent economy, it does not intend to examine the issue of 'exhaustible resources' as the latter belongs to a different area of research.

At sector-level analysis, this study applies individual time-series cointegration tests to separately study domestic investment determinants for each of the four major economic sectors in Iran. A possible yet important extension of this work could be to account for cross sector dependence by employing panel time-series techniques including panel unit root and panel cointegration tests to investigate whether and the extent to which sectoral dependence affects inferences.⁶

Another limit of this study concerns the scope of this thesis as it chiefly focuses on the macro determinants, rather than the micro foundations, of investment decision-making in the country. The latter is beyond the scope of this thesis, given the limited availability of (firm-level) data and detailed studies on this topic which could allow for an in-depth analysis of the nuances of investment decision-making processes at the micro level in the country. An important extension of this study hence would be an investigation of how investments are decided at micro-level in the country which gives a particular emphasis on the role of the political actors and institutional factors in the process of investment decision-making in the context of the Iranian economy.

Lastly, this study is only partially applicable to other resource-rich and -based countries. This is because these countries are not necessarily similar in their type of government, economic policies, international relations and their political institutional economic system. Thus, it is likely that the modified mainstream investment models, including the ones followed in this thesis, may not be sufficient in unravelling the determinants of investment in (oil-based) economies with imperfect financial markets. This calls for new theoretical framework and

⁶ Panel unit-root tests, among others, include Levin, Lin and Chu test, Im, Pesaran and Shin test and residual-based LM test. Panel cointegration tests, among others, include residual-based DF and ADF tests, residual-based LM tests, Pedroni tests and likelihood-based cointegration test (for details, see Baltagi (2008, pp.273-300)).

techniques for investigating investment determinants in economies whose conditions do not fully correspond to the assumptions of the existing investment models in the literature.

1.6. CONCLUDING REMARKS

The scope of this thesis has necessitated a narrowing down of the emphasis of investigation to selected features of growth and capital accumulation processes which have been especially important in the Iranian economic development, and could be so for other resource-rich and -reliant economies. Although the emphasis of the study varies over different periods, depending on data availability and its aggregate or sectoral orientation, its focus remains within three major areas. These comprise investigating: (i) economic determinants of investment within the theoretical framework of neoclassical-accelerator type investment models; (ii) the role of the state, oil and institutions in the process of capital accumulation; and (iii) the consequent sectoral shifts in the country. In fact, the study of the changing patterns of institutional evolution in Iran helps highlighting the challenges that the over-reliance on oil income posed on the state and the mechanisms through which they were dealt with within such an institutional setting over the study years. The following chapter studies these transformations and attempts to shed light on the origins of the backwardness of the Iranian economy.

2. STATE, OIL, INVESTMENT AND ECONOMIC PERFORMANCE IN IRAN

2.1. INTRODUCTION

This chapter studies various stages of economic development, capital formation and institutional changes, as well as structural shifts in the oil-based economy of Iran, with an emphasis on the role of the state and oil income during 1965-2010. Because of extensive government intervention in Iran's economic life, the state has played a central role in economic development and investment growth in the country. In particular, since the nationalization of the oil industry in 1951, an essential part of the income generated by the oil sector has accrued to the government. Oil income, therefore, is considered as a major source of development plans and financing investment with an influential impact on investment patterns of the country and its economic policy-making (Mehrrara, et al., 2010). Against this background, this chapter attempts to investigate the following research questions:

1. What role did the state play in the process of economic development, capital formation and structural changes in the Iranian economy over the years under study?
2. How did the oil sector, through its income-generating effect, influence growth, investment patterns and sectoral shifts in the country?
3. What were the policy mechanisms through which oil windfalls may have affected the process of growth, investment and sectoral balances in the Iranian economy?

The remaining of this chapter is organized as follows. Section 2.2 provides an overview of the role of the state in the Iranian economy. Section 2.3 studies the development of investment institutions in the country. Section 2.4 examines the performance of the main macroeconomic indicators and Section 2.5 sheds light on various policy mechanisms through which the presence of oil may have influenced the Iranian economy. Finally, Section 2.6 sums up the chapter.

2.2. THE ROLE OF THE STATE

The state played a major role in Iran over the years under study, and the Iranian economy experienced profound state-led economic and institutional reforms to achieve self-sufficiency and economic independence during these years. After the nationalization of the Iranian oil industry in the early 1950s, the economy of the country entered a new stage of growth and development. The most notable feature of these years was the considerable inflows of oil

windfalls as an important source of financing investment. The role of the state, which until that time was mobilizing resources for investment activities in the economy, changed into a distributor and an allocator of oil rents in the country. This in turn transformed the role of the state into an autocratic regime and brought about institutional changes with important bearing on the process of capital accumulation. Consequently, new institutions of capital formation came into existence, which included a planning system administrated by the Plan Organization (PO) (established in 1949) and specialized banks.⁷

In particular, the development plans in Iran were the practical manifestations of the state's inclination to formulate and implement national development strategies for the whole economic system of the country from a central point with the primary goal of self-sufficiency. Unlike in market-based economies, where market mechanisms allocate resources and finished products among their various uses and users, in partial-market economies like Iran, market systems can no longer function freely. Therefore, a need for an alternative mechanism arises which is provided by economic planning (Heilperin, 1960). The essential aspect of a planned economy is the domination of the state sector that institutes the incentive structure through which economic policies are formulated and implemented.

During the pre-revolutionary years, the parliament (Majlis) approved a total of five economic development plans. The first (1948-1955) and second (1956-1962) plans were chiefly concerned with the formulation and implementation of the PO's own investment projects independent of ministries and agencies affiliated with the government. During 1954-1960, Iran became integrated into the western military and political system and Mohammad-Reza Pahlavi, the Shah of that time, asserted his authority over the institutions while heavily relying on American financial and technical aid to strengthen his two pillars of political power, namely the state's bureaucracy and the army. This era of power consolidation relied upon the support of traditional merchants of the bazaar, the landlords, and the high clergy. Due to a higher unification degree of governmental administration since 1963, the PO handed over the formulation and implementation of its investment projects to various governmental agencies and ministries during the implementation of the third (1963-1998), fourth (1968-1972) and fifth (1973-1977)

⁷ See Chapters Four and Seven in Karshenas (1990) for a detailed discussion on state, oil and institutions of accumulation during 1953-1977.

plans (Karshenas, 1990, p.93).⁸ At large, this period was characterized by changes in the structure of the markets (regulated by the state) to strengthen the presence of the private sector in the economy, particularly in industry and the agriculture sector. Accordingly, various measures were introduced including credit rationing, subsidizing private capital and the establishment of specialized banks and agencies, such as the Industrial Credit Bank, the Industrial and Mining Development Bank, and the Agricultural Development Bank.⁹

Since the overthrow of the Shah in 1979, and with the emergence of the Islamic Republic of Iran, the Iranian state increased its intervention in many aspects of the economy such as controlling prices, the expected rates of return on facilities, foreign exchange and allocation of bank credits. The Constitution of the Islamic Republic was adopted in 1979 under Ayatollah Khomeini. Article 44 of this Constitution pronounced that the economy of the country consists of three sectors: the state, the cooperative and the private sector. The Constitution assigned all large-scale industries to the state and required that the private sector supplements the economic activities of the state and the cooperative sectors. After the Iran-Iraq war, lasting from 1980 to 1988, the government formulated and executed a total of four Five-Year Economic Plans (FYDPs) during 1989-2010 to promote a more equitable and fair society.¹⁰ The first post-revolutionary plan started in 1990 and ended in 1994. The plan's main focus was on reconstructing damaged infrastructure as well as dealing with the inefficient public sector and the dis-incentivized private sector, both of which were adversely affected by the changes in the economic system and the uncertainty associated with it. In comparison with the country's capacity, the first plan consisted of ambitious targets.

The second plan (1995-1999) did not start until 1995, as the policy makers spent time in evaluating the plan, and was aimed at executing basic free-market principles and promoting privatization. During the second plan, the government implemented various reforms to increase financial savings and the banking system's lending capacity. In 1991, the Council of Ministers ordered the privatization of some of the state-owned enterprises (SOEs) through three methods: the Tehran Stock Exchange (TSE), open auctions, and negotiations with potential buyers. The

⁸ In 2000, the PO, merging with the Administrative and State Recruitment Organization, was replaced by the Management and Planning Organization (MPO). See Section 2.3 for a detailed discussion on the development of institutions of investment in Iran.

⁹ See Chapters Four in Karshenas (1990) for a detailed discussion on institutions of accumulation during 1953-1977.

¹⁰ The Fifth Five-year Socio-Economic Development Plan covers the years between 2010 and 2015.

second plan mandate based on a special Majlis law limited the transfer of the SOEs only to workers and war veterans on special terms. During the third plan, three organizations were founded: the Privatization Organization of Iran (POI) with rights to dispose of the SOEs; the High Council on Shares Distribution to decide which SOEs to be privatized; and a number of conglomerates or holding corporations to take over individual SOEs in specific fields and put them together in a basket destined for privatization (Amuzegar, 2007). However, the plan largely remained impracticable and was only partly implemented. The third plan, covering the years between 2000 and 2004, was mainly concerned with the promotion of the private sector, including private banks and insurance companies. The fourth plan (2005-2010) consisted of plentiful quantitative projections and similar to the third plan considered a smaller role for the government by stressing greater reliance on market forces.

While being implemented, the economic development plans were amended by the government in various ways. For instance, one of the revisions during the first post-revolutionary plan was associated with the introduction of rapid privatization to lessen the government's burdens through incentivizing the private sector to invest in the productive sectors of the economy. Table 2.1 presents selected macroeconomic indicators based on the post-revolutionary period FYDPs and their actual performance during 1989-2010. For most of the period under study, the realized figures were lower than their projections.

Table 2.1 Macroeconomic figures (average annual growth in %)

	1st Plan (1989/90-1994/95)		2nd Plan (1994/95-1999/2000)		3rd Plan (1999/2000-2004/05)		4th Plan (2004/05-2009/10)	
	Planned	Actual	Planned	Actual	Planned	Actual	Planned	Actual
GDP	8.1	7.5	5.1	3	6	5.1	8.1	7.1
Gross Fixed Capital Formation	11.6	10.7	6.2	4.4	7.1	10	12.2	5.9
Inflation	8.9	20.6	12.4	26.7	15.9	14.2	8.6	15.8
Liquidity (M2)	8.2	27	12.5	25.9	16.4	28.9	20	28

Note: Data are calculated based on real figures in billion Rials at constant 2004/05 prices. Source: Central Bank of Iran (CBI).

From the 1980s onwards, the state interventions in the Iranian economy ensured the survival of enterprises through giving substantial financial subsidies to inefficient or preferred economic sectors in order to avoid various problems such as unemployment. During the last three decades after the revolution, state-owned banks took on the role of satisfying the credit requirements of loss-making SOEs and semi-state owned institutions that had access to rationed bank credits with substantial interest subsidies (Karshenas and Hakimian, 2008, p.202). In practice, in the post-revolutionary Iran, because the SOEs and semi-SOEs have been increasingly in control of the majority of production units and activities, the government has provided them with financial support to keep production intact and planning consistent.

During the war years in the 1980s, as the public sector grew so did the semi-state organizations, of which the most influential ones were the Bonyads and the Iranian Revolutionary Guard Corps (IRGC). Bonyads are semi-public organizations who initially were to control and manage seized assets of the important players in the Shah's regime and then to allocate profits among the poor. The IRGC were founded to protect the Islamic revolution from enemies inside and outside the country. The role of the IRGC started growing mainly after the Iran-Iraq war. After the war ended in 1988, the 'pragmatist' president Rafsanjani (1989-1997) was the first who publicly proposed the issue of privatization of the SOEs. Rafsanjani's first plan intended to reduce the state control in the economy through marketizing the distribution of consumer goods and by borrowing foreign capital. However, the parliament in the late 1980s accused the government of pursuing Western capitalism, favoring industry over agriculture, and being dependent on foreign debt.

During the early 1990s, the struggle over the SOEs' privatization continued. In line with the Constitution, from 770 public companies, merely 391 were identified by the government that could be privatized. Yet, the sales of the SOEs became even more protracted and often took place through negotiations with buyers rather than public auctioning (Harris, 2013). In 1994, transaction units were established in order to sell the SOEs' shares to large

foundations whose beneficiaries consisted of mainly Basiji militia (the key subordinates of the IRGC) and war veterans. Over the years between 1989 and 1994, a total of 331 companies were fully or partially privatized, half of the shares of which went to the semi-state organizations. Some other buyers of privatized assets were subsidiaries of the state's banks and insurance companies and others semi-SOEs (Moradi, 2005). Also, a large number of privatized shares were transferred to the Social Security Fund and the Government Employee's Pension Fund as part of the treasury's contributions to these funds (Amuzegar, 2007).

During 1997-2005, the 'reformist' president Khatami focused on privatization and economic liberalization. Justified by Article 44 of the Constitution, the government began to grant licenses for establishing private companies in various economic sectors. The plan specified that public ownership would be transferred except where the government had a monopoly. First taking place in the banking and insurance sector, licenses were then extended to the subsidiary oil, airlines, telecommunications, construction, power plant and postal sectors. This resulted in the emergence of new enterprises in sectors which were previously controlled by quasi-monopolies (Harris, 2013). Accordingly, the government required only 128 companies out of 724 SOEs to remain state-owned, and proposed that more than a thousand semi-SOEs to be privatized (Khajepour, 2000). After the financial reforms in 2001, private banking system was re-introduced and flexibility was given to the banks in setting deposit and lending rates of return. Another major structural reform during the implementation of the third plan was the establishment of the Oil Stabilization Fund (OSF) in 2000 to mitigate the impact of oil price volatility on government expenditures and to make public finances less reliant on oil rents.¹¹ Table 2.2 reports the accruals to the OSF's during 2000-2008.¹² Based on the published rules by the government, in excess of the amount allocated to the national budget, 85.5% of the earnings from oil and gas were to be allocated to the OSF (IMF, 2011, p.8).¹³

¹¹ In theory, the channeling of revenues into a stabilization fund is intended to smooth future income projections, hence government revenues and public spending. This in return enables industrial diversification and reduces commodity dependency (Kalyuzhnova and Nygaard, 2008).

¹² In 2009, the government replaced the OSF by the National Development Fund (NDF). Since then, public data on inflows and outflows to the NDF have not been available.

¹³ In practice, however, the funds are being used to finance the budget deficits rather than loans to the private and public sectors (Mahdavi, 2012).

Table 2.2 Oil Stabilization Fund accruals (current prices - billion US \$)

	2000	2001	2002	2003	2004	2005	2006	2007
Inflows	5.9	1.8	5.9	5.8	10.4	13	21.6	34.3
Outflows	0	0.8	5.1	5.4	9.4	11.5	23	24.7

Source: CBI.

After Ahmadinejad was elected as a ‘principalist’ president in 2005, the conservatives’ stance on the issue of privatization significantly changed. Privatization of SOEs continued, yet the benefits of it were to be distributed to the people. In 2006 and during the implementation of the fourth plan, Article 44 of the Constitution was finally amended. Consequently, the Article authorized the state to divest some of its major possessions including downstream oil and gas. Furthermore, Justice Shares were introduced to distribute ownership and to grant stock rights to the lowest-income families. According to the privatization plan, 40% share of the assets were to be distributed under the Justice-Shares scheme, 35% to be offered to private investors through the TSE or auctioning, 5% to be allocated to the workers and managers of the privatizing entities, and the state was to maintain 20% of the shares (Amuzegar, 2007).

Overall, since the early 1950s until 1979, the development plans concentrated on structural reforms, interactions between the public and the private sector, their investment needs as well as stabilization policies to support investment and development in the Iranian economy. However, following the revolution and particularly during the 1980s, the role of the state sector strengthened, the activities of the private sector weakened. After the war, the government gradually promoted privatization so as to strengthen market mechanisms in the economy. Nevertheless, because of the presence of a large number of semi-SOEs and SOEs in the country, the boundaries between the public and the private sector became vague. Therefore, because of the institutional, political and economic setup in Iran, market forces became only partially effective. In this setting, banks played a crucial role in facilitating investment in Iran and, as largely determined by the government, they channelled financial resources to various economic sectors (Taghipour, 2009). The next section, therefore, provides an overview of the role of the banking system and investment institutions in the country.

2.3. INSTITUTIONS OF INVESTMENT

The Iranian banks are categorized into three major groups: state-owned banks, private banks and investment banks (see Appendix 2A for a list of banks in Iran). All private and investment banks are commercial banks, whereas the state-owned banks consist of commercial banks and specialized banks. State-owned specialized banks provide loans and financial services to corporate sectors. These banks include agriculture (Keshavarzi), housing (Maskan), industry and mining (Sanat-o-Madan), export development (Toseye-o-Saderat) and cooperatives (Toseye-Taavon). The specialized banks lend at subsidized rates, and their lending is rationed and highly concentrated on a small number of large companies or priority sectors. These banks also take deposits, but a greater part of their loanable funds comes from the commercial banks, the Central Bank of Iran (CBI), and other public sources including the central government.

The CBI, established in 1960, is officially responsible for the supervision of all banks and credit institutions, and since the 1980s for the design and the conduct of monetary policies in the

context of the Islamic Constitution and the Monetary and Banking Act. Each year, after the government's approval of the annual budgets, the CBI presents its monetary and credit policy to the Money and Credit Council (MCC) for approval.¹⁴ Major elements of these policies are then incorporated in the development plans. The sectoral credit allocation is set by the MCC which is the highest banking policy-making body of the CBI. Since the 1990s, the MCC also sets annual targets for credit allocation to the private sector (CBI, 2002). The CBI implements monetary policies, both directly through its regulating power and indirectly through its effects on money market conditions (CBI, 2002). Direct instruments include banking profit rates and the setting of credit ceilings. The MCC determines the profit rates (the expected rates) of return on banking facilities and the minimum and maximum profit rates of return within the framework of the Usury-Free (interest-free) Banking Law. Based on the Usury-Free Banking Act (passed in 1983), the provisional rates paid to depositors or received from borrowers should reflect the profits or losses of a business (Jalali-Naini and Khalatbari, 2002). The CBI can intervene in determining these rates both for investment projects or partnership and for other facilities extended by the banks. In accordance with the Monetary and Banking Law of Iran, the CBI can further intervene in monetary and banking affairs for instance by restricting banks via setting sector-level ceilings for loans and credits (CBI, 2002).

The CBI's indirect instruments consist of the reserve requirement ratio, issuing participation papers (bonds) and opening deposit accounts. The CBI determines the reserve ratio for all the banks, and on this basis, the banks are required to deposit part of their liabilities in the form of deposits with the CBI. According to the Islamic Sharia, the use of bonds is illegal because of their fixed rates nature. Instead, the utilization of participation papers or payment of profit is encouraged. Since the implementation of the third post-revolutionary plan, the CBI has been authorized to issue participation papers as an instrument to affect the level of broad money (M2) and to control the inflation rate. Additionally, since the late-1990s, within the framework of the Usury-Free Banking Law, the banks have been allowed to open a special deposit account with the CBI to control liquidity through absorption of their excess resources (CBI, 2002).

¹⁴ The MCC's permanent members include the governor of the CBI, the Head of the Chamber of Commerce, the Finance and Economy Minister and some members of the parliament. [Online]. Available at: <http://www.icccoop.ir> [Accessed 30 July 2014].

In theory, the economic independence of the Central Bank depends on its ability to control the quantity of credit it lends, and its freedom to set the expected rates of return on facilities that is charged on credits (Grilli, et al., 1991). It has been argued that higher levels of Central Bank independence have positive effects on investment (Pastor and Maxfield, 2000). This independence can further enhance investment efficiency of the financial sector by mobilizing savings to finance capital accumulation (Shaw, 1973). Iran's Central Bank is formally an independent institution. In practice, however, the CBI is not able to formulate or implement proactive monetary policies and has no power over fiscal policies. It is the government that has direct control over the lending and investment activities of commercial banks (Jafari-Samimi, 2010).

According to the Islamic Banking Law, liabilities incurred by the banks are of two types, (i) current and saving Gharz-al-hassanh deposits, and (ii) short- and long-term investment deposits. In using current Gharz al-hassanh accounts, similar to demand deposits in conventional banks, customers make transactions and payments. For the saving Gharz al-hassanh accounts, non-fixed bonuses and prizes as well as priorities in using bank facilities are given to depositors. For short-term deposits, the minimum time limit is three months and for long-term deposits time limits vary between 1 and 5 years. In theory, no fixed rate of return can be guaranteed to the depositors in advance and the term 'provisional' rates are officially used to reflect that the rates that are paid indicate the profits or losses of a business. Yet, in practice, deposit rates or 'dividends' have become pre-determined (rather than being dependent on the banks' profitability) and the depositors have never lost their savings or gained higher returns than the pre-set provisional rates.

Moreover, various modes of contact financing include (i) Mudarabah (profit sharing); (ii) Musharakah (partnership); (iii) Direct Investment; (iv) Murabahah (differed payment sale); (v) Salaf (purchase with differed delivery); (vi) Ijrah be shart-e-tamlik (lease purchase); (vii) Jualah (transaction based on commission); and (viii) Gharz-al-hassanh (benevolent loan).¹⁵ Since, in

¹⁵ (i) Mudarabah: banks provide credits to the commercial sector, and business profits are shared based upon previous agreement; (ii) Musharakah: this is of two forms of 'civil' and 'legal' partnership. The former is project-specific for short and medium periods. Capital is provided both by banks and their partners on a joint-ownership basis for the conduct of a specific job. The latter is a joint venture concerning longer term projects and banks provide a portion of total equity of a newly established firm or purchases part of the shares of the existing companies; (iii) Direct Investment: banks can invest directly in any long-term economic activity in the public sector except for projects involved in the production of luxury products; (iv) Murabahah: banks are permitted to purchase

these practices, the lenders and the borrowers are to share the profits and risks of projects based on previous agreement, the actual size of the profits to the lender could be known only after the completion of the projects. Such a risk sharing approach has encouraged borrowers to take on riskier projects, which in turn has made the loan portfolios of the banks riskier. As a result, banks have rationed their credits more strictly and have diverted a large share of their assets to commercial and short-term investments (Hassani, 2010).

In theory, interests charged on loans are considered as fees or shares of business profits and the transactions are operated through the modes of financing contracts as mentioned above. In practice, however, banks charge fixed pre-set amounts at rates that are approved by the CBI at least once a year. During the last two decades, for instance, from the above eight most commonly used methods of contract financing by commercial banks, on average about 40% of the contracts have been under the installment sale category, the closest to interest-rates based conventional banking (Hassani, 2010). Also, banks' commercial risks are minimized as at the time of defaults, the principal amount, the expected rates of return on facilities and the late fees are collected through possession and or sale of secured high value collateral items such as real estate or machinery.

During the first two pre-revolutionary plans (1949-1962), the Plan Organization (PO) formulated and executed its investment projects independent of the government. However, since the formulation of the third pre-revolutionary plan in 1963, and with the establishment of the Supreme Council, the Prime Minister became in charge of the PO as a means to coordinate the government's economic policies. Accordingly, the responsibilities of the PO were revised and since then it became responsible for national planning, execution of governmental projects, and

raw materials, machinery, equipment, spare parts and other needs of businesses in industry, agriculture, mining and services. Banks can then resell these items based on short-term installments. Prices in these transactions are expected to cover costs as well as profits (under certain regulations); (v) Salaf: banks can purchase goods from productive businesses to provide them with capital. Therefore, banks do not lend money; instead they buy parts of the future products at an agreed-upon price which must not surpass the market price of the product at the time of the contract; (vi) Ijarah be shart-e-tamlik: banks buy real property or other assets required by businesses (or individuals) and lease the assets to them. The price of the asset is set on a cost-plus basis and its ownership is transferred to the lessees at the end of the contract; (vii) Jualah: projects related to the expansion of production, commercial and service activities are undertaken by banks or customers on a short-term basis to pay a specific sum in return for a service and the fee to be charged must be set at the time of contract formation; (viii) Gharz al-hassanah: it is a non-commercial facility without any expectation of profits. The loans are financed by Gharz al-hassanah saving deposits and are often given to small producers, farmers and small-scale businesses. In the agriculture sector, there are also other financing methods such as Muzarah and Masaqat which are employed when the other financing methods cannot be used (see the Law for Usury (Interest) Free Banking. [Online]. Available at: <http://www.cbi.ir> [Accessed 1 May 2015]; see also Hassani (2010).

financing of investment schemes via the plans' budget. During 1956-1972, about 71% of total oil income was allocated to the PO and its role in the process of capital accumulation became central.

With the implementation of the fifth pre-revolutionary plan (1973-1977), the current and development expenditures of the government were combined and the PO lost its financial independence. During these years, the oil income-bred substantial liquidity expansion in the economy resulted in a rapid growth of investment. Following the oil boom of 1973, and due to the consequent oil-financed expansionary monetary effects, Iran's monetary base and domestic liquidity rose considerably. Coupled with a rapid rise in deposits and the expansion of financial resources, all the banks increased their credits, which intensified inflationary pressures in the economy. As a result of a high inflation rate, the real expected rates of return on facilities became negative and the real cost of capital decreased which in turn stimulated the demand for credits in all sectors of the economy. With increased lending capacity and low costs of debt, companies borrowed extensively, and consequently the ratio of bank-financed capital investment including private investment rose significantly (Jalali-Naini, 1985). During this period, the government revised the sectoral loan rates in its development plan, and based on the revised plan, the share of credits in low productive sectors such as agriculture declined, whereas sectors with higher productivity such as industry and construction enjoyed a greater share of credits.

The Iranian banking system consisted of six banks in 1950, four of which were state-owned. The number of banks increased to twenty-six by 1960, of which seventeen were private banks and four were specialized banks. By 1976, the number of banks rose even further to thirty-five, of which ten were specialized banks (Karshenas, 1990, p.98). Over the 1960s and the 1970s period, the government in particular pursued a policy of financial aid to the private sector through two banks, the Industrial Credit Bank and Industrial and Mining Development Bank.

In the post-revolutionary era, the banking system and the credit market underwent substantial structural changes. Soon after the revolution, all the commercial banks and insurance companies were nationalized and consolidated, and banking regulations changed with the approval of the Islamic Banking Law of Iran. The formulation of guidelines for monetary and credit policies remained in control of the MCC. In 1979, any fundamental market-oriented reforms, such as

privatization and market-liberalization, became greatly constrained because of Article 44 of the Constitution. Following the war, the role of the state and the scope of government operations increased significantly. The state nationalized large-scale industries and the entire banking system. By the end of the war, the SOEs and Bonyads (semi-state-owned charitable foundations) were the major players in the economy of the country and in charge of all the large scale economic activities in the energy and strategic sectors. The role of the private sector during this period was limited to small-scale agriculture, mining and manufacturing, and domestic trade and services. By 1982, in line with the Banking Nationalisation Act, the number of banks decreased to six commercial and three specialised banks (Jalali-Naini and Khalatbari, 2002).

Consistent with the Islamic banking practices, after the revolution, the Iranian government played an important role in converting the banking system, which until 1979 was dominated by conventional banking practices, into Islamic banking. The law of Usury-Free banking was passed by the Majlis (the parliament) in 1983, and started being implemented by the banks in 1984. Under the Usury-Free Banking Act, the charging of interests on all borrowing and lending activities was banned and banks were obliged to engage only in interest-free Islamic transactions and commercial transactions that involved the exchange of goods and services in return for a share of the expected profit.

Overall, the years from 1979 to 1988 were characterized by the complete state ownership of the banking sector, strict government restrictions on banks' deposit and lending ceilings, high reserve ratio requirements, extensive control of capital flows, and state-led credit allocation programs. In 1989 and during the first plan, the government re-opened the Tehran Stock Exchange (TSE) in order to find new domestic and foreign investors in the capital market. Fueled by favorable oil prices, financial resources of the banking sector increased during this period. Since the financial sector was state-owned, most of investment funds were channeled to the public sector.

Limits on sectoral credit allocation and control of the return rates of state-owned banks were gradually relaxed. Participation shares were introduced as securities for medium-term financing of investment projects, and deposits and lending rates in the banking sector were further

adjusted (Jalili-Naini and Toloo, 2001). Sector-level lending rates, which had been kept significantly below inflation, were revised upwards and deposit rates were increased. Initially, as a result of these policies, deposits relative to cash holding increased (Jalili-Naini and Khalatbari, 2002). However, with the significant rise in inflation during the early to mid-1990s, deposit and lending rates in real terms began to fall again.

During the fourth plan, the government obliged all the banks to reduce deposit and lending rates of return (CBI, 2003). The government further imposed different rates and conditions on public banks to give high priority in their lending operations to technology-driven projects, small and medium enterprises, and to housing projects for low income earners (Amuzegar, 2010). Consequently, the level of non-performing loans (NPLs) of state-owned banks increased dramatically after 2006. According to the CBI (2006), the annual growth rate of state-owned banks' NPLs was less than 30% before 2005, while it significantly increased to 129% in 2006. CBI (2006) also stated that the highest share of the NPLs belonged to the manufacturing and mining (20.1%), and the construction (19.5%) sectors.

In brief, with the establishment of the Central Bank and the Credit and Currency Council in 1960, the government exerted a tight control over the amount and distribution of funds in the country's formal credit market. This was mainly realized through different forms of credit controls and a policy of differential rates. The system of differentiated rates was set up to encourage investment in the state's favored sectors. For instance, over the period 1973-2010, the lending rates for the agriculture sector were the lowest in comparison to other major sectors of the economy, whereas this rate was the highest in the services and commercial sectors. Appendix 2B reports the expected rates of profit on facilities provided by the specialized bank during 1973-2010. Seemingly, the expected rates of return on facilities instruments were not used to combat inflationary pressures in the Iranian economy since this would have required the government to set higher rates, which in return would have had adverse effects on investment and growth. On the deposit side, the rates paid on investment deposits were lower than the inflation rate. Hence, the real expected rates of return on facilities were negative. This adversely affected the economy partly because considerable resources were invested in financial assets, like foreign currencies, or in durable goods such as gold, houses and cars, rather than in savings with the banking system. Appendix 2C illustrates the term-investment deposit rates over the period under investigation.

Overall, during the years under consideration, the government determined the official rates of return in the banking system. To stimulate economic growth, the official rates in real terms were set at a low or even negative level. Because of the low costs of official loans, the demand for credits always surpassed the banking system's supply. In addition to the control of rates of return, the government regulated the quantities of credits allocated to the economy through different methods. Firstly, the government determined the credits that were to be directly distributed in its annual budgets. Secondly, the government controlled the supply of credits made by banks through a system of quotas (CBI, 2002). Similarly, the government determined the quantity of credits allocated for the major economic sectors including agriculture, manufacturing, construction, exports, and services in order to give priority to its preferred sectors.

Hence, the Iranian government played an interventionist role in the size of real investment and in the allocation of oil-driven financial resources to various sectors of the economy. Under the state's interventionist stance, the Iranian banking sector became the core domestic vehicle for financing the country's development projects and its growing public sector.

Yet, interestingly, the private banking system was re-introduced in 2001 and since then private banks' ratio of deposits to total banking deposits has been on increase. Also, rather than being dependent on the banks' profitability according to the Usury-Free Islamic Banking Law of Iran, deposit rates have become pre-set and the depositors have never gained higher returns than the pre-determined provisional rates or lost their savings (Hassani, 2010; Jafari-Samimi, 2010). Hence, as discussed above, it appears that the Iranian Usury-Free Banking Law has established a context within which the Iranian banking system functions similar to other systems in developing or planned economies with non-Islamic banking systems. Therefore, it is of interest for this thesis to investigate the extent to which

aggregate and sectoral investment patterns in the context of the Iranian economy are consistent with neoclassical-accelerator type investment models which were developed for competitive open-market economies.

2.4. MACROECONOMIC PERFORMANCE AND OIL DEPENDENCY

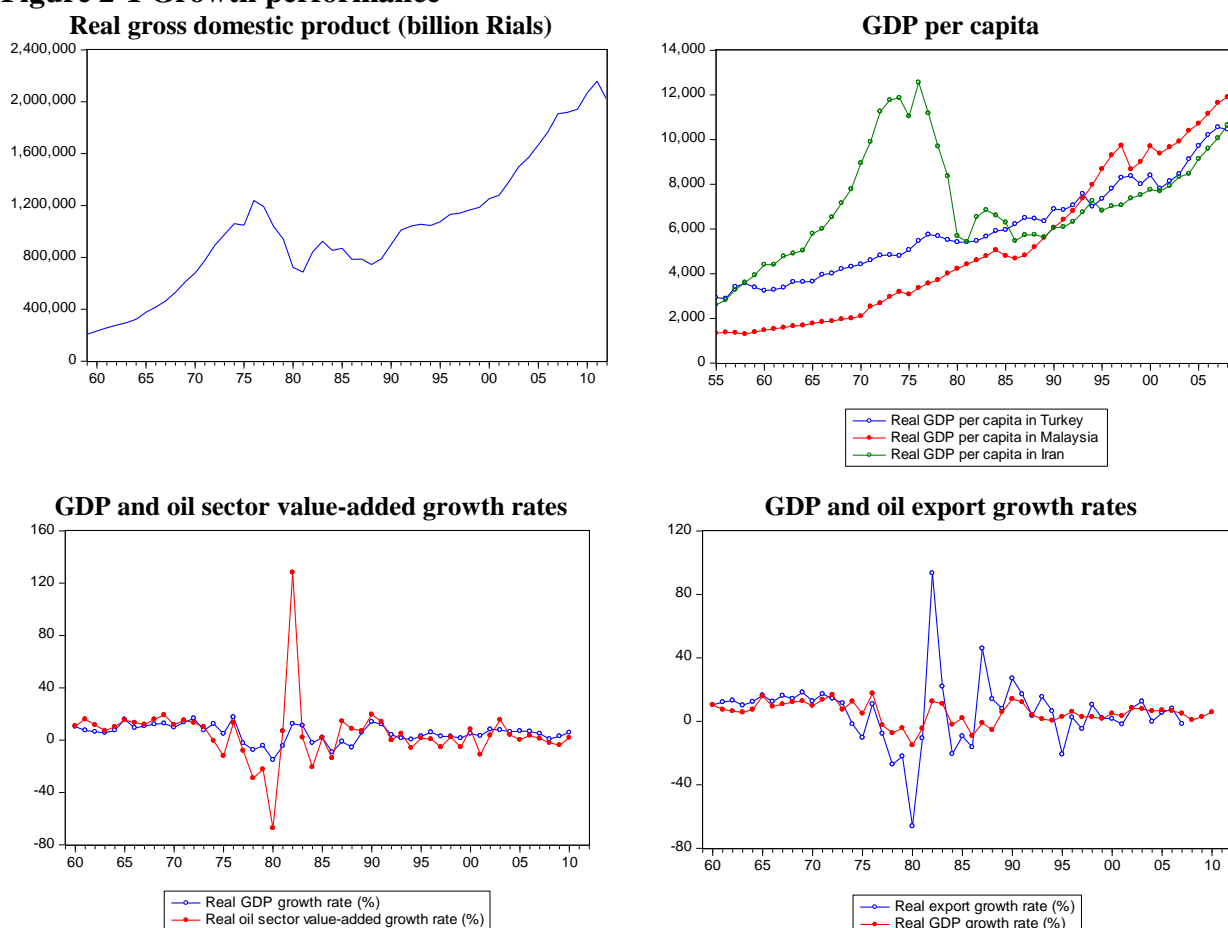
2.4.1. ECONOMIC PERFORMANCE

During 1960-2010, Iran's economy registered an average real gross domestic product (GDP) growth rate of 4.9% p.a. However, a more detailed study of the country's economy at different sub-periods reveals a rather volatile economic picture. The panel on the top left in Figure 2.1 plots the evolution of real GDP during these years. In general, the trend of output seems to change in slope, and more visibly illustrates three stages: a rapid growth period prior to the revolution; a slow growth and contraction period during the 1980s; and a growth recovery period since the 1990s. After having enjoyed considerably increased output from 1960 to 1978, the expansion of the Iranian economy deteriorated during the mid-1980s. This was the result of the revolutionary upheavals, the destructive war with Iraq and the collapse of international oil prices during the 1980s. Economic activities weakened noticeably during this period and declined on average by 1.05% p.a., although with the cessation of the war in 1988, the country experienced some growth towards the end of the decade.

Not only had the costly war with Iraq caused the destruction of property and infrastructure, it also increasingly drained resources away from investment in productive activities. After the war and in the early 1990s, the economy grew significantly on average by 7.5% p.a. during the implementation of the first post-revolutionary economic development plan. This period of growth, nevertheless, soon came to its end in the wake of the debt crisis of 1993 during the implementation of the second plan. Having emerged from the crisis of 1993, growth picked up at a steady level since 1994, although during these years the realized annual rates of GDP growth were less than their targets as projected in the FYDPs (see Table 2.1). Figure 2.1 (the panel on the top right) plots the real per capita GDP of Iran, Turkey and Malaysia during 1955-2010. On a comparative basis, the development of real GDP per capita in Iran demonstrated a remarkable increasing trend until 1977. But the country's economic performance underperformed that of Malaysia and Turkey who started from similar per capita GDP during

the mid-1950s and grew consistently ever since.¹⁶ Malaysia, also an oil economy, performed considerably better than Iran since 1955. Turkey likewise illustrated steady economic growth during this period.¹⁷

Figure 2-1 Growth performance



Note: Constructed based on data in billion Rials at constant 2004/05 prices. Source: CBI; International Monetary Fund (International Financial Statistics).

Furthermore, the development of the changes in real GDP appears to be associated with the evolution of the oil sector in Iran. The panel on the bottom left in Figure 2.1 plots the rate of growth in real GDP and in value-added by the oil sector during 1960-2010, demonstrating a rather similar pattern between the growth rates of these two variables during this period. In a similar vein, annual growth rates of real GDP and real oil exports suggest an association

¹⁶ See also Hakimian and Karshenas (2000) for a comparison of per capita GDP trends of Iran, Korea and Turkey during 1950-1995.

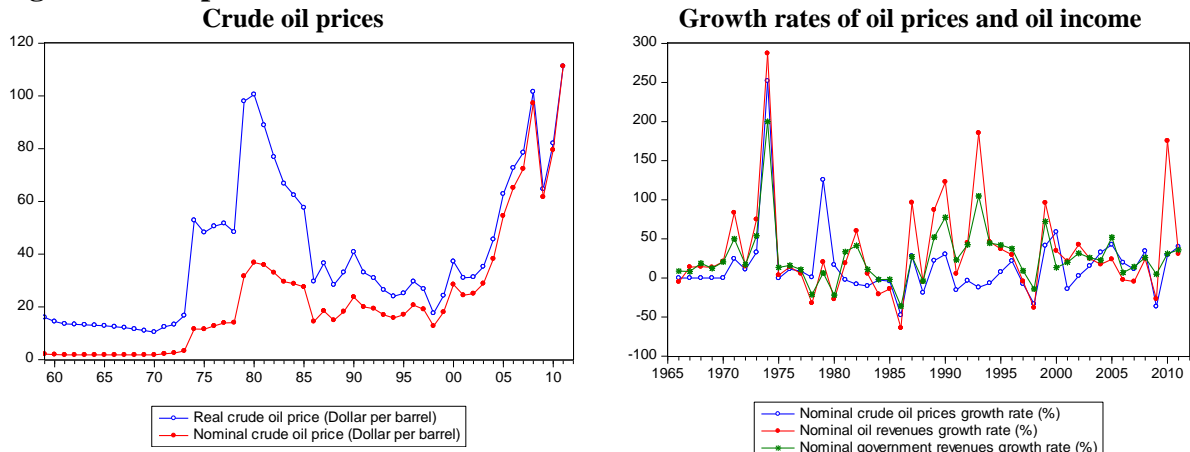
¹⁷ The main reason for Turkey's sustained economic performance was its major structural economic reforms initiated in the early 1980s. Among others, see Ersel (1991) for Turkey's structural adjustments in the 1980s.

between both variables' boom and bust cycles during these years as shown in the panel on the bottom right in Figure 2.1. For instance, Iran's strong economic recovery during the revolution was aided by strong recovery in oil exports. On the other hand, the country's poor economic performance in the mid-1980s was associated with the collapse of international oil prices during that period.

The effects of variations in oil prices have been profound on the economy of Iran as a whole and particularly on the country's total income. During the study period, international oil prices behaved with wide fluctuations in response to war and conflicts in the Middle East and as a result of changes in global demand and supply. The panel on the left in Figure 2.2 shows the evolution of nominal and real international oil prices over the years under study. The latter refers to Brent dated crude oil prices (in 2010 US \$). Since the 1970s, the trend in oil prices can be divided into four sub-periods. Following the first oil boom in 1973, there was an upward trend in international oil prices until 1980. Nominal oil prices increased from \$1.4 per barrel in 1972 to \$3.3 per barrel in 1973 and to \$12 in 1974. Bred by the second oil boom, nominal oil prices further exhibited a dramatic increase from \$14 per barrel in 1978 to \$32 per barrel in 1979 and to \$37 per barrel in 1980. In the next sub-period from 1981-1986, nominal oil prices had a declining trend until the collapse of international oil prices, the so called the third oil shock, in 1986. During this period, nominal oil prices dropped to \$14 per barrel, their lowest level since 1979.

During 1987-2001, oil prices fluctuated around a seemingly constant mean. In 1990, nominal prices of oil spiked to \$24 per barrel following the lower production of crude oil and uncertainty stemming from the invasion of Kuwait by Iraq and the ensuing Gulf War. After the Gulf War, nominal oil prices dropped steadily until 1994, when oil prices fed by the booming Asian Pacific region and the US economy slightly increased to \$20 per barrel in 1996. Stemming from the East Asian crisis and a combination of lower consumption and higher OPEC production, oil prices declined to as low as \$12 per barrel in 1998. Nominal oil prices started to increase from 1999 reaching to \$28 per barrel in 2000, until 2001 when the prices fell again to \$24 in the wake of September 11 terrorists attack in 2001. During 2001-2008, oil prices showed an upward trend for most of the period, chiefly fueled by the weak Dollar, growth in emerging markets, and increasing petroleum demand and consumption. In 2008, nominal international oil prices averaged \$97 per barrel.

Figure 2-2 Oil prices and oil income



Source: See Appendix 5A for detailed references of the data.

Figure 2.2 (the panel on the right) displays the changes in nominal values of oil prices, oil revenues, and government total revenues. From this figure, it can be seen that the changes in oil revenues and government’s total revenues appeared to be associated for most of the years under study. Following the second oil shock, government revenues rose, although the start of the war with Iraq mitigated this increasing trend. As a result of the collapse of oil prices in 1986, both government revenues and oil revenues dropped considerably. Afterwards, revenues again started rising steadily. This rise particularly became sharp in the early 1990s due to an increase in oil prices caused by the Gulf War and because of the substantial devaluation of the Iranian currency in 1993. Since the mid-1990s, both government revenues and oil revenues displayed associations with changes in international oil prices. This demonstrated the extent to which the government’s income was oil-dependent.

2.4.2. CONSUMPTION, CAPITAL ACCUMULATION AND NATIONAL SAVINGS

Real consumption and investment growth averaged 5.6% p.a. and 6.7% p.a. during 1965-2010, respectively (Table 2.3). In essence, the use of oil income for financing investment as well as the imports of capital goods resulted in the growth of consumption in the Iranian economy. Particularly, during 1965-1978, the high growth rate of total consumption (over 11%) in the domestic economy was in line with the fast growth rate of investment which was greater than 13% p.a. during that period. This pattern of domestic expenditure was feasible due to an increasing reliance on external sources of finance in that time, namely foreign borrowing and oil income (Karshenas, 1990). The development patterns of public and private consumption during

1965-2010, are illustrated in the panel on the top left in Figure 2.3. During 1965-1978, government consumption in real terms increased on average by over 16% p.a., with private consumption registering annual average growth rate of over 9% p.a. throughout these years.

Table 2.3 Composition of gross national expenditure

	1965-1970	1971-1978	1979-1988	1989-1994	1995-1999	2000-2004	2005-2010	1965-2010
	Annual average growth rates							
Real final consumption expenditure								
Private	8.5	10.6	1.2	4.8	5.2	7.1	4.7	5.8
Public	17.8	14.7	-4.3	4.1	1.3	4.9	-0.77	5.1
Total	11.1	11.8	-0.7	4.4	4.2	6.5	3.6	5.6
Real gross fixed capital formation								
Total	13.1	8.6	-0.96	4.6	10.1	11.6	5.2	6.7

Note: Constructed based on data in billion Rials at constant 2004/05 prices. Source: CBI.

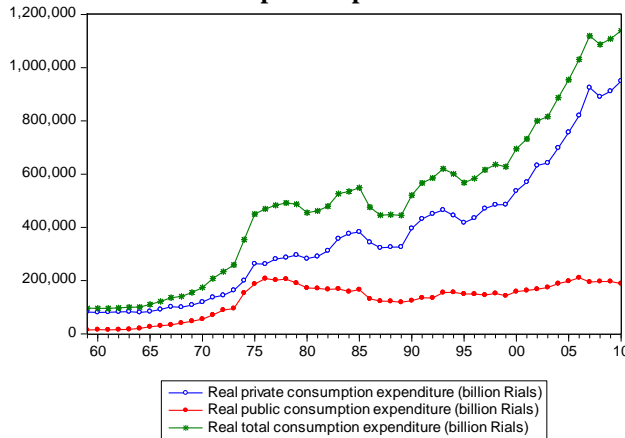
By contrast, during 1979-1988, both consumption and investment growth initially levelled off and then fell respectively by just less than 1% p.a. following the Iranian revolution, the Iran-Iraq war and the period of precipitous decline of global oil prices. Real consumption and investment recovered after the war and during the implementation of the first plan (1989-1994), although started declining towards the end of the period when the Iranian economy was hit by the deficit crisis. Despite the fact that the growth rate of real investment rebounded after the debt crisis during 1995-1999, lower oil prices and foreign debt repayment did not leave sufficient foreign exchange resources to drive domestic consumption during that time. Thus, real consumption increased slightly during the years of the second plan. From 2000 to 2004, real consumption and investment rose again bred by the recovery of international oil prices.

The centrality of oil in Iran's economy can further be understood by assessing the degree to which investment patterns have been affected by oil price changes over time. The panel on the bottom left in Figure 2.3 illustrates the annual variations in real investment and in real oil prices. As for real GDP, the rate of growth in real investment followed a similar pattern to the movements of real oil prices for most of the years under consideration. This pattern of co-movement was only interrupted by the revolutionary upheavals of the late 1970s.

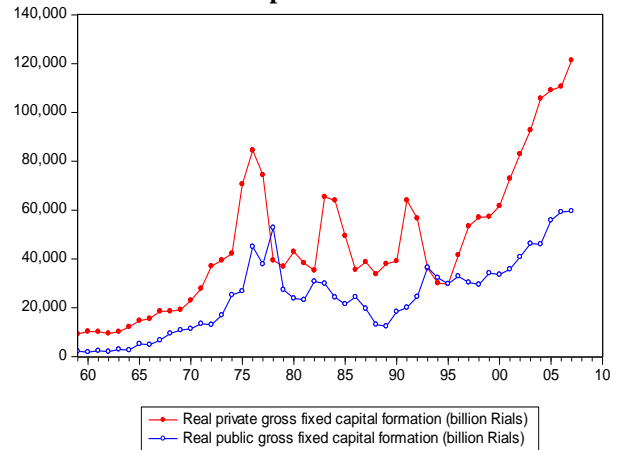
The annual growth rates of public and private investment and their shares in total gross fixed capital formation during the period under study are presented in Table 2.3. Investment by the public sector registered a higher growth compared to that of the private sector with respective

rates of 10% p.a. and 7% p.a. on average over the period 1965-2010. The share of public investment averaged 34.3% p.a. during 1965-2010. More than 64% of the public sector investment throughout this period was spent on construction and the remaining on machinery.

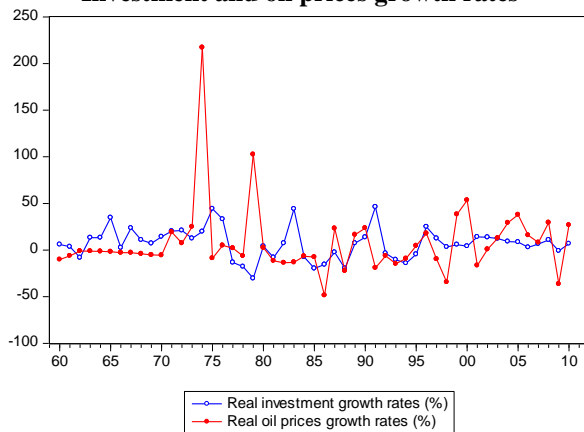
Figure 2-3 Consumption and investment
Consumption expenditure



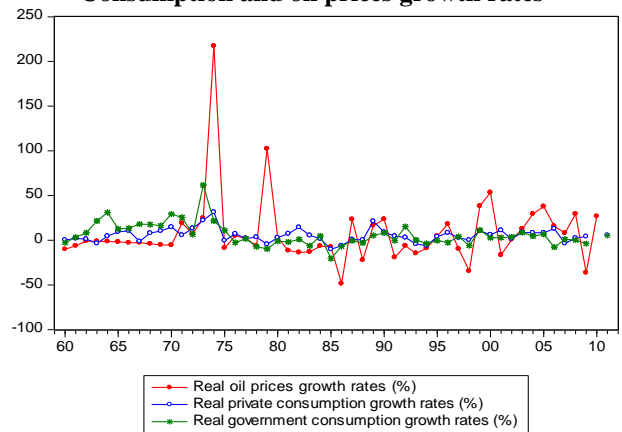
Public and private investment



Investment and oil prices growth rates



Consumption and oil prices growth rates



Note: Constructed based on data in billion Rials at constant 2004/05 prices. Source: CBI; BP Statistical Review of World Energy 2010.

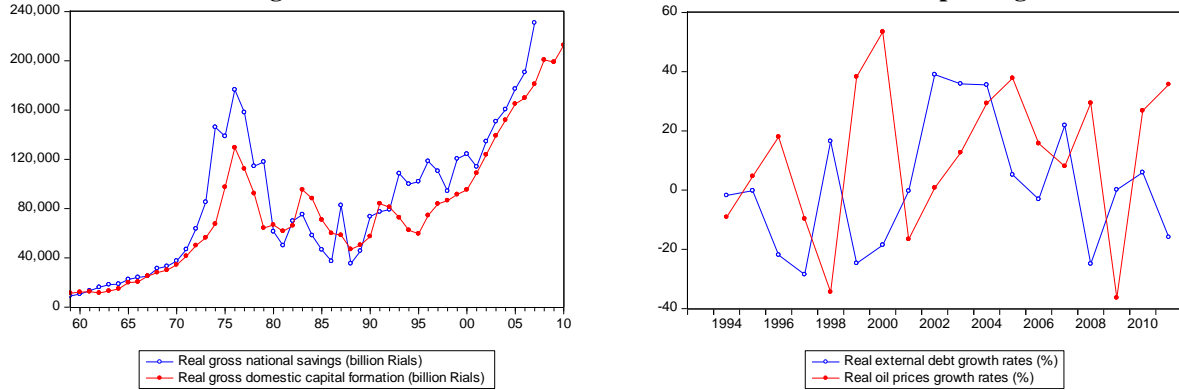
Interestingly, during 1965-2010, real public and private investment demonstrated an association for most of the years under study (see the panel on the top right in Figure 2.3). In fact, the common view that government investment crowds out private investment was not applicable to the case of the Iranian economy. In the pre-revolutionary years, due to the abundance of external finance in the country, the significant growth rate of investment by the public sector did not have a bearing on the interests of the private sector and its investment activities during the 1960s and the 1970s. In contrast, the support of the government for both domestic and private enterprises, coupled with the rapid growth of domestic demand following the available external

finance during that time, resulted in the growth of investment by the private sector (Karshenas, 1990). Over the post-revolutionary period, likewise, the private sector grew along with the public sector as the Iranian government earmarked a greater amount of oil income for capital expenditure to stimulate growth and investment in that sector (Valadkhani, 2001).

Relative to the post-revolutionary period, investment by the public sector enjoyed a higher growth rate over the years 1965-1978. This was because investment activities of various ministries were merged into the expenditure plan during that time and the government imposed a greater degree of control over the public sector's investment activities. Also, the availability of new external sources of investment funds, namely foreign capital and oil revenues, was translated into higher government expenditure with highly expansionary effects on the economy. The role of the state, therefore, became that of a key producer in heavy and basic industries which resulted in the acceleration of investment by the public sector over that period (Karshenas, 1990).

The data on national savings and investment during the years under consideration are reported in Appendix 2D. Overall, real investment and national savings appeared to move together (see the panel on the left in Figure 2.4). The dramatic improvements in national savings as well as investment in the mid-1970s were associated with the significantly higher oil prices in that time. During 1971-1978, the annual average growth rate and share of real gross national savings in total GDP registered 16% and 56.8%, respectively. However, the revolutionary instabilities, the war years and the sharp decline in oil prices contributed to the sharp decline in national savings and investment in the late-1970s and the 1980s. The fall in national savings maintained the high levels of consumption while the economy was experiencing high inflationary pressures and over-valued exchange rates during that period. Since the mid-1990s, despite some variations, the favorable growth of oil prices played an important role in the positive development of national savings in the Iranian economy. Over the years between 1989 and 1994, national savings growth recovered. However, during 1995-2010, savings grew at a slower pace (about 7% p.a.) than that of during 1965-2010. At large, similar to GDP and investment, the growth of national savings followed that of oil prices during most of the study period, signifying the importance of oil in shaping the development pattern of national savings in the country.

Figure 2-4 National savings and external debt



Note: Constructed based on data in billion Rials at constant 2004/05 prices. Source: CBI; BP Statistical Review of World Energy 2010.

Iran's total external debt fluctuated considerably during the study period between zero during 1970-1979 and 23.5 billion US \$ in 1993, and was inversely related to the changes in real oil prices for most of these years (see the panel on the right in Figure 2.4).¹⁸ External debt rose in constant prices on average by 8% p.a. from 1979 to 1988 and by 29% p.a. during 1989-1994. After the war and due to Iran's reconstruction program reflected in the first plan coupled with its increased interaction with the rest of the world, the country's appetite for foreign loans to finance its post-war reconstruction was significant. This resulted in the flow of foreign capital (mostly bank loans) into the country. However, the foreign debt had been unsustainably accumulated by 1992, which led to the debt crisis of 1993. In fact, the first plan's implementation was considerably blemished by an increasing external debt crisis which, in particular towards the end of the plan, resulted in severe discrepancies in the country's external accounts. The debt crisis in that period was further worsened due to the declining oil income.

In this setting, a matter of concern was the composition of the foreign debt, of which a great share was related to short-term debt. This was because debts of less than one-year maturity averaged 80% of the total debt over the years of the first plan's implementation due to Iran's isolationist stance and its inability to raise long-term credits. As a result, short-term finance was used on a large scale for medium and long-term investment projects with longer gestation periods. Consequently, austerity measures were introduced in 1994 to tackle external debt imbalances which were done mainly through import restriction policies. During the second plan,

¹⁸ External debts were financed by the World Bank, IMF and a number of private and commercial creditors (World Bank International Debt Statistics, 2013, pp.160-161).

external debt decreased due to increasing oil prices and oil exports. During the implementation of the second plan between 1994 and 1999, the external debt contracted from 21 billion US \$ in 1995 to 9 billion US \$ in 1999, and the economy moved towards gradual recovery. External debt rose again (on average by 22% p.a.) during the third plan, however, benefited from favorable oil prices, it contracted during the implementation of the fourth plan.

Table 2.4 Real government consumption expenditure by function

	1965-1970	1971-1978	1979-1988	1989-1994	1995-1999	2000-2004	2005-2007
	Annual average % share in total government consumption expenditure						
General expenditure	45.0	39.2	39.5	23.6	23.7	32.9	48.4
General services	8.9	4.0	2.7	3.4	3.8	3.8	2.7
Defense	36.1	35.3	36.9	20.2	19.9	29.1	45.7
Productive expenditure	38.4	40.4	40.9	59.0	58.3	50.9	37.2
Education	18.2	11.0	19.1	24.7	20.9	21.5	15.5
Health and medical services	4.6	3.9	6.0	8.1	5.5	4.5	3.2
Social affairs and security	3.6	5.4	6.3	9.1	11.7	12.0	8.9
Economic affairs and housing	12.0	20.1	9.4	17.1	20.2	13.0	9.5
Others	16.6	20.4	19.6	17.4	18.0	16.2	14.4

Note: Constructed based on data in billion Rials at constant 2004/05 prices. 'Others' include disciplinary services, cultural and recreational services and municipalities. Economic affairs include urban and rural development, public utilities, manufacturing and mining, agriculture, transport, communication and commerce. Source: CBI.

Due to its size, government consumption expenditure exerted an important influence on income distribution during the period under consideration. The impact of the government's development expenditure worked through the long-run structural changes it created in the Iranian economy. At large, two types of government consumption expenditure can be identified namely general and productive expenditures.¹⁹ The former is related to general administration and military expenditure, while the latter is related to the expenditures on education, health, social as well as economic affairs. As presented in Table 2.4, a substantial share of total government consumption expenditure during 1965-2007 was absorbed by the general expenditure category, of which a great deal was spent on defense. For instance, the share of defense expenditure in total government expenditure averaged as high as 45% p.a. over the years 2005-2007. The share of education expenditure was the greatest among the productive expenditures followed by that of the economic affairs and housing. In total government expenditures, the share of education expenditure averaged 15.5% p.a. during 1965-2007, while that of economic affairs recorded an annual average rate of 9.5% over the same period.

¹⁹ See Karshenas (1990, p.195) for a similar classification of government consumption expenditures during 1963-1977.

Table 2.5 Growth and structural changes in capital formation

	1965-1970	1971-1978	1979-1988	1989-1994	1995-1999	2000-2004	2005-2010	1965-2010
Gross fixed capital formation - Annual average growth rates (%)								
Total	15,5	14,9	-4,7	6,6	8,4	10,7	5,8	7,3
Agriculture sector	5,7	13,5	-1,2	8	16,1	10,3	12,9	8,4
Manufacturing and mining sector	21,6	16,2	-2,1	10,2	18,1	18,1	-0,32	10,4
Oil sector	34,4	30,4	-10,8	23,8	28,1	-2,6	-0,05	13,3
Services sector	16,3	14,3	-4,05	5,02	4,02	13,7	6,5	7,1
Private sector	11,5	11,9	1,9	2,4	14,8	13	4,7	7,6
Machinery	11,3	12,6	19,7	6,2	26,8	14,4	2,7	13,4
Construction	12,4	15,2	-1,7	-0,36	0,91	9,5	10,8	5,6
Public sector	31,6	24	-10,3	18,5	1,6	6,3	9,3	9,9
Machinery	51,6	29,7	-10,1	17	0,28	8,1	7,3	13,3
Construction	26,8	22,9	-9,5	19,5	2,4	5,8	10,4	9,5
Gross fixed capital formation as % share in total investment (annual average)								
Agriculture sector	4	4	3,7	4,6	4,3	4,7	6,2	1,4
Manufacturing and mining sector	10,8	12,8	7,8	12,4	13	19,1	18,9	12,8
Oil sector	7,9	6,8	4,3	2,6	6,2	4,1	2,6	5
Services sector	53,04	48,5	56,8	50,4	44,5	45,5	47,4	50,3
Private sector	71,7	65	64,5	64,5	59,6	67	66,1	65,6
Public sector	28,2	34,9	35,4	35,4	40,4	32,9	33,8	34,3
Gross fixed capital formation as % share in private sector investment (annual average)								
Private sector								
Machinery	61,8	65,4	39,7	56,2	62,7	71,8	72,8	58,7
Construction	38,1	34,5	60,2	43,7	37,2	28,1	27,2	41,3
Gross fixed capital formation as % share in public sector investment (annual average)								
Public sector								
Machinery	26,3	32,6	45,8	38,2	33,6	33,3	34,7	35,7
Construction	73,6	67,3	54,1	61,7	66,3	66,6	65,2	64,2

Note: Constructed based on data in billion Rials at constant 2004/05 prices. Source: CBI.

Table 2.5 presents the growth rates of sectoral real investment during the study period. Over these years, the economy of Iran witnessed a structural shift from agriculture to the manufacturing and the service sectors. During 1965-1979, real investment in all of the major economic sectors increased. Notably, real investment in the oil sector averaged over 32% p.a., whereas it was 9% p.a. in agriculture. After the revolution and during the war period, redistributive conflicts undermined investment incentives in the country. The fluctuations in oil prices and particularly the sharp collapse of oil prices in 1986 further contributed to the deterioration of real investment at both aggregate and sector-levels. As oil revenues shrank, so did the rate of growth in capital formation. Compared to the pre-revolutionary era, the real growth rate of investment contracted in all sectors, with the exception of the construction sector, which grew on average about 7% p.a. because of a high demand for new construction projects driven by the destructive consequences of the war.

Overall, various policies adopted by the governments of pre- and post-revolutionary periods together with the increased state control of resources altered the distribution of wealth particularly in favor of services and to a smaller degree manufacturing. This was an indication

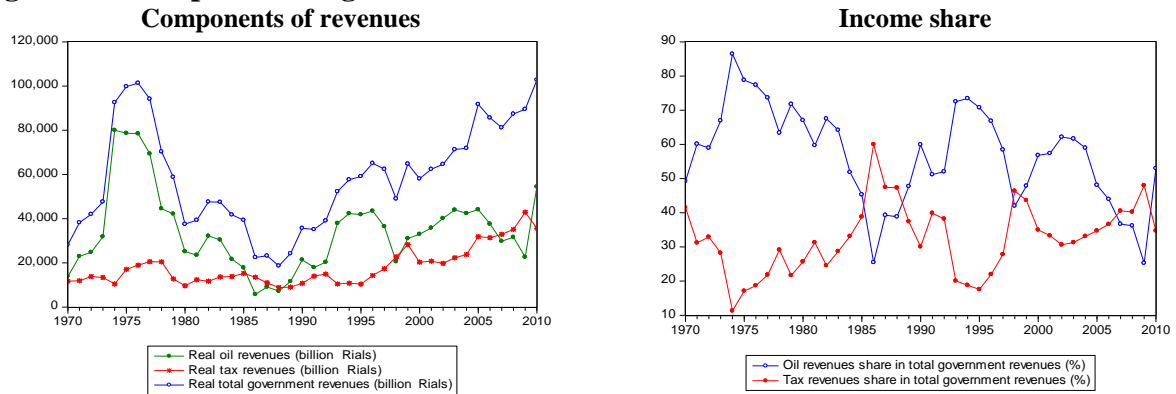
of structural shifts in the actual investment picture of the economy away from agriculture and even the oil sector towards services and manufacturing. This, in line with the empirical findings presented in Chapter Six, could suggest the presence of an ‘Iranian Disease’, which is a special case of the Dutch Disease. According to the Dutch Disease theory, one could expect that the relationship between oil revenues and investment in the sectors of oil and services to be positive, and that relation in manufacturing and agriculture sectors to be negative. Yet, the Iranian-type Dutch Disease is characterized by the expansion of capital formation as well as output in the sectors of services and manufacturing, but by their respective contractions in oil and agriculture sectors. In fact, these observations suggest that, chiefly through state-led investment expenditures for the promotion of industrialization in Iran which began in the early 1950s, oil income were invested in the sectors of services and manufacturing throughout the study period.

2.5. MACROECONOMIC POLICIES AND OIL DEPENDENCY

2.5.1. INCOME GENERATION BY THE STATE AND FISCAL REGIME

The main characteristic of Iran’s fiscal system during the study period was the substantial and increasing proportion of revenues from oil exports compared to that of taxes in financing government expenditure (see Figure 2.5). This significant feature of public finances in the country particularly came into existence when the share of oil revenues in total revenues increased. This share rose to about 50% during the third pre-revolutionary plan, then to over 70% during the 1970s, and for most of the post-revolutionary period it remained over 55% p.a. The share of domestic taxes in total revenues, however, recorded as low as 13% during the pre-revolutionary years and about 20% over the post-revolutionary period.

Figure 2-5 Components of government income



Note: Constructed based on data in billion Rials at constant 2004/05 prices. Source: CBI.

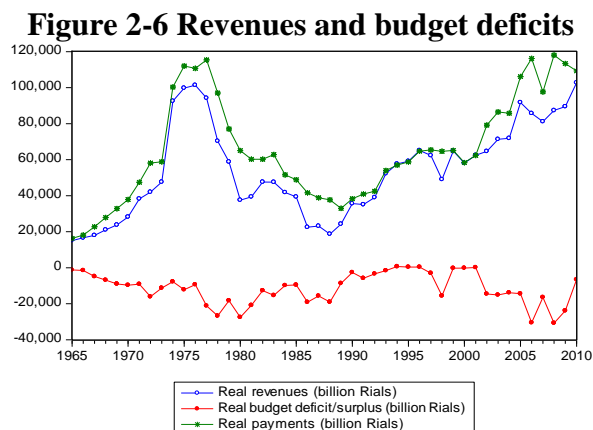
Table 2.6 presents the figures related to government revenue components and a breakdown of income taxes by main groups during the years between 1970 and 2010. The share of taxes in total revenues remained low, and tax income played an insignificant role in financing expenditure and in income distribution in the economy over the study period. During 1970-2010, taxes accounted for only about 30% of total income, of which domestic taxes registering about 20% of real tax revenues. A notable feature of the tax structure in the Iranian economy was the considerably low share of wealth taxes and income taxes, compared to that of corporate and import taxes, over these years. The declining growth rate of taxes during the years 1979-1988 was due to the decrease in total imports, tariffs on which comprised a considerable part of the state's tax income. In fact, the decline of oil prices in the mid-1980s reduced both oil revenues and tariff revenues. This was because the volume of imports was largely determined by the amount of foreign exchange made available by income from oil.

Table 2.6 Revenue components of the state

	1971-1978	1979-1988	1989-1994	1995-1999	2000-2004	2005-2010	1971-2010
	Annual growth rates (%)						
Real total government revenues	13,51	-10,4	21,8	3,8	2,3	6,7	4,9
Real oil revenues	19,7	-9,6	39,9	-1,2	6,6	14,5	10,1
Real tax revenues	10,4	-6	5,2	22,05	-2,2	8,2	4,9
Real corporate tax	27,6	15,2	7,5	8,9	1	19,7	14,3
Real income tax	8,1	-4	7,11	11,7	-1,5	7,6	4
Real wealth tax	1,9	6	-1,5	4,4	8,2	4,5	3,9
Real import tax	4,9	-10,6	20,5	16,7	17,8	0,94	5,8
Real sales and consumption tax	3,3	0,66	-8,2	101,5	-19,1	14,1	12,2
Real payments	13,3	-8,6	7,8	2,7	6,3	5,1	3,3
	% Share of total government revenues (annual average)						
Real oil revenues	70,7	53	59,4	57,1	59,3	40,5	56,9
Real tax revenues	23,8	35,8	30,7	31,4	32,6	39,1	32,2
Real corporate tax	7	12	9,9	10,8	10,2	19,3	11,4
Real income tax	3,2	5,5	5,4	5,6	5,4	4,9	4,9
Real wealth tax	0,83	1,7	1,8	1,2	1,4	1,3	1,4
Real import tax	9,6	10,1	9,3	5,9	10,1	9,7	9,3
Real sales and consumption tax	3,2	6,4	4,1	7,7	5,3	3,7	5

Note: Constructed based on data in billion Rials at constant 2004/05 prices. Source: CBI.

During the study years, total revenues of the Iranian government were affected by fluctuations in oil prices and oil revenues, both directly and indirectly. At the time of increased oil revenues, the windfalls went to the government and directly affected its revenues. Subsequently, through its expenditures, the government tried to stimulate domestic activities and to accumulate more tax revenues. Tax revenues from imports increased as long as the imports of final and intermediate goods increased. The rise in tax revenues thus indicated the indirect effects of oil on government revenues, making them even more reliant on oil income.



Note: Constructed based on data in billion Rials at constant 2004/05 prices. Source: SCI.

Figure 2.6 depicts the changes in real government revenues, government payments and budget deficit over the study period. The rate of growth in government payments averaged 5.4% p.a. The two spikes in the series reflect the impacts of the oil boom of 1973 and the big devaluation of the Iranian currency in 1993. Since the revolution until 1988, long-term projects particularly in the productive sectors were sacrificed and state payments declined on average by more than 8% p.a. After the war, and due to the war-driven shrinkage of infrastructure and domestic output, government payments rose by 7.8% p.a. during 1989-1994, most of which were channeled to finance reconstruction projects and state subsidies. Since the execution of the second plan, however, government payments depicted an average growth rate of 4% p.a. over the years between 1995 and 2010. This was mainly due to the government's attempts to restore the country's balance of payment and a gradual removal of subsidies on non-basic goods. On the whole, increases in government payments, stemming from the influx of oil income, influenced the government's fiscal policy in an expansionary direction. However, as the government's income was largely oil-driven, its size remained beyond the control of the authorities due to the unpredictable nature of oil prices and thus oil revenues.

2.5.2. MONETARY POLICY, MONEY SUPPLY AND INFLATION

The way that monetary policy has been implemented explains the responses of the Central Bank of Iran (CBI) to international oil price variations. The development of money supply, showing the growth rate of M2, is plotted in the panel on the left in Figure 2.7. In 1974, following the first oil boom, the growth rate of money supply reached a peak of 56%. As part of its anti-inflationary policy, the government pursued a tighter monetary policy. This restrictive policy continued during the early years of the war until 1984. At the same time, demand for investment declined and the economy experienced a deep recession.

Following the collapse of oil prices in 1986, government revenues dropped to less than one-third of the level of the preceding year. Consequently, the government financed its budget deficit through borrowing from the CBI. This policy resulted in an increase in the money supply which persisted in the succeeding years, mainly because of the monetization of the budget deficit and converting foreign loans to the Iranian currency to implement the first plan. Although the first plan formulated certain monetary guidelines to curb the government's injection of cash into the economy, bred by favorable oil prices in the early 1990s, money supply expanded during 1989-1994. When the debt crisis hit the economy in the mid-1990s, money supply grew further and monetary policy became even more expansionary. Similarly, during the implementation of the third plan, as oil prices rose, so did money supply. The fourth plan further aimed at limiting liquidity expansion in order to curb inflation. Nevertheless, during 2005 to 2010, thanks to higher than expected oil-revenues, money supply grew and the government pursued expansionary monetary policies once again.

Figure 2-7 Money and inflation



Source: CBI.

The growth rate of inflation (measured by the changes in Consumer Price Index (CPI)) is shown in the panel on the right in Figure 2.7. Overall, inflation revealed a fluctuating pattern over the years under consideration. During the years 1960-1972, CPI inflation was in single figures and averaged below 3% p.a. Following the first oil shock and the increase in the quantity of oil exports, this rate grew sharply and averaged over 14% p.a. during 1973-1978, and about 19% p.a. during 1979-1993. However, it reached a peak of about 50% a year after the big currency devaluation of 1994 in response to the debt crisis and then remained mostly over 25% p.a. on average throughout the rest of the period under study.²⁰ Oil prices affected inflation in the country through various channels. One channel was the conversion of foreign currencies earned from increased oil exports to domestic currency by the CBI, which in turn increased the supply of money, government spending and consequently the demand for goods. (Higher) oil prices further affected inflation via imports and the rise in the cost of foreign inputs used by national producers.

For most of the years under study, the government attempted to tighten its monetary policy in order to curb inflation. In practice, however, expansionary policies were conducted particularly at the time of higher oil prices and budget deficits. In fact, the conversion of foreign exchange mainly from oil rents into the Iranian currency created a close connection between monetary and fiscal policies and led to the expansion of government spending, money supply and inflationary pressures. This was because the growth of oil income relaxed the constraints on government expenditure to distribute oil rents in the economy, most of which was utilized to finance the government's current spending. Coupled with low tax income, this logic negatively affected the government's budget deficits to the degree that they were funded by converting foreign exchange from the export of oil into the Iranian currency. This in turn linked fiscal and monetary policies and resulted in the expansion of money supply and inflation in the Iranian economy.

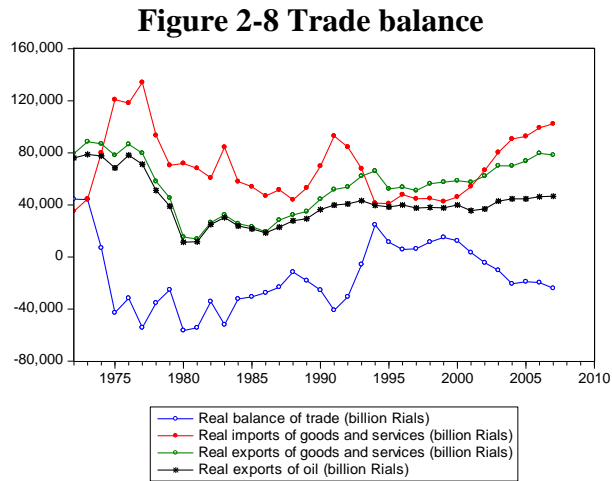
Overall, high rate of inflation affected investment negatively in various ways. Under inflationary pressures, the Iranian currency constantly lost its value. Combined with mostly negative profit rates on term deposits, the public was left with low incentives to deposit their money in the

²⁰ An exception was related to the period during the implementation of the third plan as, according to the official data from CBI, the inflation rate declined to on average 14% p.a. over that time. Esfehiani (2006) argues that this low rate of inflation could be plausible if one takes into account the relative stability of the Rial and the rising real rates of return during that period.

banking system. Alternatively, investment in durable goods like gold coins, cars, foreign currencies and real estate became common due to their expected higher future returns. Thus, saving declined and so the availability of funds for domestic investment activities.

2.5.3. TRADE POLICY

Figure 2.8 depicts the evolution of the balance of trade during 1970-2010. Generally, real exports and imports moved together during these years. This suggests the reliance of imports on oil exports as the import of goods was largely financed by the income generated from oil exports. During these years, oil exports and non-oil exports accounted for about 78% and 22% of total exports, respectively.



Note: Data are in billion Rials at constant 2004/05 prices.
Source: CBI; BP; Statistical Review of World Energy 2010.

During the period under study, Iran’s state-led trade policies were characterized by several switches between liberalization and restriction policies. Following the first oil boom, Iran’s oil exports registered a strong positive trend, making the country even more dependent on oil resources. The government pursued liberalization policies that stimulated imports through reductions in custom duties and through financial supports. Consequently, imports rose by 23% p.a. on average during 1973-1979, and reached its peak of 80% growth after the first oil shock in 1974. The costly war with Iraq together with the shrinking of oil revenues and the country’s increasing international isolation resulted in foreign exchange shortages, and consequently led to import restrictions by means of tariffs and quotas, and strict foreign exchange controls. For

example, by the end of the war, an extensive network of controls that covered over 300 products subject to official price controls had appeared (Hakimian and Karshenas, 2000).

During this period, total imports shrank on average by 6.1% p.a., whereas oil exports and total exports rose by 37% p.a. and 2% p.a., respectively. During the post-revolutionary first plan, the government formulated a liberalization program which involved foreign exchange devaluation with the intention of improving non-oil exports and restricting imports. As a result, total exports and imports increased on average by 14% p.a. and 11% p.a., respectively. The growth rate of non-oil exports, however, stayed below the plan's projections, although the share of non-oil exports in total exports averaged about 22% p.a. Also, non-oil exports were still reliant on imported goods for production and thus a considerable part of their earnings was absorbed by production processes.

The government imposed more restrictions on trade during the implementation of the second plan. This plan sought to enhance the competitiveness of domestic production and technology in the international market. To promote domestic production and to achieve self-sufficiency, the government assigned tariffs for the imported goods, prohibited imports of goods and services that could be produced domestically, and lifted bureaucratic procedures on non-oil exports to facilitate the export of domestically produced products. Consequently, during 1994-1999, total imports shrank on average by 5% p.a. Oil exports and total exports also contracted on average about 1% p.a. During the third plan (2000-2005), the government adopted open trade policies; thus, total imports and exports showed a steady growth and, on average, increased by about 12% p.a. and 4% p.a., respectively. Furthermore, oil exports and non-oil exports rose on average by 5% p.a. and 8% p.a. During the implementation of the fourth plan, because of Iran's relatively cheap foreign exchange, imports increased over 2.5% compared to the third plan.

Iran's trade policies also influenced the level of foreign direct investment in the country. During 1956-1978, over 1600 Iranian companies with foreign private stockholders were registered in the country. However, after the Islamic revolution until the early 1990s, foreign investment slowed down significantly. Article 81 of the Islamic Republic of Iran's Constitution forbade the establishment of foreign companies or organizations in the sectors of industry, mining, agriculture, commerce and services. Article 82 of the Constitution prohibited the employment of

‘foreign experts except in cases of necessity’, still subject to governmental approval. Similarly, Article 83 forbade property transferal to foreigners, unless approved by the government. In a similar vein, Article 153 of the Constitution prohibited agreement conclusions related to the foreign control of natural and economic resources and military affairs. As a result, Foreign Direct Investment (FDI) in the country reduced from 6 billion US \$ in 1979 to as little as 2 billion US \$ in 1981 and then became negative during most of the 1980s. After the war and with the improvement of the country’s interaction with the rest of the world, foreign investment started to improve gradually since the mid-1990s and amounted to 395.6 million US \$ in the 1990s. The country further attracted 10.3 and 10.9 billion US \$ during 2000-2004 and 2005-2010, respectively. At large, however, Iran’s inability to attract FDI both in absolute size and given its share in total GDP, has been a notable weakness in the economy.

On the whole, the government played a central role in Iran’s international trade during the study period and had a direct impact on the trade balance, for instance, by exporting oil, importing goods and services, and through employing quantity- and price-based measures. Particularly, as the main exporter, the government received most of the foreign exchange earned by the country. Since the Iranian oil industry is nationalized, the government had an allocative power over the supply of foreign exchange from oil income and in setting its value (Sadeghi, et al., 2007). Next section, thus, describes important aspects of foreign exchange policies in the country during the years under consideration.

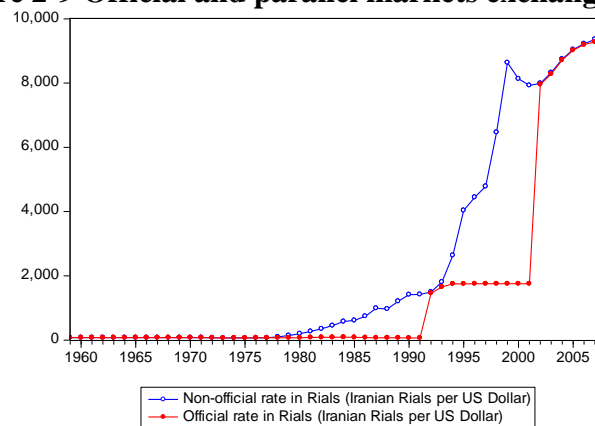
2.5.4. FOREIGN EXCHANGE POLICY

For most of the period under study, the exchange rate regime in Iran was characterized by multiple exchange rate practices as a means to control imports and to pursue its nationalistic economic objectives. Also, a parallel market for foreign currencies operated along with the official market. In 2002, the exchange rate was unified and determined based on a market-based managed floating system. Figure 2.9 shows the trends of exchange rates in the official and parallel markets during the study period.

During 1960-1973, the real exchange rate (the number of Rials per US \$) did not change much thanks to the high level of economic growth and the low level of inflation in the Iranian economy (Pesaran and Mohaddes, 2013). After the first oil shock, however, the real exchange

rate started to appreciate. Over the period 1979-89, the official and the market rates diverged broadly and the premium (the ratio of the parallel market for the US \$ over the official rate) increased on average by 42.1% p.a. This was because, since 1979, the demand for foreign exchange rose due to the increased budget deficit, military imports and high capital flight. This, together with the decline in oil revenues and foreign exchange constraints resulting from the freezing of Iran's foreign assets in the West, led to the escalation of capital controls and the introduction of a multiple exchange rate system. The government introduced a variety of official exchange rates according to the nature of transactions. For instance, during the war, the number of exchange rates applicable to imports surpassed seven (Pesaran, 1992).

Figure 2-9 Official and parallel markets exchange rates



Source: CBI.

In 1990, the parallel market rate for the Dollar reached its peak of over 20 times the official rate (Pesaran, 1992). In 1991, the number of official exchange rates was reduced to three: the basic official rate (Rls.65.7 per US \$); the competitive rate (Rls.600 per US \$), and the floating rate (Rls.1459 per US \$) (Farzin, 1995). There was only a minor difference between this floating rate, at which commercial banks sold foreign exchange supplied by the CBI, and the free rate at which foreign exchange was sold on the free market (Farzin, 1995). The official exchange rate was applied to the public sector, while the competitive rate was introduced mainly for private sector imports, and the floating rate was used for final goods, education, travel, and medical services. Additionally, the parallel rate (Rls.1498 per US \$) was active outside the banking system.

In 1993, the government attempted to unify the exchange rate regime. This policy aimed at removing the duality in the foreign exchange market and implied the devaluation of the official rates towards the level of the parallel rate. Creating a unified exchange rate system was further motivated by the balance of payment problem and was expected to reduce imports while encouraging exports. In theory, the immediate impact of the devaluation was to make imports more expensive in Rial terms and non-oil exports cheaper in Dollar (Rezazadeh, et al., 2011). With oil exports as Iran's main source of foreign exchange, this system failed to achieve its objectives. Instead of creating more competitiveness for the domestically produced goods in the international markets, it boosted their cost of production due to the enhanced cost of the import of raw and intermediate materials for the use in their production process. Consequently, wholesale prices increased through the rise in input costs, and expected future price increases were passed onto retail prices, adding to higher inflationary pressures in the Iranian economy (Sadeghi, et. al., 2007).

Failure of the unification policy forced the government to introduce two exchange rates: an official exchange rate (Rls.1749 per US \$) in 1993 and an export exchange rate (Rls.2345 per US \$) in 1994. The aim was to curb the demand for non-essential imports and to promote exports (Celasun, 2003). Because of high inflation and the anticipation of tightened trade sanctions by the US against Iran, the premium of the parallel market exchange rate over the official rate increased steadily. In 1997, a third exchange rate regime was introduced through the Tehran Stock Exchange (TSE) and a significant amount of imports was shifted to this market. During 1999-2000, the authorities took initial steps in stabilizing the foreign exchange system through a more sustainable reform policy. In May 1999, an open deposit account facility was set up and a substantial proportion of commercial banks' excess reserves were absorbed by the CBI. The TSE rate was considerably depreciated in line with the parallel market rate.

Consequently, the premium on the parallel market exchange rate over the TSE rate steadily declined from about 17% to less than 2% by early 2000 (Celasun, 2003). The export rate was removed in 2000 and the TSE exchange rate became the major market-determined rate applied to official current account transactions. The official rate (Rls.1750 per US \$) was applied to the import of subsidized essential commodities and debt service payments. In 2002, the exchange rate was unified and its rate was Rls.8614 per US \$. During 2003-2004, the entire foreign exchange transactions that were formerly conducted in the TSE market were moved to a newly

introduced interbank market. Since then, the CBI used a managed floating exchange rate regime and the unified exchange rate gradually rose to about Rls.1000 per US \$ in late 2010.

At large, in the oil-based economy of Iran, real exchange rate fluctuations were pegged against the oil prices and the exchange rate regime was heavily controlled by the government. This was because foreign exchange from oil rents financed a great deal of government current as well as investment spending. This in turn increased the government's intervention in the Iranian economy and its controlling power in deciding the pace and pattern of the capital accumulation process in the country.

2.6. CONCLUDING REMARKS

This chapter provided a description of the development of Iran's real economy, the evolution of the political structure in the country and the major institutions of capital accumulation since the 1960s. Particular attention was given to the high degree of the autonomy of the state and its key role in distributing a substantial proportion of oil income in the Iranian economy. At large, the size of government expenditure for capital formation in the development plans was determined by the projected oil revenues. In practice, it was the availability of mainly oil income-driven external finance, rather than taxation or other forms of the state's intervention, which determined the size of government development expenditure during the years under study. Furthermore, with the availability of external funds for investment, the interaction between public and private investment appeared to be complementary. Nevertheless, the government budget presented a tendency towards deficit and the method of financing investment was through fiscal and monetary expansionary policies for most of the study period.

Since the first oil shock, Iran's oil-driven economy has undergone various institutional and economic reforms. The impacts of oil shocks on investment, growth and macroeconomic policies were particularly profound. In particular, government current expenditure

increased rapidly during the years under investigation and attracted a lion share of oil income. The expansionary macroeconomic policies of the government further fueled inflationary pressures in the economy throughout these years with severe implications for growth and investment processes in the Iranian economy.

3. SURVEY OF THE THEORETICAL AND EMPIRICAL LITERATURE ON INVESTMENT BEHAVIOR AND NATURAL RESOURCE CURSE

3.1. INTRODUCTION

The purpose of this study is to contribute to the current debates in the literature on investment and the natural resource curse thesis, as well as the relevance of the investment literature in the context of resource-rich and resource-based economies. This chapter, therefore, critically surveys the most important aspects of the development of the literature on investment and on natural resource curse theories along with their empirical applications. At large, the review of the theoretical and empirical literature on investment indicates that investment models have been principally developed and employed for advanced and market-oriented economies. In particular, the investment literature has largely disregarded the impact of a country's deeper characteristics such as natural resources or its institutional political economy setup on the evolution of investment patterns in resource-abundant and resource-dependent economies.

Also, only little attention is given to study how investment behavior reacts to uncertainty associated with resource price or resource revenue volatility in resource-abundant and -dependent economies. The latter issue is particularly important because the literature on the resource curse thesis shows that resource-rich economies tend to underperform compared to resource-poor economies in terms of economic performance and development. While many researchers try to explain this paradox, this relationship is still subject to debate. This study attempts to address this relationship from the perspective of investment behavior in the context of such resource-driven economies.

Accordingly, the purpose of this chapter is to shed light on how the extant literature on investment and on resource curse theories addresses the following questions:

1. What are the determinants of investment in market and partial-market economies?
2. How does the presence of natural resources or resource windfalls affect economic performance and investment patterns of resource-rich developing economies?

It is reasonable to expect that some of the predictions of the conventional investment models may only be partly relevant in the context of resource-rich and -dependent economies like Iran.

In these economies, investment behavior could be distorted as the availability of oil windfalls as a major source of financing investment is subject to uncertainty stemming from the volatile nature of oil prices. Besides, the ability of these economies to borrow from the international capital markets is often limited. Also, as a result of the dominant role of the state, the allocation of financial resources to various economic sectors could be only partially driven by market mechanisms and consequently some non-market determinants of investment could emerge in these countries. Therefore, it is of theoretical and empirical interest to find out the extent to which the conventional investment theories are applicable in the context of these economies and then to investigate the underlying reasons for (likely) partial applicability of these theories in such a context.

This chapter proceeds as follows: Section 3.2 surveys the conventional investment theories. Section 3.3 reviews the literature on investment and uncertainty. Section 3.4 presents the theoretical and empirical evidence that is presented in the literature on investment behavior in partial-market and resource-rich economies. Section 3.5 concludes the chapter.

3.2. CONVENTIONAL INVESTMENT THEORIES

3.2.1. DEFINITIONS

Net capital stock K at the end of a time period t , assuming a constant exponential depreciation rate δ , is defined as:

$$(3.1) K_t = I_t + (1 - \delta)K_{t-1},$$

where I_t refers to gross. From equation (3.1) it follows that net investment, referring to the net increment to capital stock since the preceding time period ($K_t - K_{t-1}$), equals gross investment, I_t , minus replacement investment, δK_{t-1} . Accordingly, gross investment is the sum of replacement investment and net investment. Denoting the actual level of capital by K_t and the desired or optimal level by K_t^* , then according to most investment theories, the demand for new plants and equipment is related to the gap between K_t and K_t^* . These aspects of capital stock raise the following related questions:

1. What factors determine K_t and K_t^* , and how can these determinants be modelled?
2. Why does a gap exist between K_t and K_t^* , and what is the speed at which K_t adjust towards K_t^* ?

Denoting the speed of adjustment between K_t and K_t^* by λ_t , then by definition, net investment during time period t equals $\lambda_t(K_t^* - K_t)$. As gross investment I_t equals replacement investment plus net investment, then gross investment can be shown as:

$$(3.2) I = \lambda_t(K_t^* - K_t) + \delta K_{t-1}.$$

The gap between K_t and K_t^* would be closed within one time period if λ_t is one, whereas if λ_t is zero then there would be no net investment to reduce this gap.

3.2.2. THE ACCELERATION PRINCIPLE OF INVESTMENT

In 1917, Clark introduced the acceleration principle in an attempt to study the formulation of the link between the demand for products and the demand for the means of production both in quantity and in time. He stated that the demand for expanding the means of production depends on the acceleration of the demand and not on the volume of the demand for the finished product; therefore, the demand for equipment may decline, even though the demand for the finished product might be still increasing. In its simplest form, 'the principle states that percentage changes in the production of consumers' goods are equal to percentage changes in the stock of capital goods' (Tinbergen, 1938, p.165). Thus, actual capital is equal to desired capital, $K_t - K_{t-1} = K_t^* - K_{t-1}^*$, and the optimal capital stock is a fixed proportion of output (Jorgenson, 1971, p.1111). This can be represented as follows:

$$(3.3) K_t^* = \mu Y_t$$

where Y_t is output at time t and μ is the fixed capital-output ratio. Consequently, net investment denoted by I_{nt} equals:

$$(3.4) I_{nt} = K_t - K_{t-1} = \mu(Y_t - Y_{t-1}).$$

The acceleration principle can answer the question of how much additional capacity will be needed when output increases.²¹ But it assumes that total capacity is always optimal for the current output, and that there is an immediate adjustment of the stock of fixed capital goods to current output (Koyck, 1954, p.46). This assumption is the major limit of the principle in explaining short-run fluctuations in investment as in reality there is sometimes too much or too little capacity.

Tinbergen (1938) argues that there are further limiting conditions for the validity of the acceleration principle. Firstly, 'very strong decreases in consumers' goods production (i.e. output) must not occur' (ibid, p.165). This is because further to the principle this would result in a corresponding disinvestment which can only occur to the extent of the replacement investment. To put it simply, once machines are made, they cannot be unmade at will. When output decreases, excess capacity may arise. An increase in demand and in output later on will not lead to an expansion of capacity needed if there is excess capacity available. Secondly, 'there should be no abrupt changes in technique leading to a sudden increase in the amount of capital goods necessary to the production of one unit of consumers' goods' (ibid, p.165).

The acceleration principle has two aspects: the correlation aspect and the regression aspect. The former states that new investments in durable capital goods and in consumers' goods production are correlated. The latter states that percentage changes in consumers' goods production and in the stock of capital goods are equal. Tinbergen (ibid) proposes amendments to the accelerator model. He states that instead of the assumption of equality between percentage changes in the production of consumers' goods and the stock of capital goods, there may only be a proportional or linear relationship between them, implying that there will still be correlation but the regression coefficient would be smaller than one. This is because during a period of increasing production, not all firms reach the point of full capacity simultaneously. Even if idle capacity exists, a firm would increase its plant proportionally (but not equally) to the increase in consumers' goods production. This implies that there would not be an immediate need for investment; but, investment would mainly depend on the rate of increase in the production of consumers' goods. The accelerator theory was later on developed by Chenery (1952) and Koyck (1954) who originated the flexible accelerator theory as an alternative to Clark's model. This

²¹ Here, finished products, consumers' goods, and output are used interchangeably.

model focused on the time pattern of investment behavior (Jorgenson and Siebert, 1968, p.681). Chenery (1952, p.13) and Koyck (1954, p.74) analyzed the structure of the investment process and argued that the desired level of capital is determined by long-run considerations, so that changes in desired capital are transformed into actual investment expenditures by a geometric distributed lag function. In their model, capital is adjusted toward its desired level by a constant proportion of the gap between desired and actual capital in each period. By setting the partial adjustment coefficient λ_t equal to λ for all t ($\lambda_t = \lambda$), net investment can be specified as follows:

$$(3.5) I_{nt} = \lambda(K_t^* - K_t).$$

Accordingly, substitution of equation (3.3) into equation (3.5) gives:

$$(3.6) I_{nt} = (K_t - K_{t-1}) = \mu\lambda(Y_t - Y_{t-1}).$$

Then, based on the assumption of a constant rate of depreciation (δ), gross investment can be defined as:

$$(3.7) I_t = K_t - (1 - \delta)K_{t-1} = \mu\lambda Y_t + (\delta - \lambda)K_{t-1}.$$

In Koyck's (1954, pp.48-73) investment model, the supply of capital to a firm is constrained in a given time and has consequences for the capacity-output problem. Also, the number of finance opportunities that a firm is confronted with is quantitatively limited. The rising supply of funds makes long-run marginal unit costs, beyond a certain point, an increasing function of the number of new machines purchased in a given time. When output increases to a sufficiently high level, the scarcity of funds would reduce the purchase of new machines and also the scrapping of old machines, to make the rising part of the long-run marginal cost effective. So, the capacity-output ratio will be lower than would be the case if the supply of funds were perfectly elastic.

Koyck further argues that the response of capacity to output during favorable and unfavorable conditions is asymmetric due to the cyclical fluctuations in demand since firms' expectations, and thus their investment planning, are affected by uncertainty (e.g., uncertainty with respect to the firm's future sales). If available capacity is optimal for the current output, an increase in

sales would be followed by a lagged adjustment of capacity due to the uncertainty associated with the possibility that the increase in sales can be temporary. The incentive to adjust capacity would become stronger if high levels of sales continue. At the beginning of the fall in output, there will generally be firms for which the available capacity is still below the optimum level for the current output due to the lagged adjustment in the boom. When the decrease in output continues, capacity expansion will decline. Thus, excess capacity arises with available capacity being higher than optimal for the current output.

The flexible accelerator theory addresses the limiting assumption of the naïve accelerator theory (i.e. capital stock is always optimally adjusted) by assuming that the level of desired capital is proportional to output. Problematically, although the flexible accelerator models relate investment to a fixed capital-output ratio, they do not take into consideration other determinants of investment such as factor prices. Therefore, they are not adequate to study the effects of other (market-based) economic determinants of investment as it is one of the objectives of this study. This drawback is taken care of in the neoclassical theory of investment which is the subject of Section 3.2.5.

3.2.3. CASH FLOW MODEL OF INVESTMENT

As discussed earlier, in the empirical studies of Chenery and Koyck, the level of desired capital is assumed to be proportional to output. An alternative theory of investment is that investment depends on the level of profits. This theory of investment was first proposed by Tinbergen (1938) who argued that actual profits measure expected profits, and that investment is driven by profits expectations. Cash flows, often measured by profits after taxes plus depreciation allowances less dividend payments to shareholders, is a variable commonly used to measure available funds and may account for a substantial portion of firms' sources of funding for fixed investment. The cash flow model states that investment is proportional to internal cash flows. Since the supply of internal funds is affected by the current levels of profits, the desired capital stock K_t^* should be made dependent not on the level of output, but on variables which capture the level of profits or expected profits. The use of profits as a determinant of desired capital, however, has been challenged by Grunfeld (1960), who added lagged profits into a flexible accelerator model and found that, given capital stock, the partial correlation of profits and investment is not significant (ibid, p.219). He argued that this is because profits are just another

measure for the capital stock of a firm. Grunfeld (ibid) proposed that discounted future earnings less the costs of future additions to capital offer a more suitable measure of expected profits than current realized profits. In his model, desired capital is proportional to the market value of the firm's outstanding securities as follows:

$$(3.8) K_t^* = \alpha + \beta V_t,$$

where V_t is the market value of the firm and β is its associated coefficient. In his empirical studies, Grunfeld found that the partial correlation between the value of the firm and investment is significant (ibid, p.233).

Similar to the accelerator models of investment, the cash flow models are restrictive as they do not allow for substitution of production factors to play a role. This shortcoming has been overcome in the neoclassical investment theory. However, the cash flow models allow controlling for the importance of capital market imperfections and financial constraints for investment. In practice, often investment models are augmented with various measures that may proxy for financial constraints. Therefore, the principles of the cash flow models appear relevant for the case of oil-rich and -based economies. This is because, in these economies, capital markets are imperfect and investment practices are expected to be constrained to the extent that oil income, as a key source of finance for investment, is available.

3.2.4. TOBIN'S q MODEL OF INVESTMENT

Tobin (1969) generalizes the cash flow model and provides a framework for an investment model in which net investment is an increasing function of marginal q , which is the ratio of the market value of an additional unit of capital to its replacement cost. Tobin's q theory formalizes a notion of Keynes (1936, p.151) that the incentive to construct new capital depends on the market value of the capital in relation to the cost of building the capital. If an additional unit of installed capital adds to the market value of the firm by more than the cost of obtaining and placing the capital, a profit maximizing firm will obtain and put it in place.²² In empirical work, however, average q (the ratio of the market value of existing capital to its replacement cost) is

²² Yoshikawa (1980) emphasizes the importance of adjustment costs in the q theory and argues that the effective price, which is the price after taking into account the adjustment costs, increases as investment increases.

often used as an instrumental variable for marginal q . However, average q and marginal q may differ.²³ Abel (1990) distinguishes the marginal q from the average q . If q_t^A is defined to be the ratio of the average value of the existing capital stock $(V/K)_t$ to the fixed price of a unit of capital c_t , average q at time t is as follows:

$$(3.9) \quad q_t^A = (V/K)_t/c_t,$$

where V_t is the market value of the firm. Marginal q , however, is the ratio of the marginal value of an additional unit of installed capital dV/dK to the price of a unit of capital c_t as follows:

$$(3.10) \quad q_t^M = (dV/dK)_t/c_t,$$

where q_t^M is the marginal q . Hayashi (1982, p. 214) states that marginal q and average q are equal if a firm is price-taker with constant returns to scale in production and installation. Besides, the empirical measurement of average q requires data on prices and outstanding shares and thus prevents the inclusion of private and smaller firms in the sample (Perfect and Wiles, 1994). If a firm is price-maker, then average q will be greater than marginal q by monopoly rent.

Blanchard, et al., (1993, p.116) identified three reasons for the potential different movements in marginal and average q : i) managers may have more information than the market; ii) even if information sets are the same, the market valuation may consist of a speculative bubble due to future price expectations; and iii) the market can be subject to fads leading to the deviation of the market valuation from fundamentals for long periods of time.²⁴ The theory underlying Tobin's q is closely related to the neoclassical investment model. Managers determine the price they are willing to pay for an investment project (i.e. the demand price for an asset) on the basis of expected profitability. The demand price for an entire firm is the market value of all of its

²³ 'For example, consider a firm that has a large amount of energy-intensive capital. If the price of energy rises dramatically, then the value of the firm would fall as the quasi-rents available on existing energy-intensive capital would fall. However, the firm may undertake substantial investment in energy-saving capital. Therefore, an observer of this firm would see a drop in average q coinciding with an increase in investment. This example makes clear that heterogeneity of capital can potentially destroy the relation between average q and investment. As for marginal q , it is important to distinguish the marginal q , or shadow price, for the different types of capital. In the example above, the marginal q of energy-intensive capital is reduced and the marginal q of energy-saving capital is increased by the rise in the price of energy' (Abel, 1990, p. 766).

²⁴ Fads are mean-reverting deviations from intrinsic value caused by psychological or social forces (Camerer, 1989).

securities. The cost of producing all new capital goods is the supply price and is typically measured by assessing the replacement costs of a firm's assets. In equilibrium, the demand and supply prices for fixed investment must be equal. If the ratio of the market value of the firm to the replacement value of its assets is unity, then there would be no incentive for the firm to invest.

In practice, investment equations based on Tobin's q have shortcomings. Generally, 'estimated equations relating investment to Tobin's q leave a large unexplained serially correlated residual' (Abel, 1990, p.766). There are also measurement problems associated with these models such as valuation of the outstanding debt obligations of the firms (the nominator of q) and measuring the replacement value of the firm's assets (the denominator of q). Also, what can usually be observed is average q , and consequently in empirical work, the average q rather than marginal q is often used. These measurement problems make the use of the q models particularly unsuitable for estimating investment behavior at aggregate level, and therefore these models are not explored any further.

3.2.5. THE NEOCLASSICAL MODEL: THE JORGENSONIAN APPROACH

Under conditions of perfect certainty, which is the assumption based on which most of the classical theories have been developed, the cost of capital is the market rate of interest. Keynes (1936) explains a theory of investment which involves the construction of the marginal efficiency of capital (MEK). In his theory, Keynes defines the prospective yield of investment as a series of annual returns which are expected to be gained from selling output minus the running costs of obtaining that output during the asset's life time of t years. Keynes calls the relation between the prospective yield of one more unit of capital and the cost of producing that unit (or the supply price), the marginal efficiency of capital. The MEK is 'equal to that rate of discount which would make the present value of the series of annuities, given by the returns expected from the capital-asset during its life, just equal to its supply price' (ibid, p.135).

Keynes' theory of investment has been criticized on the basis of the differences between the theory of capital and the theory of investment. The former seeks to explain the determinants of desired capital stock, whereas the latter seeks to explain the rate of adjustment when capital stock differs from its optimal level. The accelerator model of investment is also limiting because

it assumes a fixed capital-output ratio, implying that the substitution between factors of production such as capital and labor are constrained to zero. Likewise, in the cash flow models, no role for substitution of production factors is allowed and optimal capital stock is only affected by internal cash flows. In contrast, the Jorgensonian neoclassical model of investment allows for input substitution as a key element of cost and production, and therefore is commonly referenced in the area of neoclassical theory of domestic investment.

The basis of Jorgenson's approach (1963, p.248) is the neoclassical theory of desired capital accumulation and is based on an explicit model of optimization behavior, relating the desired level of capital stock to output, interest rates, capital prices and tax policies. Jorgenson defines the user cost of capital as the cost which a firm incurs as a consequence of owning an asset and the user cost of capital transforms the acquisition price of an asset into an appropriate rental price, which depends on the rate of return and depreciation. The rate of return is the opportunity cost of holding capital goods rather than financial assets. Depreciation arises from the decline in the price of capital goods with age. In Jorgenson's model, the demand for capital stock follows from maximizing net worth, which is the amount that a buyer is willing to pay for the firm and is defined as the sum of the net present value of the future streams of profits from time zero. Constrained by a neoclassical production function, $Y_t = f(K, L)_t$, the optimization problem is:

$$(3.11) \max_{K,L,I} = \int_0^{\infty} \exp(-R_t)[p_t f(K, L)_t - w_t L_t - q_t I_t] dt, \text{ with } R_t = \int_0^1 r_s ds,$$

where r_s is the real rate of interest at time s , R_t is the discount rate at time t , I_t is gross investment at time t , p_t is the price of output at time t , and w_t and q_t are the prices of input factors at time t . All prices, including the interest rate, are taken as fixed and the firm is a price-taker as Jorgenson assumes a perfectly competitive market. At each point in time, the firm must choose K_t , L_t and I_t to maximize the net worth of the firm (equation 3.9). In this setting, I_t and K_t are related through capital accumulation identity presented in equation (3.1). Under certainty assumption regarding input and output prices, this model reduces to its static form and postulates that the firm aims at maximizing its profits at each period within the following one-period-optimization problem (Nickell, 1978):

$$(3.12) \max_{K,L} = \pi_t (Y_t, K_t, L_t, p_t, c_t, w_t) = p_t Y_t - [w_t L_t + c_t K_t],$$

where c_t is the user cost of capital at time t and is introduced by Jorgenson as an implicit rental price for capital services supplied by the firm to itself as:

$$(3.13) c_t = p_t[(1 - hv/1 - h)\delta]_t + [(1 - hm/1 - h)r]_t,$$

where h_t is the rate of taxation of net income, v_t is the proportion of replacement investment chargeable against income for tax purposes and m_t is the proportion of interest deductible from income. Under the profit-maximization condition stated above, the necessary conditions for optimality of capital can be obtained by employing the Lagrangian multiplier procedures as follows:

$$(3.14) p_t \cdot \frac{\partial Y_t}{\partial K_t} = c_t \rightarrow \frac{\partial Y_t}{\partial K_t} = MPK_t = \frac{c_t}{p_t}, \text{ and for labor as:}$$

$$(3.15) p_t \cdot \frac{\partial Y_t}{\partial L_t} = w_t \rightarrow \frac{\partial Y_t}{\partial L_t} = MPL_t = \frac{w_t}{p_t},$$

where MPK_t and MPL_t respectively denote the marginal productivities of capital and labor. Equation (3.14) forms the basis of the neoclassical theory of investment. Based on the assumption of a Cobb-Douglas production function with elasticity of output with respect to capital α , the desired capital stock K_t^* resulting from the optimization problem is:

$$(3.16) K_t^* = \alpha Y_t(p/c)_t.$$

This shows that there is an inverse relationship between the desired capital stock and the user cost of capital; consequently, investment is inversely related to the rate of interest for any given change in desired capital stock depending on the rate at which the adjustment process develops.

It must be noted that, the Jorgensonian model is not a dynamic model since its optimality conditions only include variables in the current period due to the absence of adjustment costs. This implies that capital stock can be adjusted without incurring costs at each point in time. A drawback of disregarding adjustment costs for capital is that firms can jump immediately to the desired capital stock. To address the latter short-coming, Jorgenson and Siebert (1968) employed a distributed lag function to study the time structure of investment behavior, taking

the flexible accelerator model as a point of departure. They incorporated a model of replacement, where net investment is equal to total investment minus replacement, to derive the following investment function:

$$(3.17) I_t = \sum_{\tau=0}^{\infty} \alpha \omega_t (Yp/c)_{t-\tau} + \delta K_{t-\tau},$$

where ω_t denotes the share of the orders that takes t periods to be delivered. In this model, they assumed that replacement is proportional to capital stock and the time pattern of investment behavior is the average lags between the changes in desired capital and actual expenditure.

Table 3.1 surveys the empirical studies on investment motivated by the conventional theories of investment reviewed above. At large, models of investment behavior differ in terms of their determinants and can be categorized as: i) capacity utilization, represented by the level of and changes in real output, the output-capacity ratio, and changes in sales; ii) internal funds, measured by cash flows (or profits); and iii) external finance measured by interest rates, the market value of firms and stock prices. Changes in desired capital are then translated into investment expenditure to provide an explanation for net investment. The time structure of the investment process also matters. In earlier studies, distributed lag functions were used to account for the time needed for the completion of investment projects. One ambiguity that arises from the above discussion concerns whether cash flow has an impact on the desired level of capital stock or whether it operates through influencing the speed at which actual capital adjusts towards its desired level. If cash flow affects the adjustment speed, then λ becomes endogenous and varies with time.

Table 3.1 Comparison of alternative investment models

Authors	Data and Time Period	Econometric Model of Investment	Findings
Eisner (1962)	Quarterly data on US total durables and total non-durables manufacturing industries during 1948-1960	$I_t = \beta_0 + \beta_1 \Delta \text{SAL}_{t-1} + \beta_2 \Delta \text{SAL}_{t-2} + \beta_3 \Delta \pi_{t-1} + \beta_4 \Delta \pi_{t-2} + \beta_5 I_{t-1} + \varepsilon_t$	The results, employing a modified Koyck distributed lag model, indicate that investment is mainly determined by expected profits, and that expected profits are explained by past sales changes
Bourneuf (1964)	Annual data on US total manufacturing and thirteen individual industries during 1950-1961	$I_t = \beta_0 + \beta_1 (u^A_{t-1} - Y_{t-1}) + \beta_2 u_{b,t} + \beta_3 \Delta Y_t + \varepsilon_t^1$	The results show that for total manufacturing, investment in current year is explained by excess capacity in the last year, total capacity at the beginning of the year and the changes in output in the current year; for individual industries, the fluctuating output growth rates lower investment and investment-output ratios ²⁵
Evan (1967)	Quarterly data on thirteen US industries in manufacturing and non-manufacturing sectors during 1949-1963	$I_t = \beta_0 + \beta_1 u_{t-1} + \beta_2 \text{SAL}_{t-5} + \beta_3 K_{t-5} + \beta_4 \text{CF}_{t-5} + \beta_5 r_{t-5}$	The results show that interest rates and cash flows are important determinants of investment for non-manufacturing and manufacturing sectors, respectively ²⁶
Jorgenson and Stephenson (1969)	Quarterly data on US manufacturing industry and sub-groups of total durables, total non-durables and total manufacturing during 1949-1960	$I_t = \beta_0 + \beta_1 \Delta (\text{PY}/c)_{t-4} + \beta_2 \Delta (\text{PY}/c)_{t-5} + \beta_3 \Delta (\text{PY}/c)_{t-6} + \beta_4 \Delta (\text{PY}/c)_{t-7} + \beta_5 (I - \delta K)_{t-1} + \beta_6 (I - \delta K)_{t-2} + \beta_7 K_t + \varepsilon_t$	The results, based on a distributed lag function, support a relationship between investment expenditures and economic policies, namely taxation and the cost of capital ²⁷
Blanchard, et al., (1993)	Aggregate US firm-level data during 1900-1990	(1) $\Delta \ln(I/K)_t = \beta_0 + \beta_1 (L) \Delta \ln(q_t^A) + \beta_2 (L) \Delta \ln(q_t^M) + \varepsilon_t$; (2) $\Delta \ln(I/K)_t = \beta_3 + \beta_4 (L) \Delta \ln(q_t^A) + \beta_5 (L) \Delta \ln(\pi_t) + \varepsilon_t$	The results suggest that both q^A and q^M are significant determinants of investment, but the elasticity of investment with respect to q^M is greater

Notes: I is gross investment; K is the actual level of capital; P is the price of output; c is the price of a unit of capital; Y is output; q^A is the average q and q^M is the marginal q; r is the rate of real interest; and SAL is real sales. u^A and u_b are the average capacity and the capacity at the beginning of the year, respectively; CF is cash flows; π is profits; and (L) is the lag polynomial. Subscript t represents the time period, and subscripts 1, 2, 4, 5, 6 and 7 indicate that variables are lagged for one, two, four, five, six and seven periods. β s are unknown parameters; Δ and \ln indicate changes and natural logarithm, respectively; and ε is an independently and identically distributed error term.

²⁵ Weight of first value of output is arbitrary and the remaining weights decline geometrically.

²⁶ The lag structure follows the actual planning periods and various financial variables based on industry differences.

²⁷ The distributed lag function is: $I_t - \delta K_t = \beta_0 (K^*_{t-1} - K^*_{t-1}) + \beta_1 (K^*_{t-1} - K^*_{t-2}) + \dots + \beta_m (K^*_{t-m} - K^*_{t-m-1}) - \theta_1 (I_{t-1} - \delta K_{t-1}) - \dots - \theta_n (I_{t-n} - \delta K_{t-n}) + \varepsilon_t$, where δ is the depreciation rate.

For the case of firm level investment behavior, as proposed by Jorgenson, it is sensible to assume that firms are profit maximizers, and that relative factor prices, current and expected levels of demand as well as taxation imposed on business income influence the current level of investment. These are all important determinants of a firm's investment and therefore the Jorgenson's model has been regularly referred to in empirical work. However, some of the assumptions of the neoclassical theory of investment are restrictive. For instance, the theory assumes a perfect capital market, perfect certainty regarding the future profitability, and that demands for capital and labor are functions of current prices. Hence, it is assumed that future expectations do not influence the present since capital stock can be costlessly and instantaneously adjusted in the future. Yet, these assumptions do not hold completely if the firms have different expectations or are uncertain about the future values of investment determinants. This poses a question as how well the Jorgensonian neoclassical theory of investment holds in the context of imperfect, partial-market or resource-based economies, which is of interest for this study.

3.2.6. INVESTMENT AND CAPITAL MARKET IMPERFECTION

This section reviews the literature on the sources of capital market imperfections and explains how they may affect investment. This body of literature is of relevance for the case of resource-rich and resource-dependent economies like Iran as markets in these economies tend to be imperfect. This is because, often due to the central role the state in these economies, the allocation of financial resources to various economic sectors could be preferential and determined by some non-market factors. Hence, it could be expected that some of the market-based determinants of investment not to be fully relevant in the context of partial-market, resource-abundant and -reliant economies like Iran. It is therefore of interest for this thesis to investigate the extent of applicability of the conventional investment theories in such context.

At large, investment can be financed with external funds or internal funds. In the neoclassical models of investment, no wedge exists between these costs of funds. However, from a microeconomic standpoint, due to information asymmetry or agency problems, the use of external funds may generate additional costs. Asymmetric information between borrowers and lenders thus results in the creation of a gap between the cost of internal and external financing. From a macroeconomic perspective, cyclical movements in investment appear too large to be

explained by market indicators of expected future profitability of the user cost of capital. Therefore, a body of literature identifies financial factors in intensification of initial shocks by financial market imperfections in the economy (Bernanke, et al., 1996).

Neoclassical models assume that agents have full information on the characteristics of goods and services. In practice, however, asymmetric information often exists where one agent has better information on the characteristics of a good or an investment project than the other agent. This problem is particularly important to credit relationships since it can lead to adverse selection and moral hazard.²⁸ In credit markets, the former refers to a situation in which an increase in interest rates may result in a less favorable composition of loan applicants. This is because those borrowers who are willing to pay higher interest rates are usually risk lovers. The latter states a situation in which two parties agree on a contract, but one party takes hidden actions afterwards to enhance its welfare at the expense of the uninformed agent. Information asymmetries may lead to credit rationing, implying that a borrower's demand for credit may be turned down. The literature identifies two types of credit rationing (Keeton, 1979). The first type, known as redlining, explains a situation in which an agent cannot borrow the amount he wants to borrow at the existing interest rate, and therefore is entirely or partially excluded from borrowing. The second type takes place when only some agents from an identical group are able to borrow.²⁹

In his Separation Theorem, Fisher (1930) states that in an economy without uncertainty, a firm should determine its production plan in such a way as to maximize the present discounted value of its profit stream. This implies that a firm's objective function is independent of the preferences of the owner and his financing decision. Modigliani and Miller (1958) extend the Separation Theorem to a setting with uncertainty and show that the market value of a firm depends only on its profit streams and is invariant to its financial policy and capital structure. Their basic argument is that when the profit flow is given, a change in a firm's financial policy

²⁸ Moral hazard is also known as adverse incentive and the principal agent problem.

²⁹ A firm can finance its investment by issuing either equity or debt. The former refers to ownership in a firm and an equity-holder receives an uncertain share of the future profit stream of the firm, while the latter refers to a fixed payment to the lender. A debt contract has limited liability, such that if the earnings of a firm are not sufficient to cover the debt payments, debt will not be fully repaid. Since the return characteristics of equity and debt are different, one would expect an optimal level of the leverage ratio (i.e. debt to equity ratio) which would maximize the value of the firm. However, the literature on neoclassical models shows that this is not necessarily the case.

remains unchanged due to arbitrage.³⁰ Overall, the theoretical models of capital market imperfections commonly argue that the risky nature of borrowers' investment projects results in a gap between the cost of internal and external financing, and that for many firms, external financing is more costly than internal financing. There are two main types of empirical models on the investment-capital market imperfection relationship including reduced form accelerator type or q investment models and structural investment models based on the Euler equation.

Most of the empirical studies on capital market imperfections and corporate investment employ the reduced form investment models (i.e. by identifying particular relationships between variables) including the accelerator type investment models, the q model of investment, or a combination of these models. The basic determinant of investment behavior in the accelerator type models is the changes in total expected sales. A positive relationship between investment and the sales variables implies that investment decisions are based on observed patterns of past demand for final output. The q theory of investment states that all variations in investment are related to q and that an increase in q should affect investment positively. To study the effects of capital market imperfections on investment, the variables that may represent financial constraints are added to the reduced form investment models. The commonly included variables are internal funds based on the notion that investments are sensitive to internal funds only if there are financial constraints. Since most firms are prone to be financially constrained, investment is expected to be sensitive to cash flows for most firms. Following Fazzari, et al., (1988), firms are often divided into sub-samples for which the extent of financial constraints is expected to be different. Then, the investment-cash flow sensitivity of the different sub-samples is compared to examine whether different types of firms face more financial constraints. A greater investment-cash flow sensitivity indicates a more severe capital market constraint. The investment equation estimated frequently in the accelerator type models of investment is as follows:

³⁰ In the modern neoclassical theory of finance, three pillars of arbitrage, optimality and equilibrium are usually mentioned. Arbitrage explains that, in the absence of any restrictions, the same good or asset has to have the same price in each period. Optimality states that rational investors strive for optimal returns. Equilibrium refers to the neoclassical notion that markets clear by price adjustment at each moment in time. If markets are complete, the present value of investment projects is well-defined, and all shareholders agree that the firm should take the investment decision that maximizes the value of the firm. However, where markets are incomplete, the present value prices are not unique and the market alone does not offer a well-defined signal for the value of investment (Lensink, et al., 2001, p.8).

$$(3.18) (I/K)_t = \beta_0 + \beta_1(\Delta\text{SAL}/K)_t + \beta_2(\text{CF}/K)_t + \varepsilon_t,$$

where SAL_t is real sales and CF_t is internal cash flow. To avoid heteroskedasticity, the variables are usually scaled by capital stock K_t , where the investment part of the process involves the term $\beta_0 K_t$. In the absence of capital market imperfections, parameter β_2 is zero and a higher value for β_2 indicates that firms are more financially constrained. The above relationship is, nevertheless, criticized because the measures of internal funds may also proxy for the profitability of investment and accordingly a positive relationship between internal funds and investment can be expected (Hoshi, et al., 1991, p.43). This may cause problems particularly when the cash flow coefficients are being interpreted in terms of the extent to which they reflect capital market imperfections. Due to this criticism, Fazzari, et al., (1988) estimated the following alternative Tobin's q model, employing an *a priori* classification of firms based on their dividend pay-out for a panel of 421 US firms during 1970-1984 and found significant estimates of β_2 , indicating high investment-cash flow sensitivity:

$$(3.19) (I/K)_t = \beta_0 + \beta_1 q_t + \beta_2(\text{CF}/K)_t + \varepsilon_t.$$

A number of issues require attention in reduced form investment models. Firstly, *a priori* classification of firms in different sub-samples appears to be important in obtaining external funds. For instance, firms that belong to a business conglomerate generally have less difficulty in obtaining external funds because a close relationship often exists between firms and banks within their conglomerates. Also, younger firms tend to face more capital market constraints because they are less able to communicate information with private banks. This is because banks may not have enough time to learn about the younger firms' creditworthiness (Chirinko and Schaller, 1995). Moreover, it is often assumed that smaller firms confront more capital market imperfections since information gathering by banks has the characteristics of a fixed cost. Also because the volume of lending to small firms is generally lower than that to large firms, the relative costs of monitoring and screening are higher per unit of capital.³¹ Table 3.2 gives an overview of a selected number of key empirical studies of the investment-capital market imperfections relationship.

³¹ The use of the investment-cash flow sensitivity as a measure of financial constraints is challenged by Kaplan and Zingales (1997) who argue that comparing the investment-cash flow sensitivities across sub-samples of firms corresponds to looking at differences in dI/dF ; thus this approach is only useful if the sensitivity of investment to cash flow (dI/dF) decreases when a firm's availability of internal liquidity increases, i.e. d^2I/dF^2 should be negative.

Table 3.2 Empirical Euler equation models

Author(s)	Data and Time Period	Econometric Model of Investment	Findings
Whited (1992)	Annual data on 325 US manufacturing firms during 1972-1986	Shadow value of investment = $\beta_0 + \beta_1 \text{DAR}_{it} + \beta_2 \text{DAR}_{it}^2 + \beta_3 \text{COV}_{it} + \beta_4 \text{COV}_{it}^2$	The results, employing GMM, indicate that the mean and median values of the debt-assets ratio and the interest coverage ratio are higher for the firms without bond ratings; debt growth is negative for the firms without bond ratings and positive for the firms with bond ratings; smaller firms are more credit rationed
Bond and Meghir (1994)	Annual data on 626 UK manufacturing firms during 1968-1986	$(I/K)_{it} = \beta_1 (I/K)_{i,t-1} + \beta_2 (I/K)_{i,t-1}^2 + \beta_3 (\text{CF}/K)_{i,t-1} + \beta_4 (Y/K)_{i,t-1} + \beta_5 (D/K)_{i,t-1}^2 + \eta_i + \nu_t + \varepsilon_{it}$	Their findings, employing GMM, show that investment is sensitive to the measure of cash flows when the investment model is estimated using the full sample of companies; measures of dividend payments and new share issues are significant when added to the basic specification
Hubbard, et al., (1995)	Data on 428 US manufacturing firms during 1976-1987	$(I_{it}/K_{i,t-1}) = \beta_0 + \beta_1 (\text{CF}_{it}/K_{i,t-1}) + \beta_2 (Y_{it}/K_{i,t-1}) + \beta_3 \text{DAR}_{it} + \beta_4 \text{COV}_{it} + \eta_i + \nu_t + \varepsilon_{it}$	The findings, using GMM, indicate that capital market imperfections significantly and negatively affect firms' investment decisions for firms with low dividend pay-outs
Love (2001)	Data on 7,000 firms in a total of 40 developed-and less-developed countries during 1988-1998	$(I/K)_{it} = \beta_1 (I/K)_{i,t+1} + \beta_2 (I/K)_{i,t-1} + \beta_3 (\text{SAL}/K)_{it} + \beta_4 \text{CF}_{i,t-1} + \beta_5 \text{CF}_{i,t-1} \text{FD} + \eta_i + \nu_t + \varepsilon_{it}$ (K is the capital stock at the beginning of the period)	The results, using GMM, indicate that financing constraints, measured by the sensitivity of investment to the availability of internal funds, are significantly and negatively related to financial development even after controlling for firms' size and the country's business cycles; small firms are disproportionately more disadvantaged in less financially developed countries than large firms
Harrison, et al., (2004)	Data on 7,000 large publicly-traded firms in 38 developed- and less-developed countries during 1988-1998	$(I/K)_{it} = \beta_1 (I/K)_{i,t+1} + \beta_2 (I/K)_{i,t-1} + \beta_3 (\text{SAL}/K)_{it} + \beta_4 \text{CF}_{i,t-1} + \beta_5 \text{CF}_{i,t-1} \text{FDI}_c + \beta_6 \text{FDI}_{ct} + \eta_i + \nu_t + \varepsilon_{it}$ (K here is the beginning period capital)	The findings, employing GMM, indicate that FDI is associated with a reduction in financing constraints and less sensitivity of investment to cash flows for firms without foreign assets and for domestically-owned enterprises; restrictions on capital account transactions, which is one type of capital control, negatively affect firms' financing constraints; these effects are stronger in low-income countries
Poncet, et al., (2010)	Data on contact information, activities, and ownership of 20,000 Chinese firms during 1998-2005	$(I/K)_{it} = \beta_1 (I/K)_{i,t-1} + \beta_2 (L/K)_{it} + \beta_3 (\Delta \text{REV}/K)_{it} + \beta_4 (\text{CF}/K)_{i,t-1} + \eta_i + \varepsilon_{it}$	The results, using OLS-IV, indicate that Chinese private firms are credit constrained while state-owned firms and foreign-owned firms in China are not; the geographical and sectoral presence of foreign capital alleviates credit constraints faced by the Chinese private firms

Notes: Cash refers to cash plus equivalents scaled by total assets; CF is cash flows; COV is the ratio of the firm's interest expense to the sum of interest expense plus cash flow or the interest coverage ratio; D is debt; DAR is the ratio of the market value of a firm's debt to the market value of its total assets; FD is a country-level index of financial development and is equal to the sum of the standardized indices of the stock market and financial intermediaries development; FDI is foreign direct investment; I is gross investment; L is the number of employees; Y is output; SAL is real sales; and REV is revenues. Subscript t, c and i represent the time period, the country, and the firm, respectively. η is fixed effects; ν is time effects; and ε is an independently and identically distributed error term. GMM, IV and OLS stand for Generalized Method of Movements, Instrumental Variables, and Ordinary Least Squares, respectively.

The issues related to the reduced form models of investment can to some extent be avoided by employing a structural model approach and by directly estimating the Euler equation. The Euler approach is often used in intertemporal investment modelling. The intuition behind this approach is that intertemporal optimization yields optimality conditions for adjacent periods, so that the marginal cost of investing in the current period is equal to the discounted marginal cost of postponing investment until the next period. The Euler approach has advantages and disadvantages. For instance, this model explicitly takes into account dynamics, and since investment models are dynamic models, this is a desired property. Like the q models, the sample can be divided into sub-samples of firms using several criteria. The model is a structural model, in which structural parameters, i.e. the policy variant parameters, are estimated directly. However, similar to the q models, Euler equation models are restrictive as they require assumptions concerning adjustment costs and technology. Also, Euler model estimates are sensitive to specifications and tend to be poor for small samples. Therefore, this approach is not considered any further for the current study.

3.3. INVESTMENT UNDER UNCERTAINTY

Investment behavior in resource-rich and -based economies such as Iran could be distorted as the availability of oil income as an important source of financing investment is subject to uncertainty due to the unpredictable nature of oil prices and thus oil revenues. Therefore, the predictions of the conventional investment theories, which assume certainty, may be only partly relevant for the case of these economies.

A growing theoretical literature focuses attention on the impact of uncertainty on investment and suggests that the impact may be large. This is because conventional investment models failed to consider three major issues in determining most investment decisions (Dixit and Pindyck, 1994, p.3). Firstly, most investment decisions face inherent uncertainty about future benefits and costs from investing. Secondly, investors can control the timing of their investment, thereby waiting for relevant information that may reduce uncertainty. Thirdly, investment is partially or completely irreversible, implying that the initial cost of investment is at least partially sunk and cannot be recovered if market conditions turn out to be worse than expected.

The basic intuition behind the effects of uncertainty on investment stems from the option characteristics of an investment project, suggesting that greater uncertainty raises the value of the option to wait due to the existence of irreversibility effects. The general finding is that heightened uncertainty lowers investment rates, both at aggregate and disaggregates levels (Bernanke, 1983; Caballero, 1991; McDonald and Siegel, 1986, Dixit and Pindyck, 1994). For instance, Dixit and Pindyck (1994) examine how option theory helps to understand investment behavior when investors face uncertainty about future prices and returns, and when their investment decisions are irreversible. They argue that there exists an option value to postpone investment decisions in order to wait for the arrival of new information about market conditions. The existence of this option to wait drives a wedge between the conventional net present value calculation of the current value of an investment project and the current value of the project to the investor. For an investment to be made at a given point in time, its net present value must be adequately larger than zero to keep the investment option alive. This contrasts with the views of Hartman (1972) and Abel (1983) who show that, under certain conditions, an increase in

uncertainty may also give rise to the value of a marginal unit of capital and hence the incentives to invest.³²

A number of problems, nevertheless, arise in the literature. For example, the option-based models of irreversible investment under uncertainty attempt to identify the factors which might affect the threshold at or above which investment is undertaken and not the investment level *per se*. Moreover, Bloom (2000) and Bloom, et al., (2007) argue that the real option effects of uncertainty affect investment in the short-run, but it does not have any impact on investment in the long-run because these effects on the rate of investment and the rate of disinvestment exactly cancel out in the long-run. Consequently, the option theory seems unsuitable for investigating the relationship between investment and uncertainty in the long-run and therefore this approach is not explored any further in this thesis.

Another point concerns aggregation. Uncertainty elements affecting firms' investment decision-making may be submerged in the dynamic specification (timing of investment) in aggregate time-series empirical studies. Therefore, the quest to find good measures of aggregate uncertainty may be an elusive one. In other words, uncertainty may well be an important determinant of investment. But in aggregate empirical models, attempts to find a role for explicit proxies may be fruitless because the effects of uncertainty may already be embedded in the modelling of investment dynamics. Bernanke (1983), however, makes two arguments for why the effects of uncertainty would not disappear at the aggregate level. Firstly, macroeconomic factors, such as uncertainty about future interest, exchange and inflation rates or shocks in monetary, fiscal or regulatory policy regimes, may be important in determining firm-level decisions. Secondly, if a firm is uncertain about whether a shock is transitory or permanent, it may delay investment decisions in order to learn more about its degree of permanence.

³² Abel-Hartman models assume a perfectly competitive risk neutral firm with constant returns to scale production function and convex adjustment costs. Abel (1983) assumes that there is only future uncertainty and that all current variables are known. He further assumes that the stochastic variable follows a Wiener process. In line with Hartman (1972), Abel considers a risk neutral competitive firm that is confronted with price and demand uncertainty, and shows that an increase in price uncertainty leads to an increase in the rate of investment where adjustment costs are convex. 'This result differs completely from the Hartman (1972) result. Hartman shows that an increase in price uncertainty will increase the investment rate if the production function is linearly homogenous and therefore the marginal revenue product of capital is a strictly convex function of the price of output, irrespective of the adjustment function. However, Abel (1983) assumes that the firm optimizes the present value of cash flows, subject to the capital accumulation equation and the stochastic process of the price of output' (Lensink, et al., 2001, p.68).

Table 3.3 Empirical survey on investment-uncertainty relationship

Author(s)	Data and Time Period	Uncertainty Measures	Econometric Model of Investment	Findings
Campa and Goldberg (1993)	Data on US manufacturing sectors during 1972-1986	The volatility of exchange rate is measured as: i) the ratio of the standard deviation to the mean of the exchange rate index; and ii) the standard deviation of the first differences of the log of the exchange rate over the previous twelve quarters	$I_{it}/I_{i,t-1} = \beta_0 + \beta_1(SAL_{it} - 1/SAL_{i,t-2}) + (\beta_2 + \beta_3K_{it})e_{t-1}/e_{t-2} + (\beta_4 + \beta_5K_{it})\sigma_{t-1}^e/\sigma_{t-2}^e + \beta_6r_{t-1}/r_{t-2} + \varepsilon_{it}$	The results, employing 2SLS ³³ and fixed effect regressions, illustrate that for a given export share, the depreciation of the home currency adversely affects those industries with a higher share of imported inputs and lowers profit margin, whereas it improves the external competitiveness of the home industry to the degree that it sells to foreign markets; the latter gives rise to investment
Leahy and Whited (1995) ³⁴	Annual data on US manufacturing sector during 1949-1987	The variance of the firm's daily stock return for each year, scaled by the variance of the firm's debt-equity ratio	$\Delta(I/K)_{it} = \sum_{n=0}^N \gamma_n \Delta \sigma_{i,t+n}^* + \sum_{n=0}^N \Delta DIS_{i,t+n} + \Delta \varepsilon_{it}$	The results, employing VAR and GMM, suggest that an increase in uncertainty has a negative impact on investment; no evidence is found in support of the positive impact of uncertainty through the convexity channel, nor in support of the CAPM-based impact of risk
Price (1995)	Data on US firms during 1961-1992	Natural logarithm of GDP as a proxy for uncertainty ³⁵	$I_t = \Delta K_t + \delta K_{t-1}$, where $\Delta K_t = \beta_1(L)\Delta K_{t-1} + \beta_2(L)Z_{t-1}$ ³⁶ - $\beta_3(K - K^*)_{t-1}$	The findings, employing GARCH model to measure uncertainty and using OLS, ECM and SUR estimates, show that the level of aggregate uncertainty has a significant and negative impact on manufacturing investment decisions
Carruth, et al., (1997)	Quarterly data on UK industrial and commercial company (ICC)	Quarterly averaged international gold prices deflated by the UK GDP deflator and converted to Sterling	$\beta_1(L)\Delta I_t = \beta_0 + \beta_2(L)\Delta GDP_t + \beta_3(L)\Delta C_t + \beta_4(L)\Delta \psi_t + \beta_5(L)\Delta \pi_t + \beta_6 I_{t-j} + \beta_7 GDP_{t-j} + \beta_8 r_{t-j} + \beta_9 \psi_{t-j} + \beta_{10} \pi_{t-j} + \varepsilon_t$	The findings, employing ECM, show that real profits and the real gold prices are the main determinants of investment spending by the ICC sector

³³ The current interest rate influences investment both in total manufacturing and in individual industry level. Thus, the authors implement two-stage least squares regressions (2SLS) using as instruments for the other exogenous variables in addition to the lagged values of the interest rates variable to take care of the endogeneity of interest rates.

³⁴ At microeconomic level, Leahy and Whited (1995) examine the channels through which uncertainty affects investment, namely convexity and concavity of the marginal product of capital. They also investigate if there is any Capital Asset Pricing Model (CAPM)-related impact of risk on investment. In order to test for the convex return theories, they split the sample at the median based on the industry variances of the labor-capital ratio. A greater ratio indicates a greater ability to substitute labor for capital and thus a smaller negative impact of uncertainty on investment. To evaluate the CAPM, they obtain the covariance of the firm's daily stock return with a value weighted index as a measure of risk. Based on the CAPM model, the required rate of return on investment is positively linked to the risk in investment.

³⁵ Because 'it serves as an index for aggregate demand, which will affect demand in the manufacturing sector as well as the wage and other prices' (ibid, p.148).

³⁶ Z_{t-1} is a set of I(0) variables including terms in real raw material price changes, real labor costs changes, real interest rate measured by the US Treasury Bill Rate less producer price inflation, and the uncertainty measure.

	sector during 1963-1995			
Fielding (1999)	Quarterly data on South African manufacturing industry during 1946-1993	Indexes of volatility for the real user cost of capital, for the average product of capital, and for the rate of capital goods price inflation	$\ln K_t^M = \sum_i \beta_i \ln(K_{t-i}^M) + \sum_j \beta_{1j} \text{DUM} + \beta_2 \ln(C^N/P^M)_t + \beta_3 \ln(w^N/P^M)_t + \beta_4 \ln(K^G)_t + \beta_5 \ln(Q^M/J)_t + \beta_6 S(1)_t + \beta_7 S(2)_t + \beta_8 S(3)_t + \beta_9 \text{INS}_t + \varepsilon_t$	The findings, based on time-series estimates, suggest that capital stock only partially lies within the neoclassical framework; investment is very sensitive to the current level of manufacturing output and its elasticity is greater than that of the user cost of capital; decreases in the volatility of the opportunity cost of capital (i.e. the return to financial investments) have a significantly negative impact on the stock of physical capital
Bond, et al., (2005) ³⁷	Data on a panel of 655 non-financial UK firms during 1987-2000	Within-year volatility of the firm's share price and of the average forecasts of the firm's future earnings; and dispersion across individual analysts in their forecasts of the firm's future earnings	$I_t/K_t = A_1 + 1/A_2(q_{t-1}^M) + \beta_1 \sigma_t + \beta_2 \sigma_{t-1} + \varepsilon_t$	The findings, employing the q-model of investment augmented with uncertainty measures, illustrate that investment is negatively affected by each of these uncertainty measures individually and jointly, and that higher volatility lowers investment rates in the short-run; also, permanent increases in uncertainty are linked to the lower levels of capital stock in the long-run
Bloom, et al., (2007)	Data on a sample of 672 publicly-traded UK manufacturing firms during 1972-1991	A forward looking measure of uncertainty measured by the standard deviation of daily stock returns for firm i in year t	$I_{it}/K_{i,t-1} = \beta_1 \Delta \ln \text{SAL}_{it} + \beta_2 (\Delta \ln \text{SAL}_{i,t-1}) + \beta_3 (\sigma_{*i,t}^* \Delta \ln \text{SAL}_{i,t}) + \beta_4 (\ln \text{SAL}_{i,t-1} - \ln K_{i,t-1}) + \beta_5 \sigma_{it} + \beta_6 \Delta \sigma_{it} + \eta_i + \delta_i + \varepsilon_{it}$	The findings based on GMM and allowing for time-varying uncertainty and temporal aggregation, ³⁸ indicate that cautionary effects of uncertainty are significant in the short-run investment dynamics of firms i.e. greater uncertainty lowers the impact of demand shocks on investment and makes the reaction of the firms to any given policy weaker at the time of higher uncertainty; and temporary effects of higher uncertainty on capital-sales ratio represent a weaker impact of sales growth at higher levels of uncertainty
Diallo (2008)	Data on 23 low-income and 28 middle-income countries during 1975-2004	$e^{v_{j/i}} = \sum_{j=1}^{10} (e_{j/i} \text{CPI}_i \text{CPI}_j)_{\omega_j}$	$I_{it}/K_{i,t-1} = \beta_1 e^{v_{it}} + \beta \text{EXP}_{it} + \eta_i + v_t + \varepsilon_{it}$	The findings, employing GARCH for volatility measures and based on panel data cointegration techniques, indicate that the exchange rate volatility has a significant and negative impact on investment, and that this impact is higher in low-income countries

³⁷ Since marginal q is unobservable, following Hayashi (1982), the authors set q^M equal to q^A and add the stock of debt to Hayashi's model to obtain an observable proxy for q^M as $q^A = q^M = \text{NPV}(t) + D_t/p_t(1 - \delta)K_{t-1}$, where q^A is average q, and NPV is a firm's maximized net present value of expected future profits (adjusted for debt and taxes). The denominator is the replacement cost of capital. The authors further calculate a proxy for expected profitability to control for average q as $E(\pi)_{it} = \pi_{it} + \rho_{t+1}\pi_{i,t+1}/p_t(1 - \delta)K_{i,t-1}$, where $E(\pi)$ is expected profitability and provides an *ex ante* measure of discounted expected profitability of the firm in the current and the following year.

³⁸ This explains that the frequency of shocks and investment decisions tend to be considerably higher than that of the (annual) data (Bloom, et al., 2007, p.394).

Henriques and Sadorsky (2011)	Data on a panel of 1000 non-financial, publicly-traded US firms during 1990-2007	$OPV_t = \frac{\sqrt{(1/n) - 1 \sum_{t=1}^n (r_t^o - E(r_t^o))^2}}{\sqrt{n}}$ <p>where r_t^o is the daily oil price return $r_t^o = 100 \ln(p_t^o/p_{t-1}^o)$, n is the number of trading days in the year, and p_t^o is daily oil prices</p>	$(I/K)_{it} = \beta_0 + \beta_1(I/K)_{i,t-1} + \beta_2(1-q)_{it} + \beta_3(1-q)_{i,t-1} + \beta_4X_{it} + \beta_5X_{i,t-1} + \beta_6OPV_t + \beta_7OPV_{t-1} + \beta_8\rho_{2t} + \beta_9(OPV)_{2,t-1} + (1-\rho)\eta_i + \nu_t - \rho\nu_{t-1} + \varepsilon_{it}$	The results, employing GMM, indicate that there is a U-shape relationship between firm's investment and oil price volatility, meaning that an increase in uncertainty increases the value of option to wait and postpones investment; however, after some point, a greater increase in uncertainty increases investment because, compared to the option value of waiting to invest, the value of the preemptive strategic effects start rising
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Notes: C and C^N are the real and the nominal user costs of capital; DIS is the discrepancy between the observable volatility and its expectation; e and e^v are the real exchange rate and the exchange rate volatility. GDP is gross domestic product; I is gross investment; K is capital stock; K^* is the desired capital stock; K^M is real capital stock in the manufacturing sector; K^G is public capital stock; q^M is the marginal q ; and r is the rate of real interest. SAL is real sales; CF is cash flows; P^M is the aggregate price of manufacturing output; Q^M is real output of the manufacturing sector; w^N is the nominal wage rate in the manufacturing sector; and OPV is oil price volatility. $S(1)$, $S(2)$, and $S(3)$ are indexes of volatility for the real user cost of capital, the average product of capital, and the rate of capital goods price inflation, respectively. CPI is the consumer price index; ω_j is trade partner j 's weight; and EXP indicates explanatory variables and here includes GDP over lagged capital stock, real interest rate, the user cost of capital. INS is an index for macroeconomic instability. $A1$ and $A2$ are parameters of adjustment cost function; π is real profits; σ is volatility measure; δ is the depreciation rate; and ψ is the wedge between the user cost of an extra unit of capital and its present value arising from the option value of waiting. DUM is a set of quarterly dummies. β_s are unknown parameters; Δ and \ln indicate changes and natural logarithm, respectively; and (L) is the lag polynomial. Subscripts t represents the time period; and j refers to the number of firms in the manufacturing sector. η is fixed effects; ν is time effects; and ε is an independently and identically distributed error term. ECM , $GARCH$, GMM , IV , OLS , SUR , VAR and $2SLS$ stand for Error Correction Model, General Autoregressive Conditional Heteroskedasticity, Generalized Method of Movements, Instrumental Variables, Ordinary Least Squares, Seemingly Unrelated Regressions, Vector Auto-regression, and two-stage least-squares, respectively.

Furthermore, while a majority of literature provides evidence in support of a negative linear relationship between investment and uncertainty, some researchers suggest asymmetric effects of uncertainty on investment (Baum, et al., 2001; Darby, et al., 1999; 2002). There is also the issue of which variables to choose for measuring uncertainty. Byrne and Davis (2002) assess a range of uncertainty measures in the G7 countries, including measures based on the volatility of exchange rates, long-term interest rates, inflation, share prices and industrial production. Only uncertainty measures related to exchange rates and, to a lesser extent, interest rates were found to be significant. Other scholars use some other measures of uncertainty such as volatility of government consumption expenditures or government budget deficits as a share of GDP (Aizenman and Marion, 1995, 1999), terms of trade (Bleaney and Greenaway, 2001) and nominal money growth, finding significant negative correlations between these measures and (private) investment. Table 3.3 illustrates the findings of a selected empirical work on the investment-uncertainty relationship and their measures of uncertainty. At large, the empirical evidence for the effect of uncertainty on investment is mixed, but it tends to imply adverse effects of various measures of macroeconomic uncertainty on aggregate investment (Pindyck, 1986; Pindyck and Solimano, 1993; Aizenman and Marion, 1999; Asteriou and Price, 2000; Carruth, et al., 2000; Byrne and Davis, 2003; du Toit and Moolman, 2004; Demir, 2009).

The investment literature uses different methods to measure uncertainty. These methods include: i) the variance of the normal distribution of a variable (Pindyck, 1986; Bell and Campa, 1997); ii) the variance of the unpredictable part of a stochastic process (Aizenman and Marion, 1999); iii) the variance of geometric Brownian motion (Pindyck and Solimano, 1993; Caballero and Leahy, 1996); iv) the GARCH model of volatility (Engle, 1982; Price, 1996); and v) the variance derived from survey data (Ferderer, 1993; Pattillo, 1998).

To measure the variance of the unpredictable part of a stochastic process, the process that generates the predictable part of the stochastic process needs to be selected before computing the variance of the unpredictable part of a stochastic process and its distribution.³⁹ Furthermore, in the theoretical models of investment under uncertainty, it is often assumed that the future development of an uncertain investment-related variable can be modelled by a geometric

³⁹ More precisely, this method of volatility measurement can be summarized as follows: i) first setting up a forecasting equation for the uncertainty model; ii) then estimate the forecasting equation to obtain the residuals i.e. the unpredictable part of the fluctuations of the variable; and iii) lastly calculating the conditional standard deviations of the residuals as the uncertainty measure.

Brownian motion. In the empirical applications of the geometric Brownian motion in the field of investment, volatility is often assumed to be constant. Since continuous data are needed for the modelling of volatility, using this method it is less popular than the GARCH-approach. GARCH modelling of volatility allows for the time dependence of the second moment of the random variables, hence is an appealing measure of uncertainty. In particular, the GARCH models assume that the error terms have variance which is a function of the actual size of the error terms in the previous periods and thus the variance is related to the squares of the previous error terms. Although attractive, the application of GARCH-type models for volatility measurements requires longer time-series and high frequency observations. This limits the application of this method in the field of investment and macroeconomics where the frequency of observations is relatively low. Moreover, GARCH modelling is often criticised on the basis that the estimated conditional variance may be biased due to possible misspecification of the equation defining the conditional mean. Survey data directly contains information on agents' expectations of future variables. The main advantage of using survey data is its forward-looking property. This approach, however, requires a large number of respondents to obtain reliable measures of uncertainty.

Notably, investment theories do not explicitly identify a role for oil prices and focus on output and factor costs. In addition, the literature pays little attention to investigating how investment behavior reacts to uncertainty stemming from the volatility of resource prices or resource revenues in resource-rich and -based economies. The latter issue is of importance since, according to the literature on the resource curse thesis, resource-abundant economies often lag behind resource-poor economies in terms of economic performance. In the context of resource-rich economies, the literature on natural resources identifies symmetric and asymmetric measures to capture uncertainty associated with resource price movements. Following Hamilton (1983), linear effects of resource price uncertainty are commonly measured by calculating the changes in international oil prices:

$$(3.20) \text{d}p_{o_t} = p_{o_t} - p_{o_{t-1}},$$

where po_t is the price of oil per barrel in the US \$. Mohaddes and Pesaran (2013) use the changes in monthly international oil prices to calculate the realized annual volatility of oil prices as follows:⁴⁰

$$(3.21) \text{vol}_t = \sqrt{\sum_{\tau=1}^{12} (g_{t\tau}^o - \bar{g}_t^o)^2},$$

where $g_{t\tau}^o$ denotes the rate of change in oil prices $po_{t\tau}$ during months τ and t ($g_{t\tau}^o = d(po_{t\tau})$) and $\bar{g}_t^o = 1/12 \sum_{\tau=1}^{12} (g_{t\tau}^o)$.

Moreover, the literature commonly uses three major methods for non-linear transformation of resource prices: (i) asymmetric specification (Mork, 1989); (ii) scaled specification (Lee, Ni and Ratti, 1995); and (iii) net specification (Hamilton, 1996). Mork (1989) allows for asymmetric responses to oil price changes by specifying increase and decrease in the real price of oil as separate variables as:

$$(3.22) \text{dpoi}_t = \max(0, (po_t - po_{t-1})), \text{ and}$$

$$\text{dpod}_t = \min(0, (po_t - po_{t-1})),$$

where dpoi_t and dpod_t are real oil price increase and real oil price decrease, respectively. Lee, et al., (1995) focus on volatility, proposing that ‘an oil shock is likely to have greater impact in an environment where oil prices have been stable than in an environment where oil price movement has been frequent and erratic’, because price changes in a volatile environment are likely to be soon reversed. They utilize a generalized autoregressive conditional heteroscedasticity (GARCH (1, 1)) model to construct the conditional variation of oil price changes and to normalize unexpected movements in real oil prices. Scaled oil price accounts for the fact that oil price increases after a long period of price stability have more dramatic macroeconomic consequences than those that are merely corrections to greater oil price decreases during the previous quarter.⁴¹ Hamilton (1996) suggests another form of asymmetric transformation of real oil prices and states that most of the oil price increases are simply

⁴⁰ Anderson and Bollerslev (2003) and Barndorff-Nielsen and Shephard (2002, 2004) use intra-daily data to compute the daily realized volatility of asset returns. Mohaddes and Pesaran (2013) apply the same method to calculate the annual volatility using the monthly changes in international oil prices. They expect the results not to be much affected when weekly or daily observations are used instead of the monthly data.

⁴¹ For details on asymmetric GARCH models, among others, see Section 16.7 in Patterson (2000).

corrections of earlier declines. He argues that it seems more appropriate to compare the current price of oil with that during the previous year rather than during the previous quarter alone. Accordingly, he proposes using the percentage change over the previous year's maximum if the oil price of the current quarter exceeds the value of the preceding four quarters' maximum. If the price of oil in time t is lower than in the previous year, the net oil price increase is defined to be zero in quarter t . In this case, no positive oil price shocks have occurred.

3.4. INVESTMENT IN PARTIAL-MARKET AND RESOURCE-RICH ECONOMIES

Investment models have been principally developed for market-based and developed economies. Therefore, the theoretical and empirical literature reviewed thus far is mostly related to the studies of investment behavior in such economies. However, these models may be only partly applicable for economies which are partially market-based, planned, in transition or resource-dependent. In these economies, the SOEs or semi-SOEs are commonly in control of the majority of production units and activities, and the state provides them with financial support to keep production intact and to gain some return on investment even if they do not achieve their planned targets (Maskin and Xu, 2001). These economies are often subject to soft budget constraints, arising from a state's political considerations or a poorly defined profit drives of a rescuing institution, manifested through occasional or regular state fiscal subsidies to loss-making firms, soft taxation or soft bank credits.⁴²

⁴² This includes: i) tax rates may vary across the sectors or firms (i.e. they may be lower for preferred sectors and firms); taxing regulation may be un-uniform, leaving legal ways open to make exceptions; or firms may not pay taxes.

Table 3.4 Investment in partial-market economies

Author(s)	Data and Time Period	Econometric Model of Investment	Findings
Budina, et al., (2000)	Data on Bulgarian firms during 1993-1995	$(I/K)_i = \beta_0 + \beta_1(\Delta \text{SAL})/K_i + \beta_2(\text{CF}/K_i) + \varepsilon_i$	The results, employing an accelerator-cash flow type model of investment, show that large firms' investment practices are not liquidity constrained, whereas the opposite is true for the smaller firms; also firms with small long- and short-run debts are those with positive cash flows and are liquidity constrained, whereas heavily indebted firms have negative cash flows and are not liquidity constrained
Lizal and Svejnar (2001)	Data on Czech Republican firms during the transition phase 1992-1998	$I_{it}/K_{it} = \beta_0 + \beta_1(I_{i,t-1}/K_{i,t-1}) + \beta_2(I_{i,t-1}/K_{i,t-1})^2 + \beta_3(Y_{i,t-1} \cdot w_{i,t-1} L_{i,t-1}/K_{i,t-1}) + \text{DUM} + \varepsilon_{it}$	The findings, motivated by the neoclassical-accelerator and cash-flow models and based on OLS estimates, show that lagged output is positively related to investment, but there is no relationship between profits (i.e. cash flows) and investment
Rizov (2004)	Data on Romanian manufacturing firms during 1995-1999	$(I/K)_{it} = \beta_0 + \beta_1(I/K)_{i,t-1} - \beta_2(I/K)_{i,t-1}^2 - \beta_3(\text{CF}/K)_{i,t-1} + \beta_4(Y/K)_{i,t-1} + \beta_5(D/K)_{i,t-1}^2 + \eta_i + \delta_i + \varepsilon_{it}$	The findings, using GMM-IV and based on Euler approach, confirm the SBC hypothesis and indicate that firms with unconstrained credit access reveal a weaker CF sensitivity of investment decisions
Gugler and Peev (2010)	Data on thirteen transition economies during 1993-2003	$(I_{it}/K_{it}) = \beta_0 + \beta_1(\text{CF}_{i,t-1}/K_{i,t-1}) + \beta_2(\text{SAL}_{i,t-1}/K_{i,t-1}) + \beta_3(\text{SAL}_{i,t-1}/K_{i,t-1}) + \varepsilon_{it}$	The results, based on GMM and OLS estimates, illustrate that investment-cash flow sensitivities have decreased over the transition period; also investment-cash flow sensitivities are negative for state-owned firms in early period of transition, whereas privatized firms are found to be more effective in their investment practices

Notes: I is gross investment; K is capital stock; Y is output; L is labor; SAL is real sales; w is wages; CF is cash flows; π is profits; and DUM is a set of quarterly dummies. β s are unknown parameters; Δ and \ln indicate changes and natural logarithm, respectively. Subscript t and i represent the time period and the firm, respectively. η is fixed effects; v is time effects; and ε is an independently and identically distributed error term. GMM, IV, and OLS stand for Generalized Method of Movements, Instrumental Variables, and Ordinary Least Squares, respectively.

Consequently, the operation of market competition may be weakened by failing to eradicate inefficient loss-making businesses, and may be adversely affected by the credit markets since firms may become irresponsible in their borrowing practices. This could undermine the adaptive capability of firms as well as the productivity and competitiveness of an economy. For example, Allen (2001) argues that the main objectives of firms in the Soviet Union were to meet their ambitious output targets and not to maximize profits during 1928-1940. In Allen's view, this setting made it possible for these firms to pursue higher output by increasing the number of their employees beyond the point where the value of the marginal product of labor was equal to their real wages (unlike the capitalist firms who employ workers until it equals their wages). Allen identifies planning and the formulation of ambitious output targets to lead business activities and as the main driver for the rapid industrialization of the Soviet Union during this period.

Table 3.4 illustrates the literature on investment determinants in partial-market economies. At large, the empirical literature predicts that investment behavior in such economies could be distorted because it can lead to over-investment in loss-making firms or under-investment in potentially profit-making firms due to inefficient allocation of credits by the authorities. Often, state-owned firms or large firms' investment practices are not liquidity constrained, whereas the opposite is true for the smaller firms. In the context of the transition economies, for instance, Lizal and Svejnar (2002) examine the relationship between sales, profits and investment for the case of Czech Republic during 1993-1998. The authors (*ibid*, p.361) suggest that a positive coefficient between lagged output and investment indicates that firms are credit-rationed. In contrast, a zero coefficient indicates that firms have access to bank credits for investment independent of their profitability, implying the presence of soft budget constraints. According to the authors, a negative coefficient then suggests a stronger form of soft budget constraints as unsuccessful firms have greater access to credits.

In the context of the resource-rich and resource-based economies, however, the findings should be interpreted differently if the measures of financial constraints are oil income-based. In this case, a positive coefficient between the oil income proxy and investment could suggest that firms are state- or semi state-owned or they belong to preferred sectors of the economy, hence

their investment practices are not (or less) liquidity constrained.⁴³ That is, the availability of oil income could alleviate credit constraints faced by certain prioritized firms and economic sectors compared to others in such economies.

Zarmouh (1998) investigates the determinants of investment behavior for the oil-based economy of Libya during 1962-1992. In his model, the explanatory variables motivated by the neoclassical model of investment are: i) changes in real output, because an increase in demand for consumer and producer goods output can give rise to producers' demand for capital goods and induce them to invest more through the accelerator effect; ii) a real interest rate measured by nominal interest rate minus inflation rate; iii) a real wage rate measured by the nominal wage rate deflated by producer price index (PPI); iv) an investment price index measured by the market or selling price of capital goods deflated by PPI; v) the value of oil export as well as total government expenditure to capture the effects of the availability of finance for public investment; and vi) lagged dependent variables. Since investment is mainly determined by the Libyan government during the period of study in the government's annual budgets (and not by market mechanism), the author expects the real interest rate to have very little impact only on private sector investment. Employing an Error Correction Model (ECM), he finds that investment is mostly oil-driven. He then estimates investment functions for public and private sectors and finds that investment is chiefly public sector-driven and is determined by the real value of oil exports, though there is some evidence for the influence of some market-oriented variables such as the cost of capital (i.e. real selling price of capital goods or real interest rate) on private investment.

Intuitively, natural resources are expected to increase wealth and purchasing power of resource-driven countries that are endowed with natural resources, enabling them to invest and grow, as many of these economies benefit from substantial resource windfalls. This, however, brings about challenges as how to utilize rents from their exhaustible resources in order to accelerate capital accumulation process, structural transformation and economic growth. Often, investment decisions made by the governments of these countries fail to result in productive investment, which in turn undermines investment efficiency in these economies (Sarraf and Jiwani, 2001). Many oil-rich countries have intended to utilize their enormous oil revenues to fund diversified

⁴³ The latter interpretation is not limited to resource-rich economies; for instance it could be applicable for the economies where the preferred sectors are economically prioritized.

investment projects and industrial development. Venezuelans called this ‘sowing the seeds of oil revenues’ (Larrain, Sachs and Warner, 2000, p.51). Nonetheless, due to the fact that economic diversification is extremely complicated, time consuming and hard to achieve, often resource-abundant governments neglect or adjourn formulating appropriate investment and industrial policies with a tendency to invest in non-tradable sectors of the economy. As a result, diversifying away from the natural resource sector towards manufacturing or other productive sectors of the economy may be misled or misconducted. Furthermore, although the resource sectors are prone to produce massive revenues, they typically offer rather few jobs and operate with the rest of the economy in a very restricted way.

Accordingly, ‘the natural resource curse’ thesis attempts to explain the paradox that resource-rich countries often underperform resource-poor countries in terms of economic growth and development (Auty, 1993). The literature suggests various explanations for the causes of the resource curse phenomenon. The most regularly discussed explanations of the resource curse thesis include the structuralists argument, the Dutch Disease theory, the rentier state paradigm, the voracity effects, resource prices and revenues volatility and inadequate institutions and policies (see Table 3.5). Early explanations of the resource curse thesis were within the structuralist theoretical framework of the 1950s that focused on the decline of terms of trade of primary commodities, the price volatility of such commodities and the poor linkages between the natural resource sector and the rest of the economy (Prebisch, 1950; Hirschman, 1958). However, the explanatory power of the structuralist arguments was weakened by the results of empirical investigations (for instance, among others see Lutz, 1994; Dawe, 1996). A number of alternative theoretical approaches were developed to address the question as to why resource-rich economies experienced a slower economic growth compared to resource-poor economies.

One economic explanation emphasized the Dutch Disease phenomenon (Corden and Neary, 1982; Neary and van Wijnbergen, 1986; Krugman, 1987). The Dutch Disease theory attempts to describe the association between the exploitation of natural resources and a decline in the manufacturing sector. This term originally referred to the decline of the Dutch manufacturing sector due to the discovery of large natural gas fields in 1959, which subsequently led to the appreciation of the Dutch real exchange rate (Humphreys, et al., 2007). In this model, there is a non-tradable good sector (e.g., services), and two tradable good sectors: the booming sector (e.g., oil or natural gas) and the lagging sector or the non-booming tradable sector(s) (e.g.,

manufacturing or agriculture). A boom in the natural resource sector leads to the ‘resource movement effect’ and the ‘spending effect’ (Cordon and Neary, 1982). The former takes place when the resource boom leads to an increase in the demand for labor in the booming sector that shifts the direction of the production away from the lagging sector and toward the booming sector. This effect is also called ‘direct de-industrialization’. The latter results from the excessive revenues generated by the resource boom, which leads to a higher demand for labor in the non-tradable sector, taking labor away from the lagging tradable sector towards the non-tradable sector. This is also called ‘indirect de-industrialization’ (Cordon, 1984).

The abundance of resource revenues may therefore lead to the formulation and implementation of unsustainable industrial policies as most resource-rich economies have not succeeded in promoting a competitive manufacturing sector (Ranis, 1991; Krause, 1995; Mikesell, 1997; Sachs and Warner, 1997). These economies have commonly pursued industrial policies with two main elements, namely protectionism and generous subsidy payments. Once these elements are in place, the growing resource revenues may reduce incentives to create competitive manufacturing industries. Often as a reaction to the appreciation of the real exchange rate and the declining tradable sectors of the economy, many resource-rich developing economies tend to encourage industrialization through adopting import substitution policies to support infant industries. However, the key problem is thought to be that ‘the relaxation of market discipline and associated accumulation of economic distortions ... retards competitive diversification and lies at the heart of the underperformance of the resource abundant countries’ (Auty and Kiiski, 2001, page 28). An export-oriented competitive industrial policy is instead expected to help maintaining the competitiveness of such industries (Auty, 1994). Also, often based on the infant industry argument, ample resource rents have encouraged unsustainable allocation of sizable subsidies, which has often been accompanied by the formation of powerful interest groups and rent-seeking activities in these economies (Auty, 1994; Sarraf and Jiwaji, 2001).

Table 3.5 Leading arguments in explaining the resource curse thesis

Political-economy and Institutional Explanations		
Approach	Proposition	Key literature
Rent-seeking behavior	Resource windfalls can be appropriated, incentivizing distorted public policies, bribes and diversion of the public towards corruption	Mahdavi (1970); Torvik, (2002); Vicente (2010)
Corruption effects	Natural resource abundance de-incentivizes to reform and to be held accountable and triggers corruption and misuse of resource windfalls	Moore (2000); Auty (2001); Collier and Hoeffler (2004)
Voracity effects	Transfer of capital from the formal sector to the informal sector by the powerful political groups, hence shrinking formal capital eventually due to resource price volatility	Lane and Tornell (1996); Lane and Tornell (1999)
The role of institutions	Abundant nature of natural resources constitutes the preferred means of governance in resource-rich economies, allowing for redistributive and resource allocative policies that direct extractive rents to preferred sectors and groups	North (1990); Kalyuzhnova and Nygaard (2008)
Economic Explanations		
Approach	Proposition	Key literature
Structuralist approach	Decline in terms of trade of primary commodities and poor linkages between natural resource sectors and the rest of the economy	Prebisch (1950); Hrischman (1958)
The Dutch Disease theory	Decline in the non-resource tradable manufacturing sector (or agriculture) is associated with the exploitation of natural resources; real exchange rate appreciation is caused by inflationary pressures from resource revenue spending, which in turn leads to the contraction of the non-resource tradable sectors	Corden (1984); Neary and Wignbergen (1986); Sachs and Warner (1997)
Resource revenue management and government policies	Resource rents may result in unsustainable government and industrial policies, retarding competitive economic diversification in resource abundant economies	Sachs and Warner (1997); Auty and Kiiski (2001); van der Ploeg (2011a)
Volatility of natural resource prices	Natural resource price volatility may make it hard to adopt prudent macroeconomic and fiscal policies, which may be exacerbated by resulting in resource revenue volatility; this may worsen investors' willingness to invest given changeable expenditure policies, hence resulting in unsustainable consumption rather than investment	Behrman (1987); Sachs and Warner (1997); Rodriguez and Sachs (1999); Atkinson and Hamilton (2003)

Although the Dutch Disease theory was first associated with real exchange rate appreciation bred by inflationary pressures from resource income spending and the resulting contraction of the manufacturing sector, this understanding has developed over time. For instance, more narrowly, the meaning of the Dutch Disease has been associated with the failure of resource-rich economies to promote a more competitive manufacturing sector (Sarraff and Jiwanjo, 2001). Also, earlier work on the Dutch Disease theory often focused on the contracting effects of the Disease on the manufacturing sector. Yet, more lately, attention is also given to the contracting effects on the agriculture sector (Love, 1994). Therefore, a controversy exists over the Dutch Disease effects in explaining the resource curse thesis (Auty, 2001; Leite and Weidmann, 2002; Sala-i-Martin and Subramanian, 2003).

Another body of literature attempts to explain the resource curse thesis by suggesting that the abundance of natural resources and resource dependency may deteriorate or undermine institutional and governance quality (Collier and Hoefeler, 2004; Ross, 2001; Rosser, 2004). This is because institutions provide the incentive structure for an economy. As that structure evolves, it shapes the direction of economic change towards growth, stagnation or decline (North, 1990). Institutions can facilitate economic exchanges and determine resource allocation and efficiency of economic activities. However, if combined with poorly defined property rights and an ill-functioning legal system, natural resources could entail corruption, voracity and civil conflicts (Mauro, 1995; Tornell and Lane, 1999; Leite and Weidmann, 2002; Torvik, 2002; Collier and Hoeffler, 2004; Robinson, et al., 2006). For instance, the voracity effects could constrain economic growth through an increased transfer of capital generated by positive resource price shocks from the formal sector to the informal sector by powerful political groups (Lane and Tornell, 1996).

Resource gains may also cause a 'feeding frenzy' in which various groups fight over the rents from natural resources, thus leading to inefficient exhaustion of the resources (Lane and Tornell, 1996; Robinson, et al., 2006). The latter may further be aggravated through direct accrual of resource rents to the government, hence adversely affecting the structural reforms in such economies and distracting the respective governments from carrying out growth-inducing investment activities (Isham, et al., 2003; Collier and Hoeffler, 2005). Moreover, resource-rich economies often pursue more protective trade policies which could affect institutional development in these economies, often motivated by diversifying the economy away from

resources (Sachs and Warner, 1997). This in turn may reduce incentives of the governments of these economies to reform and to establish a well-functioning taxing system. Lax taxation, consequently, undermines the relationships between such governments and their citizens as the income of these governments is guaranteed from resource rents rather than taxes from the citizens (Moore and Unsworth, 2007).

Substantial windfalls from natural resources may therefore encourage rent-seeking activities (Mahdavy, 1970). In the rent-seeking literature, it is assumed that resource rents can be easily appropriated by the governments of resource-abundant countries, thus incentivizing distorted public policies, bribes and diversion of the public towards corruption (Torvik, 2002; Vicente, 2010). In these economies, thus, rent appropriation (as opposed to wealth creation) may dominate as it offers immediate political as well as economic gains. Resource rents, consequently, can be used for power consolidation by the respective governments. The appealing nature of these gains, that is favoring specific groups of the elites, may in turn give rise to the emergence of 'extractive' political states (Ross, 2001). However, the trade-off between appropriating rents to favor specific interest groups and adopting economic policies which could promote economic development may be significantly large. That is, to maintain the ruling elites in power, resource revenues prevent the distribution of power towards the middle class and the adoption of growth-promoting economic policies. Also, as a result of the existence of abundant natural resources, rent-seeking may make the respective governments responsive to public pressure in spending more and in triggering ill-coordinated decisions which would induce distortions in the economy (Auty, 2001; Sarraf and Jiwanji, 2001; Stevens and Dietsche, 2008). Moreover, the development of human capital may be neglected by these governments due to inadequate devotion of attention to education or lack of incentives for financing it (Ascher, 1999; Gylfason and Zoega, 2006; Stijns, 2006).

An additional line of argument is associated with the volatility impact of natural resources. Such volatility could cause a range of challenges for resource-rich economies. Unexpected increases or decreases in commodity prices trigger resource wealth fluctuations, which could result in cycles of boom and bust in resource revenues (van der Ploeg, 2011b). Volatility of resource revenues, hence, exposes public finances of resource exporting countries to unpredictable booms and busts in their fiscal cash flows. In fact, some studies suggest that the volatility of resource revenues, driven by violent fluctuations in resource prices, is a cause for the presence of the

resource curse in resource-based economies (Mikesell, 1997; Auty, 1998). This induces macroeconomic costs including swift changes in public expenditures, the volatility of real exchange rates and distortions in allocation of investment funds to the rest of the tradable sectors of the economy. In fact, fluctuating resource revenues make it hard to adopt prudent fiscal policies due to creating an uncertain environment for investment activities resulting from changeable expenditure policies. Also, under these circumstances, resource revenues may not be used for investment but rather for excessive unsustainable consumption (Behrman, 1987; Rodriguez and Sachs, 1999; Atkinson and Hamilton, 2003).

A body of literature focuses on fiscal policy challenges in managing the volatility of natural resource revenues. For instance, Atkinson and Hamilton (2003) provide evidence to support the idea that the resource curse may stem from governments' inability to sustainably manage sizable resource windfalls. Inefficient management of fiscal surpluses in times of resource price booms and financing of the deficits in times of price busts may result in the transmission of resource revenue volatility to the rest of the economy. Many resource-rich countries suffer from poorly developed financial systems and financial remoteness, so that they are likely to experience greater macroeconomic volatility and instability (Aghion, et. al, 2006; Rose and Spiegel, 2007).

At large, both developed and developing economies aim at achieving and maintaining high levels of economic growth. In this picture, domestic investment is particularly crucial in developing economies mainly for the purpose of sustainable economic development, and is a prior objective on the agenda of policies-makers in these economies. In fact, to achieve sustainable growth, investment is a prerequisite. Without sufficient investment, physical capital cannot be accumulated and economic growth will be limited even if other conditions of economic growth are satisfied. Anderson (1987) relates economic growth to allocative efficiency and the investment rate, and concludes that when investment is applied efficiently, it 'accounts for most of a country's growth'.

In developing economies, the investment requirements are far greater than the available size of finance. In contrast, in natural resource exporting economies like Iran, resource revenues are the main source of financing investment activities. As a result, the main challenge of such economies, particularly during times of favorable natural resource prices, is how much to invest rather than where to get the finance from. Thus, it is possible for resource-rich and resource-

driven economies to mismanage or even waste the windfalls from resources if they under-invest or over-invest. Furthermore, if resource income is the only major source of financing investment, actual investment can be subject to instability and uncertainty since natural resource prices are prone to be volatile. Consequently, it is often very difficult for the governments and economic policy-makers in these economies to determine the direction towards and the extent to which investment should be channeled.

The literature has therefore identified some solutions to the resource curse on the grounds of efficient investment and saving (see Table 3.6). Based on the Hotelling rule, to ensure the sustainable depletion of natural resources in a competitive world, the rate of capital gains from depletable resources must equal the rate of return on any other assets. In this setting, the equality between the prices of natural resources and the interest rate should direct resource extraction. Depletion of a finite resource will cause a scarcity rent since less of that resource is left for the future. This would lead to an increase in the resource price. Higher prices lower the quantities demanded; thus, more is conserved for future consumption. This process will result in efficient allocation of resources over time in competitive markets (Hotelling, 1931). Such optimal depletion of natural resources, however, does not account for rent-seeking activities and corruption which may emerge due to the abundance of natural wealth in resource-rich economies. Matsen, et al., (2005) propose that the share of natural resources which are used for consumption should be optimally adjusted downwards over time and that some degree of the Dutch Disease effect should be accepted to represent the existing economic distortions in many resource-rich economies.

The Hartwick rule states that the resource windfalls should be re-invested in reproducible capital to overcome the problem of the current generation's over-consuming of the exhaustible resources. The total value of net investment accordingly will be kept equal to zero which would be sufficient for a constant utility path (Hartwick, 1977). Another body of literature argues that distortions caused by a booming resources sector, which potentially can hamper the competitiveness of the non-resource sector, could be corrected with a tax on natural resources (Dixit and Newbery, 1985; Karp and Newberry, 1991). An alternative approach suggests that resource windfalls should be directly distributed among the citizens of the resource-rich economies, and that the governments of such economies may tax their citizens to reduce debts and to finance their investment activities (Sala-i-Martin and Subramanian, 2003). Various

practical issues, nevertheless, undermine the success of the latter approach such as difficulties in identifying the citizens who should be entitled to such transfer payments and the associated administrative costs. Another view is to allocate the excess resource revenues to a sovereign wealth fund (SWF) in order to cushion the economy from over-injections of resource windfalls and macroeconomic instability, and then to live on the interest on the fund (Davis, 2001; Barnett and Ossowski, 2003; Stevens, 2003). Thus, a SWF can be a means to accumulate resources for precautionary savings purposes or can be saved for intergenerational equity, hence allowing for a sustained increase in consumption (Bacon and Tordo, 2006).

The establishment of a SWF may give rise to the bird-in-hand policy with no increase in consumption before the windfall and a slow increase in consumption during the windfall. Also, future resource revenues can be used as security for borrowing which would give rise to borrowing before the windfall and paying off the debt and accumulating enough SWF to maintain a rise in consumption during the windfall. This is in line with the permanent income hypothesis (PIH) which suggests an increase in consumption financed by borrowing ahead of the windfall and then accumulating a SWF during the windfall. In contrast, van der Ploeg (2010) argues that these policies are not relevant for resource-rich developing economies. This is because they do not consider common issues in many of these economies such as capital scarcity, absorptive capacity constraints, adjustment costs of capital stock, and demand pressures on the expansion of the non-tradable sectors due to exchange rate appreciation. For example, absorptive capacity can be constrained by three factors: (i) scarcity of supply of skilled workers, physical capital and infrastructure; (ii) institutional constraints; and (iii) relative price effects (e.g., increases in the price of non-tradable) with implications for sector-level competitiveness in the economy (Bourguignon and Sundberg, 2006).

Table 3.6 Some proposed solutions to the resource curse

Approach	Proposition	Motivation	Key literature
The Hotelling rule	The rate of capital gains from exhaustible resources, in a competitive world, must be equal to the rate of return on any other assets	To achieve sustainable depletion and efficient allocation of resources, under competitive markets, resource extraction should be guided by the equality between the rate of return on any other assets and the prices of natural resources. Depletion of an exhaustible resource results in a scarcity rent as less resource is left for the future, which in turn increases the resource price. Higher prices reduce the quantities demanded; hence more is saved for future consumption	Hotelling (1931); Dasgupta and Heal (1979); Matsen and Torvik (2005)
The Hartwick rule	An efficient constant utility path, in an economy with stationary technology and instantaneous preferences, must be characterized by the value of net investment being null at each point in time	To deal with the problem of current generation's over-consuming of the current finite resources, resource revenues should be reinvested in reproducible capital. Consequently, net investment total value would be kept equal to zero, hence sufficient for a constant utility path	Stiglitz (1974); Hartwick (1977); Dasgupta and Heal (1979)
Introducing taxes on natural resources	Tax on natural resources can correct economic distortions caused by the booming sector	To correct distortions induced by the booming resource sector, which hinders the competitiveness of non-resource sectors, taxes must be imposed on natural resources	Dixit and Newbery (1985); Karp and Newbery (1991)
Direct allocation of resource revenues	Direct allocation of resource revenues	Resource revenues should be directly distributed to the citizens of a resource-rich economy; the government may tax citizens to finance investment or to reduce debt	Sala-i-Martin and Subramanian (2003)
Establishment of sovereign resource funds and precautionary savings	Excess resource revenues must be allocated to a resource fund to cushion the economy from volatility in natural resource prices and revenues	To efficiently manage resource income and to achieve intergenerational fairness, parts of natural wealth can be saved in sovereign resource funds for future generations and for smooth consumption	Davis, et al., (2001); Stevens (2003)
Investing-to-investing strategy	Efficiency of public investment management and promotion of private investment through open-to-trade policies and removing rigidities in the business environment; windfall-driven structural adjustment through home-grown private, public and human capital	To spend resource revenues effectively, governments must anticipate resource discovery booms and address bottlenecks that are possible to be dealt with so as to build up government capacity for investment project selection and implementation along with private sector investment	Collier (2010); Dabla-Norris et al. (2011); Gupta, et al., (2011); van der Ploeg and Venables (2011c)

Van der Ploeg (2010) proposes an optimal response which takes into account the need for ‘investing to investing’ strategy, home-grown public capital (e.g., to be produced by non-tradable sector) and a temporary tolerance of the Dutch Disease. In this setting, home-grown public capital can give rise to the Dutch Disease. This happens if increased private demand for consumption, driven by a windfall of foreign exchange, leads to real exchange rate appreciation or increase in the relative price of non-tradable goods and services. This would prompt factors of production to move away from the tradable sector to the non-tradable sector. When the production of the tradable sector falls, the increased demand for tradable are met by higher imports of tradable which are funded by the windfall of foreign exchange. An increase in production of non-tradable is further required to meet the rise in demand for non-tradable. Yet, an economy’s response to a foreign exchange windfall varies depending on the initial level of income and capital, absorptive capacity and expectations about the sustainability of resource windfalls (Gelb and Grasmann, 2008; van der Ploeg and Venables, 11a). For instance, the challenge of the ‘investing to investing’ strategy is that absorption constraints get bigger as the home-grown components of public capital increase (van der Ploeg, 2011b).

Overall, the literature on the natural resource curse thesis has tried to study and investigate the impact of the abundance of natural resources on economic growth, political stability and the quality of institutions in the economies of resource-rich countries. But the findings have been inconclusive and subject to debates. Some researchers suggest that there is a negative relationship between the abundance of natural resources and economic growth. Others argue that natural resource endowment *per se* is not a problem, and that natural resource wealth can advance economic growth if complemented with the accumulation of high levels of human capital, physical capital and innovation. Furthermore, as a result of profound fluctuations in the price of oil since the early 1970s, a body of literature studies the macroeconomic implications of resource price volatility in both resource-exporting and resource-importing economies. Some scholars emphasize the channels through which price fluctuations affect the economy. Others attempt to explore the optimal fiscal policy responses, such as government expenditure, to price shocks in these countries. Consequently, different suggestions and policy implications regarding the optimal management of resource income and addressing the resource curse thesis have been developed.

However, there has been very little research investigating how investment behavior and policies in resource-economies respond to resource price shocks. Furthermore, the existing literature on investment has largely ignored the question as to what role a country's deeper characteristics, such as endowments, may play in shaping investment patterns of resource-rich economies (Bond and Malik, 2007). This thesis, therefore, attempts to contribute to the existing debates in the literature on investment and the natural resource curse thesis along with the application of such theories in the context of oil-abundant and oil-dependent countries. The current study therefore investigates the theory-consistent economic determinants of domestic investment in Iran, both at aggregate-level and at sector-level, within the theoretical framework of modified neoclassical-accelerator type investment models. The theoretical framework is further extended by incorporating measures of resource-driven uncertainty in order to consider the effects of resource-driven financial constraints on investment patterns in the country.

3.5. CONCLUDING REMARKS

The review of the theoretical literature on investment in this chapter presented the conventional demand-side theories of investment, theories of irreversible investment under uncertainty and the supply-side theories of investment. The review of the empirical literature included individual country and cross-country comparison studies of investment at firm, industry and aggregate levels. Findings based on various investment models and econometric techniques vary depending on individual industry and country specific factors and measures of uncertainty. Moreover, it seems that investment behavior is influenced by political environments and by the efficiency of institutional arrangements. Most empirical studies are not based on testing the theoretical models, but are motivated by them. Broadly speaking, different models serve various purposes and there is no single model even for the same problem in the same country. Agenor and Montiel (1996, p.12) state that 'the standard analytical tools of modern macroeconomics are indeed of as much relevance to developing countries as they are to industrial countries, but that different models are needed to analyze familiar issues'.

In sum, the accelerator model of investment assumes a fixed capital-output ratio and therefore is restrictive as the substitution between factors of production is constrained to zero. Similarly, the cash flow models, according to which optimal capital stock is merely affected by internal cash flows, do not consider any roles for the substitution of production factors. The Jorgensonian

neoclassical investment models, however, allow for substitution of input factors of production as a crucial element of production and cost, hence these models remain a common reference in the studies of the neoclassical theory of domestic investment. The distinguishing feature of the neoclassical models is that they are based on an explicit model of optimization behavior that associates the optimal level of capital stock to capital prices, interest rates, output and tax policies. Jorgenson assumes a perfectly competitive market. Yet, in practice, investment decisions can be affected by capital market imperfections. The literature accordingly identifies financial factors in causing and intensifying financial market imperfections in the economy. To study the effects of capital market imperfections on investment, a range of variables that may represent financial constraints are incorporated to the reduced form investment models, of which the most commonly used ones are cash flows. The literature often divides firms into sub-samples for which the extent of financial constraints is expected to vary. In addition, a growing body of literature emphasizes on the effects of uncertainty on investment behavior. At large, the findings support that increased uncertainty adversely affects aggregate and disaggregate investment patterns.

Since investment models have been mainly developed for market-driven economies, they are only expected to be partially applicable for studying investment behavior in mixed-market, developing or resource-based economies. The latter are usually faced with soft budget constraints, where ambitious investment and output targets replace profit- or value-maximizing objectives. In fact, the role of governments in allocating resource rents to various economic sectors gives rise to non-market determinants of investment in these countries. Hence, investment behavior in the respective economies could be distorted, leading to under-investment in firms which could potentially be profit-making or over-investment in loss-making firms as a result of inefficient credit allocations by the authorities. In particular, in oil-rich and oil-based developing economies such as Iran, investment could be chiefly oil-driven. Therefore, in determining domestic investment in these economies, the influence of market-oriented variables as specified by the conventional investment models may be relevant, but partially.

Further, the survey of the literature on the resource curse thesis provides several explanations in addressing this paradox of plenty. At large, the literature identifies a range of arguments for the curse such as the structuralist and the Dutch Disease theories, the paradigm of the rentier state, volatility of resource prices and revenues as well as institutional causes. Nevertheless, the

question as to what causes the ‘curse’ rather than ‘blessing’ in resource-rich and developing economies cannot be answered by a single explanation. This is because these economies differ in their type of government, economic policies, political institutional economic system and international relations. This suggests that rather than trying to impose some sort of generalization, a case-by-case or a country-specific approach would be more appropriate in providing explanations for the resource curse. Therefore, the focus of this study is on the oil-rich and oil-based economy of Iran due to the country’s distinctive economic, political and institutional structure. As discussed in Chapter Two, the control of the state over resources coupled with different policies adopted by the government during the period under study brought about structural shifts in actual investment patterns within the Iranian economy by altering the distribution of financial resources towards services and manufacturing. This suggests that the country has been the subject of the Iranian-type Dutch Disease and, therefore, it is important to empirically evaluate this argument in the context of Iran’s actual investment behavior during the years under consideration.

In brief, the Iranian economy has become an oil-based economy since the 1950s. The country has undergone dramatic political and economic upheavals during the period under study including the big nationalization and the introduction of the Islamic financial system during the early 1980s. Throughout the study period, the state has enjoyed a high degree of control in distributing a sizable share of oil income to decide on the pattern and pace of investment, and has played an influential role in the evolution of political structure and institutions of capital accumulation in the country. Also, the extent of government development expenditure for capital accumulation has been highly influenced by the expected oil income and its availability during the years under study. However, the availability of oil income as an important source of financing investment has been subject to uncertainty and Iran’s ability to borrow from the international capital markets has been restricted. Furthermore, the country’s economy is a partial market economy and the allocation of financial resources to firms in various economic sectors is not completely driven by the market mechanism. Having reviewed the literature on investment, and given Iran’s unique political economy and institutional setup, some interesting questions arise that are in line with the objectives of this study:

1. (i) Are the modified neoclassical-accelerator type investment theories relevant and applicable at all in the context of the mixed-market, oil-rich and oil-based economy of

- Iran? (ii) If yes, how successful are these models in describing aggregate- and sector-level economic determinants of investment in the Iranian economy?
2. To what extent can the modified neoclassical-accelerator type investment models, to which oil-driven financial constraint measures are incorporated (as specified by cash flow models), explain investment patterns in the country?

The second question further allows accommodating the principles of the theoretical framework of investment under uncertainty as financing investment in the Iranian economy are expected to be driven by the availability of oil income, and hence subject to uncertainty.⁴⁴

Consequently, the next chapter first aims at discussing the theoretical propositions behind the hypothetical relationships based on the modified neoclassical-accelerator type models of investment; the chapter also describes the methodology employed in the empirical analysis, namely the cointegrated vector autoregressive (CVAR) method, to determine the theory-consistent long-run cointegrating relationships. This is because a cointegration interpretation within the neoclassical-accelerator type framework is supported in the literature as an enriching method to model investment behavior (see among others, see Gerard and Verschueren, 2000). Moreover, employing the CVAR methodology, the identification and validation of long-run relations are supported by the evidence rather than by imposing them as *a priori* and allows producing new insights by testing economic phenomena associated with more than one economic theory.

⁴⁴ See Chapters Five (Sections 5.4.5) for a discussion on oil-driven financial constraint measures used in this study.

4. THEORETICAL FOUNDATIONS AND METHODOLOGY

4.1. INTRODUCTION

This thesis investigates economic determinants of domestic investment in Iran and the extent to which these determinants are consistent with the theoretical framework of modified neoclassical-accelerator type investment models. Given the distinguishing characteristics of the Iranian economy, it could be expected that the existence of imperfect capital markets have influenced the country's investment behavior. Also, the uncertainty associated with the unpredictable nature of international oil prices is expected to have had affected the availability of finance for investment activities in the country. Hence, it is necessary to incorporate uncertainty-driven financial constraints proxies as specified by the principles of cash flow models in modelling investment behavior in Iran. Furthermore, the CVAR approach developed by Johansen and Juselius allows identifying and validating theory-consistent long-run relationships between the variables of interest, rather than imposing them as *a priori*. Importantly, the CVAR methodology makes it possible to take a flexible approach to the empirical exploration through testing more than one economic theory, hence producing new insights based on the available data.

Accordingly, the objectives of this chapter are:

- i) to develop a theoretically consistent model of investment within the framework of the neoclassical-accelerator type investment theories for the Iranian economy;
- ii) to extend this theoretically consistent model by incorporating (oil-driven) financial constraints measures as specified by cash flow models;
- iii) to describe the empirical methodology used in this thesis.

Following this introduction, Section 4.2 provides an overview of the major issues related to the modeling of investment behavior, mainly in the context of imperfect capital markets. Section 4.3 outlines the models of investment related to this study and develops a theoretically consistent model of investment based on the neoclassical-accelerator type investment models. Section 4.4 explains the empirical methodology used in this study in detail. Finally, Section 4.5 concludes the chapter.

4.2. GENERAL OVERVIEW

In this section, as a prerequisite background before the construction of a theoretically consistent model of domestic investment for the Iranian economy, some general issues are reviewed. Investment is one of the major determinants of long-term growth and plays a key role in explaining business cycle fluctuations.⁴⁵ Yet, as discussed in Chapter Three, there is no general consensus on the identification of the factors that are believed to drive capital spending. If markets are characterized by imperfect information, investment funds may only be available in capital markets on less favorable terms, or may not be available at all. This entails that the investment spending of some firms may be constrained by the scarcity of funds; thus the main suggestions of the neoclassical investment theory are expected to hold partially.

Modigliani and Miller (1958) show that in perfect capital markets, the financing decision of a firm is irrelevant for its investment behavior, implying that external and internal finance are perfect substitutes. The literature on financing constraints, however, suggests that in the presence of capital market imperfections investment is determined by a firm's expected future profitability and not by the firm's net worth or internal funds. Accordingly, some empirical papers examine the sensitivity of investment to cash flows as a proxy for financing constraints (see, among others, Bond and Meghir, 1994; Fazzari, et al., 1988; Harisson, et al., 2004). This body of literature supports the hypothesis that investment-cash flow sensitivities reflect the extent of financing constraints. At a macroeconomic level, however, capital market imperfections may result from a country's limited ability to borrow from abroad. When an economy is credit-rationed in the face of the world credit markets, then it will be capital-scarce. In the context of the oil-based economy of Iran, the country's ability to borrow in the international capital markets is constrained because of the economic sanctions imposed against Iran by the US and the international community. Also, the availability of oil revenues as the major source of financing investment is uncertain and affected by the volatility of international oil prices.

Furthermore, the country's economy is a mixed-market economy and investment has been partly determined by the Iranian government in its development plans and annual budgets over the

⁴⁵ Investment is a crucial determinant of long-run economic growth and involves the formation of: (i) fixed (or tangible) capital e.g., machinery or factories; (ii) intangible capital e.g., reputations or technical knowledge; and (iii) human capital e.g., skills or education. This study is mainly concerned with investment in fixed capital.

years under study. As a result, the allocation of financial resources to firms in various economic sectors is expected to be incompletely driven by the ‘free play’ of market forces. Consequently, although market forces existed in the country throughout the study period, the border between the public and the private sector became blurred over time, particularly because of the role that state-owned enterprises (SOEs) played in the country. As explained in Chapter Two, the SOEs and semi-SOEs are in charge of a high share of production units and activities in the economy and are provided with (indirect) financial support by the state regardless of their efficiency. In this picture, the presence of imperfect capital markets may have had an impact on investment behavior in the country’s various economic sectors. Also, investment is expected to have been affected by uncertainty stemming from the volatile nature of oil prices and oil revenues. This, in return, affects the government’s fiscal policy (via government spending channel) and monetary policy (through the user cost of capital and money supply channels) in the country. Thus, given the distinctive political economy and institutional features of the Iranian economy in comparison to that of less regulated economies, the question arises as to the extent to which the predictions of the conventional investment models hold in the context of the mixed-market economy of Iran.

To address this question, this study uses two specifications on the demand side. The first one relates to Jorgenson’s neoclassical and the second one relates to Clarck’s, Chenery’s and Koyck’s accelerator models of investment demand. These models have been broadly used in the context of advanced economies and allow for testing whether, and the degree to which, investment behavior in the planned economy of Iran is consistent with the profit maximization hypothesis inherent in these models. It would be of interest for this thesis to investigate how well a mixed-market economy is able pre-determine some market-based determinants such as factor prices so as to generate the desired effects through incentivizing individual agents to respond to these factors in a profit-maximizing manner. On the supply side, I accommodate the principles of the cash flow model by incorporating oil-driven uncertainty measures of financial constraints related to financing investment both at aggregate and sectoral levels. This allows examining the significance of the availability of external finance for domestic investment in the country. The nature of imperfect capital markets in Iran makes it possible to assume that the investment behavior in some sectors (i.e. the prioritized sectors of the economy) could be more (structurally) influenced by the availability of oil windfalls in the economy.

4.3. THE NEOCLASSICAL-ACCELERATOR TYPE MODELS

Clarck's (1917) accelerator model relates investment to changes in output and Keynes' (1936) General Theory provides an explanation for investment behavior based on the user cost of capital. Jorgenson (1963), based on a firm's maximization behavior, proposes a synthesis of both approaches by providing an investment function taking into account Clark's output demand and Keynes' user cost of capital, postulating a long-run relationship of proportionality between capital, output and the user cost of capital.⁴⁶ Accordingly, on the demand side, I start with the neoclassical model of investment which constitutes this study's main conceptual framework for explaining the development of investment in the long-run.

In the neoclassical model, as shown in Chapter Three, it is assumed that a firm maximizes a profit function $\pi_t = p_t Y_t - w_t L_t - C_t K_t$, subject to the Cobb-Douglas (CD) production function with constant returns to scale, $Y_t = f(K_t, L_t)$, $Y_t = AK_t^\alpha L_t^{1-\alpha}$, where $\alpha + (1 - \alpha) = 1$, capital (K_t) and variable factor inputs (L_t) are substitutable and α is the output-capital elasticity.⁴⁷ Y_t is output, p_t is the price of output, w_t is the price of the labor input, and C_t is the user cost of capital services.⁴⁸ All prices are taken as given. The maximization leads to the first order conditions

⁴⁶ In line with the static analysis of the optimal capital stock, in his neoclassical theory of growth, Solow (1956) predicted that the growth rate of output would be independent of that of investment in the long-run. This (counter-intuitive) outcome is derived as follows. Given the assumptions of constant return to scale, diminishing marginal productivity and a constant saving rate, there is a single optimal level of capital stock at any point in time in equilibrium, which corresponds to capital-output ratio. If the growth rate of capital stock rises above the growth rate of output, the production will become more capital-intensive and due to diminishing returns, then the risen rate of investment will have smaller impacts on output. For a given population, however, higher levels of investment results in higher output per capita as long as the marginal productivity of capital exceeds zero (although such investment will be increasingly inefficient and in the long-run, the growth rate of output per capita will be determined by technological progress that increases total factor productivity. The neoclassical growth theory does not address the sources of such critical technological advances. The (post-neoclassical) endogenous growth theory, however, explains that investment on R&D or human capital may be crucial factors in determining the long-run growth rate in an economy.

⁴⁷ The CD production function used here assumes: i) constant returns to scale ($\alpha + (1 - \alpha) = 1$): if capital and the variable factor inputs are multiplied by a positive constant, then the amount of output is also multiplied by the same amount (i.e. $F(\lambda K, \lambda L) = \lambda F(K, L)$ for all $\lambda > 0$); ii) positive and diminishing returns to inputs: for all $K > 0$ and $L > 0$, F exhibits positive and diminishing marginal products with respect to each input. If the level of the variable factor inputs is held constant, then each additional unit of capital delivers additional output, but these additions decrease as the stock of capital rises. The same is true for the variable factor inputs (i.e. $\partial F/\partial K > 0$; $\partial^2 F/\partial K^2 < 0$; $\partial F/\partial L > 0$; $\partial^2 F/\partial L^2 < 0$); iii) Inada conditions: the marginal product of capital (the variable factor inputs) approaches infinity as capital (the variable factor inputs) goes to zero and approaches zero as capital (the variable factor inputs) goes to infinity (i.e. $\lim_{K \rightarrow 0} (\partial F/\partial K) = \lim_{L \rightarrow 0} (\partial F/\partial L) = \infty$; $\lim_{K \rightarrow \infty} (\partial F/\partial K) = \lim_{L \rightarrow \infty} (\partial F/\partial L) = 0$).

⁴⁸ Based on the neoclassical theory of investment, given the assumptions of constant return to and diminishing marginal productivity of factors of production, the optimal capital stock will be at the point where the expected rate of return from the marginal investment equals the marginal cost of capital. Any investment more than this level would not be efficient and could result in a capital stock that is too high. This could become a policy concern, for instance, if the rate of return that investors require on investment (the cost of capital) becomes too high. Under the assumption of risk neutrality, the cost of capital would be identical to interest rate as it would not be important how

equating the marginal product of capital and inputs to their user cost and price of inputs, respectively. It must be noted that the maximization problem is actually intertemporal (i.e. maximize net worth over an infinite horizon). However, it reduces to a static profit maximization problem, because its optimality conditions only include variables in the current period due to the absence of adjustment costs, implying that capital stock can be adjusted without incurring costs at each point in time. From the first order derivative with respect to K_t , assuming that investment requires one period to be fully installed and given the CD production function, one can obtain:

$$(4.1) \alpha(Y/K)_t = (C/p)_t.$$

Accordingly, the equilibrium level of capital stock K_t is given by:⁴⁹

$$(4.2) K_t = \alpha(pY/C)_t.$$

Equation (4.2) is the basis for the neoclassical investment equations, stating that investment depends on the cost of obtaining capital, and that there exists an inverse relationship between the desired capital stock and the cost of capital. Bean (1981) first incorporated the neoclassical theory of investment within a general-to-specific approach to the parameterization of the dynamic relationships between the variables (see also Carruth, et al., 2000).

In this thesis, in line with Bean's (ibid.) steady state approach, a static framework is adopted to show the basic arguments resulting in a reduced form empirical specification. Assuming a CES production function, which includes the CD production function as a special case and constant returns to scale technology, the demand for capital is:⁵⁰

investment is financed (for example, by debt or equity). Nevertheless, since investors may be risk-averse, the cost of capital will be equal to interest rate plus a risk premium and could be time-varying. The required rate of return is net of depreciation known as the cost of finance. This rate, if gross of depreciation, is often referred to the user cost of capital.

⁴⁹ According to the Jorgensian model of investment, capital will be employed until the marginal cost of capital equals the marginal product of capital.

⁵⁰ In general, the three most commonly used production functions are the Constant Elasticity of Substitution (CES), the Cobb-Douglas (CD), and Transcendental Logarithmic (Translog). The CD production function is a special case of CES and is thought to provide a reasonable description of actual economies. A unit elasticity of substitution corresponds to the Cobb-Douglas production function. Generally, the literature on macroeconomic production functions does not provide any support that would lead to choose one form over the other and aggregation issues pose a serious theoretical challenge to both CD and CES forms, hence one should avoid making strong inferences

$$(4.3) K_t = \alpha(pY/C)_t^\sigma,$$

where K_t is capital, α is a constant, Y_t is output, C_t is the user cost of capital and σ is the elasticity of substitution between factor inputs in equilibrium.⁵¹ Equation (4.3) yields:

$$(4.4) \partial Y_t / \partial K_t = \alpha(pY/K)_t^{1/\sigma}.$$

Employing the static profit maximization condition implies:

$$(4.5) \alpha p_t (Y/K)_t^{1/\sigma} = C_t. \text{ Hence:}$$

$$(4.6) K_t = p_t Y_t (\alpha/C)_t^{1/\sigma}.$$

In logarithmic form, equation (4.6) is:

$$(4.7) k_t = \alpha' + y_t - c_t,$$

where $k_t = \ln(K_t)$, $\alpha' = (1/\sigma)\ln(\alpha)$, $y_t = \ln(p_t Y_t)$, $c_t = (1/\sigma)\ln(C_t)$ and \ln refers to the natural logarithm. Given the capital accumulation identity equation (i.e. $K_t = I_t + (1 - \delta)K_{t-1}$), capital stock in each period is derived from investment as well as the rate of depreciation δ and capital stock in the preceding period. In steady-state, the long-run equilibrium growth rate of capital stock is $g_t^K = \Delta K_t / K_{t-1}$. Accordingly, the capital accumulation identity equation in the steady state level can be written as:

$$(4.8) I_t = (g_t^K + \delta_t)K_{t-1}.$$

that cannot be justified (for the review of the empirical performance of the CES and the CD and their general theoretical problems with the use of aggregate production functions, see Miller, 2008). The Translog production function is a generalization of the CD production function and allows the partial elasticities of substitution between inputs to vary, thus avoiding strong assumptions about the production functions.

⁵¹ A general form of the CES production function is as follows: $Q_t = F[\alpha K_t^r + (1 - \alpha)L_t^r]^{1/r}$, where F is factor productivity, α is the distribution parameter, $r = (\sigma - 1)/\sigma$, and σ is the elasticity of substitution (for instance see Eisner and Nadiri (1968)).

Substituting equation (4.3) into equation (4.8) eliminates the capital stock term and gives the following equation:

$$(4.9) I_{t+1} = \alpha(g_t^K + \delta_t)[pY/C]_t.$$

From (4.8), $I_t = g_t^K K_{t-1} + \delta_t K_{t-1}$, which can be written as $K_{t-1} = I_t / (g_t^K + \delta_t)$. Accordingly, in the steady state level at time t:

$$(4.10) k_t = i_t - \ln(g_t^K + \delta_t),$$

where $i_t = \ln(I_t)$. Equating equations (4.7) and (4.10) gives the following long-run equation:

$$(4.11) i_t = \beta + y_t - c_t + \ln(g_t^K + \delta_t),$$

where $\beta = \ln(\alpha')$.

As implied by equations (4.10) and (4.11), two cointegrating or long-run equilibrium relationships within the framework of modified neoclassical-accelerator type theories of investment are identified. This is an example of multi-cointegration introduced by Granger and Lee (1991). Equation (4.10), based on the capital accumulation identity (CAI) equation, implies that k_t is positively related to i_t and negatively related to $\ln(g_t^K + \delta_t)$. Equation (4.11), based on substituting the steady-state condition into the first order equation, implies that i_t is positively related to y_t and $\ln(g_t^K + \delta_t)$ and negatively related to c_t in the long-run. Furthermore, the lagged capital accumulation identity can be written as:

$$(4.12) \Delta K_t / K_{t-1} = -\delta_t + I_t / K_{t-1}.$$

This, to represent the error correction form, can be approximated as:

$$(4.13) k_t \approx \alpha_0 + \alpha_1(i_{t-1} - k_{t-1}),$$

where α_i are coefficients.

However, as mentioned earlier, the Jorgensonian model is not a dynamic model because its optimality conditions only consist of variables in the current period as a result of the absence of adjustment costs.⁵² Yet, it is important to take into account the temporal nature of the data by examining both the stationarity of the data-series and cointegration in the investment functions. This is one of the reasons why investment can be well described by distributed lag models. For instance, following Bean (1981) and Carruth, et al., (2000), the discrete time equivalent of equation (4.11) can be shown in the following form, allowing for a general polynomial lag structure to model dynamic adjustment processes:

$$(4.13) \quad \alpha_1(L)\Delta i_t = \alpha_0 + \alpha_2(L)\Delta y_t + \alpha_3(L)\Delta c_t + \beta_1 i_{t-j} + \beta_2 y_{t-j} + \beta_3 c_{t-j} + e_t,$$

where L is the lag operator and e_t is the error term. According to Carruth, et al., (2000), the parameterization of the log levels terms allows the imposition of a long-run steady-state solution in a conventional equilibrium correction form. Modelling investment in a vector error correction model will be explained in Section 4.4. However, it must be noted that the capital stock equation is just a capital accumulation identity equation. That is, if the capital stock is measured by cumulating the next investment flows, it is identically true that it will be related to investment and depreciation; hence it is not a behavioral equation. Therefore, the focus of this thesis will be merely on investment function and its dependence on oil.

Given the recent theoretical focus on the role of uncertainty and financial constraints on investment, and that current profitability is a rather backward-looking signal of potential future earnings, a more accurate reflection of the expectations of investment determinants may be needed. Hence, in modelling the determinants of the steady-state level of investment, it could be crucial to take into account that investment spending may be responsive to uncertainty-driven financial constraints. This need could be more pronounced for the case of economies in transition, partial-market economies, and equally for resource-based economies like Iran. The latter is due to the significance of expectations of resource-rich and -dependent economies about resource rents for the formulation and implementation of their economic development plans and

⁵² This corresponds to a situation in which capital stock is adjusted without incurring costs and immediately at each time, implying that the rate at which capital changes over time (net investment) is infinite. In such models, it is not possible to study the effects of uncertainty on investment behavior.

investment spending.⁵³ For instance, an oil shock due to decreased international oil prices could indirectly constrain the access of firms in various economic sectors to external finance through the bank lending channel effects. This in turn could intensify the fluctuations of the real economy and adversely affect investment spending in the country. This setting raises questions: (i) to what degree can the conventional neoclassical-accelerator type models help explain domestic investment in the oil-based Iranian context? (ii) To what extent is Iran's investment pattern are related to oil-driven uncertainty measures of financial constraints? (iii) Could a windfall of oil revenues as a primary source of external financing be associated with a rise in investment spending at aggregate or sector-level?

Within the body of literature on investment and financial constraints, the credit rationing theory of Stiglitz and Weiss (1981) explains that due to information asymmetries in the relationship between lender and borrower, firms' demand for external capital is faced with an inadequate supply. This in turn leads to underinvestment for credit-rationed firms. To account for the likelihood that a firm may face constraints or transaction costs in obtaining external financing, a common approach is to augment firms' investment demand equations by cash flow variables (Fazzari, et al., 1988).⁵⁴ In these studies, a positive and significant investment-cash flow coefficient in the estimated models corresponds to binding liquidity constraints. Nevertheless, the estimated coefficients should be interpreted with caution depending on the context in which the study is conducted and the variables according to which financial constraints proxies are construed. For instance, in the context of resource-rich economies for which the measures of financial constraints tend to depend upon the availability of oil income, the findings should be explained in a different way. In the latter case, a positive relationship between investment and oil-based proxies of financial constraints may suggest that firms' investment practices are not credit-rationed. However, an insignificant or negative coefficient may indicate that firms are liquidity-constrained.⁵⁵

⁵³ A body of literature attempts to explain that investment and financial decisions are related in such economies (see, among others, Rizov (2004) and Lizal and Svejnar (2002)).

⁵⁴ Cash flow is defined as profits after taxes plus depreciation less dividend payments to shareholders, and traditionally has accounted for a substantial share of firms' sources of funding for investment. Other sources of funds, for instance, include debt financing and issuing of shares (see Chapter Three for discussion on models with cash flow variables).

⁵⁵ Another body of literature, concerning investment and financial constraints, is related to the soft budget constraint (SBC) theory of Kornai, et al., (1998). This theory explains the willingness of the state or other institutions to provide additional resources and extend credits to unprofitable or preferred firms with credit and tax privileges, direct or indirect subsidies and other policy instruments (or otherwise bail them out). Faced with SBCs,

Accordingly, this study extends the theory-consistent investment equation derived above (equation 4.11) by accommodating the principles of cash flow models in the modelling of Iran's investment as follows:

$$(4.11') \quad i_t = \beta + y_t - c_t + \ln(g_t^K + \delta_t) + \lambda f_t,$$

where λ refers to parameters associated with uncertainty-driven financial constraints variables f_t in logs. The latter includes symmetric oil measures which are constructed and explained in detail in Chapter Five Section 5.4.5. The symmetric measures include: (a) the level of oil revenues; and (b) oil price volatility. As discussed in Chapter Two, it must be noted that the sign and persistence of investment and uncertainty relationship is yet subject to debates. Therefore, it is of both theoretical and empirical interest to investigate the importance of these measures on investment in the context of the oil-rich and oil-dependent economy of Iran (see also Section 5.3).

In sum, the main long-run equilibrium relationship is identified within the framework of (modified) neoclassical-accelerator type models of investment for the situation in which the financial constraints proxies do not have long-run impacts on domestic investment behavior in Iran. This long-run relationship is given by equations 4.10. As specified by the principles of the cash flow models, this equation is then incorporated by oil-driven financial constraints measures as shown in equation 4.11'.

In modelling investment, when aggregate data are used, the most commonly employed econometric framework is the cointegrated vector autoregressive (CVAR) model. In this study, similarly, Juselius' (2006) approach is used to allow for investigating the existence of long-run relationships among the variables under consideration as specified by the theory. In what follows, the methodology used in this study is explained.

firms' investment may take place regardless of the availability of external funds as capital access is not limited due to public support and may not depend on the firms' capital structure. This can result in over-investment in unprofitable firms, leading to capital misallocation and waste of resources. For the case of Iran, because of the existence of the SOEs, the border between the public and private sector is unclear. Therefore, it is very hard to gather adequate and reliable data to draw conclusions based on the SBC theory. Besides, a body of literature questions the SBC theory and argues that 'there are only binding and non-binding constraints; no such thing as a 'soft' constraint has ever existed' (Lue, 2014, p. 206). For the reasons mentioned above, this study does not consider this concept any further.

4.4. THE COINTEGRATED VAR METHODOLOGY

This section describes the CVAR methodology employed in the empirical analysis of this thesis. The CVAR methodology is a data first methodology, which allows structuring the data in such a way that *prior* hypotheses can be examined rather than imposed from the outset.

4.4.1. THE CVAR METHODOLOGY

Many economic time-series exhibit non-stationary behavior in their mean or trending pattern. Therefore, in order to determine the appropriate method of time-series econometric analysis, a common approach is to identify the form of the trend in the data and whether individual data series contain unit root properties.⁵⁶ If the data is trending, then some form of de-trending is needed. The most common de-trending practices are differencing and time-trend regressions. The former is appropriate for I(d) time-series (where $d \neq 0$), whereas the latter is relevant for trend stationary I(0) time-series data. ‘A stochastic process is stationary if its first and second moments are time invariant’ (Lutkepohl, 2005). A series can have both a stochastic and a deterministic trend component. Formally, if a series y_t becomes stationary on differencing once, such as a pure random walk series, then it is said to be integrated of order one, denoted by I(1). For example, a pure random walk is given by $\Delta y_t = (y_t - y_{t-1}) = (1 - L)y_t = \varepsilon_t$, where Δ is the difference operator, L is the lag operator, and ε_t are the errors assumed to be independent and identically distributed random variables with constant variance. In this case, y_t is I(1), thus Δy_t is I(0); if y_t is I(d), then Δy_t is I(d-1).

When two or more non-stationary variables of different orders of integration are linearly combined to form a relationship, the relationship will be zero (not necessarily spurious). A spurious relationship, however, arises when one nonstationary variable is regressed on another unrelated variable of the same order of integration. If the variables are integrated of the same orders, cointegration techniques can be employed to model the long-run relations present in the data series. Thus, the first step in cointegration modelling is often taken by testing for unit roots to determine whether trending data should be differenced or regressed on deterministic functions of time. The most common unit root tests are Augmented Dickey-Fuller (ADF) (Dickey and Fuller, 1979), Kwiatkowski, Phillips, Schmidt and Shin (KPSS) (Kwiatkowski, et al., 1992), and Elliott, Rothenberg and Stock (ERS) (Elliott, et al., 1996) tests.

⁵⁶ However, it must be noted that the strength of the CVAR model is that it works equally well whether all variables are unit root variables or some of them are stationary. Also, contrary to the static regression model, two unrelated non-stationary variables cannot be cointegrated and the test is very powerful to show this.

However, the CVAR model does not require explicit univariate unit root test. Alternatively, it tests for the presence of unit root and stationarity relationships between the time-series variables (in a multivariate manner) in a vector when testing for cointegrating ranks (see Juselius, 2006, pp.131-36). Employing the CVAR methodology, it is shown in Chapters Five and Six that the process generating the time-series data used in this study are not stationary; therefore, we can proceed to cointegration tests.

Vector autoregressive (VAR) models, based on normally distributed (Gaussian) errors, have been frequently used to model time-series macroeconomic data. This is mainly because these models provide a good fit to macroeconomic data and allow for combining short-run and long-run information in the time-series data by exploiting the cointegration properties of them (Juselius, 2006, p.14). The CVAR methodology employed in this study follows Johansen (1996) and Juselius (2006) approach. Under the assumption of multivariate normality, the CVARs are the linear representation of a vector of observable variables on their own lags (and possibly on exogenous variables), and are economically interpretable under certain theoretically-driven and statistically acceptable identifying and over-identifying restrictions. Assuming a p-dimensional VAR(k), vector x_t can be expressed as follows:

$$(4.14) \ x_t = \sum_{i=1}^k \Pi x_{t-i} + \Phi D_t + \varepsilon_t,$$

where x_t comprises both endogenous and exogenous variables, a vector of deterministic components D_t (including constant and dummies), and independent Gaussian errors ε with zero mean and variance Ω (see Chapters Five and Six for details). Equation (4.14) refers to an unrestricted VAR model because no conditions on the parameters are imposed, and is equivalent to the reformulation of the covariance of the data (Juselius, 2006, p.46). For simplicity, assuming a VAR(2) model where $k = 2$, then equation (4.14) can be written as:

$$(4.15) \ x_t = \Pi_1 x_{t-1} + \Pi_2 x_{t-2} + \Phi D_t + \varepsilon_t.$$

The error correction form of the above VAR(2) model is then obtained by adding $-x_{t-1}$ to both sides of expression (4.15) as follows:

$$(4.16) \quad x_t - x_{t-1} = \Pi_1 x_{t-1} - x_{t-1} + \Pi_2 x_{t-2} + \Phi D_t + \varepsilon_t,$$

where D_t is a vector of deterministic components. Then, first adding and then subtracting $\Pi_2 x_{t-1}$ to the right hand side of equation (4.16) gives the following:

$$(4.17) \quad x_t - x_{t-1} = (\Pi_1 - I)x_{t-1} + \Pi_2 x_{t-1} + \Pi_2 x_{t-2} - \Pi_2 x_{t-1} + \Phi D_t + \varepsilon_t.$$

Equation (4.17) can be re-written as:

$$(4.18) \quad \Delta x_t = (\Pi_1 + \Pi_2 - I)(x_{t-1}) + (\Pi_2)(x_{t-2} - x_{t-1}) + \Phi D_t + \varepsilon_t.$$

Lastly, setting $-(I - \Pi_1 + \Pi_2) = \Pi$ and $-\Pi_2 = \Gamma$ in equation (4.18), gives the following vector error correction model (VECM):

$$(4.19) \quad \Delta x_t = \Pi x_{t-1} + \Gamma \Delta x_{t-1} + \Phi D_t + \varepsilon_t, \quad \varepsilon_t \sim N(0, \Omega) \text{ for } t = 1, \dots, T.$$

Equation (4.19) can then be generalized with k lags as follows:

$$(4.20) \quad \Delta x_t = \Pi x_{t-1} + \sum_{i=1}^{k-1} \Gamma_i \Delta x_{t-i} + \Phi D_t + \varepsilon_t,$$

where x_{t-1} is the lagged levels, and Π is the matrix of coefficients and contains information about long-run effects, hence is of particular interest when solving the cointegration problem. Γ contains short-run information about the time-series data and describes pure transitory effects measured by the lagged changes of the variables (Juselius, 2006, p.63).

The presence of unit roots (i.e. the stochastic trends) in the unrestricted VAR model corresponds to non-stationary stochastic behavior and leads to a reduced rank condition ($r < p$) restriction of the long-run level matrix Π . Within the VAR model, accordingly, the cointegration hypothesis can be formulated as a reduced rank restriction on the Π matrix. If the vector $x_t \sim I(1)$, then $\Delta x_t \sim I(0)$, indicating that Π cannot have full rank as this would result in inconsistency in equation (4.20) (Juselius, 2006, p.80). Therefore, Π has a reduced rank and can be decomposed as follows:

$$(4.21) \Pi = \alpha\beta'$$

$$\Delta x_t = \alpha\beta'x_{t-1} + \sum_{i=1}^{k-1} \Gamma_i \Delta x_{t-i} + \Phi D_t + \varepsilon_t, \quad \varepsilon_t \sim N(0, \Omega),$$

where Π is a $p \times r$ matrix of long-run coefficients, α is the matrix of loading coefficients, and β is the matrix of long-run coefficients. If $r = p$, then x_t is stationary, hence standard inference applies. If $r = 0$, then there are p independent trends in x_t and the vector process is driven by p different stochastic trends which have no stochastic trends in common and do not move together. Thus, no stationary cointegration relations between the levels of the variables can be obtained. Under these circumstances, the VAR model in levels can be re-written as a VAR model in differences, and as $\Delta x_t \sim I(0)$, standard inference for this model is applicable. On the other hand, if there are r cointegrating relations ($0 < r < p$) between the variables, then $x_t \sim I(1)$ and there exists r stationary linear combinations in the data-series. The reduced form in equation (4.21) can be written in a structural form by pre-multiplying it with a non-singular $p \times p$ matrix A_0 as follows:

$$(4.22) A_0 \Delta x_t = A_0 \alpha \beta' x_{t-1} + \sum_{i=1}^{k-1} A_0 \Gamma_i \Delta x_{t-i} + A_0 \Phi D_t + A_0 \varepsilon_t.$$

Finally, equation (4.22) can be written as:

$$(4.23) A_0 \Delta x_t = \Theta \beta' x_{t-1} + \sum_{i=1}^{k-1} \theta A_i \Delta x_{t-i} + \tilde{\Phi} D_t + v_t, \quad v_t \sim N(0, \Sigma),$$

where the relation between short-run parameters of the reduced form in (4.21) and the structural form in (4.23) are given by: $\alpha = A_0^{-1} \Theta$, $\Gamma_i = A_0^{-1} \theta$, $\varepsilon_t = A_0^{-1} v_t$, $\Phi = A_0^{-1} \tilde{\Phi}$, and $\Omega = A_0^{-1} \Sigma A_0^{-1}$. The parameters of the reduced form are obtained from the data-series, whereas A_0 is estimated by the imposition of further restrictions. It must be noted that the identifications of short-run and long-run structures are considered as different statistical problems. The short-run parameters of the reduced form are uniquely defined, whereas those of the structural form are not, unless a minimum of $p(p-1)$ just-identifying restrictions are imposed. The long-run matrix β is the same in the reduced and structural forms; therefore, cointegrating relations can be estimated in both forms. However, in order for the normalized uniquely defined long-run parameters to correspond to economic identification, a minimum of $r(r-1)$ just-identifying restrictions are required to be imposed on β (Juselius, 2006).

The CVAR model used in this chapter is specified in terms of a vector ‘x’, containing both endogenous and exogenous variables. The blip dummies are specified based on large observations in some of the residuals (see Chapter Five Section 5.5 and Chapter Six Section 6.5 for discussion on blip dummies). In VECM notation, the cointegrating vectors in terms of the endogenous variables are included in the dynamic specification given by:⁵⁷

$$(4.24) \Delta x_t = \Pi x_{t-1} + \sum_{i=1}^{k-1} \Gamma_i(L) \Delta x_{t-i} + \varepsilon_t,$$

where L is the lag operator, $\Pi = \alpha\beta'$, and x is a matrix of I(1) variables. For instance, in the baseline VECM model, there are five endogenous variables with two cointegrating vectors. For this model, accordingly, the long-run matrix can be decomposed into the following reduced rank form:

$$(4.25) \alpha\beta'x_t = \begin{bmatrix} \alpha_{11} & \alpha_{12} \\ \alpha_{21} & \alpha_{22} \\ \alpha_{31} & \alpha_{32} \\ \alpha_{41} & \alpha_{42} \\ \alpha_{51} & \alpha_{52} \end{bmatrix} \begin{bmatrix} \beta_{11} & \beta_{12} & \beta_{13} & \beta_{14} & \beta_{15} \\ \beta_{21} & \beta_{22} & \beta_{23} & \beta_{24} & \beta_{25} \end{bmatrix} \begin{bmatrix} i \\ y \\ c \\ \ln(g^k + \delta) \\ dp \end{bmatrix}_t,$$

$$(4.26) \Gamma_i(L) \Delta x_{t-i} = \sum_{i=1}^{k-1} \Gamma_i(L) \Delta(i, y, c, \ln(g^k + \delta), dp)'_{t-i},$$

where β defines the cointegrating vectors. A cointegrating vector could for instance represent the long-run relationships between $(i_t, y_t, c_t, \ln(g^k + \delta)_t, dp_t)$. Inflation (dp_t) acts ‘as a proxy for the (missing) market interest rate’ for the case of the Iranian economy (Esfahani, et al., 2009, p.1).⁵⁸ However, it must be noted that a cointegration relation is not necessarily the same as an economic relation as an economic relation can be the sum of two or several cointegration relations. α is the speed of adjustment and the response of each variable to the cointegrating vectors (the loadings). Not all of the variables necessarily respond to all of the vectors. In the next two chapters, the CVAR models are estimated for the economy as a whole and on a sector-level basis, respectively.

⁵⁷ It must be noted that if some of the variables are exogenous, they have separate equations (the marginal equations). For instance, if there are p variables, but one is exogenous, then there are p – 1 equations in the CVAR.

⁵⁸ See Chapter Five (Section 5.4.3) for a description of the method of construction of this variable.

4.5. CONCLUDING REMARKS

This chapter, firstly, provided a theoretical framework for Iran's investment behavior motivated by the modified neoclassical-accelerator type investment models. Accordingly, domestic investment in the Iranian context is modelled by a function for gross domestic investment given by equation 4.11. In particular, the CD production function is replaced by the CES production function to relax the restrictive assumptions regarding the interactions between capital and labor in production. Secondly, because the Jorgensonian model is not a dynamic model, this thesis attempts to overcome this shortcoming by modelling investment in a vector error correction model (VECM). This approach makes it possible to take into account the dynamic nature of the data and allows for the estimation of flexible specifications for the short-run investment dynamics from the data. Further, the CVAR methodology allows producing insights based on the data by testing long-run relations instead of imposing them as *a priori*.

Thirdly, uncertainty-driven measures of financial constraints are incorporated into the long-run relationships, given by equation 4.11', to consider the presence of imperfect capital markets for investment behavior in the Iranian context as well as the effects of financial constraints for investment activities in the country. This is because, although Jorgenson identifies key factors in determining the current level of a firm's investment (e.g., current and expected levels of demand, relative factor prices and income tax), it assumes that the future variables are known and that capital markets are perfect. However, these assumptions do not hold if the firms are uncertain or have different expectations about the future.⁵⁹

In fact, investment has to be financed and is likely to be influenced by the efficiency of financial markets in providing finance and the terms upon which the finance is available. Therefore, there is a need to take into account that investment could be sensitive to proxies of financial constraints when modelling investment. This need is particularly important for investment modelling of resource-rich and -dependent economies like Iran. This is because, in these economies, the proxies for financial constraints often depend on the availability of oil windfalls

⁵⁹ As discussed earlier, the Jorgensonian-type investment models implicitly assume that the supply of investment funds is perfectly elastic and that investment decisions and financial decisions are separable under the assumption of perfect capital markets. Also, investment should not be constrained by a shortage of internal funds where capital markets are perfect and tax treatment of various sources of investment funds are the same. However, the assumption of a perfect capital market is not supported by economic facts. Some empirical studies of investment and financial constraints provide evidence that the assumption of perfect capital markets is not realistic and firms may face liquidity constraints for investment activities (Kuh, 1963; Bond and Jenkinson, 1996)

as a source for capital spending. Also, despite the uncertain nature of international resource prices, formulating economic policies in these economies is usually based on expectations about the future income streams from their resources with implications for investment practices.

Chapters Five and Six estimate the CVAR model for the Iranian economy on aggregate and sectoral levels, respectively. In each chapter, the analysis begins by conducting misspecification tests, determining cointegration ranks, and identifying the long-run equilibrium and then the short-run dynamic structures, employing general-to-specific CVAR modelling described by Juselius (2006). The robustness of the results is examined by employing alternative measures of the user cost of capital and uncertainty-driven proxies of financial constraints.

5. ECONOMIC DETERMINANTS OF AGGREGATE DOMESTIC INVESTMENT IN IRAN

5.1. INTRODUCTION

In this chapter, a theory-consistent model of investment is estimated to investigate the long-run economic determinants of aggregate domestic investment in the oil-rich economy of Iran during the period from 1974 to 2011. In Iran, investment is a rather fluctuating component of GDP (see Figure 5.1). The volatility of investment is expected to be at least partly caused by uncertainty stemming from fluctuations in international oil prices through their impact on oil revenue availability as a source of capital spending. Thus, in studying aggregate investment determinants, it is important to incorporate oil-driven financial constraint measures into the modelling of the country's investment behavior. This chapter, therefore, aims at providing answers to the following questions:

- a. (i) What are the economic determinants of aggregate domestic investment in the oil-rich partial-market economy of Iran? (ii) To what extent does the modified neoclassical-accelerator type model of investment (derived in Chapter Four) provide an explanation for aggregate investment in the country? (iii) What are the key underlying reasons for (likely) partial applicability of such model in the Iranian context?
- b. (i) Does the presence of oil play a role in shaping the investment pattern in Iran? (ii) Is aggregate investment responsive to the availability of oil windfalls and/or to the volatility of international oil prices (iii) Are these responses asymmetric?⁶⁰
- c. To what extent have other factors such as the oil shocks, the Iranian revolution or the Iran-Iraq war influenced the basic relationships discussed under (a) and (b)?

This chapter is organized as follows. Section 5.2 provides an overview of Iran's aggregate investment pattern over the period under study. Section 5.3 specifies the estimation model. Section 5.4 outlines the variables used in this study and their sources. Section 5.5 estimates a cointegrated vector autoregressive (CVAR) model for Iran's aggregate investment where the evidence of cointegrating relations is supported by the data. Section 5.6 presents the Impulse Response Functions (IRFs). Finally, section 5.7 concludes the chapter.

⁶⁰ Various methods are used, as explained in Chapter Three Section 3.3, to construct different measures of oil. Therefore, these measures, although presenting some co-moving behavior, are not the same (see also Appendix 5B, Figures for the graphs of various oil measures).

5.2. AGGREGATE DOMESTIC INVESTMENT BEHAVIOR IN IRAN

Theoretically, investment decisions can be made either by individuals, firms, governments, or all of them. In the oil-driven economy of Iran, the government intervenes in the country's economic life. This includes assigning a budget for capital spending as a tool for promoting investment activities.⁶¹ The government regulates the quantity of credits allocated to the economy for investment through different methods. Firstly, the government determines the credits that are to be directly distributed in its annual budgets. Secondly, it controls the supply of credits provided by the Iranian banks through a system of bank specific lending quotas (CBI, 2002). The government further sets the quantity of credits allocated for the major economic sectors including agriculture, manufacture, construction, exports and services in order to give priority to its preferred sectors. In addition, the government sets the official lending and deposit rates of return in the banking systems, which is one of the key determinants of investment according to the neoclassical theory of investment.⁶²

Thus, the Iranian government supports investment expenditure through intervention in the financial markets.⁶³ Such interventions have resulted in a rather rapid expansion of a system of deposit mobilization and high overdues on loans. For instance, the expansion of subsidized credits coupled with low lending real rates of return encouraged excessive lending in the country's banking system, which resulted in as high as 25 percent growth of non-performing loans in 2010 (CBI, 2010; Shajari and Shajari, 2012).⁶⁴ In addition to their lending practices, these banks take deposits; yet, a considerable part of their loanable funds is financed by the central government and the Central Bank of Iran (CBI). The latter supervises all the credit institutions and banks. Once the government approves the annual budgets, the CBI presents its credit and monetary policies to the Money and Credit Council (MCC), where the annual credit allocation to various economic sectors including the private sector is set.

⁶¹ The budget is subject to the availability of a key source of finance, i.e. oil income. Since oil activities are under the control of the Iranian state, an essential part of the income generated in this sector accrues to the government in the form of government resource (or oil) revenues.

⁶² See Chapter Two (Sections 2.2 and 2.3) for a discussion on the role of the state in the process of capital accumulation and the evolution of investment institutions in Iran during the study period.

⁶³ Although, the CBI is formally an independent institution, in practice it does not have the ability to design or conduct proactive monetary and fiscal policies. The government instead controls lending and investment activities of the banks (Jafari-Samimi, 2010; see also Chapter Two Section 2.3).

⁶⁴ A non-performing loan is 'defined as a loan that is not earning income when the bank can no longer anticipate the full payment of principal and interest which are past due by 90 days or more, or at least 90 days of interest payments have been capitalized, refinanced or delayed by agreement' (Shajari and Shajari, 2012, p.166).

The lending and deposit rates are centrally administrated and change only at infrequent intervals, hence do not reflect market conditions. Due to highly persistent inflation and the deterioration of the value of the Iranian currency, these rates have been kept superficially very low with zero or negative real returns on deposit and saving accounts.⁶⁵ This, in return, has discouraged savings and has adversely affected the flow of funds through the financial intermediaries and within the banking system, and so the availability of finance for investment activities.⁶⁶ The unavoidable consequence of low lending rates has been excess demand for bank credits and credit rationing. Consequently, the domestic credit markets in Iran operate under tight controls and lending rates are not market-determined, making them relatively non-responsive to the changes in the economy's inflationary pressures.

In 1979, the lending rates for short-term and long-term deposits were 7 percent and 8 percent, respectively. In 1984, after the approval of the interest-free banking, the MCC approved legal limitations and conditions necessary for granting of banking facilities. Since then these rates have been fluctuating widely between 4 and 23 percent across various economic sectors; the former and the latter corresponding to the minimum and the maximum expected rates of profits on facilities to the agriculture sector and commerce, respectively (see Appendices 2B and 2C). The legal reserve rates are set to mainly control the implementation of the monetary policy and the inflationary effects of credits granted by the banking system in the Iranian economy. First used in 1946, the banks were required to deposit 15 percent of their deposits in the Central Bank. This ratio demonstrated an ascending trend until 1973. For example, this rate increased to 20 percent and 30 percent in the 1950s and 1960s, respectively; but in 1974, following the sudden increase in oil prices, the CBI lowered the required reserve deposit ratio to 25 percent to

⁶⁵ This situation is worsened especially when the black market for gold coins, cars and foreign currency provides higher returns in the short-run.

⁶⁶ Under the arrangement of Islamic banking, interest paying deposits with the banking system are viewed as participation in the investment activities of the banking system. Such deposits are subject to two profit rates. An initial rate, known as the 'provisional' or 'alal-hessab' rate which is announced at the time deposits are placed with the banks; and a 'final or actual' rate which is computed on the basis of the bank's operations at the end of the year. However, in practice, the provisional and actual returns are very close. See Chapter Two Section 2.3 for a more detailed account of Iran's financial and banking system.

provide further credits for the private sector. In 1978, because of the political and economic upheavals in the country and people's inclination to withdraw their deposits from the banking system, this ratio decreased to as low as 10 percent (Izadi and Izadi, 2013). After the Islamic revolution, depending on the banks' liabilities and fields of activities and in accordance to the Iranian Monetary and Banking Law, the CBI has been determining this rate within a range of 10 and 30 percent.

During the years under consideration, the tax system in the country has helped finance only a trivial share of the government's expenditures due to the small fraction of taxes in total government revenues. Between 1971 and 2010, the share of taxes in total government revenues averaged only about 30 percent per annum with small variations throughout the period. The highest average per annum share of taxes was related to corporate tax (11%) followed by import tax (9%), sales and consumption tax (5%) and wealth tax (1%). Compared to the post-revolutionary years, during the years from 1970 and 1978, the average annual share of taxes in total government revenues recorded a slightly lower rate. In addition to the expected rates of profit on facilities in the large state-owned commercial banks, limited credits at subsidized rates have been available for various economic sectors and the state has paid the difference between the lending and the subsidized rates. In the years after the revolution, the cost of loans has often been lower for those firms with access to the state-owned banks' credits as the private banks and non-bank credit institutions are able to charge about 4-5 percent per annum higher lending rates on their loans. Small enterprises have often been rationed with low collaterals. There are also hidden costs associated with obtaining loans including long waiting lists (Jalali-Naini, 2008).

Figure 5.1 displays the aggregate investment-GDP ratio in the Iranian economy during the years under consideration. The average ratio was as high as 33% p.a. during 1965-2010, typically for commodity exporters, and particularly oil producers, due to investment-inducing effects of large influx of commodity income in these economies.⁶⁷ Nevertheless, the country's output growth did not record as high as its investment growth. For most of the years under study, the aggregate

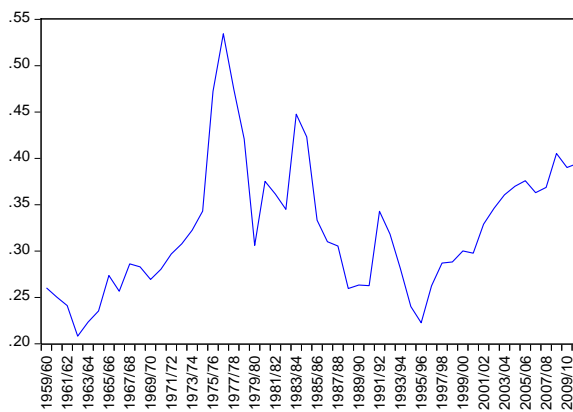
⁶⁷ See Cherif and Hasanov (2012) for a detailed discussion on oil exporting countries' investment share.

investment rate fluctuated and followed a similar pattern to the movements of real oil revenues and international oil prices, with three distinct trending patterns.⁶⁸ The aggregate investment rate rose during most of the 1960s and 1970s, with a substantial increase following the first oil shock in 1973.

The share of aggregate investment in GDP illustrated a considerable downward trend during the 1980s largely due to the revolution and the uncertain political atmosphere it left in its aftermath, the Iran-Iraq war and the third oil shock of the mid-1980s. After the war and given the favorable international oil prices, the investment rate recovered for most of the 1990s and 2000s. An exception was the decline of the aggregate investment rate in the mid-1990s chiefly due to the country's foreign debt crisis coupled with lower international oil prices, which in return, left insufficient foreign exchange resources to finance capital spending on a large scale.

Figure 5-1 Investment-GDP ratio

Aggregate investment/GDP ratio, 1959-2011



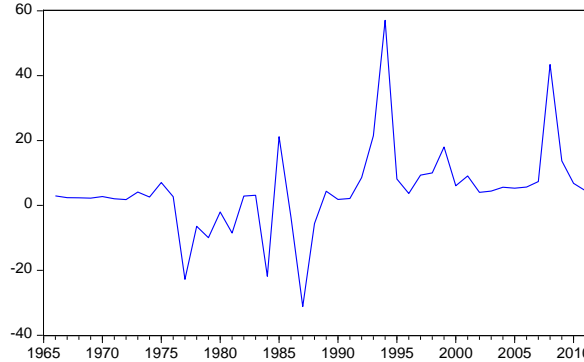
Note: Constructed based on data in billion Rials at constant 2004/05 prices. Source: CBI.

Figure 5.2 depicts the evolution of the real Incremental Capital-Output Ratio (ICOR), defined as the ratio of gross investment to changes in output, which is the reciprocal of marginal product of capital stock. The ICOR measures the increment in capital needed to produce an additional unit of output and therefore can be considered as a measure of efficiency of capital. During the years under consideration, the ICOR exhibited a fluctuating and upward trend, with recurrent hikes particularly after the revolution since 1980s, suggestive of the destruction of existing capital due to the war and the declining investment efficiency in the country. At large, it seems that Iran has

⁶⁸ See Chapter Two Section 2.4.2 for graphs and discussion on the co-moving pattern of real aggregate investment and the growth rate of real oil prices. Also see Section 2.4.2 in Chapter Two for graphs and discussion on the development of real aggregate investment, real public and private investment growth rates and real sectoral investment during the period under study.

rather over-invested particularly since the implementation of its post-revolutionary development plans and that the government has played an interventionist role in the size of real investment and in the allocation of mainly oil-based financial resources to various economic sectors.

Figure 5-2 Incremental capital-output ratio



Note: Constructed based on data in billion Rials at constant 2004/05 prices.

Source: Calculated by the author based on data from CBI.

As discussed in Chapter Two, during the years under study, Iran experienced some major political events and its political economy and institutions underwent substantial changes. These included different oil shocks, the revolution, the war with Iraq, and the implementation of various economic reforms reflected in the country's development plans throughout the study years. Therefore, although the above analysis allows investigating the long-run relationships between the theory-motivated variables under study, it could be expected that at least some of these events to have affected some of the variables in the models stated above.

In brief, from the mid-1960s until the early 1970s, real oil revenues gradually increased. Although the oil sector share in GDP was about 20 percent on average, this was achieved in a rather low inflationary economic environment due to higher oil output growth. However, the 1970s were characterized by considerable oil price increases with oil revenue growth of about 14% p.a. on average during that time. In particular, oil revenues increased over 30% p.a. until the mid-1970s. Consequently, the Shah's regime injected significant sums of money into the economy and replaced the development plans' projections by ambitious targets. As a result, the oil sector's share in the economy grew to about 50%, yet the production capacity did not increase comparatively. The state's rapid fiscal expansion considerably increased the liquidity base and the dependency of the country on oil windfalls, and resulted in inflationary pressures in the economy.

The 1980s were characterized by the regime shift, the war between Iran and Iraq, the big nationalization of various private sectors and stagnation. In the immediate post-war era, high growth rates seemed feasible with injections of money in the economy. During 1989-1996, assessments in the first post-revolutionary development plan aimed at rapid expansion of the oil sector, export promotion, reduced import controls and attracting foreign investment.⁶⁹ The key objectives of the first plan were to employ expansionary financial policy including monetary expansion and short-run external borrowing to finance public investment spending, maintaining negative real lending rates as well as depreciated exchange rates.

However, the experience of the Iranian economy during the first plan was unstable growth due to short-term planning and speculations. The optimism regarding the amount of oil windfalls due to oil price fluctuations in the 1980s proved not to be adequate. At first, the volatility of oil prices was attributed to the Iran-Iraq war and considered transitory. But, persistent fluctuations of oil prices throughout the first plan made policy makers realize that oil prices were determined in the international markets. During this period, the government's economic liberalization policies, along with the single floating exchange-rate mechanism fueled inflation and income disparity. Also, price distortions led to further inflationary pressures in the economy.

The second plan, implemented during Rafsanjani's presidency, was more inward-looking and drawn with two high-end and low-end scenarios for resources and quantitative goals. The second plan focused on issuing investment certificates, promoting private non-bank credit institutions and setting lending rates at levels that ensured positive real return on bank deposits. The economy, however, witnessed the reoccurrence of stagflation (which it suffered from during the 1980s) due to the debt crisis of 1993, high inflation and slowed economic growth. Although economic performance started to recover at a steady level since 1994, the actual annual rates of growth and investment remained lower than their targets.

Coinciding with Khatami's presidential years, the third plan's main macroeconomic policies focused on the privatization of the large public sector, limiting subsidies and price decontrols,

⁶⁹ See Chapter Two Table 2.1 for a comparison of projected versus actual figures on economic indicators in Iran.

moving away from administered credit allocation and establishing an oil fund. Also, the plan aimed at encouraging investments through reducing aggregate consumption for the promotion of faster fixed capital formation and FDI. The former proved to be disappointing mainly because both public and private consumption expenditures highly exceeded their projected figures. The increase in the private sector expenditure was driven by plentiful oil receipts, greater money supply and new possibilities for purchases on credit. The higher than targeted increase in public consumption was partly because of the reckless spending inclination among public agencies and stickiness of government current expenditures. The real expected rates of return on facilities remained mandatorily low. Further, due to increased use of capital-intensive technology and the choice of capital-intensive projects, capital productivity did not increase much.

The main objective of the establishment of the Oil Stabilization Fund (OSF) during this period was to cushion the economy from unexpected oil price fluctuations and eventual oil price decline. The government was authorized to draw from the OSF only when the oil windfalls fell below the budget target for the year. In practice, however, during the plan's period which coincided with steady increase in oil prices, the parliament (Majlis) frequently allowed withdrawals from the fund to curb budget deficits. The rest of the fund was partially used to support the war veterans, disabled and military militia (Basij), to help the agriculture sector against drought and to finance subsidies. The plan proved to be unable to control prices and inflation. Even though the actual oil windfalls earnings in the fourth plan were about three times of the projected amount, their economic impact was much less than expected. The real annual average investment growth recorded much lower than its target, contributing further to low GDP growth and high inflation.

Accordingly, it could be expected that at least some of the events above to have affected the estimation models presented in Section 5.3. According to Juselius (2006), the need for dummies could be (tentatively) identified by checking the residuals, but should only be considered if the large residual corresponds to a known intervention, a reform or a regime shift. Further, a large

residual does not imply that the model exclusively needs an impulse dummy. A large outlier could indicate a shift in the level of one or more variables. Hence, the appropriate procedure is first to examine whether there has been a shift in the equilibrium mean (using a step dummy) and, if so, to estimate the model with such a shift plus additionally an impulse dummy (blip dummy) in the short-run part of the model. If the step dummy is insignificant, then only the impulse dummy can be included in the model. Given that the interventions in the Iranian economy have been very significant, a priori one would expect to see changes in the equilibrium means. When appropriate, therefore, dummy variables are included in the empirical models to capture their associated effects on the models (see Section 5.5.2). In what follows, the estimation investment model for the oil-based economy of Iran is explained and a number of hypotheses are stated.

5.3. THE ESTIMATION MODEL

In specifying and estimating Iran's model of investment behavior within the modified neoclassical-accelerator type investment models, the widely-used Johansen's (1996) and Juselius' (2006) CVAR approach is employed. The basic idea behind this methodology is to describe the macro-economy by a linear representation of a vector of observable variables on their own lags, and where applicable, on exogenous variables. These vectors are economically interpretable under certain identification and over-identification restrictions imposed by economic theories.

As discussed in Chapter Four (Section 4.3), the following long-run capital equation (4.11) was derived in Chapter Four:

$$(5.1) \quad i_t = \beta + y_t - c_t + \ln(g_t^K + \delta_t),$$

where $\beta = \ln(\alpha')$, k_t is the capital stock at time t , y_t is output at time t , c_t is the user cost of capital at time t , g^k is the growth rate of capital and β is a constant.

Since Iran's economy is an oil-based economy, it is important to incorporate measures of oil-driven uncertainty into investment modelling of the country (as specified by the cash flow models). This provides an insight into whether any relationships exist between aggregate

investment and alternative measures of oil-driven uncertainty. In resource-rich economies, the relationship between natural resources and economic activities is yet subject to debate. Some scholars argue that there is a negative relationship between the abundance of natural resources and economic performance. However, others suggest that natural resources are neither curse nor blessing, and that various factors such as low levels of human capital, debt overhang or poor political and financial institutions are among the core issues causing crises (Sachs and Warner, 1997; Lederman, 2007). However, the capital stock equation could be considered as a capital accumulation identity equation. That is, if the capital stock is measured by cumulating the next investment flows, it is identically true that it will be related to investment and depreciation; hence it is not a behavioral equation. Accordingly, this study chooses to focus merely on the investment function in the empirical analysis.⁷⁰

A common approach in the early studies was to stipulate a linear relationship between the changes in oil prices and economic performance (Darby, 1982; Hamilton, 1883). The oil price collapse of the 1980s spurred research efforts to derive new specifications that produce a more responsive oil-macroeconomy relationship, one of which was the notion of asymmetry in the economy's response to positive and negative oil price changes (Hamilton, 1996; Mork, 1989). Early studies on net oil importing economies show that oil price increases and decreases are associated with significant recession and insignificant boom, respectively (Mork, 1989, 1994; Mory, 1993; Hamilton, 1996). Asymmetric responses could be different in net oil exporting economies where positive and negative oil shocks may have significant aggregating and insignificant dampening effects, respectively, on the economic activities of these countries (Eika and Magnussen, 2000; Jimenez-Rodriguez and Sanchez, 2005; Korhonene and Ledyeva, 2010; Dissou, 2010; Gausden, 2010; Mendora and Vera, 2010).

Intuitively, an increase in oil windfalls in an oil-dependent economy relaxes foreign exchange constraints and stimulates government expenditures. For instance, Talvi and Vegh (2005) argue that in countries where the revenue base is highly fluctuating, budget surpluses create political

⁷⁰ The capital stock accumulates net investment flows, that is, gross investment net of depreciation, but it must be noted that depreciation could itself be a function of economic variables, as it almost certainly is; this imparts a time subscript to depreciation, which becomes behavioral. The measurement of the capital stock may vary depending on the method of construction, i.e., the perpetual inventory method (PIM) and the capital accumulation identity (CAI). The PIM usually assumes a constant depreciation rate; the actual capital stock may – or may not – have a constant depreciation rate. For the two, PMI and CAI, to be the same, the depreciation rate for the PIM must match the actual depreciation rate for the CAI.

pressures to increase government spending. In this picture, positive oil shocks can induce faster growth in government spending. However, it is often less recognized that this stimulating effect could only be transitory and that such blessing could turn into a curse in the long-run. This is because a sudden inflow of oil windfalls could result in the appreciation of real exchange rate, inflationary pressures on the economy and contraction of tradable sectors including non-oil exports. Furthermore, the notion of asymmetric response to oil revenue changes (rather than oil price changes) may arguably be of greater importance for oil exporting economies where oil revenues have been and are expected to be a crucial feature of their economies. Also, some studies found a stronger economic impact from the volatility of oil prices than the changes in oil prices (Mohaddes and Pesaran, 2013). Therefore, the long-run investment equation is augmented with measures of oil, namely oil revenues and oil price volatility (see Section 5.4.4 for the construction of oil-driven financial constraint measures).

Accordingly, employing the CVAR methodology, the stated relations (equations 4.25-26) are tested for the Iranian sample during the period from 1974 to 2011. Table 5.1 outlines the hypotheses which are divided into two parts. The first part reports hypothesis H1 under the heading of ‘Baseline Investment Equation’. This hypothesis predicts that, in the long-run, investment (i_t) is positively related to output (y_t) and the sum of the growth rate of capital (g_t^k) and capital depreciation (δ), while it is negatively related to the user cost of capital (c_t), as implied by substituting the steady-state condition into the FOC equation.

Table 5.1 Hypotheses of long-run relationships

Baseline Investment Equation	
H1	Long-run relationships between [$i_t, y_t, c_t, \ln(g^k + \delta)_t, dp_t$]
Investment Equation Augmented with Symmetric Oil-driven Measures	
H1.1	Long-run relationships between [$i_t, y_t, c_t, \ln(g^k + \delta)_t, dp_t, orev_t$]
H1.2	Long-run relationships between [$i_t, y_t, c_t, \ln(g^k + \delta)_t, dp_t, volo_t$]

Note: i_t : investment; y_t : output; c_t : user cost of capital; δ : capital depreciation rate; g^k : capital growth rate; $orev_t$: oil revenues; $volo_t$: oil volatility; and dp_t : inflation as measured by the changes in the implicit deflator of gross domestic product (percent). Data are in natural log and in real terms (Base Year 2004/05). Source: CBI, Time-series Data; See also Section 5.4.

The second part of Table 5.1 presents two hypotheses H1.1-H1.2, under the heading ‘Investment Equation Augmented with Symmetric Oil-driven Measures’, investigating the long-run relationships between aggregate domestic investment and oil-based measures in the Iranian economy. Inflation (dp_t) based on the changes in the implicit deflator of gross domestic product

is further included in the models to act ‘as a proxy for the (missing) market interest rate’ (Esfahani, et al., 2009, p.1). As discussed in Chapter Two, ‘the theoretical literature leaves open the sign and persistence of any relationships between investment and uncertainty’ (Bond, et al., 2005, p.10). Thus, it is of interest for this thesis to empirically estimate the relationship between oil-based uncertainty and aggregate investment in Iran, using symmetric oil-driven financial constraint measures as explained in Section 5.4.5.

As mentioned in Chapter Four (Section 4.4.1), the CVAR model used in this chapter is specified in terms of a vector ‘x’, comprising endogenous and exogenous variables, and deterministic terms including constant term and dummies ‘D’. In VECM notation, the cointegrating vectors are included in the dynamic specification given by:

$$(5.2) \Delta x_t = \Pi x_{t-1} + \Gamma_i(L)\Delta x_{t-i} + \Phi D_t + \varepsilon_t,$$

where L is the lag operator, $\Pi = \alpha\beta'$, and x is a matrix of I(1). In the macroeconomic analysis of small open (oil-based) economies like Iran, it is plausible to assume that some variables are exogenous, implying that these variables have a direct contemporaneous impact on the endogenous variables, but they are not affected by the error correction terms which are the disequilibria in the economy. D_t is a set of variables weakly exogenous in the long-run cointegration space, and may contain deterministic terms such as constant and trend as well as intervention dummies.⁷¹ The error term ε_t is thus partitioned to $\varepsilon_t = (\varepsilon'_{x^*t}, \varepsilon'_{zt})'$. For instance, in the baseline VECM model, there are five endogenous variables, with two cointegrating vectors ($i_t, y_t, c_t, \ln(g^k + \delta)_t, dp_t$) and the long-run matrix can be decomposed into the following reduced rank form:

$$(5.3) \alpha\beta'x_t = \begin{bmatrix} \alpha_{11} & \alpha_{12} \\ \alpha_{21} & \alpha_{22} \\ \alpha_{31} & \alpha_{32} \\ \alpha_{41} & \alpha_{42} \\ \alpha_{51} & \alpha_{52} \end{bmatrix} \begin{bmatrix} \beta_{11} & \beta_{12} & \beta_{13} & \beta_{14} & \beta_{15} \\ \beta_{21} & \beta_{22} & \beta_{23} & \beta_{24} & \beta_{25} \end{bmatrix} \begin{bmatrix} i \\ y \\ c \\ \ln(g^k + \delta) \\ dp \end{bmatrix}_t,$$

⁷¹ In this chapter, there exist linear trends in the level of variables, but the linear trends in the variables do not cancel in the cointegrating relations, i.e. the models contain trend stationary variables or trend stationary cointegrating relations. Therefore, the trend is restricted only to appear in the cointegration relations, but the constant is unrestricted in the model (see case four in Juselius, 2006, p, 100).

$$(5.4) \Gamma_i(L)\Delta x_{t-i} = \sum_{i=1}^{k-1} \Gamma_i(L)\Delta(i, y, c, \ln(g^k + \delta), dp)'_{t-i} + \varepsilon_t,$$

where β defines the cointegrating vectors and α is the response of each variable to the cointegrating vectors as defined above.

5.4. VARIABLES AND CONSTRUCTION OF THE DATA

In this chapter, the data comprises annual observations for the years from 1974 to 2011. The variables include real investment, real output, the user cost of capital, the sum of the growth rate of capital and the rate of capital depreciation, inflation and alternative measures of oil. Appendix 5A provides a summary of the variables used in this chapter and their sources. Figures 5B1-B11 in Appendix 5B illustrates the graphs of these variables. These data are collected from the Central Bank of Iran (CBI), the Statistical Centre of Iran (SCI) and British Petroleum (BP). Where possible, the data have been cross-checked with international databases including the International Monetary Fund's International Financial Statistics (IMF IFS), the World Bank and the Energy Information Administration (EIA). The choice of the period under consideration is based on data availability for all the variables. All of the variables are in natural logarithms, corresponding to the specifications of the derived empirical equations presented in Section 5.3 and Chapter Four Section 4.3. The use of logarithms transforms some non-linear models into linear ones, thus allowing the use of linear estimation procedures. Accordingly, the estimated regressors are the coefficients of elasticity and not the coefficients of marginal effects.

5.4.1. INVESTMENT

The data on gross fixed capital formation (in billion Rials at constant 2004/05 prices) are used to proxy for real investment, and are collected from the CBI's annual national accounts (historical data series) available from 1959/60-2010/11. This variable in natural log is denoted by i_t and is illustrated in Figure 5B1.

5.4.2. OUTPUT

The data on real gross domestic product or GDP (in billion Rials at constant 2004/05 prices) are used to proxy for real output. This variable in logarithm form is denoted by y_t and is shown in

Figure 5B2. The data on gross domestic product are collected from the CBI's annual national accounts (historical data series) available from 1959/60-2010/11.

5.4.3. THE USER COST OF CAPITAL AND INFLATION

The user cost of capital for the Iranian economy is shown in Figure 5B3, denoted by c_t and calculated as follows:

$$(5.5) c_t = (1 - \text{Tax}_t)((\text{Return}_t/100) - dp_t + \delta_t),$$

where Tax_t is the corporate tax rate variable calculated by dividing corporate taxes by total revenues in current prices, and their data are collected from the CBI's Time-series Government Budget and Fiscal Data. Return_t refers to the weighted average of the expected rates of return on facilities and is used as a proxy for the rates of interest at the economy level. This variable is calculated as follows. First, the shares of i) Agriculture, ii) Manufacturing and Mining, iii) Construction and Housing, and iv) and the Rest of the Economy, in total GDP were computed. Then, the associated averages of minimum and maximum expected rates of return on facilities (presented in Appendix 2B) were calculated. Lastly, the weighted average of the expected rates of return on facilities was calculated. dp_t is used as a proxy for inflation and refers to the implicit deflator of gross domestic product. The annual data for this variable is collected from the CBI's online database for the years from 1973/74-2010/11. The growth rate of capital (g_t^k) is calculated as:

$$(5.6) g_t^k = (K_t - K_{t-1})/K_{t-1},$$

where K_t denotes the capital stock. Assuming geometric depreciation at a constant rate δ , net capital stock in each period can be shown to be a function of net capital stock in the previous period and gross investment in the current period as follows: $K_t = (1 - \delta)K_{t-1} + I_t$, where I_t is gross investment. Thus, the following can be obtained: $K_t = I_t + K_{t-1} - \delta K_{t-1}$. Accordingly, $K_t - K_{t-1} = I_t - \delta K_{t-1}$ and $\delta K_{t-1} = I_t - (K_t - K_{t-1})$. Hence:

$$(5.7) \delta = (I_t - (K_t - K_{t-1}))/K_{t-1}.$$

Capital stock is the stock of produced tangible fixed assets and the data on real capital stock (in billion Rials at constant 2004/05 prices) are obtained from the CBI's annual national accounts (historical data series) available from 1974/75-2010/11. In addition, as explained earlier, inflation (dp_t) based on the changes in the implicit deflator of gross domestic product is calculated to proxy for the user cost of capital. The inclusion of dp_t is due to the fact that the data available on interest rates are centrally set and change infrequently, hence do not represent the market conditions in the Iranian economy. Therefore, depicted in Figure 5B4, this variable 'acts as a proxy for the (missing) market interest rate' in the country (Esfahani, et al., 2013, p.221). The variable $\ln(g^k + \delta)_t$ is constructed employing equations (5.6) and (5.7), and is shown in Figure 5B5, corresponding to the sum of depreciation rates and the growth rates of capital stock. Appendix 5L presents a table illustrating the methods of construction of these variables.

5.4.4. OIL-BASED MEASURES

This sub-section outlines different transformations of data on oil revenues and oil prices. Each of these measures suggests a different channel through which the presence of oil may have affected investment.

In this study, first, the oil revenue variable is introduced to the model of investment. Annual data on oil revenues at current prices are collected from the CBI's annual national accounts (historical data series) from 1973/74-2010/11, and are converted to real figures using the implicit deflator of gross domestic product as follows: $orev_t = norev_t - p_t$, where $orev_t$, $norev_t$ and p_t refer to real oil revenues, nominal oil revenues and the implicit deflator of gross domestic in (natural) logarithmic forms. Figure 5B6 demonstrates the graph of the real oil revenue variable for the period under study. Mork's (1989) commonly used asymmetric specification as given in equation (3.22) in Chapter Three is then employed to calculate oil revenue increase and oil revenue decrease variables, displayed in Figures 5B8 and 5B9 and denoted by $dorevi_t$ and $dorevd_t$, respectively.

Next, the volatility of international oil prices is introduced to the investment model. The data on monthly real crude oil prices are collected from the BP Statistical Review of World Energy. First, the changes in international oil prices (dpo_t) are calculated. Then, following Mohaddes and Pesaran (2013), the changes in oil prices are used to compute the realized annual volatility of oil

prices based on equation (3.21) in Chapter Three. Figure 5B7 illustrates the development in realized annual volatility of oil prices, denoted by vol_t , based on this method. Mork's (1989) asymmetric specification, explained in equation (3.22), is further used for a non-linear transformation of oil price volatility by specifying oil price volatility increase and decrease, shown in Figures 5B10 and 5B11 and denoted by vol_{oi} and vol_{od} , respectively.

5.5. THE COINTEGRATED VAR MODEL

In this section, first, the long-run economic determinants of aggregate domestic investment in Iran within the modified neoclassical-accelerator type models of investment are investigated. Two measures of oil, namely oil revenues and oil price volatility, are next incorporated in the model of investment to study the extent to which the presence of oil has influenced aggregate domestic investment in the country.

5.5.1. THE COINTEGRATION ANALYSIS

This section uses the integration and cointegration properties of the data to infer the strength of the link between the relations explained in Section 5.3 as potential long-run equilibrium relations. First, the appropriate lag length is determined for each model based on the Schwarz (SC) and the Hannan-Quinn (H-Q) criteria. The suggested criteria vary in terms of the strength of the penalty associated with the increase in model parameters due to adding more lags. The test criteria for different values of lags denoted by 'p' are calculated and accordingly the value of p corresponding to the smallest value is chosen. The results of the lag length determination tests, reported in Appendix 5C, suggested $p = 2$ for all the models. The Lagrange Multiplier (LM) tests in each VAR (p) are further used to check for left-over residual autocorrelation in each VAR (p) model (Juselius, 2006, p.72). These tests seem to accept absence of autocorrelation in the VAR (2). Following Juselius (2006), both multivariate and univariate misspecification tests are then implemented to test for the statistical adequacy of the chosen VAR models. These include tests of residual autocorrelation, residual heteroscedasticity and normality tests. The multi- and uni-variate test results, presented in Appendix 5D, suggest that the models are adequately specified with $p = 2$.⁷² Therefore, the analyses are carried out with VAR(2).

⁷² See Juselius (2006, pp.66-145) for details on how to conduct misspecification tests and obtain results.

The Johansen cointegration rank tests based on the Bartlett corrected trace test and the maximum eigenvalue test are then conducted on the data to determine the rank for each model. Appendix 5E reports the estimated eigenvalues (λ_i), the trace test (Trace), the Bartlett corrected trace tests (Trace*) with p-values in brackets, and the 95% quantile from the asymptotic tables ($Q_{.95}$), all of which are generated in CATS software. The trace tests analyses have been corrected for small sample size.⁷³ Statistically significant, the Bartlett corrected trace test results suggest the choice of $r = 3$ for both models. Appendix 5F reports the moduli of the roots of the companion matrix where the rank is chosen so that the largest unrestricted root is far from a unit root (i.e. it has modulus less than one).⁷⁴ The findings are further confirmed by the graphs of the cointegration relations shown in in Figures 5G1-5G2 in Appendix 5G.

With estimation based on such a long time-series of data in a country that has undergone substantial political changes, it is crucial to test the stability of the model parameters. Therefore, the statistical adequacy of the models is investigated by conducting recursive stability tests, beginning with a sample of 1977-2003 and then adding observations until the full sample size is reached. The tests are based on the log-transformed eigenvalues demonstrated in Figures 5H1-5H2 Appendix 5H, as these tests provide more detailed information about the constancy of the individual cointegration relations.⁷⁵ The findings could suggest that there is no significant change in the model parameters over the period under study. Yet, it must be noted that the sample is small and not many observations are left for testing the constancy of the parameters.

Shown in Appendix 5I, the test results for a unit vector in β (variables' stationarity), suggest that the variables are non-stationary, hence supporting the treatment of the main variables as being I(1). Appendix 5J presents tables from CATS' short-run parameters output for weakly exogenous/fixed variables, time t-1 and t-2, dummy variables and constant, with their associated t-values. For each equation, Figures 5K1-K2 in Appendix 5K plot the residuals including the fitted and the actual values of Δx_{it} , the residuals scaled by their standard deviation, autocorrelations of the residuals and the histogram. On the whole, the graphs of the residuals

⁷³ Juselius (2006) argues that for moderately-sized typical macro-economic samples (50-70 observations), the corrections can be substantial. This is because for a small sample, the asymptotic distributions often do not tend to be good approximations to the true distributions and using asymptotic tables can lead to size and power distortions.

⁷⁴ It must be noted that the characteristic roots are reported without confidence bands and the discussion as whether a root is big or not is only indicative.

⁷⁵ See Juselius (2006, pp.157-162) for a detailed discussion on forward recursive tests.

illustrate that the estimated values capture the dynamic responses and follow the actual values reasonably closely.

Juselius (2006) suggests transforming the long-run matrix $\Pi = \alpha\beta'$ by a non-singular $r \times r$ matrix Q as follows: $\Pi = \alpha Q Q' \beta' = \tilde{\alpha} \tilde{\beta}'$, where $\tilde{\alpha} = \alpha Q$ and $\tilde{\beta} = \beta Q^{-1}$. The matrix Q imposes a total of $r(r - 1)$ just-identifying restrictions on β and $(r - 1)$ just-identifying restrictions on each β_i .⁷⁶ In order to identify long-run structures, one approach is to first impose just-identifying restrictions on β vectors and then imposing over-identifying restrictions by setting the least significant coefficients in the just-identified model to zero one after another. The just-identifying restrictions do not change the likelihood function, whereas the over-identifying restrictions constrain the parameter space and change the likelihood function and therefore are testable. Another approach is to test sets of irreducible relations. This study takes the latter approach. The over-identification restriction tests are based on the log-likelihood ratio (LR) test procedures detailed in Juselius (2006, pp.209-12).

Accordingly, the cointegrating structures of the steady-state relations are formulated. In all of the models, further to equation (4.11'), the first relation (β_1) is normalized on the investment variable. Tables 5.2 and 5.3 illustrate the results of the over-identified cointegrating structures of the theoretically motivated relations in the data, where the reported over-identifying restrictions in all of the models are not rejected based on the p-values associated with the LR test statistics reported in the tables. Respectively, the β and α coefficients correspond to the long-run structures and the estimated adjustment dynamics. The statistically significant β estimates are in bold face to distinguish them from the α coefficients.⁷⁷ Section 5.5.2 estimates the baseline model of investment incorporated with symmetric measures of oil for the Iranian economy.

⁷⁶ The hypotheses tested are of the form $\beta^c = (H_1 \phi_1, \psi_1, \psi_2)$ and implies that the test is for whether a single relation is on $sp(\beta)$. β^c is the constrained cointegrating vector, H_i , $i = 1, \dots, r$, are the design matrices of the long-run structure of dimension $p_1 \times s_1$, ϕ_i are $s_i \times 1$ matrices of unrestricted coefficients, and ψ_1 and ψ_2 are the unrestricted cointegration vectors. The cointegrating relationships which are not rejected are chosen for further identification by imposing just- and over-identified restrictions on them.

⁷⁷ In this approach, for the just- and over-identified structures, the degree of freedom is computed employing the following formula, $v = \sum_{i=1}^r (m_i - r + 1)$, where r is the cointegration rank and m_i is the number of restrictions on β_i (see Juselius, 2006, pp. 212-21).

5.5.2. TESTS OF SYMMETRIC LONG-RUN RELATIONS

This section tests the long-run relationships between i_t , y_t , c_t , $\ln(g^k + \delta)_t$, dp_t and symmetric measures of oil for the Iranian sample. The oil measures include the level of oil revenues ($orev_t$) and oil price volatility ($volo_t$), corresponding to hypotheses H1.1 and H1.2, respectively. As explained earlier, the rate of inflation based on the changes in the implicit GDP deflator (dp_t) is included in the model to proxy for the user cost of capital in the country.⁷⁸ Accordingly, two CVAR models are estimated based on the above set of variables given by the vector $x_t^{(H1.1)} = [i_t, y_t, c_t, \ln(g^k + \delta)_t, dp_t, orev_t]'$ and $x_t^{(H1.2)} = [i_t, y_t, c_t, \ln(g^k + \delta)_t, dp_t, volo_t]'$, $t = 1974-2012$. The variables $orev_t$ and $volo_t$ are *a priori* assumed to be weakly exogenous variables, $z_t^{(H1.2 \text{ and } H1.2)} = [orev_t, volo_t]'$. This is because, oil prices are set in the international oil markets as the demand for crude oil is mainly determined by global economic growth and oil markets' speculations, and that the production of Iran's crude oil and export quota are pre-determined by OPEC.

The inspection of the data does not reveal any large residuals in the models. However, an intercept is needed to account for the initial level of measurements (Juselius, 2006, pp. 99-100). Accordingly, based on the observation of the plots of the data and their first differences in Appendix 5B and the graphs of the cointegration relations in Appendix 5G, the specification for the constant term in both estimations is as follows. The trend is restricted to appear in the cointegration relations, while the constant term is unrestricted in the model.⁷⁹ Table 5.2 reports the results of over-identified cointegrating structures of the theoretically motivated relations in the data given the baseline investment model augmented with the measure of oil revenues. The over-identified structures specify three interpretable long-run relations accepted based on $\chi^2(2) = 0.739 [0.691]$.

The first relation (β_1), normalized on investment, is the investment equation implied by substituting the steady-state condition into the FOC equation.⁸⁰ According to the empirical findings, investment largely depends on factors which lie within the modified neoclassical-

⁷⁸ Among others, see for instance Esfahani, Mohaddes and Pesaran (2009), for a similar approach.

⁷⁹ Linear trends in the level of variables and a non-zero mean of the cointegration relations are allowed (corresponding to Case 4 in Juselius, 2006, p.100).

⁸⁰ The findings are interpreted taking into account the three meanings of identification, consistent with Juselius (2006): the formal meaning (related to the adequacy of the statistical model), the empirical meaning (related to the significance of actual estimated parameter values) and the economic meaning (related to the economic interpretability of the estimated coefficients).

accelerator framework. That is, the findings show that investment is strongly and positively related to output (y_t) and $\ln(g + \delta)_t$ with the estimated coefficients equal to 0.87 and 1.22, respectively. In addition, the coefficient of oil revenue variable ($orev_t$) is positive and statistically significant with the magnitude of 0.06, implying that oil income and real investment are positively associated in the long-run. Consistent with the theory, the empirical evidence further supports a long-run negative relationship between investment and inflation (dp_t), which acts as an alternative proxy for the user cost of capital, with the corresponding coefficient magnitude -0.89.

However, the long-run relationship between investment and the user cost of capital (c_t) does not hold. This behavior mainly results from the government's attempts to maintain the lending rates non-responsive to high and persistent inflationary pressures by imposing tight controls over the credit markets and centrally determining expected rates of return. Even despite the partial deregulation of the rates of returns since the late 1990s, the real rates tend to become negative when inflation rises and less negative when inflation falls. This is contrary to the equilibrating effects of market forces in credit markets where real rates increase in response to inflationary pressures. In fact, during the period under consideration, high and persistent inflation has been translated into lower real lending rates and thus lower user cost of capital, resulting in insignificant relation between investment and the user cost of capital in the long-run.

Based on the estimated α loading coefficients for the first relation, the error correction coefficients for investment is found to be statistically insignificant. This finding is not surprising because by their very nature investment projects are rarely so flexible that they can adjust instantaneously to changes in the availability of finance. Instead, they need to continue for some time even when the windfall revenues have been exhausted. However, the estimated α loading coefficients for variable $\ln(g^k + \delta)_t$ is error correcting with an adjustment coefficient equal to 0.84, indicating a very fast adjustment of this variable to the system. This suggests that a higher rate of capital depreciation or a lower rate of capital growth could considerably affect investment spending in the short-run.

Table 5.2 Fully-identified long-run structures (1974-2011)**H1.1: BASELINE MODEL AUGMENTED WITH OIL REVENUE MEASURE****OVER-IDENTIFIED VECTORS - $\chi^2(2) = 0.739$ [0.691]**

r = 3	i_t	y_t	c_t	$\ln(\delta + g^k)_t$	dp_t	$orev_t$	trend
$\beta_1(H1.1)$	1.000 (NA)	-0.873 (-53.056)	0.000 (.NA)	-1.220 (-48.674)	0.893 (7.851)	-0.061 (-6.378)	0.000 (.NA)
$\alpha_1(H1.1)$	0.595 (1.329)	-0.174 (-0.759)	0.089 (0.271)	0.841 (1.839)	-0.148 (-0.408)	-	-
$\beta_2(H1.1)$	0.000 (.NA)	1.000 (NA)	2.703 (14.516)	0.000 (.NA)	1.443 (7.650)	0.000 (.NA)	-0.036 (-45.834)
$\alpha_2(H1.1)$	-0.675 (-1.698)	-0.629 (-3.096)	-0.769 (-2.640)	-0.507 (-1.249)	0.802 (2.480)	-	-
$\beta_3(H1.1)$	0.000 (.NA)	0.000 (.NA)	3.099 (7.430)	1.000 (.NA)	4.286 (10.546)	-0.188 (-5.202)	0.000 (.NA)
$\alpha_3(H1.1)$	-0.790 (-5.866)	-0.066 (-0.961)	0.060 (0.606)	-0.823 (-5.992)	-0.139 (-1.270)	-	-

Note: the analysis is conducted employing WinRATS Pro8.1 software.

Table 5.3 Fully-identified long-run structures (1974-2011)**H1.2: BASELINE MODEL AUGMENTED WITH OIL PRICE VOLATILITY MEASURE****OVER-IDENTIFIED VECTORS - $\chi^2(3) = 1.820$ [0.611]**

r = 3	i_t	y_t	c_t	$\ln(\delta + g^k)_t$	dp_t	$volo_t$	trend
$\beta_1(H1.2)$	1.000 (NA)	-0.883 (-56.663)	0.000 (.NA)	-1.287 (-66.380)	0.230 (2.850)	0.000 (.NA)	0.000 (.NA)
$\alpha_1(H1.2)$	1.204 (2.927)	-0.219 (-1.041)	0.202 (0.543)	1.444 (3.498)	-0.277 (-0.654)	-	-
$\beta_2(H1.2)$	0.000 (.NA)	1.000 (NA)	2.414 (14.514)	0.000 (.NA)	1.775 (9.607)	0.309 (3.835)	-0.036 (-42.973)
$\alpha_2(H1.2)$	0.099 (0.304)	-0.899 (-5.394)	-0.405 (-1.371)	0.265 (0.809)	0.374 (1.114)	-	-
$\beta_3(H1.2)$	0.000 (.NA)	0.000 (.NA)	3.175 (5.888)	1.000 (NA)	3.136 (7.031)	0.000 (.NA)	0.000 (.NA)
$\alpha_3(H1.2)$	-0.557 (-3.373)	0.000 (0.000)	0.041 (0.272)	-0.572 (-3.456)	-0.147 (-0.866)	-	-

Note: the analysis is conducted employing WinRATS Pro8.1 software.

The second identified relation (β_2) is a long-run output equation, which is consistent with a number of other long-run output equations for the Iranian economy (for instance see Esfahani, et al., 2013).⁸¹ According to the empirical results, in the long-run, output is negatively associated with inflation with a coefficient magnitude equal to -1.44, implying that inflation in the Iranian economy has major long-run adverse effects on output. This finding is in line with a body of literature that argues for a negative long-run relation between output and inflation in both advanced and emerging economies when the latter is above a certain level (for instance, see López-Villavicencio and Mignon, 2011). This, in the context of Iran, could be explained by the adverse effects of high inflation on productively growth, suggesting that economic policies in the country are insufficient, and that inflation must be controlled in order to encourage output growth in the country. The α loading coefficients in the second cointegrating relationship show that the error correcting coefficient for output is expectedly signed and adjusts with a coefficient equal to 0.62. The estimated α coefficient for inflation is error increasing with a magnitude of 0.80 owing to persistent and high inflationary pressures, whereas that of the user cost of capital is error correcting with an adjustment coefficient equal to 0.76, suggestive of the error correcting behavior of this variable in the short-run for the output equation.

The third relation (β_3) is normalized on $\ln(g^k + \delta)_t$. According to the empirical evidence, in the long-run, the growth rate of capital is negatively associated with inflation and the user cost of capital with respective coefficients equal to -4.28 and -3.09. This is because Iran imports most of its capital equipment and, bred by continuously high inflation, the country's currency depreciates resulting in a lower real value (or a higher depreciation rate) of capital assets. Thus, the rate of capital depreciation in the country could be large. In the long-run, however, the relationship between $\ln(g^k + \delta)_t$ and oil income is positive with a coefficient magnitude equal to 0.18, indicative of a positive association between the growth rate of capital and oil income through the latter's positive impact on investment and capital accumulation process over the study period. The α loading coefficients in the third cointegrating relationship reveal that the error correcting coefficient for the variable $\ln(g^k + \delta)_t$ is correctly signed and adjusts rather fast

⁸¹ Esfahani, et al. (2013) develop a long-run growth model for the Iranian economy and drive conditions under which oil income could have a long-run impact on output. Accordingly, they investigate a long-run output equation involving (among others) log per capita output, log per capita oil income and the rate of inflation, employing a cointegration analysis. According to their empirical findings, the long-run relationship between output and oil income is statistically significant and positive, whereas that of between output and inflation is statistically significant but negative and large.

with an error correcting coefficient equal to 0.82, suggestive of its short-run equilibrating effects in the system.

The results of the over-identified cointegration structures of the data based on the investment model augmented with the oil price volatility measure are shown in Table 5.3. Three interpretable long-run relations based on the over-identified structures are not rejected with $\chi^2(3) = 1.820 [0.611]$. When the same over-identifying restrictions as before are imposed, the coefficients of the non-oil macroeconomic variables in all three relations show similar signs and magnitudes to those of the model with oil income. However, oil price volatility is statistically significant only in the output equation with a coefficient magnitude of -0.30, indicative of its negative long-run relationship with output. This finding is in line with the suggestion of Mohaddes and Pesaran (2013) that volatility in commodity prices adversely affect the resource-rich and -dependent economy of Iran. This is because the volatility of oil prices gives rise to perceived price uncertainty in the country and therefore reduces planning horizons with negative implications for investment activities. In fact, for the budget-constrained economy of Iran which relies on oil income, formulating robust annual budgets and development plans becomes much harder. Among others, the subsidy system exposes the government to significant budgetary risks leading to substantial economic costs, which further gives rise to the magnitude of volatility-induced investment losses in the country.

It must be noted that this study employs the CVAR methodology to identify the theory-consistent long-run relationships between the variables of interest as this approach allows ‘the data to speak for itself freely’ rather than by imposing them as *a priori* (Juselius, 2006). Yet, the choice of the CVAR model as the empirical methodology is a rather flexible approach to the empirical investigation as it allows producing new insights based on the available data through examining economic phenomena and testing of more than one economic theory, i.e., the second and the third identified long-run relations in both models in this study. Given that this study primarily focuses on investigating the economic determinants of investment, notably, the first long-run relations in both models correspond to the theory consistent investment equation as derived in Chapter Four and are therefore more straightforward to interpret.

The empirical findings associated with the investment equation in both models are largely consistent with the theoretical framework, with the exception of the long-run relation between i_t

and c_t due to the missing market interest rates in the country as discussed earlier (for instance, see Chapter Two Section 2.3). The empirical results seem most consistent in the estimate of the elasticity of substitution in a CES production function from the investment equation, which is typically positive and less than unity. It must be borne in mind that the assumptions in the standard investment models are restrictive with conditions that are at least partially at variance with the assumptions of the standard investment. This applies to both market- and mixed-market economies where distortions in output and capital markets provide incomplete support for the associated underlying assumptions (e.g., perfect capital markets or price takers). Nevertheless, even though the neoclassical model does not fully apply here, the partial applicability of the theoretical framework in the context of the mixed-market economy of Iran seems plausible, provided that relative prices are signaling some appropriate substitution opportunities (for example to reduce costs).

In brief, the government's direct investment in different productive sectors of the economy was noticeable before the Iranian revolution in 1979. Since then, however, direct investment by the government and the share of public investment compared to that of the private sector has been significantly reduced (Figure 2.3, p.37). Also, the share of government development expenditures in manufacturing as well as that of credit facilities extended to public enterprises has been declining over time (see Tables 6M3 and 6M4 in Appendix 6M). Relative to market economies, it may not be easy to define the private sector in the context of the partial market economy of Iran. Nonetheless, the semi-SOEs could still be categorized as private entities in investment analysis. This is because they are commercial entities producing for the market; hence follow the same logic as private businesses, i.e., some parts of the market at least take relative prices as the appropriate signals on input and output decisions.

Given the fluctuating behavior of investment and output in the country, it can be expected that aggregate investment spending could have been influenced by effects from the oil shocks, the Iranian revolution and the subsequent regime shift in 1979, the Iran-Iraq war during 1980-1988 or different policies during Iran's FYDPs. In order to identify the outliers in the data corresponding to the above events, the data were checked for large residuals. This is because, following Juselius (2006), blip dummies must be included in the models where the residuals are

large (greater than $|3.5\sigma_\varepsilon|$) in the data so as to achieve normality and thus valid statistical inference. However, no large residuals were inspected in the investment models augmented with measures of oil revenues and oil price volatility, suggesting insignificant impacts from the above events on the over-identified long-run structures.⁸² These findings, at first, seem surprising. A closer look, however, proves otherwise. For instance, some of the plans' achievements were not so much the outcome of the planning process, but mostly that of a range of various exogenous factors, such as considerable increase in the unprecedented oil windfalls.

Section 5.6 employs the Impulse Response Functions (IRFs) to investigate the degree to which shocks from symmetric and asymmetric measures of oil contribute to the shorter-run variability of investment and output in the country's economy.

5.6. SHORT-RUN DYNAMICS: IMPULSE RESPONSE FUNCTIONS

This section employs the generalized Impulse Response Functions (IRFs), developed by Koop, et al. (1996) and Pesaran and Shin (1998), to study the extent to which shocks from oil revenues and oil price volatility contributed to the shorter-run variability of investment and output in the Iranian economy.⁸³ The use of the generalized IRFs is due to their invariance to the ordering of the variables in the VAR model (unlike the orthogonalized IRFs). The IRFs trace the dynamic effect of a one-time shock to one of the innovations on the current and future values of the macroeconomic variables. The innovation process ε_t is an unobservable zero-mean white noise process with a time invariant positive-definite variance-covariance matrix.

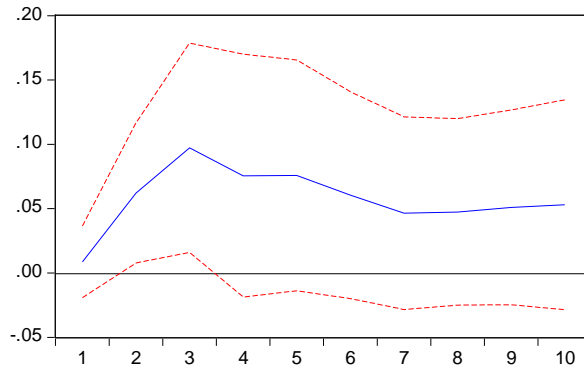
It has been argued that the relationship between oil and the macroeconomy is non-linear (among others, see Mork, 1989; Lee, et al., 1995; Hamilton, 1996). Both linear and non-linear specifications of oil measures are used for the IRFs, where the models with linear oil measures are considered as the benchmark models. The IRFs are presented in Figures 5.3-5.4 and 5.6-5.7

⁸² The dummies associated with the above events have no explanatory powers when they are included in the models.

⁸³ It has been argued that in the short-run, the unrestricted VAR model performs better compared to the cointegrated VAR model or VECM (Engle and Yoo, 1987, Clements and Hendry, 1995, Naka and Tufte, 1997). Hence, the unrestricted VAR models are used for the IRFs analysis.

for the years from 1974 to 2011. The middle dark lines in the graphs show point estimates of the responses to the level of each variable to a one standard deviation positive shock. The simulation horizon covers ten years and is shown on the x-axis. The y-axis plots the percentage change response to the shock. The IRFs analysis is conducted using EViews-7 software.

Figure 5-3 Incremental Responses to $orev_t$ Generalized One S.D. Innovations
 Response of LNINV to LNOREV



Response of LNY to LNOREV

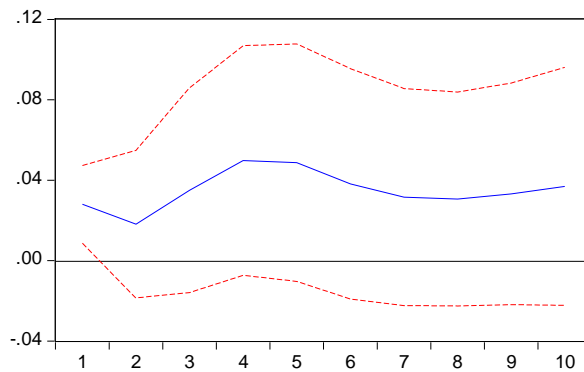
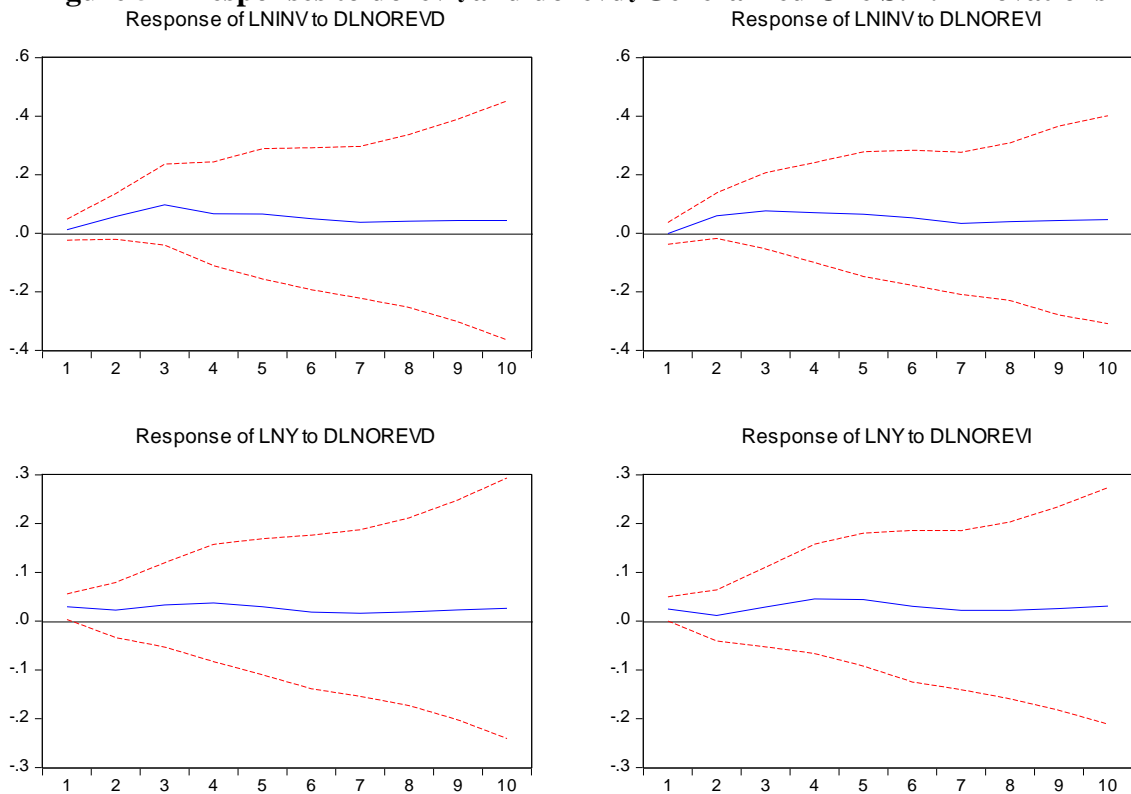


Figure 5.3 shows the IRFs of the macroeconomic variables to a shock in the linear benchmark measure of oil revenues. The responses of investment and output variables to a shock in real oil revenues are positive until the fifth period, after which they return to the long-run level but stay above the equilibrium level throughout the period. Yet, the response of investment appears to be statistically insignificant. This indicates that, even though the Iranian economy is oil-based, oil revenues cannot be considered as an important driver of financing investment activities in the short-run.

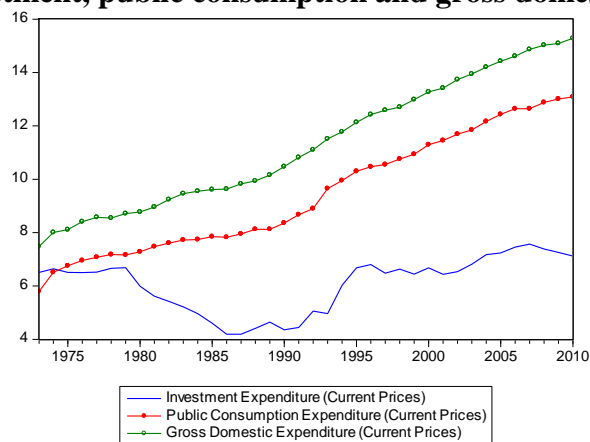
Figure 5-4 Responses to $dorev_{it}$ and $dorev_{it}$ Generalized One S.D. Innovations



The responses of investment and output to shocks to asymmetric measures of oil revenues are statistically insignificant (Figure 5.4). Such outcome, at first, might appear to be counter-intuitive. Yet, this can be (at least partly) explained through the structure of the government expenditures in Iran. Government expenditures can broadly be categorized into current and capital expenditures. The former relates to recurrent expenditures including subsidies and payments of the state's employees, whereas the latter aims at adding to physical and capital assets of the economy. Since the early 1970s, an increasingly large share of the expenditures in the country is preliminarily used to finance the payments of the government's sticky current expenditures and its external debt rather than investment spending. Interestingly, the reactions of investment and output to a shock to the differenced real oil revenue decrease appear to be very similar to that of oil revenue increase. This can be described through the inflationary effects of negative oil shocks. Due to the high inflexibility of the government's current expenditures, any significant negative oil revenue shocks will adversely affect the government's budget deficits, hence creating further inflationary pressures in the economy. Furthermore, such results appear to be consistent with the differenced real oil revenue variable being a stationary variable.

Figure 5.5 illustrates gross domestic expenditure, public consumption expenditure and investment expenditure during the period under consideration. During 1965-2010, the average annual share of current expenditures in total expenditures recorded about 70 percent, whereas that of capital expenditures registered under 30 percent. Due to the high level of state engagement within the domestic economy and the rigidity of its current expenditures, the increased oil income has mostly been used to pay for the state's sticky current spending. In this picture, subsidies have played an important role in the size and inflexibility of the current expenditures. The government, as the main recipient of oil windfalls, has tried to redistribute part of the windfalls through subsidies in the form of free or below cost provision of state services such as utilities, education, health, transport and inputs for specific economic sectors. Spending efficiency has consequently suffered due to high amount of unfinished projects and capital investments that could not be efficiently utilized because of inadequate recurrent resources. Hence, the presence of oil seems not to have contributed to the long-run sustainable investment spending in the country.

Figure 5-5 Investment, public consumption and gross domestic expenditures



Source: CBI.

Since the government's revenue mainly depends on the oil sector, it is beyond the control of the authorities, thus the effects of oil-driven uncertainty have been profound on macroeconomic policies. That is, the evolution of monetary and fiscal policies has been dominated by the oil windfalls. Monetary policy involves printing money to convert oil revenues into the Iranian currency before being used by the government and is connected to fiscal policy through the monetization of the budget deficits. The government budget has been mostly in deficit, largely as a result of pressures in favor of expansionary expenditures. The current government

spending, on average, has been more than twice the level of the government development expenditures. Although the government has realized the importance of anti-inflationary policy, a tighter fiscal policy as scheduled in the development plans often has not been maintained. Negative real rates of return have further adversely affected the economy by altering the combination of assets held by the public since the financial resources have been mostly invested in durable goods (e.g., gold, cars and houses) or in financial assets (e.g., foreign currencies).

Figure 5-6 Response to vol_{ot} Generalized One S.D. Innovations

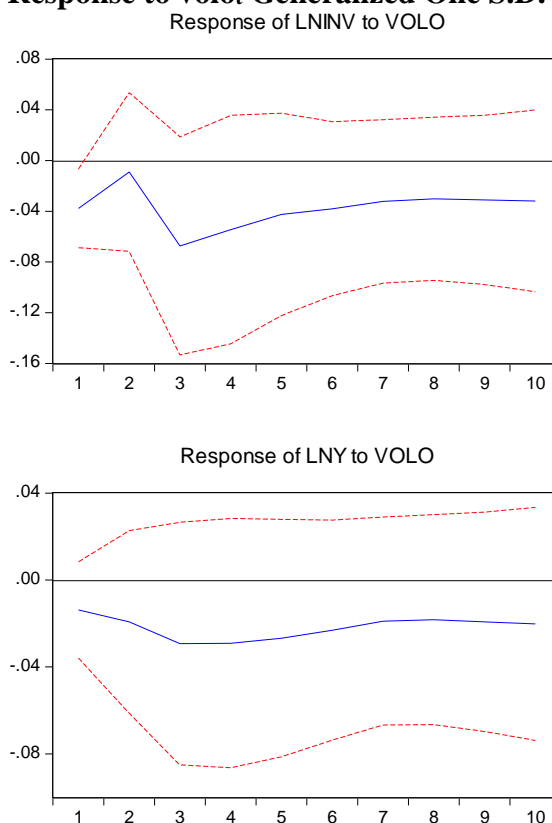


Figure 5.6 presents the reactions of investment and output to a shock to oil price volatility, after which investment responds slightly positively and reaches its peak in the second period. It then decreases and remains below its steady state level throughout the period. Similarly, output shows a sustained negative reaction, indicative of the adverse effects of a shock to oil price volatility on output in the short-run.

Figure 5-7 Responses to $voloi_t$ and $volod_t$ Generalized One S.D. Innovations
 Response of LNINV to VOLOI Response of LNINV to VOLOD

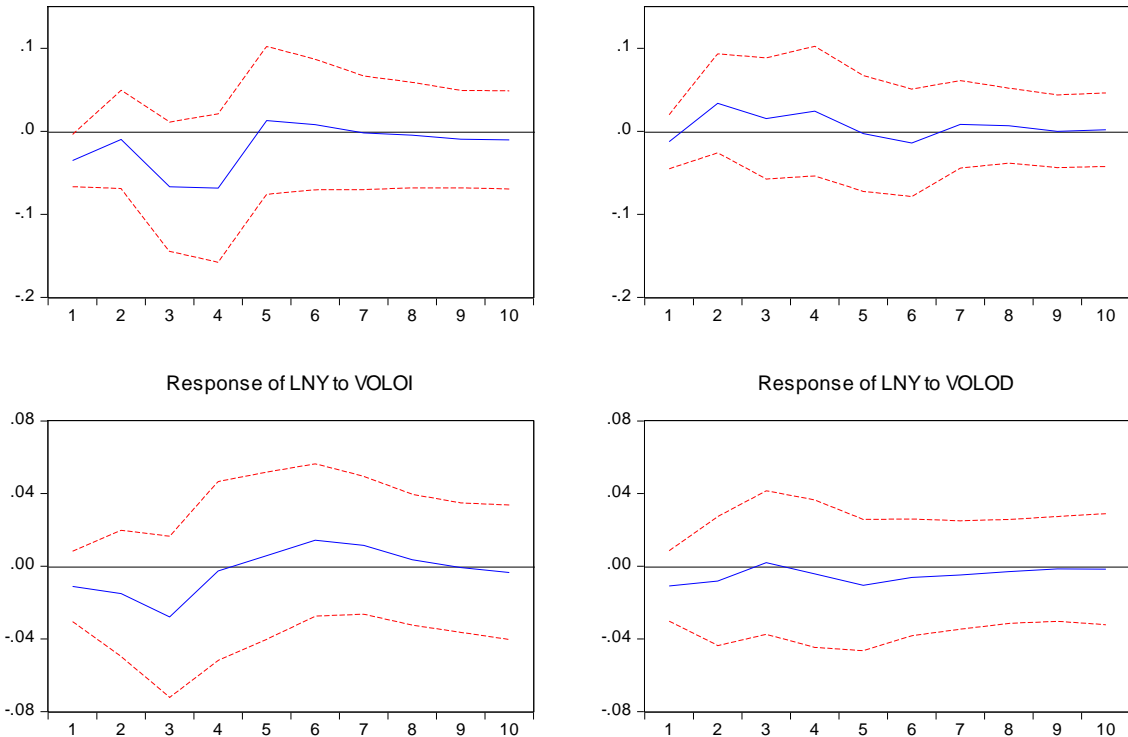


Figure 5.7 presents the responses of investment and output to innovations to oil price volatility increase and decrease. The responses of investment to a unit shock to both oil price volatility increase and decrease are statistically insignificant. The response of output to a unit shock to oil price volatility increase is initially negative, reaching its lowest point in the third period, respectively. Then it starts reverting to the steady state level from the fourth period. However, output appears to be insensitive to innovations to oil price volatility decrease in the short-run and remain very close to the long-run equilibrium level throughout the period.

The findings at large suggest that there are non-linear effects of shocks to various measures of oil on investment and output. Investment seems rather insensitive to shocks to various symmetric and asymmetric measures of oil. The response of output to one standard innovation in oil revenues is positive and tends to persist for a longer period, whereas its response to a unit shock to oil price volatility seems negative and rather shorter lived. Considering the asymmetric measures of oil, shocks to oil revenue increase and decrease seem not to stimulate or suppress output in the short-run. However, output responds negatively to a unit shock to oil price volatility increase relative to the insignificant effect of an innovation to oil price volatility decrease.

Overall, the rapid increase in government expenditures, stemming from the influx of oil windfalls, have affected spending quality and brought about unsustainable entitlements like recurrent cost commitments in the long-run. Fiscal and monetary policies have become expansionary and had obvious inflationary effects. Despite the government's attempts to tame inflation, high inflation has remained a problem, creating economic uncertainty which has led to the lower level of investment spending. Seemingly, policies, in particular fiscal, seems to be one of the main underlying reasons for the presence of the natural resource curse in the Iranian economy chiefly through the inflation channel.

5.7. CONCLUDING REMARKS

This chapter, using annual data over the period 1974-2011, investigated the economic determinants of aggregate domestic investment in the oil-rich partial-market economy of Iran and the importance of oil in shaping investment patterns in the country. Two oil-based proxies, namely oil revenues and oil price volatility were used to explore the relationships between oil-driven constraint measures and investment in the long-run. Employing the IRFs, this chapter further examined the short-run impacts of shocks to oil income and oil price volatility on investment and output.

Some key findings emerge from this analysis. Firstly, the results are largely consistent with the modified neoclassical-accelerator theoretical framework used in this study for the mixed-market economy of Iran. The empirical results appeared particularly consistent in the estimate of the elasticity of substitution in a CES production function from the investment equation, which is typically less than unity and positive. Moreover, it is plausible to use a CVAR model, to assess the extent of the applicability of such a theoretical framework in the context of partial-market economies like Iran. Further to the empirical evidence, inferences could be made based on the theoretically motivated relationships within such a framework obtained by utilizing the integration and cointegration properties of the data in the sample, bearing in mind that the outcome of such an analysis depends on the market conditions prevailing in such economies. For instance, in the Iranian context, a variable such as the user cost of capital needs to be more carefully defined in the face of external and government influences which affect the economy through the regulation of the lending rates.

The empirical results further showed that investment is related to oil-driven measures in the long-run; the relationship between investment and oil revenues was found positive while that of between investment and oil price volatility was found negative. Surprisingly, the regime shift and dramatic political and economic upheavals during the period under study did not have determining effects on the underlying investment relationships in the long-run. This could be to some extent due to rigidities in government current expenditures coupled with persistent inflationary pressures throughout the years under study. Similarly, the IRFs of the macroeconomic variables to shocks to symmetric and asymmetric oil measures were found insignificant in most cases.

6. ECONOMIC DETERMINANTS OF SECTOR-LEVEL DOMESTIC INVESTMENT IN IRAN

6.1. INTRODUCTION

This chapter investigates the theory-based economic determinants of sector-level domestic investment in Iran during 1974-2011 within the modified neoclassical-accelerator type models of investment, augmented with an oil-driven financial constraint measure, namely oil revenues. Consistent with the Dutch Disease theoretical framework, the economic sectors in this study includes the non-resource tradable sectors of agriculture and manufacturing, the resource sectors of oil and gas, and the non-tradable sector of services. This is because one regularly studied topic in the literature on resource-rich economies is the macroeconomic effects of the discovery of natural resources on non-resource sectors which often centers on the Dutch Disease theory (see Chapter Three Section 3.4). The use of sector-level data further allows the recognition of sectoral heterogeneity in modelling investment behavior in the presence of resource windfalls. Accordingly, this chapter attempts to study the following questions:

- a. (i) What are the long-run economic determinants of sector-level domestic investment in Iran? (ii) Do the modified neoclassical-accelerator type models of investment, augmented with oil income measure, explain sector-level investment in the country?
- b. (i) Do long-run relationships exist between sector-level investment and the availability of oil windfalls? (ii) Are there sectoral differences?
- c. Do the empirical findings suggest the presence of a mechanism in line with the Dutch Disease theory in the Iranian context?⁸⁴

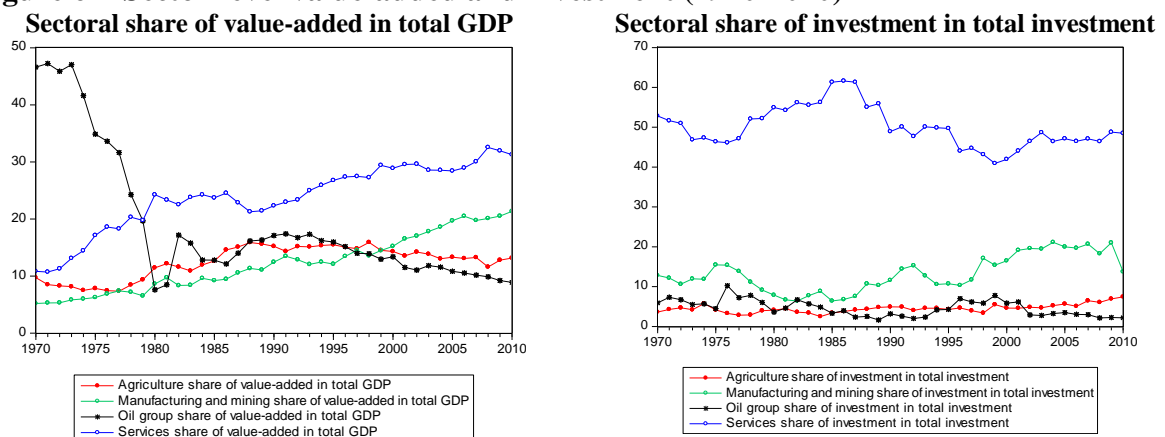
This chapter is structured as follows. Section 6.2 provides an overview of growth and structural changes in the major economic sectors under study. Section 6.3 specifies the estimation model. Section 6.4 reports the data and their sources used in this study. Section 6.5 estimates sectoral CVAR models and discusses the empirical findings for each economic sector. Section 6.6 concludes the chapter.

⁸⁴ It must be noted that according to the Dutch Disease theory, one of the main mechanisms through which the (lagging) tradable sector(s) are expected to decline (relative to the non-tradable sector) is the appreciation of the exchange rate. Chapter two Section 2.5.3 provides an overview of the Iranian exchange rate movements where the data reveal the appreciation of the real exchange rate for most of the years under study.

6.2. OVERVIEW OF SECTORAL GROWTH AND STRUCTURAL CHANGES

In Iran, the major economic sectors include manufacturing and mining, oil and gas, agriculture and services. The Iranian economy is an oil-based economy; however, the value-added contribution of the oil sector in total GDP averaged only 19 percent during 1970-2010 and declined from 46.6 percent in 1970 to only 8.8 percent in 2010. The panel on the left in Figure 6.1 illustrates the development of sectoral value-added share in total GDP over the years under study. Overall, the sectors of services and manufacturing have gained higher value-added shares in GDP, whereas the sectors of agriculture and oil have lost their shares over the years under study. The panel on the right in Figure 6.1 depicts the pattern of sector-level investment share in total investment over the same period. Comparatively, the service sector enjoyed the greatest share of investment in total investment throughout this period, averaging as high as 50 percent, followed by that of the manufacturing and mining sectors (13 percent), the oil sector (4 percent) and the agriculture sector (4 percent).

Figure 6-1 Sector-level value-added and investment (1970-2010)



Note: Constructed based on data in billion Rials at constant 2004/05 prices. Source: CBI.

A rather similar but less pronounced shift took place in the composition of sectoral employment in Iran. In particular, the service sector substantially increased its share of employment compared to the other sectors. Table 6.1 presents the sector-level shares of employment in the country during 1956-2007. Since the mid-1960s, the employment share of the service sector registered the highest among the other major economic sectors and increased from 33 percent in 1966 to 64 percent in 2007. Similarly, the employment share of the oil sector grew from 0.4 percent in 1966 to 0.7 percent in 2007. On the contrary, the employment share of the agriculture and on a smaller scale the manufacturing and mining sectors fell respectively from 47 and 18

percent in 1966 to 18 percent and 17 percent in 2007. Even though the growing pattern of the service sector's employment share corresponds to the high value-added share of this sector, the considerably greater magnitude of the former does not appear to be proportionate to the latter, suggesting the relatively low labor productivity in the service sector.

Table 6.1 Employment by sector (% share)

Year	Agriculture	Services					
		Manufacturing and mining	Oil	Utilities	Construction	Transport and communication	Other services
1956	56.3	13.8	0.4	0.2	5.7	3.5	20.1
1966	47.5	18.2	0.4	0.7	7.2	3.1	22.9
1976	34	19	1	0.7	13.5	4.9	26.9
1986	29	13.2	0.3	0.8	11	5.7	40
1996	22.9	17.5	0.82	1.09	11.32	6.6	39.77
2007	17.97	17	0.73	1.07	12.48	9.47	41.28

Note: the figures include employees of age 10 years old and older. Source: SCI (various years).

Overall, the growth rates of output and investment as well as the changes in the structure of value-added and employment of the major economic sectors in the country varied during the years under consideration. In particular, the value-added contribution of the oil sector significantly fell, whereas that of the service sector witnessed a two-fold increase during this period from 10 percent in 1970 to 24 percent in 2010. Interestingly, the value added contribution of the manufacturing sector more than doubled from 5 percent in 1970 to 12 percent in 2010. Similarly, but to a smaller extent, the value-added share of the agriculture sector grew from nearly 10 percent in 1970 percent to 12 percent in 2010. Nevertheless, particularly relative to that of the service sector, the share of the agriculture sector's investment in total investment remained small during these years.

6.3. MODEL SPECIFICATION

In this section, the long-run economic determinants of investment in the major Iranian economic sectors, namely agriculture, manufacturing and mining, oil group and services are specified within the modified neoclassical-accelerator type models of investment. As discussed in the previous chapters, because Iran is an oil-based economy, it is important to incorporate an oil-driven uncertainty measure into the investment modelling in order to investigate the extent of sector-level oil dependency in the economy of the country. Therefore, the long-run investment

model for each sector is augmented with an oil measure, namely oil revenues ($orev_t$). Accordingly, $H1^{\text{sector-level}}$ hypothesizes the long-run relationships between:

$$\{i_t^{\text{sector-level}}, y_t^{\text{sector-level}}, c_t^{\text{sector-level}}, \ln(g^k + \delta)_t^{\text{sector-level}}, dp_t, orev_t\}.$$

Table 6.2 presents the hypothesis under the heading ‘Sector-level Investment Equation’. Further to the first hypothesis ($H1^{\text{sector-level}}$), as implied by substituting the steady-state condition into the FOC equation, investment is expected to be a positive function of output and $\ln(g^k + \delta)_t$, and a negative function of the user cost of capital in the long-run. As discussed in Chapter Five Section 5.3, the theoretical literature on (oil-driven) uncertainty and investment relationship, both in terms of the sign and the magnitude is ambiguous and subject of debates. Therefore, this chapter attempts to first empirically test the presence of any long-run relationships between investment and the oil-driven measure on a sector-level basis, and then to shed light on the direction and the size of any existing relationships.

Table 6.2 Hypotheses of long-run relationships

Sector-level Investment Equation	
$H1^{\text{sector-level}}$	Long-run relationships between $[i_t^{\text{sector-level}}, y_t^{\text{sector-level}}, c_t^{\text{sector-level}}, \ln(g^k + \delta)_t^{\text{sector-level}}, dp_t, orev_t]$

Note: i_t : investment; y_t : output; c_t : user cost of capital; δ : capital depreciation rate; g^k : capital growth rate; $orev_t$: the level of oil revenues; and dp_t : inflation measured by the changes in the implicit deflator of gross domestic product (percent). The superscript ‘sector-level’ refers to sector-level variables. Data are in natural log and in real terms (Base Year 2004/05). Source: CBI, Time-series Data.

Based on the Dutch Disease theory, it is expected that the relation between the oil variable and investment in the sectors of oil and services is positive, while that between the oil proxy and investment in the manufacturing and agriculture sectors is negative. As explained in Chapter Three Section 3.4, in its simplest form, the Dutch Disease theory posits a drop in the output and employment of the non-resource tradable sector(s), especially manufacturing or agriculture, through resource movements and spending effects (Corden and Neary, 1982; Krugman, 1987; Torvik, 2001). The former is related to the migration of the mobile factors of production to the resource sector and the booming non-tradable (service) sector. The latter refers to spending of the extra income generated by the resource sector on the non-tradable (service) sector, leading to an increase in the price of the non-tradables relative to that of the non-booming tradables. Thus, the investment resources are taken away from the lagging tradable sectors, lowering the productivity of those sectors and deterring their growth.

6.4. VARIABLES AND CONSTRUCTION OF THE DATA

This chapter uses annual data spanning the period 1974-2011 for Iran on a sector-level as well as on an economy basis. The economy level data used in this chapter are the same as the aggregate data explained in Chapter Five Section 5.4. These include data on real investment, the user cost of capital, inflation and the measure of oil revenues. The sector-level data consists of investment, output, value-added, the user cost of capital, capital growth rates, capital depreciation rates and employment for the sectors of agriculture, manufacturing and mining, oil and gas, and services. Appendix 6A presents a list of the variables and their sources used in this chapter. Figures 6B1-20 in Appendix 6B presents the graphs of these variables.

The data on sector-level real gross domestic product (in billion Rials at constant 2004/05 prices) are collected to proxy for real output of agriculture, manufacturing and mining and services sectors. The data on the oil sector's value-added (in billion Rials at constant 2004/05 prices) are used to proxy for the sector's real output.⁸⁵ These variables in level and logarithm forms are respectively denoted by $Y_t^{\text{Agriculture}}$ and $y_t^{\text{Agriculture}}$ for the agriculture sector, $Y_t^{\text{Manufacturing}}$ and $y_t^{\text{Manufacturing}}$ for the manufacturing and mining sectors, Y_t^{Oil} and y_t^{Oil} for the oil and gas sectors, and Y_t^{Services} and y_t^{Services} for the service sector. The data on gross fixed capital formation (in billion Rials at constant 2004/05 prices) for each sector are used to proxy for real investment and collected from the CBI's annual national accounts (historical data series) available from 1959/60-2010/11. These variables in level and logarithm forms respectively are denoted by $I_t^{\text{Agriculture}}$ and $i_t^{\text{Agriculture}}$ for the agriculture sector, $I_t^{\text{Manufacturing}}$ and $i_t^{\text{Manufacturing}}$ for the manufacturing and mining sectors, I_t^{Oil} and i_t^{Oil} for the oil and gas sectors, and I_t^{Services} and i_t^{Services} for the service sector.

The sector-level user cost of capital variables are denoted by $c_t^{\text{Agriculture}}$ for the agriculture sector, $c_t^{\text{Manufacturing}}$ for the manufacturing and mining sectors, and c_t^{Services} for the service sector and are calculated as:

$$(6.1) \ c_t^{\text{sector-level}} = (1 - \text{Tax}_t)((\text{Return}_t^{\text{sector-level}} / 100) - dp_t) + \delta_t^{\text{sector-level}},$$

⁸⁵ This is due to the lack of data available on real output in billion Rials at constant 1997/98 prices for the oil sector. To test the robustness of the empirical findings, the model was also estimated employing the data on oil output in thousand barrels per day. The empirical findings were robust using both measures of oil output.

where Tax_t is the corporate tax rate variable calculated as explained in Chapter Five (Section 5.4.3). $Return_t^{\text{sector-level}}$ refers to the sectoral average of the expected rates of return on facilities, and is used as a proxy for the rates of interest at the sector-level and are measured as sectoral averages of minimum and maximum expected rates of return on facilities. As in Chapter Five, dp_t is used as a proxy for inflation and refers the implicit deflator of gross domestic product.⁸⁶ Due to lack of data on expected rates of return on facilities for the oil and gas sectors, the economy-level weighted average of expected rates of return on facilities, denoted by c_t and as described in Section 5.4.3 in Chapter Five, are used to proxy for the user cost of capital for these sectors. The sector-level $\ln(g^k + \delta)_t$ variables are constructed employing equations (5.6) and (5.7) based on the sectoral data. These variables are denoted by $\ln(g^k + \delta)_t^{\text{Agriculture}}$ for the agriculture sector, $\ln(g^k + \delta)_t^{\text{Manufacturing}}$ for the manufacturing and mining sectors, $\ln(g^k + \delta)_t^{\text{Oil}}$ for the oil and gas sectors, and $\ln(g^k + \delta)_t^{\text{Services}}$ for the service sector. Appendix 6P reports the calculation of the data in details.

In what follows, the CVAR model for each sector is estimated and some of the theoretically-driven long-run relationships are identified employing Johansen's (1996) and Juselius' (2006) 'general to specific' method. Then, the empirical findings are discussed.

6.5. ESTIMATION AND ANALYSIS

This section estimates the long-run determinants of domestic investment on a sector-level basis within the theoretical framework of neoclassical-accelerator type investment models. Further, the section is complemented with economic discussions related to the empirical findings for each economic sector. As in Chapter Five, Johansen's (1996) and Juselius' (2006) cointegrated vector autoregressive (CVAR) method is employed to specify and estimate the model of investment behavior for each of the major economic sectors in the country. This approach allows a linear representation of an economically interpretable vector of observable variables on their own lags, and where applicable, on exogenous variables.⁸⁷ Accordingly, for each sector, a CVAR model is estimated based on a set of variables given by the vector:

⁸⁶ The expected rates of profit on facilities include those for economic sectors of agriculture, manufacturing, mining, construction, housing, trade, service and export (see Chapter Two Section 2.3 for further discussion on the concept of profit rates in the Iranian Islamic Banking System).

⁸⁷ For a detailed discussion on model specification see Chapter Four Section 4.4 and Chapter Five Section 5.3.

$$x_t = [i_t^{\text{sector-level}}, y_t^{\text{sector-level}}, c_t^{\text{sector-level}}, \ln(g^k + \delta)_t^{\text{sector-level}}, dp_t, orev_t],$$

and the hypotheses are tested over the period from 1974 to 2011. First, the appropriate lag length is determined for each model based on the SC and the H-Q criteria as well as the LM tests (see Appendix 6C). Next, multivariate and univariate misspecification tests are conducted according to which the statistical adequacy of the chosen VAR models for all the sectors is established (see Appendix 6D). The Johansen cointegration rank tests, based on the Bartlett (corrected) trace test and the maximum eigenvalue test, are then conducted to decide on the rank for each model, the results of which are reported in Appendix 6E. The Bartlett corrected trace test results for all the models suggest the choice of $r = 2$. The eigenvalues of the companion matrix and the graphs of the cointegration relations are presented in Appendix 6F and Appendix 6G, respectively.⁸⁸

The models' statistical adequacy is next investigated by conducting recursive stability tests based on the log-transformed eigenvalues depicted in Figures 6H1-4 in Appendix 6H.⁸⁹ The results of the stationarity tests are then reported in Appendix 6I and support the treatment of the variables as non-stationary. Furthermore, the graphs of the residuals presented in Figures 6K1-4 in Appendix 6K show that the estimated values of the residuals follow the actual values closely.⁹⁰ Where the residuals are greater than $|3.5\sigma_\varepsilon|$, blip dummies are included in the models to achieve normality and thus valid statistical inference, the results of which are presented in Appendix 6J. Lastly, over-identifying restrictions are imposed. The latter is done by testing sets of irreducible relations to formulate the cointegrating structures of the long-run relations. In all the models, the first relation (β_1) is normalized on the investment variable. The results of the over-identified cointegrating structures of the theoretically-driven relations based on the sector-level data are demonstrated in Tables 6.3, 6.6, 6.7 and 6.8. The statistically significant β coefficients in the tables are in bold face to differentiate them from the reported α coefficients. According to the p-values related to the LR test statistics shown in the tables, the over-identified cointegrating structures in the data are not rejected in any of the models. The following subsections provide overviews of the major economic sectors and discuss the empirical findings.

⁸⁸ Please note that the observation of the time-series and the graphs of the cointegration relations of the sectoral data reveal some changes in the pre- and post-revolutionary eras. However, the findings appear to be robust according to the empirical evidence presented in Sections 6.5.1, 6.5.3, 6.5.5 and 6.5.7.

⁸⁹ However, since the sample is not very large, these results are not informative.

⁹⁰ It must be noted that, given the choices of lag length and the sample size, some evidence of autocorrelations (particularly for the agriculture sector) is observed.

6.5.1. THE AGRICULTURE SECTOR: OVERVIEW

In Iran, about one third of the total surface area is suitable for farming. However, due to inadequate water distribution in many areas and poor soil, most of this surface area is not under cultivation. During 1970-2010, output and investment in the agriculture sector registered yearly average growth rates of 5 percent and 8 percent, respectively. Over these years, Iran's agricultural policy intended to protect farmers. For instance, the policy of guaranteed purchase of agricultural crops was put in place in 1989 so as to encourage the production of strategically essential crops, to establish equilibrium in the production system and to maintain farmers' income levels. Accordingly, the government guaranteed the purchase of certain products from the farmers at a pre-set price to protect them against seasonality in the market prices. On average, increases in the guaranteed prices had been in line with the changes in the rate of inflation. The government further supported the farmers through the distribution of agricultural inputs at subsidized prices as well as investment expenditures for the development of agriculture and water resources, and by implementing protectionist foreign trade policies. The government also tried to protect the agriculture sector via intervention in the financial markets such as direct credit allocations and providing the farmers with banking facilities at preferential rates.

At large, investment in the agriculture sector has been mainly financed by the government's expenditure scheme for the expansion of the agriculture sector and water resources, and by the extended facilities to the agriculture sector by the agriculture and commercial banks as well as credit institutions. The data on the extended facilities to the agriculture sector by banks and credit institutions revealed an annual average increase of 9.7 percent during 1999-2010 (see Table 6L1 in Appendix 6L). Over these years, the guaranteed purchasing prices for three major agricultural products of wheat, barley and sugar beets continued and the government's subsidy payments increased on average by 9.8 percent per annum (see Tables 6L2 and 6L3 in Appendix 6L). Table 6L4 in Appendix 6L presents the figures related to credits for the expansion of the agriculture sector and water resources based on the government's development expenditures during 1999-2010. Overall, the total changes in expenditures appeared positive and grew by 4 percent on average per annum, of which an annual average of 79 percent was allocated for the development of water resources.⁹¹

⁹¹ The figure includes programs for water supply to cities and industries as well as irrigation networks and drainage programs.

Despite the protection of this sector by the government, agricultural planning has been only partially successful. For example, the development of rural banking and subsidized lending rates gave rise to the outstanding facilities extended to the agriculture sector by banks and credit institutions, resulting in the expansion of the system of deposit mobilization and high overdue on loans. The government's adoption of new market-oriented policies since the early 2000s increased the prices of agricultural products, contributing even more to the level of inflation in the country. Also, despite the increased investment and government support for the agriculture sector, the sector's productivity remained low over the years under consideration. For instance, the production of many agricultural crops and their area under cultivation grew only marginally. Table 6L5 in Appendix 6L presents the production and the area under cultivation for major farming and horticultural products during 1999-2010. Based on the data for the selected range of products, the production of the crops and their areas under cultivation depicted average growth rates of only 5.5 percent and 2.9 percent per annum, respectively. Similarly, the harvested fishery products and livestock during this period rose merely by an annual average rate of 4.9 percent (see Table 6L6 in Appendix 6L).

Also, despite such a high share of extended credits, the usage of modern irrigation systems remained disappointing during most of this period. For instance, the area under cultivation with modern irrigation systems and the amount of water used for irrigation grew by just 3.9 percent and 5.1 percent during 1999-2007, respectively (see Table 6L7 in Appendix 6L). In addition, the agriculture sector's low productivity was partially due to the scarcity of water resources and very low amount of rainfall in the country coupled with sand dune progression and increasing size of deserts, all adversely affecting the preparation of lands under cultivation and the yield per hectare for agricultural activities. For instance, total plantation and seeding for sand dune fixation and combatting desertification fell from 521.633 hectares in 1991 to 588.12 hectares in 2006 (see Table 6L8 in Appendix 6L).

Table 6L9 in Appendix 6L exhibits the performance of agricultural insurance funds. In general, government policies that reduce production risks could encourage producers to expand production. This could be realized through bringing economically marginal lands into production, altering crop mix production in favor of certain crops and improving their cropping practices via higher deficiency payments or insurance premium subsidies. Despite their role in

stabilizing financial fluctuations for those engaged in agricultural activities and providing income support by reducing income variability in the sector, the area of insured farmlands by the funds grew from 1.9 thousand hectares in 1999 to only 4.2 thousand hectares in 2010. Due to the small operational size of the farmlands together with low and unstable income growth of the farmers as well as increasing risk of natural calamities, the demand for agricultural insurance did not come into existence on a large scale. This, in return, contributed to the low growth of agricultural production through adversely affecting the farmers' confidence in adopting new and improved farm practices and in attracting greater investment in the sector.⁹²

Other factors further contributed to the low productivity of the agriculture sector in the country. In 2004, Iran's total lands were 162.85 million hectares of which only 17.66 million hectares (about 11 percent) were suitable for agriculture, indicating the marginal share of land appropriate for agricultural activities. Of these 17.66 million hectares, about 66 percent, were lands for annual cultivation of crops, 26 percent were uncultivated lands and about 8 percent were orchards and nurseries (SCI, 2006). In addition to the small share of suitable land for agriculture, mechanisation and efficiency of production had been restricted due to the high level of fragmentation of agricultural land in the country mainly as a result of the pre-revolutionary land reform and inheritance.⁹³

⁹² Under the current Agricultural Products Insurance Law (enacted in 1983), the coverage includes the insurance of crops, livestock, forestry, pastures, and watershed management against risks of flood, hail, storm, windstorm, heavy rainfall, frost, frost-bite, earthquake and draught. Among others, some of the strategic crops under coverage are cotton, sugar-beet, soybean, rice, wheat, potato, onion, corn, sunflower, colza, grapes, date palm, citrus fruits, apple, tea, pomegranate, almond and pistachio. The activities in the field of strategic livestock insurance include coverage for dairy cattle stationed at industrialized units, poultry insurance, farmed aquatics, rural herd (sheep and goat), pure bred Iranian horses, honeybees and their respective hives, camel, shrimp, registered bull, native and hybrid cow as well as cattle raising units and breeding centers (see Agricultural Insurance in Iran. [Online]. Available at: <http://www.agroinsurance.com/en/pratice/?pid=6604> [Accessed 17 Feb 2015].

⁹³ The pre-revolutionary land reform refers to a series of reform policies, the so called White Revolution, launched by Iran's ruler of the time, Mohammad Reza Shah Pahlavi. The major element of the White Revolution was a land reform program with the aim of redistributing about one-half of private agricultural land to peasants holding traditional cropping-share rights (approximately one-half of all village families). Five other programs included the nationalization of forests; sales of shares in (some) government-owned industries; plans for workers to share in profits of large factories; voting rights for women; and the formation of a literacy corps of draftees assigned to villages as teachers. Later, the literacy corps model was extended to a health corps (for draftees who had college-level training in medicine) and a development corps (for college graduate draftees). By the mid-1970s, the White Revolution comprised a total of eighteen programs. The results of the White Revolution were mixed. On the positive side, about half a million peasants obtained adequate land under the land reform program to engage in profitable farming, primary schools were established in several hundred villages that previously had none, and small towns and rural areas benefited from various government development initiatives. On the negative side, perhaps the most serious deficiency of the White Revolution was the raising of popular expectations that remained unfulfilled. With respect to land reform, for example, one-half of all rural families received no land at all; among those obtaining land, about 73 percent got less than six hectares, an amount sufficient only for subsistence farming (growth of crops predominantly for consumption by the farm family rather than for sale). The net result was the

Table 6.3 Area of holdings lands (2003) - thousands

Area under cultivation	Number of holdings	Area
Total	4344.32	17665.18
Irrigated lands	2828.64	8297.03
Rained lands	1515.68	9368.16
Smaller than 1 hectare	1205.03	407.07
Between 1 and 5 hectares	1319.96	3032.22
Between 5 and 20 hectares	786.33	7019.16
Between 20 and 50 hectares	135.64	3736.33
50 and greater than 50 hectare	33.75	3470.4

Note: the figure of total number of holdings is a sum of irrigated and rained lands holdings. Source: SCI (various years).

Table 6.4 shows the number and area of land holdings in 2003. About 27 percent of the holdings were related to the lands smaller than 1 hectare even though their share in total agricultural lands was very small (about 2.3 percent). Nearly 30.3 percent of the holdings were associated with the lands between 1 and 5 hectares, despite their small share in total lands (about 19.4 percent). The holdings of only these two groups made up 58.1 percent of all the holdings although their total share was just 19.5 percent of the total areas under cultivation. About 18.1 percent of holdings were related to the lands between 5 and 20 hectares, despite their share in total lands (about 40 percent). Only 3.1 percent and 0.77 percent of holdings were related to the remaining two groups of lands which were between 20 and 50 hectares and over 50 hectares, respectively, with considerably high shares of lands suitable for agriculture (about 41 percent).

For the use of land to be economically productive and efficient, a minimum of 20 hectares is needed. However, in Iran, 58.1 percent of land usage is related to lands smaller than 5 hectares, indicating a very unequal pattern of agricultural activities based on the holdings and the area size in the country. Table 6L10 in Appendix L6 illustrates the agricultural holdings by type of holders and by agricultural machinery and equipment at province level in 2003. From over 4 million of agriculture holdings, about 80 percent were with private settled households and farmers' families. Out of a total of 30 provinces, three provinces held a quarter of the holdings. Similarly, about a quarter of tractors and ploughs were used in only three provinces. These figures signify the extent of the concentration of agricultural activities in certain areas and

creation of widespread disillusionment in villages. This pattern, some benefits accruing to a minority but overall disappointment for the majority, characterized many of the White Revolution programs by the early 1970s.

imbalanced use of modernization and mechanization in the sector, all of which contributed to low productivity of the sector.

Rural-to-urban migration, mainly due to low wages and poor working conditions in the agricultural sector, further led to the sluggish output growth of that sector. For instance, the total number of paid and unpaid employees at modern cattle and chicken farms rose from 25,413 employees in 1989 to 41,865 in 2003, of which the share of unpaid employees remained high and declined only slightly from 43.20 percent in 1989 to 39.80 percent in 2003 (see Table 6L11 in Appendix 6L). The high rate of migration resulted in the slower growth of the number of villages (compared to that of cities) where over 90 percent of the agricultural products were produced, hence adversely affecting the supply of particularly educated labor in the sector (see Table 6L12 in Appendix 6L). Table 6.5 shows the agricultural holdings by literacy status, educational degree and age groups in 2003. From a total of 4.32 million agricultural holders, 45.3 percent were illiterate. When the number of holders with primary and non-official education is also added to that of the illiterate ones, those with no or very little education increases to about 80 percent of total holders.

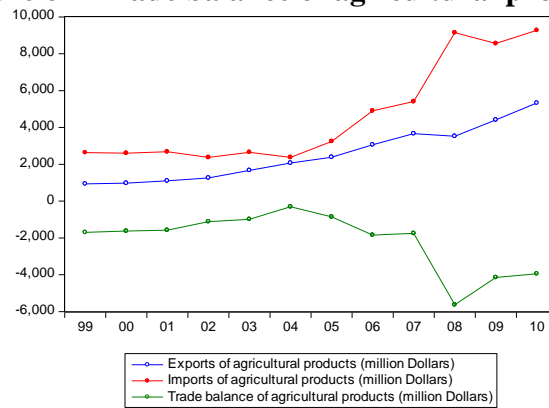
Table 6.4 Agricultural holdings owned by literacy status, educational degree and age groups (2003)

Age group (years)	Total literate and illiterate (1000 persons)	Literate		Illiterate		Literate by educational degree			
		Total (1000 persons)	Share in total (%)	Total (1000 persons)	Share in total (%)	Primary and non-official (1000 persons)	Lower and upper secondary (1000 persons)	Associate degree and higher (1000 persons)	Non-agricultural associate degree and higher (1000 persons)
All	4324.314	2363.094	54.646679	1961.22	45.353321	1489.62	739.43	34.82	99.21
Under 15 to 29	390.54	342.34	87.658114	48.2	12.341886	150.93	174.53	5.43	11.41
30-74	3653.81	1934.86	52.954587	1718.95	47.045413	1257.28	561.48	29.17	86.93
75 and older	234.87	42.86	18.248393	192.01	81.751607	38.38	3.42	0.22	0.87

Source: SCI.

Moreover, Iran has become a major importer of wheat, meat, rice and other basic food products. Due to increased oil revenues, and their impact on exchange rates, the imported agricultural products became less expensive than local production, adversely affecting the competitiveness of the sector. Figure 6.2 illustrates the balance of trade for agricultural products during 1999-2010. As it can be seen, agricultural products' imports remained higher than their exports, leaving the trade balance negative throughout this period for this sector.

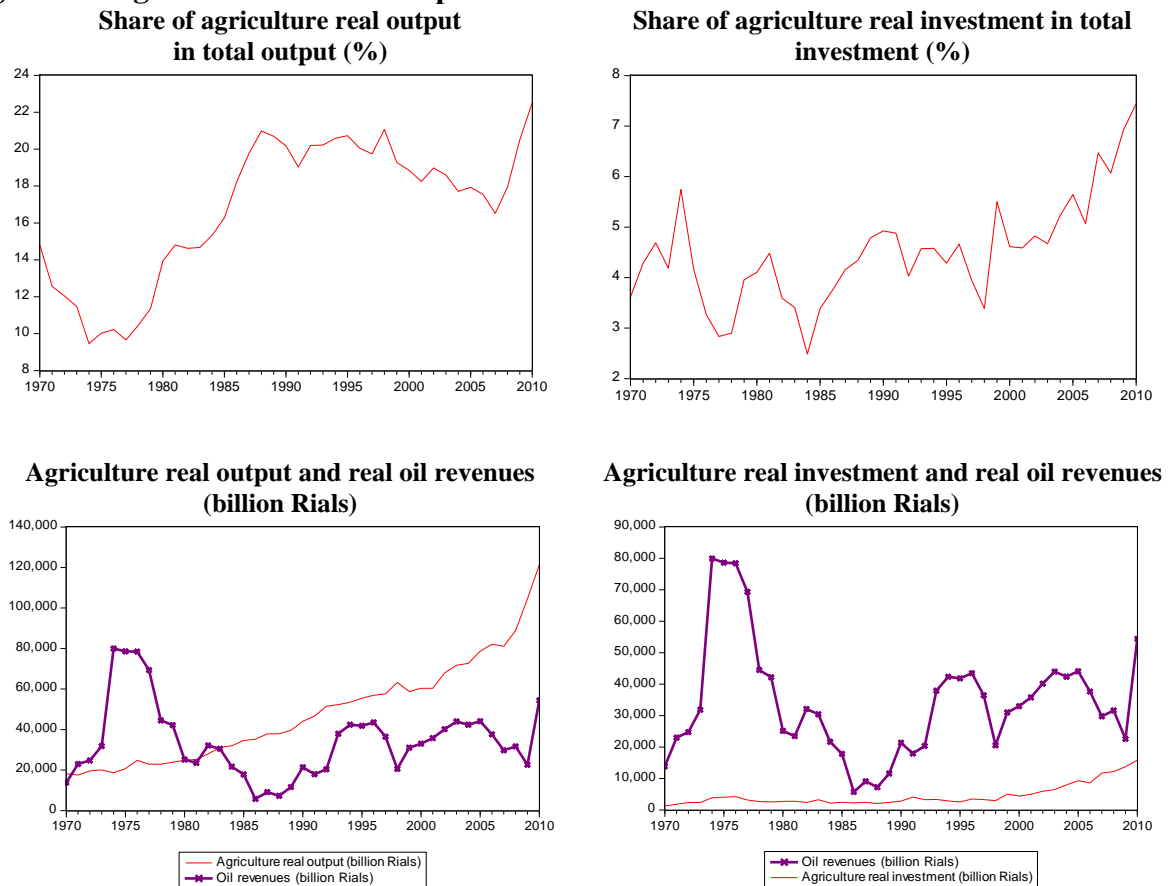
Figure 6-2 Trade balance of agricultural products



Note: Data are in current prices. Source: CBI.

The development of the agriculture sector’s ratio of real output in total output and the sector’s ratio of real investment in total investment are plotted in Figure 6.3 (the panels on the top and middle left, respectively). During 1970-2010, the former and the latter averaged 16 percent and 4 percent per annum, respectively, and their respective average annual growth rates registered only 1 percent and 3 percent over the same period. The panel on the top right in the same Figure depicts the development of the sector’s ratio of real investment to its capital stock of the earlier (see Taghipour, 2008). Even though this ratio revealed a rapidly declining trend during the revolution, it remained positive yet at a lower level compared to that of the pre-revolutionary era throughout the years under study. The panel on the middle right illustrates the development of the sector’s output to its investment of the previous period. Overall, this ratio grew merely by an annual average rate of 0.85 percent, and first depicted a fluctuating and slightly increasing trend from the mid-1970 to the mid-1990, but then appeared to decline during the rest of the period. The panels on the bottom left and right respectively plot the development of the agriculture sector’s output and investment against the movements of oil revenues. Both output and investment do not seem to co-move with oil income in the long-run.

Figure 6-3 Agriculture sector's output and investment shares



Note: Constructed based on data in billion Rials at constant 2004/05 prices. Source: CBI.

An overall strategy therefore is needed to create a longer-term vision for this crucial industry. Within this strategy, particular attention should be given to capacity development and facilitating the modernization and mechanization of the sector from a traditional setting to a more modern structure. This, combined with protection of the farmers through appropriate price, taxing and trade strategies for the agricultural products as well as the promotion of entities such as specialized insurance companies, could enhance the productive capacity and efficiency of this sector.

6.5.2. THE CVAR ANALYSIS FOR THE AGRICULTURE SECTOR

In this section, the economic determinants of investment in the Iranian agriculture sector are investigated and a CVAR model is estimated based on the set of variables given by the vector $x_t^{\text{Agriculture}} = [i_t^{\text{Agriculture}}, y_t^{\text{Agriculture}}, c_t^{\text{Agriculture}}, \ln(g^k + \delta)_t^{\text{Agriculture}}, dp_t, \text{orev}_t]'$, $t = 1974-2011$. The inspection of the data based on this model reveals large residuals in the data for output in 2008 consistent with the decline of agricultural production due to severe draught in that year.

Therefore, the dummy variable [DP2008] is included in the model to control for the largest outliers in the data. Also, based on the observation of the time-series and cointegration relations graphs (see Appendices 6B and 6G), an unrestricted constant term [trend] is included in the model allowing for trends in the levels of the variables and a non-zero mean in the cointegration relations. A shift dummy [T(1988:01)] is further added to the model as there seems to be shifts in the slopes of the trends in the agriculture sector's investment and output as the growth rates seem to have changed significantly in 1988, corresponding to the end of the Iran-Iraq war in that year. The results of tests of statistical significance for the dummy variables are presented in Appendix 6J. The appropriate lag length is determined for the model based on the SC and the H-Q criteria and the LM tests, the results of which suggest $p = 1$ for the agriculture sector (see Appendix 6C).

Table 6.3 reports the results of the over-identified cointegrating structures of the long-run relations in the data. The over-identified structures specify two long-run irreducible relations for the agriculture sector based on $\chi^2(5) = 2.653 [0.753]$. The first one, normalized on investment, corresponds to hypothesis $H1^{\text{Agriculture}}$ and relates to the investment equation according to which a positive relationship between investment and output and a negative relation between investment and the user cost of capital are expected. The empirical findings are, however, only partially in line with the predictions of the theory. That is, as expected by the theory, the long-run relationship between investment and $\ln(g^k + \delta)_t^{\text{Agriculture}}$ is positive with the coefficient magnitude 1.34.

Table 6.5 Agriculture sector's fully-identified long-run structures (1970-2010)

AGRICULTURE SECTOR (1974-2011)								
(t-values in parentheses)[p-values in brackets]								
OVER-IDENTIFIED VECTORS - $\chi^2(5) = 2.653$ [0.753]								
r = 2	$i_t^{\text{Agriculture}}$	$y_t^{\text{Agriculture}}$	$c_t^{\text{Agriculture}}$	$\ln(\delta + g^k)_t^{\text{Agriculture}}$	dp_t	$orev_t$	T(1988:01)	trend
$\beta 1^{\text{Agriculture}}$	1.000 (NA)	0.000 (.NA)	0.000 (.NA)	-1.348 (-15.245)	-0.681 (-2.591)	0.000 (.NA)	-0.142 (-11.253)	0.066 (5.710)
$\alpha 1^{\text{Agriculture}}$	-0.159 (-1.618)	-0.001 (-0.037)	0.045 (0.856)	-0.028 (-0.271)	-0.099 (-1.974)	-	-	-
$\beta 2^{\text{Agriculture}}$	0.246 (7.024)	0.000 (.NA)	1.000 (NA)	0.000 (.NA)	1.500 (10.388)	0.000 (.NA)	0.000 (.NA)	-0.012 (-4.383)
$\alpha 2^{\text{Agriculture}}$	-1.661 (-3.733)	-0.012 (-0.078)	0.375 (1.584)	-1.596 (-3.369)	-0.736 (-3.239)	-	-	-

Note: the analysis is conducted employing WinRATS Pro8.1 software.

Inconsistent with the predictions of the theory, however, the relations between investment and output as well as the user cost of capital are statistically insignificant in the long-run. Further, the long-run association between investment and oil windfalls in the non-resource sector of agriculture in the country is insignificant, hence appears to be consistent with the intuitively expected non-positive relation based on the Dutch Disease theory. Surprisingly, the empirical evidence suggests that investment is positively associated with inflation in the long-run with a coefficient magnitude 0.68. At first, this finding seems to be counter-intuitive as one would expect that higher inflation could have a depressing impact on investment behavior. However, in the context of the Iranian agriculture sector, this outcome may be plausible. At large, given the extent of the protection of this sector by the government, investment in Iran's agriculture sector has been largely financed by the government's expenditure scheme for the development of the sector. This could explain the positive long-run relation between investment and inflation resulting from expansionary monetary policies to provide funds for the expansion of the sector.

The estimated α loading coefficients for the first cointegrating relationship show that inflation is error increasing with a coefficient magnitude equal to 0.09. Evidently, despite its protectionist policies for the sector, the government's intervention has contributed further to the higher level of prices of agricultural products through adoption of market-based policies since the early 2000s. Although statistically rather insignificant, the own error correction coefficient for investment is correctly signed and slowly adjusts with a coefficient equal to 0.16. Hence, the findings may suggest a weak equilibrating role for investment in the sector's investment equation in the short-run.

The second relation is normalized on the user cost of capital. In the long-run and consistent with the theory, the results show that the user cost of capital and investment are negatively related with an investment coefficient of magnitude -0.24. That is, higher expected rates of return on facilities (or lower subsidies on these lending rates) have a suppressing long-run effect on investment in the agriculture sector through lowering (demand for) extended facilities to the sector by banks and credit institutions. Also, expectedly, the real user cost of capital is a negative function of inflation with a coefficient magnitude of -1.50. The over-identified structures do not identify any statistically significant associations between the user cost of capital and oil windfalls in the long-run. The estimated α coefficients for the second long-run relation demonstrate that both investment and inflation carry the expected error adjusting signs

with respective coefficients equal to 1.66 and 0.73, suggestive of the equilibrating roles of these variables for the user cost of capital equation in the short-run.

On the whole, the agriculture sector's investment behavior has been only partly consistent with the predictions of the neoclassical-accelerator type investment models. The insignificance of the long-run relationship between the sector's investment and output has been due to the key underlying factors affecting the economic performance of the agriculture sector as explained in the previous section. These factors include the inadequate modernization of the sector, high rural-to-urban migration, inappropriate pricing policies and trade strategies for the agricultural products as well as inefficiency and inadequate productive capacity of the sector.

Further, the insignificant relation between investment in the sector and oil revenues suggests that this sector did not benefit from investment spillovers bred by the availability of oil income in the long-run. Such insignificant long-run association between investment in the non-booming tradable sector of agriculture and oil revenues intuitively appears to be consistent with the presence of the Dutch Disease mechanism in the economy. That is, over the years under study, the abundant supply of foreign exchange being made available by oil windfalls resulted in imports of raw materials and agricultural products to meet the growing domestic demand. This, in return, made investment in the agriculture sector unattractive because of the unfavorable exchange rate, even at the time of higher oil prices when some funding for investment was available. On the other hand, when oil prices were lower, there were fewer resources available for investment in the sector. This setting consequently resulted in the lowered share of the sector's investment in total investment contributing to the contraction of the agriculture sector over time.

6.5.3. THE MANUFACTURING AND MINING SECTORS: OVERVIEW

In Iran, the most important manufactured products include petrochemical products, steel, automobile, cement, copper, electric appliances, industrial machinery and telecommunication equipment.⁹⁴ During 1970-2010, the country's real output of the manufacturing sector grew on average by about 7 percent per annum and the annual share of the sector's output in total GDP

⁹⁴ Other manufactured products include processed food, paper, rubber and leather products and textile.

averaged 30 percent. For example, during 1988-2010, the production of automobile, petrochemical products, steel and cement grew by annual average growth rates of 25 percent, 22 percent, 12 percent and 7 percent, respectively. This was mainly as a result of the increased investment in the sector and enhanced domestic demand in the country after the Iran-Iraq war as well as the booming housing sector over these years (see Tables 6M1 and 6M2 in Appendix 6M),

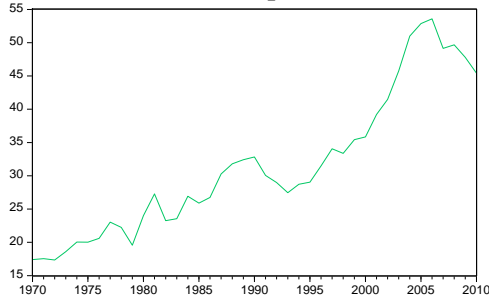
Moreover, Iran is endowed with over 68 different types of minerals, approximately 37 billion tons of proven mineral reserves and more than 57 billion tons of potential mineral reserves spread across the country.⁹⁵ The country holds more than 7 percent of the world's total mineral reserves, and with only about 1 percent share of the world's population, it is ranked among the 15 major mineral-rich countries. The most important mines in the country consist of coal, metallic minerals, sand, salt and chemical minerals. Zinc, copper, iron, uranium and lead are amongst other large yet mostly under-developed deposits in the country. The mining sector's output increased on average by 3 percent per annum and the share of the mining output in total GDP presented a remarkably small share and averaged 0.67 percent over the years from 1970 to 2010 (see Table 6M1 in Appendix 6M).

During these years, the government supported the manufacturing and mining sectors by direct credit allocations bred by increased oil revenues. Various banks and credit institutions further provided support for these sectors by extending facilities to public and non-public sectors. The figures on the allocated credits based on the government's expenditures plans for the development of the manufacturing and mining sectors during 1998-2010 are presented in Table 6M3 in Appendix 6M. The credits allocated by the government to the manufacturing and banking sectors increased on average by 12 percent annually. Table 6M4 in Appendix 6M illustrates the data on the extended facilities to these sectors by the non-public sector, namely commercial and specialized banks and credit institutions, and by the public sector. The figures show a growth rate of 8.2 percent by the former and a declining rate of 17 percent by the latter on average per annum during 1998-2010.

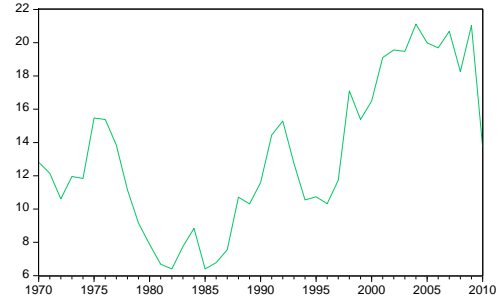
⁹⁵ 'Iran's mineral exports up 39 percent'. PressTV. 17 January 2011. [Online]. Available at: <http://www.tehrantimes.com/index.php/economy-and-business/92737-irans-copper-output-will-increase-35-fold> [Accessed 25 July 2014].

Figure 6-4 Manufacturing and mining sectors' output and investment shares

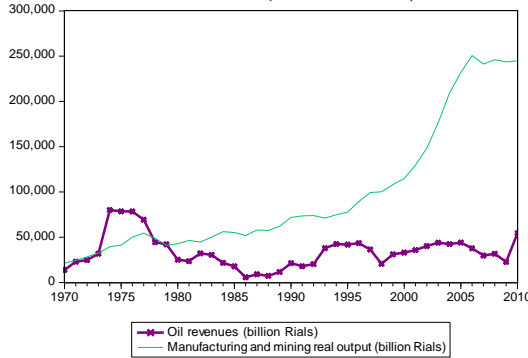
Share of manufacturing and mining real output in total output (%)



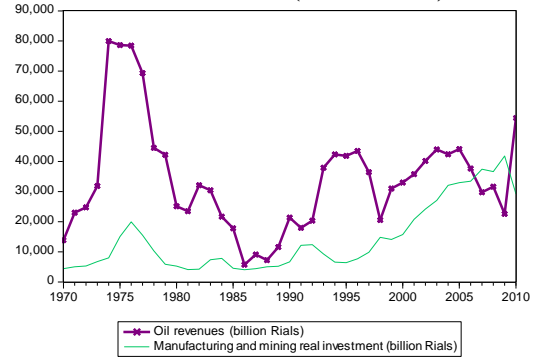
Share of manufacturing and mining real investment in total investment (%)



Manufacturing and mining real output and real oil revenues (billion Rials)



Manufacturing and mining real investment and real oil revenues (billion Rials)



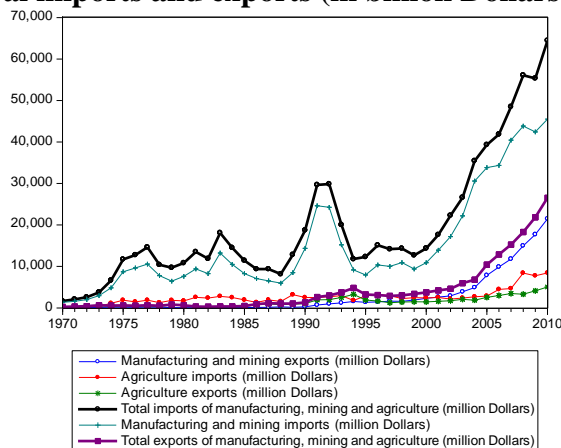
Note: Constructed based on data in billion Rials at constant 2004/05 prices. Source: CBI.

Thanks to the government's support fueled by oil revenues, on the whole, the share of manufacturing and mining sectors' output in total GDP averaged 31 percent and rose yearly on average by 2.7 percent during 1970-2010. Likewise, these sectors' output and investment presented positive growth rates of 6 percent and 8 percent on average per annum, respectively, over the same period. This increasing trend is ascribed partly to the increased number of manufacturing establishments and issued permits in the mining sector, improved technology and deployment of modern equipment, the increased ratio of the skilled to unskilled employees in these sectors as well as an increase in the effective demand for industrial products over the study period. For example, during the 17-year period interval from 1986 to 2003, the number of manufacturing establishments grew by a total of 77 percent (see Table 6M5 in Appendix 6M). Similarly, the share of the technical workers in the manufacturing establishments increased from 45.6 percent 1986 to 49.5 percent in 2003. Yet, the share of unskilled workers declined from 42.2 percent in 1986 to 29.5 percent in 2003 (see Table 6M6 in Appendix 6M). In the mining sector, the number of the operation permits issued by the Ministry of Industries and Mines rose

on average by 8.9 percent per annum. Also, over the years 1998-2010, employment related to operation permits went up on average by 9.8 percent on a yearly basis (see Table 6M7 in Appendix 6M).

The panels on the top left and right in Figure 6.4 illustrate the development of the manufacturing and mining sectors' real output and investment in total GDP and total investment, respectively. During 1970-2010, the combined share of these sectors' output and investment in total output and in total investment respectively averaged 31 percent and 13 percent. The graphs of the sectors' output and investment against oil revenues are plotted in the panels on the bottom left and right in Figure 6.4, respectively. In particular, investment appeared to co-move with changes in oil revenues over the years under study, indicating the dependency of these sectors on oil income.

Figure 6-5 Sectoral imports and exports (in billion Dollars at current prices)



Source: SCI.

At large, the productivity of the manufacturing sector in the country is heavily oil-reliant. Each year, owing to the availability of oil income, Iran imports a great deal of raw materials, machinery and equipment to be used in the manufacturing sector, while income from the export of manufactured products has remained relatively low. For instance, the sector's imports and exports respectively amounted to 25.77 and 2.59 billion US \$ in 2008. In the same year, the share of the sector's imports in total imports registered 48 percent whereas the share of exports in total non-oil exports recorded only 14 percent (SCI, Statistical Year Book, 2008, pp.432 and 435). Figure 6.5 illustrates the development of imports and exports of the manufacturing and mining as well as the agriculture sector. Over the year under consideration, a great share of total

imports was destined to the manufacturing sector. Given the import substitution policies pursued for most of the years under study, the low size of export ratios may seem unsurprising.

6.5.4. THE CVAR ANALYSIS FOR THE MANUFACTURING AND MINING SECTORS

In this section, the economic determinants of investment in the manufacturing and mining sectors within the theoretical framework of modified neoclassical and accelerator type investment models are investigated.⁹⁶ The estimated CVAR model is based on a sample of variables for these sectors given by the vector:

$$x_t^{\text{Manufacturing}} = [i_t^{\text{Manufacturing}}, y_t^{\text{Manufacturing}}, c_t^{\text{Manufacturing}}, \ln(g^k + \delta)_t^{\text{Manufacturing}}, dp_t, \text{orev}_t]',$$

$t = 1974-2011$. The examination of the data does not reveal any large outliers in the data for the manufacturing sector, but there seems to be a level shift [T(1988:01)] in the sector's investment associated with the effects from the end of the war with Iraq. An unrestricted constant term [trend] is further included in the model so as to allow for a non-zero mean in the cointegration relations and trends in the levels of the variables (see Appendices 6B and 6G for the time-series graphs of the data and cointegration relations). The test results for the statistical significance of the level shift dummy and the unrestricted constant are reported in Appendix 6J. Further to the H-Q criteria and the LM test results, the lag length of $p = 2$ is chosen (see Appendix 6C).

⁹⁶ Although the manufacturing and the mining sectors have very different characteristics, in the empirical analysis, the author uses the combined data on investment for both sectors as the disaggregate data on gross fixed capital formation for the manufacturing sector separately is not provided by the official data sources. However, because the share of the mining sector's output in total GDP is very low (0.67 p.a. on average during 1970-2010), the overall findings arguably pertain to the tradable sector of manufacturing (rather than the mining sector). Therefore, this chapter uses the terms 'manufacturing' and 'manufacturing and mining' interchangeably (see Table 6M1 in Appendix 6M).

Table 6.6 Manufacturing and mining sectors' fully-identified long-run structures (1974-2011)

MANUFACTURING AND MINING SECTORS (1974-2011)								
(t-values in parentheses)[p-values in brackets]								
OVER-IDENTIFIED VECTORS - $\chi^2(1) = 0.044 [0.834]$								
r = 2	$i_t^{\text{Manufacturing}}$	$y_t^{\text{Manufacturing}}$	$c_t^{\text{Manufacturing}}$	$\ln(\delta + g^k)_t^{\text{Manufacturing}}$	dp_t	$orev_t$	T(1988:01)	trend
$\beta 1^{\text{Manufacturing}}$	1.000 (NA)	-0.593 (-6.464)	2.905 (4.477)	0.000 (.NA)	2.369 (3.484)	-0.080 (-2.172)	0.059 (5.629)	-0.069 (-7.379)
$\alpha 1^{\text{Manufacturing}}$	-1.214 (-3.582)	-0.475 (-3.599)	-0.621 (-5.311)	-1.197 (-3.508)	0.614 (4.244)	-	-	-
$\beta 2^{\text{Manufacturing}}$	0.000 (.NA)	0.000 (.NA)	3.348 (3.353)	1.000 (NA)	5.313 (5.295)	-0.299 (-4.205)	0.131 (6.488)	-0.097 (-6.013)
$\alpha 2^{\text{Manufacturing}}$	-0.433 (-1.635)	0.009 (0.092)	0.514 (5.625)	-0.520 (-1.949)	-0.564 (-4.990)	-	-	-

Note: the analysis is conducted employing WinRATS Pro8.1 software.

The over-identified structures specify two interpretable irreducible long-run relations based on $\chi^2(1) = 0.044 [0.834]$. The first relation describes the investment equation. As predicted by the theory, the relation between investment and output is positive with a coefficient magnitude 0.59. Also, consistent with the theory, investment is strongly and negatively related to the user cost of capital with a coefficient equal to -2.90. Furthermore, investment in the sector is found to be a negative function of inflation in the long-run with the latter's coefficient equal to -2.36. In the long-run, however, the relation between investment and $\ln(g^k + \delta)_t^{\text{Manufacturing}}$ appears to be statistically insignificant.

Notably, investment is a positive function of oil revenues with an estimated coefficient equal to 0.08, indicating a positive relation between investment and the availability of oil income in the country's manufacturing and mining sectors in the long-run. This relationship, however, is inconsistent with the predictions of the Dutch Disease theory in terms of the sign of the coefficient on oil revenues for the non-booming tradable sectors of manufacturing and mining. The estimated α loading coefficients show that investment, output and the user cost of capital are all error correcting to the first long-run equilibrium relation, with respective adjustment coefficients of 1.21, 0.47 and 0.62. However, the estimated α coefficient on inflation for the first relation suggests that in the short-run the highly persistent inflationary pressure in the Iranian economy is error increasing with a coefficient magnitude 0.61. The second relation describes the capital growth equation. Expectedly, in the long-run, the growth rate of capital stock is a positive function of oil revenues with a coefficient of 0.29, and a negative function of the user cost of capital and inflation with respective coefficients equal to -3.34 and -5.31. Inflation and $\ln(g^k + \delta)_t^{\text{Manufacturing}}$ are both adjusting with error correcting coefficients of 0.56 and 0.52, indicative of the significance of these variables in the short-run for the second cointegrating relationship.

Overall, the manufacturing and mining sectors' investment pattern largely corresponds to the theoretical framework of the neoclassical-accelerator type models of investment, i.e. a long-run positive relationship between investment and output, and a long-run negative association between investment and the proxies of the user cost of capital. Interestingly, there exists a long-run relationship between investment activities in these sectors and oil revenues suggesting that they benefited from investment spillovers (facilitated by the government's decision to promote industrialization) fueled by the availability of oil income. Nevertheless, the contribution of the

manufacturing and mining sectors in GDP and employment could have been greater given the diversity of the manufacturing activities as well as the quantity and quality of the proven mineral deposits in country.

6.5.5. OIL SECTOR: OVERVIEW

Iran was the first country in the Persian Gulf which discovered oil in 1908. Since the 1920s, the country's economy became increasingly reliant on the oil sector, and oil revenues accounted for about 65 percent of the government's revenues during 1970-2010. Yet, in total GDP, the value-added of the oil sector contributed only 19 percent on average per annum over these years. The country holds the fourth largest proven crude oil reserves and the second largest natural gas reserves in the world. The country ranks among the world's top 10 and top 5 crude oil and natural gas producers, respectively, and is blessed with about 10 percent of the world's and 13 percent of OPEC's crude oil reserves (EIA, 2014). About 70 percent of the country's crude reserves are located onshore mostly in the Luristan-Khuzestan basin in the Southwest near the Iraqi border, with the rest located offshore in the Persian Gulf as well as the Caspian sea.⁹⁷ The country further shares several onshore and offshore fields with its neighboring countries including Iraq, Qatar, Kuwait and Saudi Arabia. Figure 6.6 maps the major crude oil and natural gas infrastructure and facilities in the country.⁹⁸

⁹⁷ Iran's largest producing oil fields are the onshore Ahwaz-Asmari, Marun, and Gachsaran fields, all of which are located in the Khuzestan Province.

⁹⁸ Iran's major crude oil terminals are Kharg (with a capacity of 5.0 million barrels per days), Lavan, and Sirri Islands, all of which are located in the Persian Gulf. In addition, the country has two small crude oil terminals at Cyrus and Bahregansar, one terminal along the Caspian Sea, and other terminals that handle mostly refined product exports and imports. Condensate from the South Pars natural gas field is exported from the Assaluyeh terminal.

Figure 6-6 Map of key petroleum facilities in Iran



Source: Parstimes, Iran oil and gas resources: key petroleum facilities [Online]. Available at: <http://www.parstimes.com/ioil.html> [Accessed 30 July 2014].

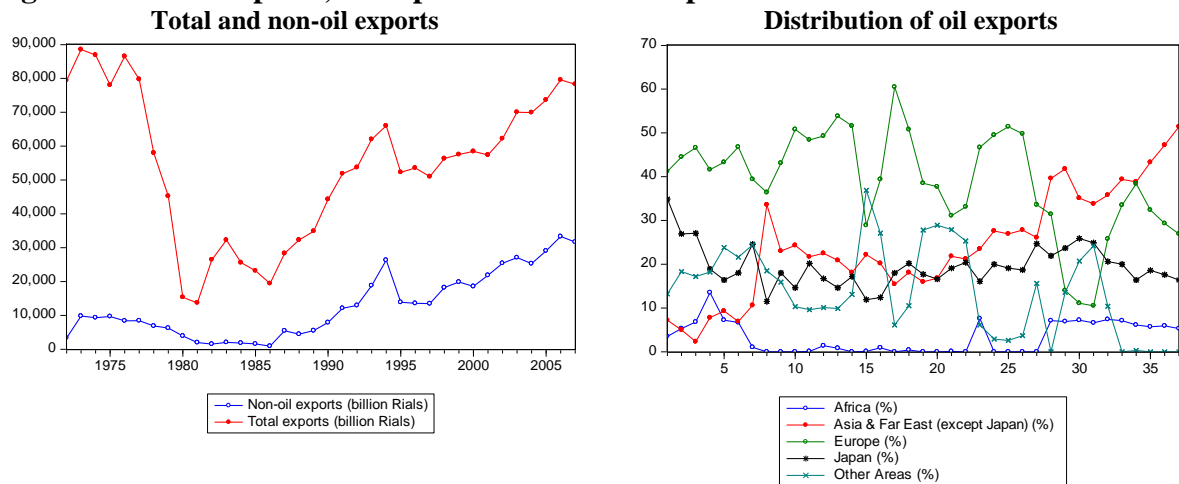
The Supreme Energy Council, established in 2001 and chaired by Iran’s president, consists of various ministries including the Ministry of Petroleum, and oversees the energy sector in the country. The Ministry of Petroleum supervises the enterprises of the National Iranian Oil Company (NIOC), the National Iranian Gas Company (NIGC), and the National Petrochemical Company (NPC), all of which are state-owned.⁹⁹ NIOC and NIGC through their subsidiaries, listed in Table 6N1 (Appendix 6N), control upstream oil and natural gas activities and downstream natural gas activities (incl. pipelines, city natural gas networks and gas processing plans), respectively.

The country’s proven oil reserves grew by a total of about 160 percent from 57 thousand million barrels in 1980 to 151 thousand million barrels in 2010 (see Table 6N2 in Appendix 6N). The country’s crude oil production increased from 3.8 million barrels per day in 1970 to 4.3 million barrels per day in 2010, illustrating a total growth rate of 12 percent over these years. During this period, the amount of the country’s oil production greatly varied. For instance, during 1970-

⁹⁹ NPC accounts for approximately 90 percent of the country’s total petrochemical production and exports through its subsidiary, the Iran Petrochemical Commercial Company (Source: National Iranian Oil Company. [Online]. Available at: <http://nioc.ir> [Accessed 28 July 2014].

1975, the crude oil production was at its highest averaging 5.1 million barrels per day, while this figure registered its lowest and averaged 2 million barrels per day during the early years of the war with Iraq from 1981-1985. The share of value added of the oil sector in total GDP declined from 46.6 percent in 1970 to as low as 8.7 percent in 2010. Despite its declining share of value-added in total GDP, during 1972-2007, the oil sector's share of export in total export averaged as high as 78 percent on a yearly basis, while that of the non-oil sector recorded merely 22 percent. The panel on the left in Figure 6.7 graphs total and non-oil exports during 1973-2010. Currently, the largest buyers of Iranian crude oil are China, India, South Korea, and Turkey (EIA, 2014). The panel on the right in Figure 6.7 shows the geographical distribution of Iran's oil exports during 1973-2009. During 1965-2006, there has been a significant shift away from Europe with a declining rate of 20 percent towards Asia and Far East (see Table 6N3 in Appendix 6N).

Figure 6-7 Total exports, oil exports and non-oil exports

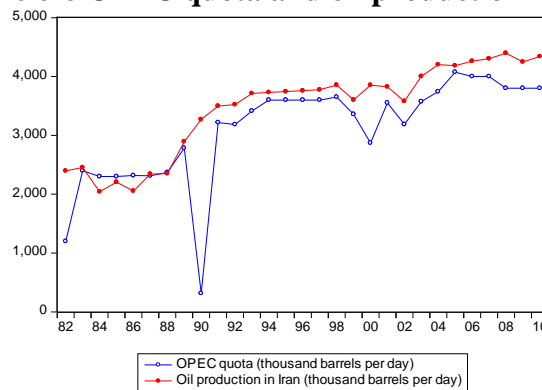


Note: Constructed based on data in billion Rials at constant 2004/05 prices. Source: CBI.

Figure 6.8 plots the oil production quota designated to Iran by OPEC against the amount of Iran's oil output. The quota for Iran increased from 1.2 million barrels per day in 1982 to 3.8 million barrels in 2010. However, the output of the oil sector grew from 2.3 million barrels in 1982 to 4.3 million barrels in 2010. Although the amount of production exceeded the allowed quota, the growth rate of oil production remained lower than that of the quota. This could suggest that the low growth of oil output was due to the sector's limited capacity rather than the designated oil quota.¹⁰⁰

¹⁰⁰ Nevertheless, exceeding the quota by a large margin may not have been possible as it would have caused disturbances within OPEC.

Figure 6-8 OPEC quota and oil production in Iran



Source: CBI.

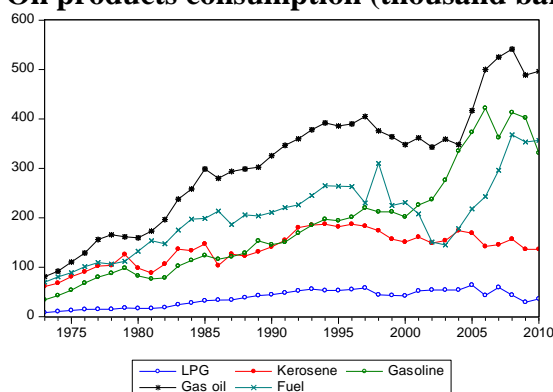
The oil industry in the country has been challenged by a number of structural problems such as financial constraints and the consequent underinvestment. Others include sanctions by the US and the West, technical shortages, and increasing demand and consumption due to heavily subsidized energy prices and the growing population. In 2012, for instance, oil and natural gas accounted for about 37 and 61 percent of the country's total energy consumption, respectively, with a minimal contribution from hydropower, coal, nuclear and non-hydro-renewables (EIA, 2014, p.4). Iran is the second largest oil consumer in the Middle East, after Saudi Arabia. The domestic oil consumption mainly includes gas oil, gasoline and fuel oil (see Figure 6.9). In order to meet the domestic demand and due to limited domestic oil refining capacity, Iran has relied on imports of refined products, particularly gasoline, and the country's import of oil products illustrated a substantial growth during 1978-2010 (see Table 6N2 in Appendix 6N).¹⁰¹

About 80 percent of the crude oil reserves in Iran were discovered before 1965. Since 2007, no new oil field has entered into production. Table 6N4 in Appendix 6N illustrates the declining development of refinery activities in the country during 1986-2007. Relatively low cost and highly productive oil fields are declining by about 2-2.5 million barrels per day (Ghanbari, 2012, p.130). Also, the country's oil fields have high annual natural decline rates of 8-11 percent and low recovery rates of 20-25 percent (EIA, p.11). The sanctions and the consequent lack of international participation have adversely affected the Iranian oil sector's activities of particularly upstream projects through affecting the availability of technology, expertise and

¹⁰¹ Iran's energy prices, in particular gasoline prices, have been substantially subsidized. In 2010, the government initiated subsidy reform and lowered the subsidies on energy prices in order to discourage wasteful energy use. Since 2010, the import of oil products and mainly gasoline fell due to subsidy cuts.

investment leading to postponements or even annulments of some of the projects.¹⁰² The development of only a few projects still continues, although at a slower pace than initially planned. Table 6N5 in Appendix 6N presents a selected number of new upstream oil projects in Iran and their status. Although there are a few Chinese and Russian companies involved in the country's oil sector, the activities of all western companies have been stopped.¹⁰³

Figure 6-9 Oil products consumption (thousand barrels daily)



Source: CBI.

In addition to its considerable proven oil reserves, Iran holds the second largest proven natural gas reserves after Russia and more than a third of OPEC's reserves. The country's proven natural gas reserves grew from 494 trillion cubic feet in 1980 to 1165 trillion cubic feet in 2010, and natural gas production increased from 1.2 billion cubic feet per day in 1970 to 14 billion cubic feet per day in 2010 (see Table 6N2 in Appendix 6N). The South Pars field, discovered in 1990, is an offshore gas field located in the Persian Gulf and the largest gas field, accounting for about 40 percent of the country's gas reserves.¹⁰⁴ The country is also estimated to hold 2 trillion cubic feet of proven onshore and offshore natural gas reserves in the Caspian basin. In recent

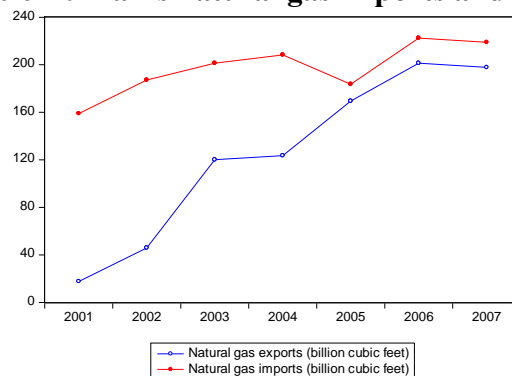
¹⁰² The contracts with CNPC for the development of Phase 11 of the South Pars natural gas field and the South Azadegan field were cancelled in 2012 and 2013, respectively, due to project delays.

¹⁰³ Further, according to the Iranian Constitution, the private or foreign ownership of natural resources and any kind of production-sharing agreements are not permitted. Instead, unattractive buyback contracts are allowed based on which an International Oil Company (IOC) enters into exploration and production activities via an Iranian subsidiary.¹⁰³ The contractor invests its own capital and expertise for the development of oil or gas fields. However, when the field is developed and production has begun, the field is given up to the NIOC or one of its agents. The IOC gets its capital costs back from a pre-determined percentage of the field's production and rate of return which varies between 12 and 17 percent within a five to seven years payback period, presuming the field generates an agreed upon amount and the international energy prices are high enough (Van Groenendaal and Mazraati, 2006).

¹⁰⁴ See *Oil and Gas Journal* (January 2014) for details. South Pars has a 24-phase development scheme, shown in Table 6J.3 in Appendix 6J, with a total cost expected to exceed 100 billion US \$. The entire project is managed by Pars Oil and Gas Company (POGC), a subsidiary of NIOC. Production from phases 1 to 10 was originally designed to be allocated for domestic market consumption and reinjection. Production from the remaining phases is planned for export via 26 pipelines and liquefied natural gas (LNG) and/or used for proposed gas-to-liquids (GTL) projects (EIA, 2014). Other gas fields in Iran are Kish, North Pars, Tabnak, Forouz and Kangan.

years, there have been substantial gas discoveries in the country yet most of the natural gas fields are underdeveloped because of a range of constraints such as financial and technical as well as contractual barriers.

Figure 6-10 Iran’s natural gas imports and exports



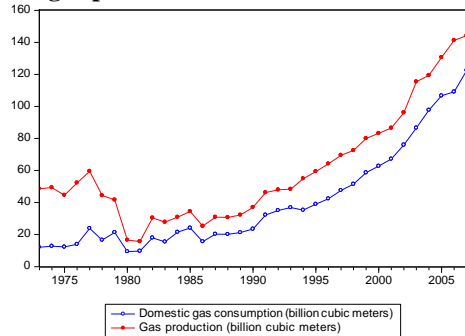
Source: CBI.

Despite holding 17 percent share of the world’s natural gas reserves, the country has relied on imports of natural gas due to high domestic needs.¹⁰⁵ Figure 6.10 graphs Iran’s imports and exports of natural gas during 2001-2007. The imports and exports of natural gas respectively grew from 158.92 and 17.657 billion cubic feet in 2001 to 218.95 and 197.76 billion cubic feet in 2007 (see Table 6N2 in Appendix 6N). Natural gas has been used domestically for residential, commercial, industrial and transportation sectors, for electric power and for reinjection into oil fields to boost crude oil production through enhanced oil recovery (EOR) techniques. The country’s natural gas consumption grew from 0.89 billion cubic feet in 1970 to 13.9 billion cubic feet in 2010. Figure 6.11 depicts the development of natural gas production and domestic consumption (the panel on the top left) and the share of domestic natural gas consumption in total gas production (the panel on the top right) during 1973-2007. At large, both natural gas production and domestic consumption increased on average by 5.6 percent and 10 percent per annum, respectively, suggestive of the higher growth rate of domestic consumption compared to that of production. Over the same period, the share of domestic gas consumption in total production increased from 25 percent in 1973 to 85 percent in 2007.

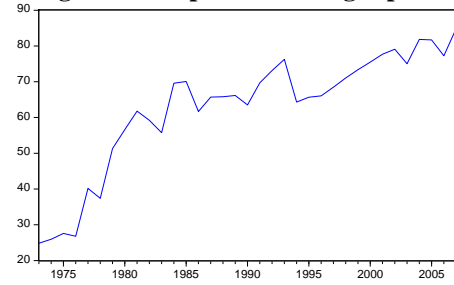
¹⁰⁵ The majority of the country’s natural gas imports come from Turkmenistan and the remainder from Azerbaijan. The country also exports gas mainly to Turkey and to a lesser degree to Armenia and Azerbaijan. Iran exports natural gas to Nakhchivan in Azerbaijan through the Salmas Nakhchivan pipeline. In return, Azerbaijan exports natural gas to the Northern provinces in Iran through the Astara-Kazi-Magomed pipeline. The NIOC started construction projects in the past to build an LNG export plant, but it has not yet built a liquefaction facility mainly due to the lack of technology and finance stemming from international sanctions. The proposed regional gas pipelines include Iran-Iraq pipeline, Iran-Oman pipeline, Iran-Pakistan pipeline and Iran-UAE gas contract.

Figure 6-11 Natural gas production and consumption

Natural gas production and domestic consumption



Natural gas consumption in total gas production

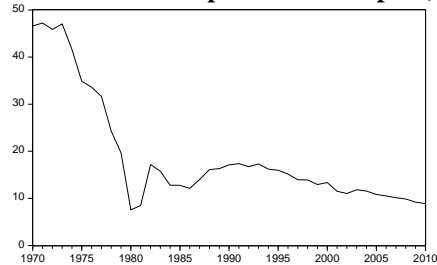


Note: Constructed based on data in billion cubic meters. Source: CBI.

During 1970-2010, the oil sector's value added and investment recorded average annual growth rates of 2 percent and 10 percent, respectively, indicative of investment inefficiency in the sector given the higher growth rate of the latter compared to that of the former (see Appendix 6N Table 6N2). The share of the oil sector's value-added in total output, shown in Figure 6.12 (the panel on the top left), fell by an annual average rate of 2 percent during 1970-2010. The share of the sector's investment in total investment, illustrated in Figure 6.12 (the panel on the top right), highly fluctuated and grew on average only by 3 percent per annum over the same period.

Figure 6-12 Oil sector's output and investment shares

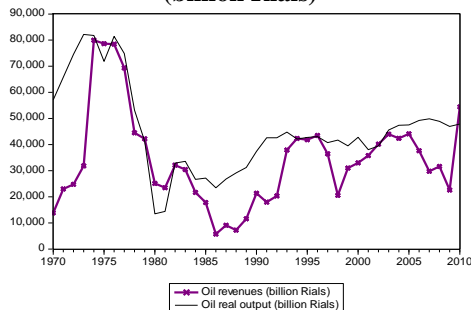
Share of oil real output in total output (%)



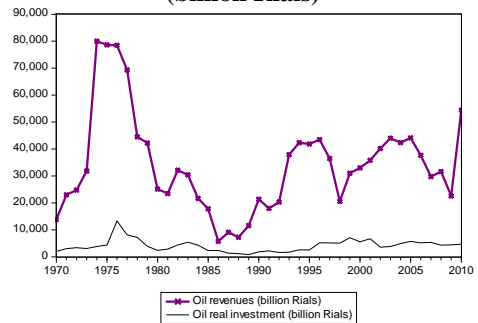
Share of oil real investment in total investment (%)



Oil real output and real oil revenues (billion Rials)



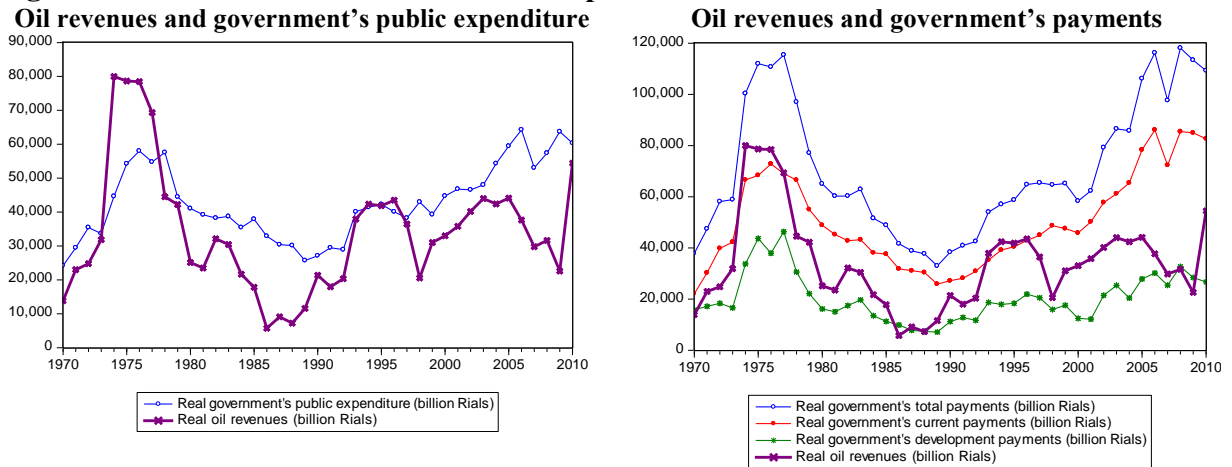
Oil real investment and real oil revenues (billion Rials)



Note: Constructed based on data in billion Rials at constant 2004/05 prices. Source: CBI.

The bottom left and right panels in Figure 6.12 plot the development of the oil's output and investment against the movements of oil revenues, respectively. The former appears to co-move closely with the movements of oil revenues. This is not surprising as oil revenues are a function of oil output and oil prices. However, unexpectedly, yet consistent with the empirical findings, investment in the oil sector does not appear to follow the movements of oil revenues, with the exception of a small rise in investment in the sector after the first oil shock. Over these years, the oil sector's share of investment in total investment averaged merely 4.7 percent.

Figure 6-13 Government's revenues and expenditures



Note: Constructed based on data in billion Rials at constant 2004/05 prices. Source: CBI.

At first, the non-trending pattern of the sector's investment with oil revenues and its low share of investment seem puzzling given the oil-driven nature of the Iranian economy as well as the country's abundant oil windfalls during these years. There are, however, some major underlying factors which contributed to this pattern. During the period under study, the government over-relied on oil income to finance its public expenditure. The co-moving pattern of oil revenues and the government's public expenditure between 1970 and 2010 is depicted in Figure 6.13 (the panel on the left). In this picture, the share of the government's current expenditure amounted to 72 percent of total expenditure. This, in return, adversely affected the government's budget available for development and capital spending in various economic sectors. Particularly the share of investment in the oil sector reduced to a very low level. Even the National Development Fund (NDF), which was introduced in 2009 to replace the country's Oil Stabilization Fund (OSF), allocated merely 14 percent to the National Iranian Oil Company (NIOC).¹⁰⁶

¹⁰⁶ According to the rules of the NDF in 2009, 63.5 percent of oil and gas are allocated to the national budget, 20 percent to the NDF, 14.5 percent to NIOC, and 2 percent to impoverished and oil-based regions (IMF, 2011, p.8).

A sizable part of the government's current expenditure was spent on subsidies including domestic energy subsidies, accounting for about 15 percent of the government's national budget.

In short, the oil sector seemed to have been caught in a vicious circle. During most of the years under consideration, the imposed sanctions against the Iranian oil sector and the resulting insufficient foreign investment, expertise and technology coupled with the maturity of existing oilfields undermined the production capacity of this key sector in the Iranian economy.

6.5.6. THE CVAR ANALYSIS FOR THE OIL SECTOR

This section tests the theory-motivated economic determinants of investment in the Iranian oil industry and estimates a CVAR model for a sample based on a set of variables given by the vector $x_t^{Oil} = [i_t^{Oil}, y_t^{Oil}, c_t, \ln(g^k + \delta)_t^{Oil}, dp_t, orev_t]$, $t = 1974-2011$. An inspection of the data shows large residuals for output in 1980 corresponding to the lagged adverse effects of the Iranian revolution in 1979 on the oil sector's output. The dummy variable [DP1980] has been accordingly included in the model to control for the largest outliers in the data for output. The examination of the time-series graphs of the data and cointegration relations (see Appendices 6B and 6G, respectively) indicates a need for an unrestricted constant term while allowing for a non-zero mean in the cointegration relations and trends in the levels of the variables [trend]. The LM test results as well as the SC and the H-Q criteria suggest that the appropriate lag length is $p = 1$ (see Appendix 6C). The results of the over-identified cointegrating structures of the long-run relations in the data based on hypotheses $H1^{Oil}$ are reported in Table 6.7. These results specify two interpretable irreducible long-run relations based on $\chi^2(4) = 3.028 [0.553]$.

The first relation is normalized on investment. In line with the predictions of the investment theory, the oil sector's investment is negatively related to the user cost of capital and positively related to $\ln(g^k + \delta)_t^{Oil}$ in the long-run with coefficients' magnitude equal to -9.38 and 1.62,

respectively. Also, investment is a negative function of inflation with a coefficient magnitude -7.28 in the long-run. However, counter-intuitively, the long-run relation between investment in the oil sector and oil income does not appear to hold. The latter points towards insignificant effects of oil windfalls on the oil sector of the economy, hence contradicts the Dutch Disease theory according to which the presence of oil rents are expected to cause investment spillovers to the oil sector of oil-based economies. The estimated α loading coefficients for the user cost of capital in this cointegrating relation is correctly signed and equilibrium adjusting with a coefficient equal to 0.08, suggesting a slow adjustment process for this variable to return to the equilibrium level. However, for this long-run relation, the α coefficient for inflation is error increasing in the short-run. The error correction term related to investment is statistically insignificant yet reveals an equilibrating behavior with an adjustment coefficient magnitude -0.11.

The second relation is normalized on the user cost of capital and describes that this variable is negatively related to oil revenues in the long-run. Considering that both variables are based on the aggregate economy level data, this relationship can be explained through oil income-driven expansionary monetary effects which gave rise to Iran's domestic liquidity and monetary base over the study period. This in turn increased inflationary pressures in the economy as a result of which lending rates became negative and the real cost of capital declined. The own error correction term for the user cost of capital carries the expected sign and is statistically significant with a rather fast equilibrium-converging coefficient 0.88.

Table 6.7 Oil sector's fully-identified long-run structures (1970-2010)

OIL GROUP (1974-2011)							
(t-values in parentheses)[p-values in brackets]							
OVER-IDENTIFIED VECTORS - $\chi^2(4) = 3.028$ [0.553]							
r = 2	i_t^{Oil}	y_t^{Oil}	c_t	$\ln(\delta + g^k)_t^{Oil}$	dp_t	$orev_t$	trend
$\beta 1^{Oil}$	1.000 (NA)	0.000 (.NA)	9.385 (9.964)	-1.621 (-54.738)	7.280 (9.153)	0.000 (.NA)	-0.029 (-12.661)
$\alpha 1^{Oil}$	-0.111 (-0.632)	0.069 (1.685)	-0.089 (-4.388)	0.027 (0.150)	0.094 (4.496)	-	-
$\beta 2^{Oil}$	0.000 (.NA)	0.000 (.NA)	1.000 (NA)	0.000 (.NA)	0.000 (.NA)	0.072 (4.999)	-0.002 (-2.522)
$\alpha 2^{Oil}$	-0.954 (-0.902)	-0.101 (-0.407)	-0.888 (-7.281)	-1.112 (-1.032)	0.964 (7.658)	-	-

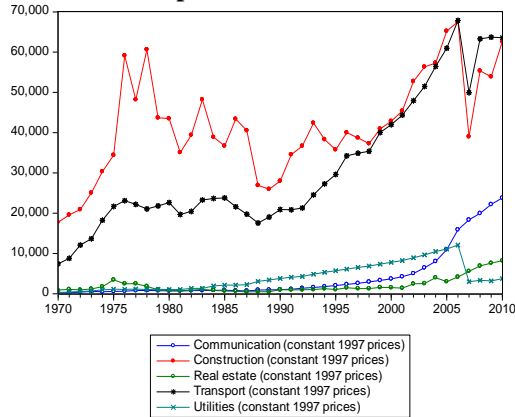
Note: the analysis is conducted employing WinRATS Pro8.1 software.

Overall, the empirical results for the oil sector do not support the prediction of the investment model. In particular, counterintuitively, investment is not related to output in the long-run due to the major underlying factors discussed in Section 6.5.5 such as inadequate investment under the sanctions, production decline rates and inherent technical challenges in production. Yet, investment in the oil sector revealed a long-run relation with the sector's growth rate of capital. The latter suggests that the true depreciation rates are not very high. This is because, in order to be able to raise output when investment is stagnant, old capital assets still need to be productive. Also inconsistent with the predictions of the Dutch Disease theoretical framework and quite surprisingly, the relation between investment and the availability of oil revenues was found statistically insignificant, suggesting that oil income has not been a blessing for domestic investment in the oil sector in the long-run.

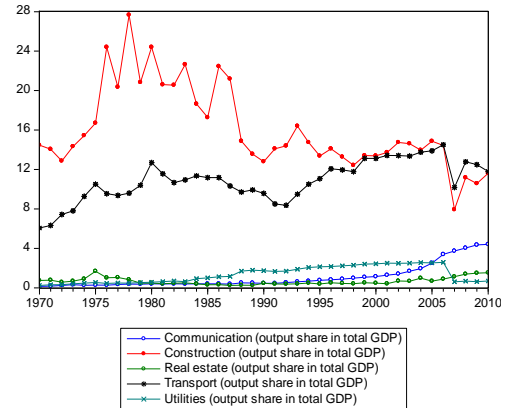
6.5.7. THE SERVIC SECTOR: OVERVIEW

During the years under study, the service sector witnessed extensive growth. The output of all the sectors under study revealed increasing trends with that of the construction sector accounting for the highest growth followed by the transport sector. Figure 6.14 illustrates the graphs of sector-level output (the panel on the left) and their output share in total GDP (the panel on the right) in the service industry during 1970-2010. In particular, the high level of output during the mid-1970s was due to the positive impact of the increased oil prices and oil revenues on the activities of the sectors, whereas the declining trend during the mid-2000s resulted from high inflationary pressures and the subsequent economic instability during that time. Between 1970 and 2010, the construction sector's share of output in total GDP averaged the highest (16 percent) followed by the sectors of transport (10.8 percent), utilities (1.3 percent), communication (0.9 percent) and real estate (0.6 percent).

Figure 6-14 The service sector output
Real output of the service sector



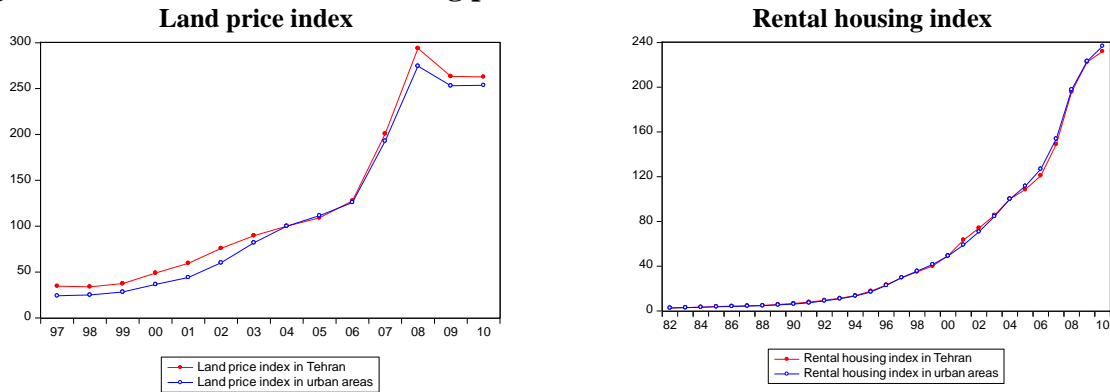
The service sector share in total GDP



Note: Constructed based on data in billion Rials at constant 2004/05 prices. Source: CBI.

The construction industry in Iran is booming, and with an annual turnover of about 39 billion US \$, it is considered as one of the most profitable sectors in the country (Asnaashari, et al., 2009). There has been a substantial increase in the number of construction permits, building units and land prices during the years under study (see Table 6O3 in Appendix 6O). On a yearly basis, the number of new buildings under construction, the total floor space, and the average cost per square meter in all urban areas registered annual average growth rates of 5.3 percent, 8.7 percent and 20 percent, respectively, during 1972-2010. Over these years, the private sector played a strong role in the construction industry. For instance, during 1975-2010, the number of residential units completed by the private sectors in the urban areas grew on average by 6.5 percent per year (see Table 6O4 in Appendix 6O). As a result of the booming construction industry in the country, the construction service index for wages as well as the land and rental price indices of the urban areas increased considerably (see Figure 6.15). For instance, during 1990-2010, the construction service index for wages grew with an annual average rate of over 20 percent (see Table 6O5 in Appendix 6O).

Figure 6-15 Land and rental housing price indices



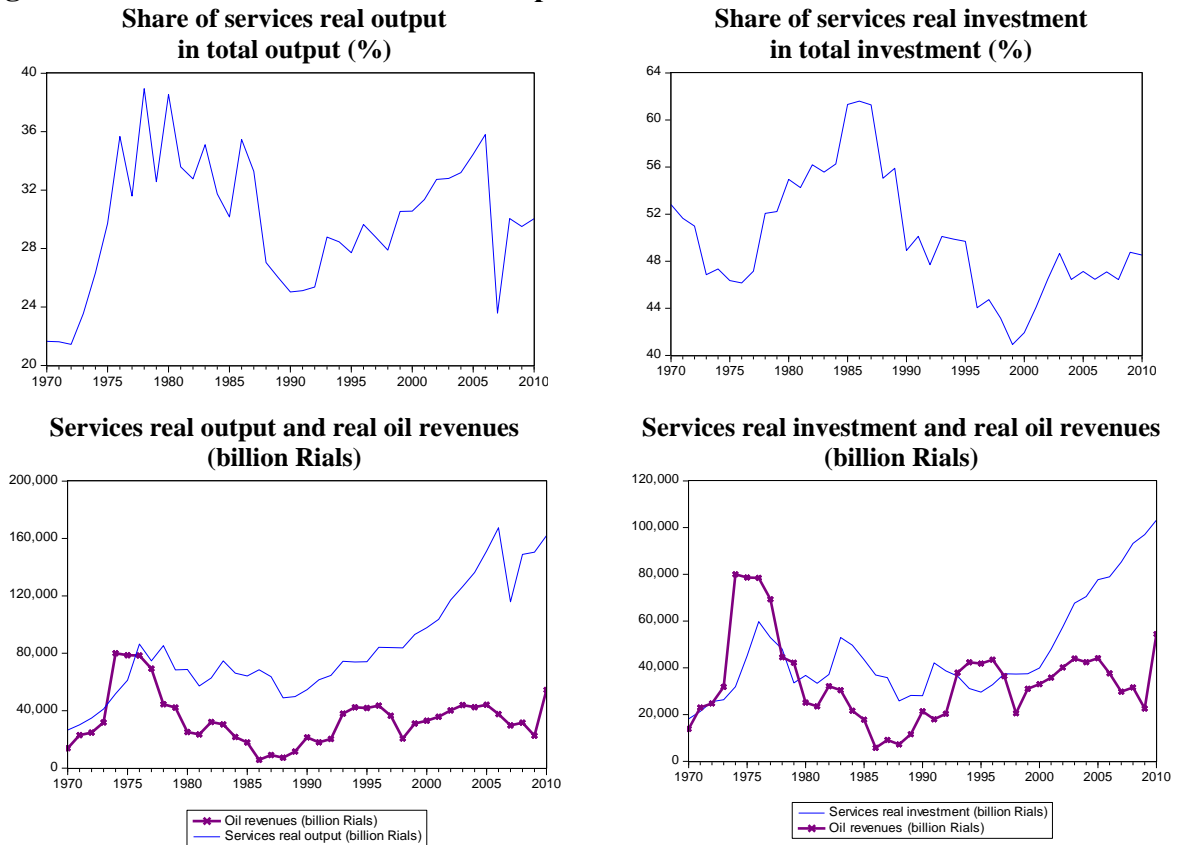
Source: CBI.

The growing performance of the transport sector during 1978-2010 is reported in Table 6O6 in Appendix 6O. The number of passengers transported by rail and air increased on average by 6 percent and 7 percent per annum over these years. The volume of goods transported by rail, air and sea recorded average annual growth rates of 5 percent, 7 percent and 8 percent per annum, respectively. Similarly, the performance of the communication sector during 1986-2006, shown in Table 6O7 in Appendix 6O, presented a significant development. At large, the number of installed and in use telephones for the housing, commercial and industrial units, radio stations and radio transmitters, television and FM main stations and transmitters all largely increased.¹⁰⁷

During the study years, investment activities in the service sector were supported in various ways. For instance, the number and the amount of extended facilities to the construction and housing sectors by Maskan Bank, the only Iranian bank specializing in the housing sector, registered respective annual average growth rates of 17 percent and 22 percent during 1978-2010. Further, the extended facilities by other banks and credit institutions to the public and non-public housing sectors rose on average by 11 percent per annum. Moreover, according to the Budget Law, yearly amounts of credits were approved to be allocated by the government for the implementation of the housing projects and for urban and rural development. Similarly, the government's allocated credits to the transport sector increased in real terms, for instance from 3256 billion Rials in 2003 to 3318 billion Rials in 2010. Likewise, during 1999 and 2010, the government's credits extended to the transport sector grew on average by 9.9 percent per annum (see Tables 6O9 and 6O10 in Appendix 6O).

¹⁰⁷ Despite an increased number of operating postal units in the country, the activities of this sub-sector declined, mainly those related to the dispatch of mail abroad and received overseas mail.

Figure 6-16 Services' investment and output shares



Note: Constructed based on data in billion Rials at constant 2004/05 prices. Source: CBI.

Overall, consistent with the Dutch Disease theory, the service sector grew significantly over the period from 1970 to 2010. Total output and total investment in this sector registered annual average growth rates of 5.5 and 5.8 percent during 1970-2010, respectively (see Tables 6O1 and 6O2 in Appendix 6O). Over the same period, the output share of services in total output and its investment share in total investment respectively averaged 30 percent and 49 percent (see the panels on the top left and right in Figure 6.16, respectively). The development of the service sectors' output and investment against oil revenues are further plotted in the panels on the bottom left and right in Figure 6.16, respectively. Both output and investment seemingly co-moved with oil revenues over this period.

6.5.8. THE CVAR ANALYSIS FOR THE SERVICE SECTOR

This section investigates the long-run economic determinants of investment in the service sector in Iran. The service sector in the country consists of utilities, construction, real estate, transport and communication, financial and monetary institutions, public service, trade, tourism,

restaurant and hotels, and social, personal and household sectors. This section focuses on the performance of utilities, construction, real estate, transport and telecommunication sectors due to data availability for all the variables. The combined output share of these sectors in total output of the services increased from 10 percent in 1970 to over 31 percent in 2010, signifying their growing importance in the country's economic picture at large and also among the services group (see Table 6O1 in Appendix 6O).

A CVAR model is estimated based on a sample of variables given by the vector $x_t^{\text{Services}} = [i_t^{\text{Services}}, y_t^{\text{Services}}, c_t^{\text{Services}}, \ln(g^k + \delta)_t^{\text{Services}}, dp_t, \text{orev}_t]$, $t = 1974-2011$. The inspection of the data does not show any large outliers in the data for the services, however, there seems to be a level shift [T(1988:01)] in the sector's investment, output and $\ln(g^k + \delta)_t^{\text{Services}}$ corresponding to the cessation of Iran-Iraq war. Based on the observation of the time-series graphs of the data and cointegration relations shown in Appendices 6B and 6G, an unrestricted constant term is included in the model allowing for trend in the levels of the variables and a non-zero mean of the cointegration relations. The H-Q and SC criteria as well as the LM tests determine the lag length of $p = 2$ as an appropriate lag length for this model, the results of which are reported in Appendix 6C.

The empirical findings identify two over-identified irreducible long-run structures based on $\chi^2(2) = 2.556 [0.279]$. The over-identified cointegrating structures of the long-run relations in the data are presented in Table 6.8. As predicted by the theory, based on the first relation normalized on investment, investment is a positive function of output and $\ln(g^k + \delta)_t^{\text{Services}}$ with coefficients magnitude equal to 0.20 and 1.82, respectively. Also, the long-run association between investment and inflation as a proxy for the user cost of capital is negative with an estimated coefficient of -1.88. Further, through its impact on the availability of funds for investment activities, oil revenues are significantly and positively related to investment in the long-run with a coefficient magnitude 0.17. This finding points toward the long-run importance of oil windfalls for investment activities in the services sector. To this cointegrating relation, the error correction terms for output, $\ln(g^k + \delta)_t^{\text{Services}}$ and inflation are statistically significant and carry the expected signs with respective coefficients equal to 0.53, 0.54, and 0.42.

Table 6.8 Services' fully-identified long-run structures (1970-2010)

SERVICES (1974-2011)							
(t-values in parentheses)[p-values in brackets]							
OVER-IDENTIFIED VECTORS - $\chi^2(2) = 2.556$ [0.279]							
r = 2	i_t^{Services}	y_t^{Services}	c_t^{Services}	$\ln(\delta + g^k)_t^{\text{Services}}$	dp_t	$orev_t$	T(1988:01)
$\beta 1^{\text{Services}}$	1.000 (NA)	-0.209 (-4.438)	0.000 (.NA)	-1.824 (-22.565)	1.887 (7.359)	-0.172 (-4.153)	0.000 (.NA)
$\alpha 1^{\text{Services}}$	0.496 (1.970)	0.530 (3.979)	0.484 (3.662)	0.547 (2.149)	-0.425 (-2.668)	-	-
$\beta 2^{\text{Services}}$	0.000 (.NA)	1.000 (NA)	2.432 (6.042)	0.000 (.NA)	4.064 (7.943)	-0.247 (-3.890)	-0.051 (-13.826)
$\alpha 2^{\text{Services}}$	-0.937 (-4.228)	-0.704 (-6.004)	-0.007 (-0.059)	-0.973 (-4.336)	-0.071 (-0.504)	-	-

Note: the analysis is conducted employing WinRATS Pro8.1 software.

The second relation corresponds to the output equation and describes that the output of the services is a negative function of the user cost of capital and inflation in the long-run, with estimated coefficients -2.43 and -4.06, respectively. Also, implicitly consistent with the Dutch Disease theory, the oil sector's output and oil revenues are significantly and positively associated in the long-run with a coefficient magnitude 0.24. To this cointegration relationship, output and inflation present error correcting patterns with respective adjustment coefficients magnitude 0.70 and 0.07. In particular, the speed at which the former converges towards the long-run equilibrium level is quite high, indicative of a significant own equilibrating role for the output equation in the short-run.

On the whole, investment behavior in the service sector is largely consistent with the predictions of the investment theoretical framework. The coefficients on oil revenues for both long-run relations are positive as implicitly expected by the Dutch Disease theory and suggest the importance of oil income for domestic investment activities and output in the service sector in the long-run. In essence, bred by the availability of oil windfalls, various financial supports coupled with the growing output promoted higher investment activities in the service sector.

6.5.9. SECTORAL ANALYSIS OF INVESTMENT AND STRUCTURAL CHANGES

The empirical results show that the neoclassical-accelerator type investment theories are partially but not uniformly successful in providing investment behavior specifications for the case of the oil-rich and mixed-market economy of Iran. Although, according to the economy-level analysis, investment is a positive function of output in the long-run, this relationship appears to be inconclusive given the findings from the sector-level analyses. That is, for the agriculture sector and particularly counterintuitively for the oil sectors, this relationship becomes insignificant. The insignificant long-run relationship between investment and output in the agriculture sector largely results from insufficient modernization and mechanization, negative balance of trade for the agricultural products, land fragmentation, and low levels of human capital and (skilled) labor caused largely by rural-to-urban migration. In the oil sector, the surprisingly lack of long-run relationship between investment and output mainly results from the lack of advanced technology

and equipment due to insufficient domestic and foreign investment coupled with the aging and declining productive oil fields in the country.

The findings from the economy-level analysis, in line with the resource curse theory, presented a negative relationship between aggregate domestic investment and the volatility of oil in the long-run for the Iranian economy. However, the long-run relationship between investment and oil revenues was marginally positive. This coefficient for the agriculture sector as well as for the oil sector was insignificant, whereas it was found positive for the sectors of manufacturing and mining as well as services. The expectedly insignificant and positive coefficients of oil revenues for the lagging tradable sector of agriculture and the booming non-tradable sector of services, respectively, appeared being consistent with the Dutch Disease theory. Nevertheless, in contrast to the Dutch Disease theory, the coefficient on oil revenues for the non-oil tradable sector of manufacturing was found positive. This positive long-run relationship, given the highly oil-based feature of this sector, largely stemmed from the sizable credits extended to this sector by the government together with high imports of raw materials as well as machinery and equipment for the sector. Also, inconsistent with the Dutch Disease theory and surprisingly, the relationship between investment in the oil sector and oil revenues was found insignificant in the long-run.

The industrialization objectives of the Iranian government throughout the period under study and the post-revolutionary government's ambition to diversify the economy away from the oil sector were key underlying reasons for the channeling of the oil revenues to other sectors of the economy, namely services and manufacturing. Furthermore, the government's over-reliance on oil rents for particularly financing its current expenditure and generous subsidies played an important role in this development. This left only a small share of the government's budget for development spending in the economy, of which a great proportion was given to the services and then the manufacturing sector. This in turn hindered investment activities and development in the oil sector and the agriculture sector over the years under study. Overall, there empirical findings suggested an upward level shift in investment and output of agriculture, manufacturing and mining as well as services sectors corresponding to the end of the Iran-Iraq war in 1988. Remarkably, both at aggregate and at sectoral levels, the trivial long-run importance of oil

shocks, the regime shift and various macroeconomic policies on investment points at the common and most important feature of the pre-and post-revolutionary Iran, that is the oil dependency of the economy of the country.

Table 6.9 Investment growth and structural changes in the Iranian economy (1970-2010)

	1971-1979	1980-1988	1989-1994	1995-1999	2000-2004	2005-2010	1970-2010
Annual average output growth rates							
Economy-level	6.53	-1.29	6.35	3.26	6.14	4.68	4.01
Agriculture	3.45	5.37	5.96	2.04	4.43	9.11	5.06
Manufacturing	8.34	4.05	4.63	7.78	14.23	2.78	6.65
Oil Group	-2.22	6.72	6.65	-1.21	4.09	0.19	2.40
Services	12.59	-2.83	7.29	4.89	7.94	5.22	5.68
Annual average investment growth rates							
Economy-level	9.94	-1.89	6.60	8.41	10.72	5.85	6.07
Agriculture	11.47	-0.69	8.00	16.19	10.31	12.96	8.88
Manufacturing	9.71	2.33	10.28	18.18	18.12	-0.32	8.74
Oil Group	21.93	-6.92	23.87	28.10	-2.65	-0.05	10.13
Services	9.39	-1.15	5.02	4.02	13.70	6.59	5.81
Structural changes - Output share in total output							
Agriculture	10.81	16.51	20.15	20.17	18.48	18.83	16.83
Manufacturing	23.94	37.42	36.55	36.52	37.54	39.37	34.45
Oil Group	36.20	12.98	16.84	14.39	11.86	9.91	18.36
Services	29.05	33.08	26.46	28.92	32.13	31.89	30.36
Structural changes - Investment share in total investment							
Agriculture	4.00	3.75	4.63	4.36	4.78	6.27	4.52
Manufacturing	12.40	7.67	12.49	13.06	19.15	18.90	13.25
Oil Group	6.78	4.18	2.65	6.21	4.17	2.68	4.56
Services	48.97	57.39	50.43	44.51	45.52	47.40	49.86

Notes: All variables are of real values. Annual average output and investment growth rates refer to cumulative annual average growth rates. Manufacturing includes mining. Oil group includes gas. Services include construction and real estate, transport, telecommunication and utilities. Years 1971-1979 and 1980-1988 cover the pre-revolutionary era and the Iran-Iraq war period, respectively. Years 1989-1994, 1995-1999, 2000-2004, and 2005-2010 correspond to the years of implementing the first, second, third and fourth development plans, respectively. Source: CBI and author's calculations.

The sector-level rates of growth and the changes in the structure of investment and output over the period 1970-2010 are reported in Table 6.9. Over these years, consistent with the empirical results, the Iranian economy underwent a structural shift from the agriculture sector to the heavy industry and the service sector. The latter, at large, benefited from the highest share of investment in total investment of about 50 percent on average during these years, whereas that of the sectors of agriculture and oil witnessed as low as 4 percent of this share. Similarly, the highest shares of

output belonged to the sectors of manufacturing and mining as well as services, both averaging about 30 percent of total output over these years. On the contrary, the output shares of the oil and the agriculture sectors registered the lowest average of 18 percent and 16 percent, respectively. On the whole, there has been an evident decrease in share of investment of the oil sector from 6 percent in 1970 to only 2 percent in 2010. Also, the share of the output of the oil sector in total investment decreased considerably accompanied by a comparable increase in the share of output of the manufacturing and mining sectors in total output. The oil sector's share of output declined from 46 percent in 1970 to 8 percent in 2010, while that of the manufacturing and mining sectors rose from 18 percent in 1970 to 16 percent in 2010.¹⁰⁸

The comparison of the oil and manufacturing and mining sectors' growth of investment and output helps substantiate some of the empirical findings and arguments made in this chapter about the shrinking investment activities of the agriculture and oil sectors and the growing manufacturing sector in the Iranian economy. The structural development took place gradually throughout the period under study. During the years between 2000 and 2004, coinciding with the third development plan, interestingly, an inverse relation between the rates of growth of investment in the sectors of manufacturing and oil is observed, with the former registering annual average growth rate of 14 percent and the latter a yearly average declining rate of 1 percent.¹⁰⁹ Over the same period, the average share of investment of the manufacturing sector in total investment witnessed its highest rate (19 percent), whereas that of the oil sector recorded merely 4 percent. Likewise, the share of output of the manufacturing sector in total output was 38 percent, while that of the oil sector registered as low as 11 percent. In fact, the objective of the third plan was to 'pave the way to establish a platform for strengthening those sectors which can be substituted for the oil sector in the long run as a mainstay of the economy' (Valadkhani, 2001, p.8).

At large, the output growth of the service sector and the manufacturing sector appeared to be pro-cyclical with regards to oil revenue movements. Similarly, the development of capital formation seemed to be pro-cyclical with respect to oil revenue changes in the sectors of services and

¹⁰⁸ It must be born in mind that these structural changes could occur also in non-resource-based economies.

¹⁰⁹ This is with the exception of the war years when the annual average growth rate of investment in the oil sector registered even lower and fell annually on average by 2 percent during that time.

manufacturing, suggestive of state-driven investment spillovers to these sectors. This is in contrast to the basic Dutch Disease theory which postulates that the presence of natural resources could depress the output of the manufacturing sector through crowding-out effects. In practice, beginning during the pre-revolutionary era and continuing in the post-revolutionary period, income gains from oil exports coupled with the pursuit of industrial policies, positively affected the manufacturing sector's investment and output throughout the years under study.

Nevertheless, this pattern of development was mainly import-driven. As discussed before, the imports associated with the sectors of manufacturing as well as agriculture co-moved with oil revenues. Consistent with the Dutch Disease theoretical framework, this stemmed from the spending effects brought about by the persistent availability of oil windfalls and the consequent restructuring of the whole economy. In practice, the latter contributed to the shift of the factors of production away from the lagging tradable sector of agriculture to the non-tradable sector of services. Also, according to the results, it seems that oil revenues were re-invested in the manufacturing sector mainly through the government-led investment expenditures. Although, not explicitly presented in the Dutch Disease theoretical model, this is a possible countering factor to the Dutch Disease framework.¹¹⁰ In contrast to the Dutch Disease theory, because the tradable manufacturing sector is capital intensive, the movement of labor towards the non-tradable sector of services implied further industrialization for this sector without resulting in the fall of investment or output of the sector.

Yet, the findings that are particularly inconsistent with the Dutch Disease theory in this study are associated with the relative contraction of the oil sector in the Iranian economy. This could be attributed to the fact that the Dutch Disease theory assumes that the booming sector's product is entirely exported. Therefore, it neglects the impact of domestic absorption considerations in the domestic markets of resource producing countries like Iran, both as final goods for consumption and as intermediate inputs for the productive activities of other economic sectors. In the case of the former, if the domestic prices are subsidized as it is the case in the Iranian economy, then the

¹¹⁰ Arguably though, this mechanism would contradict the theoretical core of the Dutch Disease model only if the manufacturing sector would be considered as the non-booming tradable sector of the Iranian economy.

increase in the income of the oil sector could be eaten up by the increase in prices for domestic use of oil, leaving little financial resources for investment in the productive activities of the oil sector. This situation has worsened due to the constrained absorptive capacity of the economy, both in terms of insufficient human capital as well as the capacity required to produce home-grown capital for development of the sector. The use of oil as an intermediate good in other economic sectors has been relatively less intensive and less needed for the service sector's productivity and profitability, hence has been a further contributing factor in the structural shifts in the Iranian economy.

The empirical results are therefore suggestive of the partial presence of the Dutch Disease mechanism in the long-run, primarily affecting the non-booming tradable sector of agriculture. It must be born in mind that the Dutch Disease theory does not assume a partial market economy like Iran, where the objectives to achieve industrial development could override the Dutch Disease effects. In essence, the findings suggest that oil windfalls spurred only partial de-industrialization through a shift away from the sectors of agriculture and oil (and not manufacturing) towards the service sector. Although there are tendencies towards the Dutch Disease, there are even stronger influences from the broad-ranging development processes where resources shifted toward manufacturing and services and away from the sectors of natural resources and agriculture. This is a special case of the Dutch Disease, and could be referred to as the 'Iranian Disease'.

6.6. CONCLUDING REMARKS

This chapter has investigated the economic determinants of domestic investment for Iran's major economic sectors of agriculture, manufacturing and mining, oil and gas, and services, within the neoclassical-accelerator type investment theoretical framework. In the long-run, as implied by substituting the steady-state condition into the FOC equation, investment is expected to be a positive function of output and $\ln(g^k + \delta)_t$, and a negative function of the user cost of capital. Given the high level of oil-dependency of the Iranian economy, the investment equation has been augmented with oil revenues measure to examine the extent to which the empirical results support the presence of the Dutch Disease mechanism particularly through the spending effect. This effect relates to the increased real income fueled by a resource boom to boost the demand for services, which in the short-run, could result in higher prices of services to clear the market. As the output of

the service sector increases compared to its initial level, the output of the lagging tradable sectors of manufacturing and agriculture declines, known as indirect de-industrialization.

According to the empirical results, the modified neoclassical-accelerator type models of investment are applicable for explaining investment on a sector-level basis in the mixed-market economy of the country, but partially, and the determinants of investment vary depending on the idiosyncrasies of across the economic sectors. The findings suggest that oil revenues resulted in state-led investment spillovers in the tradable sector of manufacturing and in the non-tradable sector of services. However, these spillovers did not benefit the agriculture and oil sectors, suggestive of the presence of a special case of the Dutch Disease in the economy of the country, i.e. the 'Iranian Disease'. The surprising and counterintuitive finding associated with the statistically insignificant long-run relationship between investment in the oil sector and oil revenues indicated that oil abundance in the Iranian economy was not a blessing for the resource sector itself.

7. CONCLUSIONS AND POLICY IMPLICATIONS

7.1. INTRODUCTION

This thesis aimed at investigating the theory-consistent economic determinants of aggregate and sector-level domestic investment for the oil-driven economy of Iran within the theoretical framework of modified neoclassical-accelerator type investment models. The investigation was centred around the importance of oil for investment and the structural shifts during the capital accumulation process with an emphasis on the role of the state and institutional changes in this process. The thesis estimated a cointegrated VAR model in which the specification of equilibrium relationships helped to identify the long-run determinants of domestic aggregate and sectoral investment, and to answer the question of how well the theoretical framework was able to explain these determinants in the context of the mixed-market economy of Iran.

At large, this study was carried out in three interlinked stages as follows:

- i) Firstly, the thesis outlined the distinctive characteristics of the Iranian economy that were taken into account for the analysis of the determinants of aggregate and sector-level domestic investment processes in Iran.
- ii) Secondly, an extensive description of principles of investment and of natural resource curse theories was provided, according to which the theoretical framework of the modified neoclassical-accelerator type investment models for Iran were developed. The models included the recent and leading developments in the investment literature such as market imperfections and uncertainty associated with investment decision-making.
- iii) Thirdly, the theoretically consistent models of aggregate and sector-level domestic investment were estimated and inferences were made. In particular, the models were evaluated in terms of economic consistency, statistical significance and sensitivity. Lastly, policy implications were drawn.

It was expected that the standard neoclassical-accelerator theoretical framework could explain investment behavior, but partially, in the context of the partial-market economies like Iran. This is because the neoclassical model of investment was principally developed for market economies.

Hence, it assumes perfect capital markets and certainty about the future profitability so that future expectations are not relevant for the present since the stock of capital can be costlessly and immediately adjusted in the future. Yet, in the mixed-market and oil-dependent economy of Iran, uncertainty associated with the volatile nature of international oil prices and thus oil revenues could be expected to affect investment activities in the economy.

This concluding chapter brings together the key findings of this thesis along with their policy implications. The rest of the chapter proceeds as follows. Section 7.2 reviews the findings of each chapter and Section 7.3 draws policy implications.

7.2. SUMMARY OF STUDY FINDINGS

This thesis focused on the determinants of aggregate and sectoral domestic investment and the associated structural problems in the context of the oil-rich and -dependent economy of Iran. The scope of this study further made it possible to shed light on the contribution of oil income availability and the role of the state in the process of capital formation in the country. Chapter One, motivated by the existing gap in the investment and natural resource curse literature, outlined key objectives of the thesis. These included: (i) examining the economic determinants of aggregate and sector-level domestic investment in Iran within the framework of modified accelerator-neoclassical type investment models; (ii) investigating how well the theoretical framework could explain investment in the context of the Iranian economy and the underlying reasons for (possible) partial applicability of such framework; and (iii) studying the role of the Iranian state in the process of growth, capital formation and structural shifts and the extent to which the presence of oil has altered the path of institutional structure in the Iranian economy. The chapter further discussed the methodology used in this study based on a comparative assessment of various econometrics methods and their applications.

Chapter Two provided a description of the development of Iran's real economy with an emphasis on the role of the state and institutions. The Iranian state enjoyed a high degree of autonomy and a dominant role in allocating resources for domestic investment in the country over the years under consideration. It appeared that the availability of oil influenced capital accumulation processes and

sectoral balances mainly through its income generating effects. Despite the presence of abundant oil income, the government's budgets presented a tendency towards deficits and were largely financed through implementation of expansionary monetary policies.

Chapter Three reviewed the key aspects of the development of the literature on investment and on natural resource curse theories together with their empirical applications. The chapter broadly identified three categories of investment theories, namely the conventional demand-side theories, theories of irreversible investment under uncertainty and the supply-side investment theories. In its simplest form, on the demand side, the desired level of capital stock was found to be related to output, the user cost of capital, capital prices and tax policies. It was, however, discussed that the restrictive assumptions related to the conventional theories spurred attention towards addressing other factors in determining investment such as uncertainty, financial constraints and the presence of imperfect capital markets. These factors are broadly identified by the literature to be distortionary for investment behavior due to their implications for over- or under-investment. The chapter argued that investment models are expected to be partly relevant in partial-market or resource-rich economies as they have been chiefly developed and applied for market economies. Yet, the extent of their relevance is subject to debates depending on different economic, political and institutional structures of resource-rich and partial-market economies. Also, the chapter discussed several causes of the curse including the Dutch Disease effects, the rentier state paradigm, resource prices volatility and a range of institutional factors. The chapter further argued that the curse in resource-rich economies could not be explained by a single reason, and that a country-specific or a case-by-case approach is more appropriate due to distinctive characteristics of these countries.

Chapter Four discussed the theoretical propositions behind the hypothetical relationships within the framework of modified neoclassical-accelerator type investment models and developed a theory-consistent investment model in which separate cointegrating relations are identifiable. Accordingly, long-run domestic investment in the Iranian context was modelled by a function for gross domestic

investment (eq. 4.11). To do so, the assumptions related to the substitutability of factors of production were relaxed by replacing the CD production function by the CES one. Equation 4.11, as implied by substituting the steady-state condition into the FOC equation, predicts that investment is positively related to output and $\ln(g^k + \delta)$, while it is negatively related to the user cost of capital. Taking into account the specifications of the principles of cash flow models, the above equations were incorporated with oil-driven measures of financial constraints, given by equation 4.11'. The latter was justified on the basis of the presence of imperfect capital markets in Iran and the inherent uncertainty associated with the availability of oil-based finance for investment due to the unpredictable nature of oil prices. The chapter further described the methodology used for the empirical analysis, namely the cointegrated vector autoregressive (CVAR) method to allow for determining the theory-consistent relationships between the variables in the long-run.

Chapter Five reported estimation of the theory-consistent model of investment within the modified neoclassical-accelerator type investment theories as developed in Chapter Four for the mixed-market and oil-abundant economy of Iran during 1974-2011. Subsequently, the chapter identified long-run economic determinants of aggregate investment and shed light on how well the theoretical framework could explain investment behavior in the country. According to the empirical results, investment was found to depend on factors which lay within the theoretical framework. That is, consistent with the predictions of the theory, the estimation of equation 4.11' indicated that investment was positively associated with output and the growth rate of capital in the long-run. Further, as expected by the theory, investment was negatively related to inflation, the common proxy for the user cost of capital in the Iranian context. Inconsistent with the expectations of theory, however, investment and the user cost of capital were not associated in the long-run when the expected rates of return on facilities were used in the calculation of the user cost of capital (see Section 5.4.3). This expected relation was explained on the grounds that the Iranian domestic credit markets function under strict government controls and the lending rates of return are centrally-set. Hence, they remain quite unresponsive to the changing market conditions.

The empirical evidence further supported that the coefficients associated with the oil income measure carried a positive sign, suggestive of the importance of oil windfalls for investment

spending in the Iranian economy. Oil price volatility, however, was found having a depressing impact on gross fixed capital accumulation in the long-run. Surprisingly, according to the empirical evidence, the regime shift and the dramatic political and economic upheavals during the study period had not had determining effects on investment due to rigidities in government current spending. The findings further suggested that the Iranian economy was characterized by oil-dependency throughout the period under consideration. Employing Impulse Response Functions (IRFs), the chapter further examined the degree to which shocks from oil revenues and oil price volatility played a role in the shorter-run variability of investment and output. In most cases, the IRFs were found insignificant.

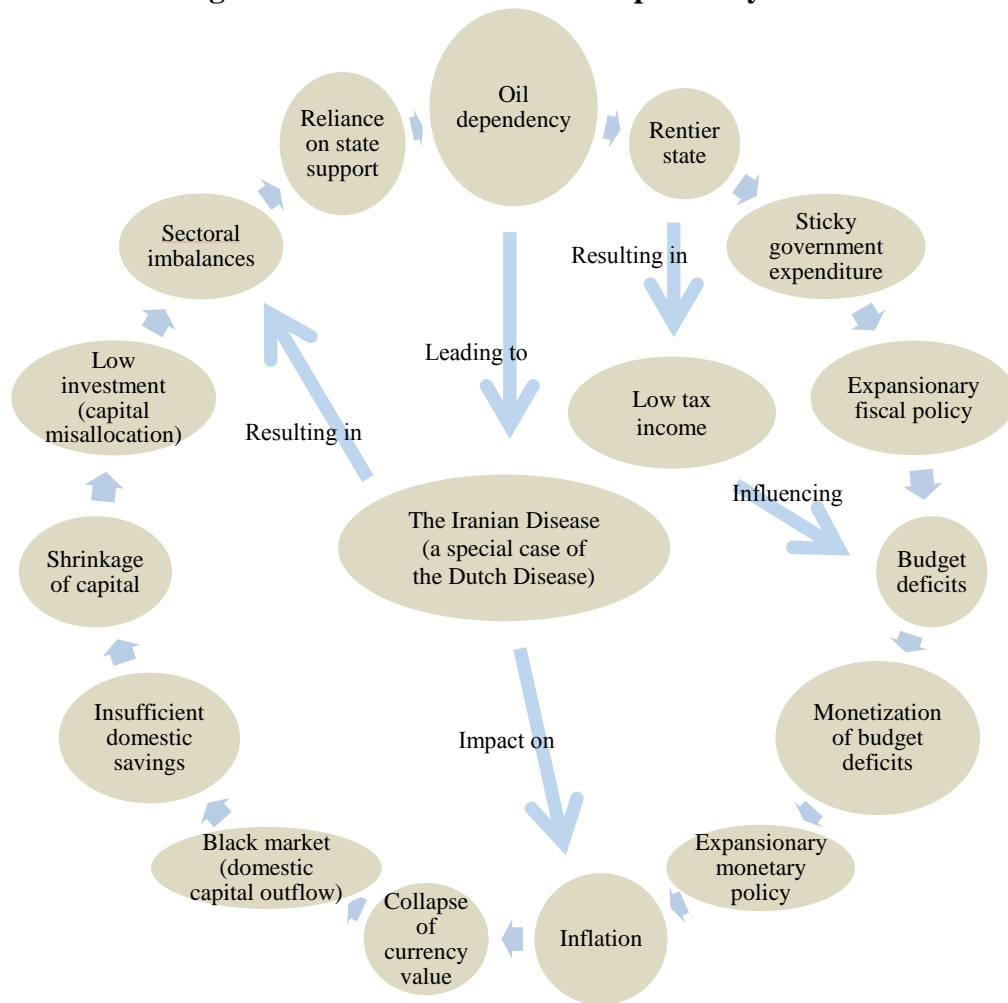
Chapter Six investigated the theory-consistent long-run economic determinants of sector-level investment, to which oil income variable were incorporated, within the modified neoclassical-accelerator type models of investment during 1974-2011. The economic sectors, in line with the Dutch Disease theoretical framework, included the resource sectors of oil and gas, the non-resource tradable sectors of agriculture as well as manufacturing and mining, and the non-tradable sector of services. Given the Dutch Disease theory, it was expected that the association between oil income and investment in the sectors of oil and services to be positive, while that association in the sectors of manufacturing and agriculture to be negative.

Based on the empirical findings, the sector-level investment behavior partly lay within the theoretical investment framework. The findings related to the manufacturing sector were inconsistent with the basic Dutch Disease theory, which postulates that the presence of natural resources has a depressing impact on the output of the manufacturing sector through crowding-out effects. Instead, oil revenues were re-invested in the manufacturing sector, primarily through state-led investment expenditures for the promotion of industrialization in Iran. However, a surprising finding was associated with the long-run insignificant relationships between investment and output of the oil sector and oil revenues. Such counterintuitive relationships, also inconsistent with the Dutch Disease theory, suggested that the abundance of natural resources in the country was not a blessing for the resource sector itself. Hence, seemingly the oil sector (rather than the manufacturing sector) was subject to the Dutch Disease.

On the whole, although the evidence suggested a partial relevance of the Dutch Disease theory, it is of a special case which was referred to as the ‘Iranian Disease’. In its simplest form, the ‘Iranian Disease’ was characterized by the expansion of output and capital accumulation in the sectors of services and manufacturing (suggestive of state-directed investment spillovers to both sectors), yet by their shrinkage in the sectors of oil and agriculture. Similar to that of the economy-level analysis, the trivial effects of the regime change as well as political and economic upheavals during the study signified the common and most significant feature of the Iranian economy in both pre- and post-revolutionary eras, that is, oil-dependency.

In brief, the Iranian economy was caught in a vicious circle over the years under consideration (see Figure 7.1). The state taxed lightly, as the major source of its revenues consisted of rents from oil exports. In fact, due to its high degree of involvement within the domestic economy, the abundant oil income was mostly utilized to finance the government’s current expenditure in a form of free or below cost provisions of state services, causing its current spending to become sticky. This, coupled with low tax income, adversely affected the government’s budget deficits to the extent that they were financed through the conversion of foreign exchange from oil rents into the domestic currency. This setting created a close link between fiscal and monetary policies and led to the expansion of money supply and therefore bred highly persistent inflation in the economy. The existence of the Iranian-type Dutch Disease effects also fueled the inflationary pressures due to shifting investment towards the non-tradable service sector particularly real estate and property markets, causing price bubbles and sectoral imbalances in the Iranian economy.

Figure 7-1 Vicious circle of oil-dependency in Iran



Source: Designed by the author

Even though higher inflation allowed the government to earn higher income through seigniorage, it led to higher uncertainty with costly implications for investment and savings in the economy.¹¹¹ Under inflationary circumstances, the Iranian currency continuously lost its value. Coupled with negative or zero real profit rates for term deposits, little incentives were left for the public to save their funds in the banking system. Instead, investment in real estate, gold coins and foreign currencies became a common practice as they provided the public with higher returns on investment both in the short- and in the long-run. Therefore, the propensity to save and consequently the

¹¹¹ Seigniorage is regarded as a form of inflation tax which redistributes real resources to the currency issuer. Rather than collecting taxes paid out of the existing money stock, issuing new currency is then considered in effect a tax that falls on those who hold the existing currency. In the long-run, inflation in the money supply may cause a general rise in prices due to the reduced purchasing power of the currency.

availability of finance for domestic investment declined. Under these circumstances, investment both in the tradable and non-tradable sectors became more reliant on support from the government. This setting in turn made the current and development budgets of the government further oil-dependent over the study period.

On the whole, during both the pre- and post-revolutionary years under consideration, the economy of Iran remained oil-driven and suffered from high inflation. The development plans were primarily concerned with economic growth, and contained abundant quantitative projections based on rather implausible assumptions, all highlighting a need to control inflation. However, the implementations of these plans' fell short of intentions. Expansionary monetary policies coupled with deficit financing by the government via the CBI borrowing increased liquidity growth and added to the persistent inflationary pressures in the economy. The share of government expenditure in GDP increased over time and became more oil-reliant. The Iranian currency lost its value, inflation rose and the economy continued to remain stagnant. This brought about an uncertain economic and financial environment with no positive impact on the promotion of investment activities or the formation of capital stock. The government chose expansionary policies when oil revenues increased, yet did not pursue contractionary policies when oil windfalls declined, partly due to its sticky current expenditures and the undertaking of more projects during the booms which had to be financed in the following years regardless of the movement of oil prices and revenues, further fueling inflationary pressures in the economy.

7.3. POLICY IMPLICATIONS

To achieve sustainable development, investment is a crucial requirement and thus it is a central objective on the agenda of policy makers. In Iran, unlike in developing economies where the investment needs are far greater than the available finance, the major challenge is how to manage oil rents so as to promote efficient investment and growth. This is especially important because oil income as the essential source of financing investment in the country is subject to uncertainty due to the notoriously volatile nature of oil prices.

With the advent of substantial oil windfalls and the consequently larger magnitude of resources at the disposal of the Iranian state, the state has played an interventionist role in the process of investment and structural changes in the Iranian economy. Yet, massive oil windfalls have not been justly distributed in the economy given the uneven expansion of credits in the economy and the differences in the significance of coefficients associated with the oil income growth variable as discussed in Chapters Two and Six. This could partly be due to inefficient utilization of oil windfalls. As a result, the economy has experienced an interrupted capital accumulation process and periodical balance of payment problems over the study period. This has influenced some of the long-run relationships among the determinants of investment predicted by the framework of modified neoclassical-accelerator type investment models used in this study, particularly at sector-level.

Based on the above discussion, two major policy-based questions arise in the context of the Iranian economy:

- 1) What can be done to improve the management of oil wealth so as to promote (efficient) investment in the country?
- 2) What are the macroeconomic measures that Iran needs to adopt to break the vicious circle of oil dependency in order to encourage and strengthen domestic investment?

Chapter Three, in accordance with the extant literature on the resource curse, has identified some solutions on the basis of resource revenue management and efficient investment and savings (see

Table 3.6). These include the Hotelling and Hartwick rules, taxing natural resources, the oil-to-cash transfers, the bird-in-hand and permanent income policies, establishment of a sovereign wealth fund and the investing-to-investing strategy. However, due to the existing institutional and political setup in Iran, these policy recommendations must be treated with caution. For example, as discussed in Chapter Two, more recently several mechanisms have been developed to cope with oil dependency and its consequences. In 2000, the government established an oil stabilization fund (OSF) to save a share of oil income for buffering against the effects of oil price variations. According to the OSF's published rules, the money available in the fund was to be given to the private and public sectors in a form of loans to promote investment.

In 2005, the government introduced the direct transfer of oil income to Iranian citizens. Initially, this reform aimed at the low-income and poor population of the country. Yet, the program's coverage expanded to include over 70 million of the Iranian population, awarding an estimated US\$45 billion on a yearly basis.¹¹² This has mainly resulted in higher public spending and budget deficits of the government. In 2009, the National Development Fund (NDF) replaced the OSF. But, according to the NDF's rules, as much as 63.5% of the profits from oil and gas are required to be allocated to the national budget and 14.5% of the profits to the National Iranian Oil Company (NIOC), leaving only 20% for the NDF to be used for saving and investment purposes.

At large, the impact of these reforms has been insignificant. For instance, during 2005-2010, inflation averaged above 15% p.a. Also, during this period, despite the favorable oil prices and high oil income during most of these years, the economy grew only by 4.8% p.a. (lower than the 8% target).

¹¹² See, for instance, Guillaume, et al., (2011)

Therefore, employing the proposed policies as stated above may prove ineffective. This could have major consequences for the efficient allocation of finance for investment in the country particularly when investment practices encounter bottlenecks that can dampen their marginal returns in the economy. Therefore, in order to achieve a greater degree of economic efficiency, Iran should enhance its capacity to alleviate investment-dampening distortions and to promote effective utilization of oil windfalls through practical reforms, some of which may include:

- i. formulating clear and enforcing rules for saving and spending of the NDF's resource income and accumulating greater savings in the fund to cushion against oil price volatility;
- ii. diversifying the economy and encouraging private sector competition to promote investment and hence growth, particularly in the resource sector and the non-oil tradable sectors of the economy;
- iii. introducing a law that necessitates cost-benefit analysis of how resource income should be spent before large public investments are exercised through independent domestic and international consulting companies;
- iv. lowering capital and corporate income taxes to enable firms to expand business opportunities so as to induce investment.

Furthermore, the results of the investigation of the determinants of domestic investment in Iran have policy implications, which should be taken into account by the Iranian authorities when considering the investment outlook for the Iranian economy. As shown by these empirical results, for instance, investment is rather insignificantly related to the user cost of capital in the long-run. This finding is not in line with the predictions of the theoretical framework and has been explained in the previous chapters on the basis that Iranian domestic credit markets function under strict government controls.

Important policy implications can be drawn from this finding. Firstly, inconsistent with the objectives of the policy-makers to enhance investment activities by lowering real rates of return, very low or negative rates did not succeed in promoting aggregate and sectoral investment in the country in the long-run. Also, because the rates of return are centrally-determined and change infrequently, they remain quite unresponsive to changing market conditions. This suggests that the user cost of capital channel of monetary transmission is rather weak. In particular, in the absence of a strong and realistic user cost of capital system, it may not be effective for the government to encourage investment by lowering real rates of return or to control inflationary pressures by increasing them to curb excess aggregate demand in the economy.

Also, despite the long-run positive relationship between aggregate investment and oil revenues, the small magnitude of the coefficient associated with oil revenues suggests that oil wealth has not been converted into productive investment. The negative long-run association between investment and oil price volatility in the Iranian economy points towards the vulnerability of the economy to the fluctuations in the oil prices. Therefore, since government spending in Iran is pro-cyclical to the movements of oil prices and oil revenues, it is strongly recommended for the government's budgets to break the vicious circle of oil-dependency. However, as discussed in the thesis, given the rather underdeveloped nature of capital markets in the country, the banking system has met almost all the financing needs of the public and the private sector. This in turn has given rise to the oil-bred

growth of money supply, the pursuit of expansionary fiscal and monetary policies and thus inflationary pressures in the economy.

Accordingly, when assessing the effects of monetary policy on the economy, due to the high degree of oil-dependency of the Iranian economy and the presence of oil-driven uncertainty as the empirical findings suggested, it is crucial to consider the structural rigidities in the economy. This is because, in Iran, monetary and fiscal policies are closely linked through the monetization of budget deficits due to the conversion of oil income into the Iranian currency. In fact, money supply will continue to rise as long as budget deficits persist and the government attempts to pay for these deficits by printing money. This explains the expansionary monetary policy that is being pursued in Iran. It is therefore strongly advisable to limit oil-income based government spending to reduce budget deficits as a key source of inflation in the economy. Hence, it is necessary for the Iranian authorities to constrain oil-fueled money growth and to adopt appropriate monetary and fiscal policies in order to control inflation and to stimulate investment activities in the country.

Further, in order to cushion the oil-based economy of Iran against volatile oil income and their adverse long-run effects on investment, the motives still remain to keep the NDF as a ‘stabilization fund’. Otherwise, if the government does not succeed to adequately manage oil income, the real exchange rate will remain volatile and the symptoms of the ‘Iranian Disease’ will become more profound. It is also desirable that the government accumulates reserves for investment purposes in a separate ‘investment fund’ to protect domestic investment in Iran against the negative consequences of exchange rate volatility.

As stated earlier, the depreciation of the free exchange rate due to inflation has lowered the demand for the domestic currency and has increased the demand for foreign currencies and gold coins, which are perceived as more credible because of their higher expected returns under inflationary circumstances. This in turn has negatively affected the propensity to save in the banking system and has consequently reduced the available finance for domestic investment activities. Hence, an investment-inducing policy should consider preserving the value of the domestic currency, stabilizing exchange rates and reducing the gap between formal and informal exchange rates. It is

therefore advisable for the government to maintain a fixed exchange rate system as a nominal anchor to control inflation. This is because a fixed exchange rate has been associated with lower volatility that could positively affect expectations with regards to higher expected return on investment. Nevertheless, further research is needed to determine the optimal exchange rate policies in the country, which is beyond the scope of this study.

From the above discussion, some policy suggestions pertinent for the case of Iran are to:

- i. exercise caution in formulating development plans based on the expected income from oil exports and to reduce overall dependence on oil;
- ii. establish a more realistic and stronger rates of return system;
- iii. limit the government's current spending and ensure that government deficits are not allowed to become large too quickly; to analyze budget deficits and pursue appropriate monetary and fiscal policies;
- iv. preserve the value of the Iranian currency and stabilize exchange rates;
- v. establish an 'investment fund' for saving and investment purposes, and a 'stabilization fund' to help protect against oil price volatility and the consequent pro-cyclical fiscal and monetary responses.

On the whole, it is a challenge to convert oil wealth into productive investment and physical capital. However, in the presence of efficient institutional and political institutions and by adopting appropriate macroeconomic policies which are not pro-cyclical to oil price movements, it is possible to harness the Iranian oil wealth for investment and economic development. Although a number of policies have been proposed, a coordinated and well-structured policy-mix with regards to the management of natural resource wealth and investment is required in order to obtain optimal outcomes. Therefore, future research could consider simulating and evaluating different individual and combined investment-promoting policy scenarios.

In Iran, even though prior to the revolution in 1979, direct investment by the government in different economic sectors was substantial, this has been reduced in the post-revolutionary era. Furthermore, as a result of the implementation of the privatization program since the early 2000s, a large part of the public enterprises has been divested by the government. Against this background, the Iranian economy is characterized by a mixed-market nature and consequently a neoclassical model of investment may be pertinent, even though the prices may provide incomplete signals to participants relative to market economies.¹¹³ Also, despite the fact that a great share of the economy's large scale private sector was nationalized at the time of the revolution, these enterprises are organized in large conglomerates and are independent of the central government. Undeniably, compared to the market economies, it may not be easy to define the private sector in the context of the mixed market economy of Iran. Nevertheless, in investment analysis, the semi-SOEs could still be considered as private entities. This is because they are commercial entities producing for the market, thus following the same rationale as private businesses.

Hence, due to the peculiarities of the country as discussed in depth in Chapter Two, the mixed market economy of Iran is not a fully neoclassical economy. Therefore, as was to be expected, the empirical findings were partially consistent with the modified neoclassical-accelerator theoretical framework used in this thesis. In particular, the empirical evidence associated with the aggregate level investment equations were found largely consistent with the theoretical framework. The results were most consistent in the elasticity of substitution estimates in a CES production function, which are typically less than unity and positive.

Overall, due to the restrictive assumptions inherent in the standard investment models, it has become evident that adjustments are needed to make the conventional neoclassical-accelerator type theoretical framework more applicable for the context of partial-market oil-based economies like Iran. For example, a variable like the user cost of capital may be required to be more cautiously defined and measured if the rates of return are centrally-determined. Also, it seems inevitable to

¹¹³ See Chapter Two for a detailed discussion on the peculiarities of the Iranian economy during 1965-2010.

extend the theory-consistent investment equations by incorporating oil-based proxies (as specified by the principles of cash flow models) to account for capital market imperfections and the importance of oil in modeling investment behavior in the context of oil-rich economies.

This, therefore, calls for the modification or development of investment theories to help better identify investment determinants in countries with conditions that are at variance with the assumptions of the standard investment models. Importantly, however, the conventional investment theories like the ones applied in this thesis are found to be relevant in identifying some of the key determinants of investment in the context of mixed-market economies like Iran. Also, these models could be used as a guide to investigate the degree of the applicability of such a theoretical framework and thus to draw policy implications in the context of partial-market, oil-abundant, and -exporting economies like Iran. Such analysis, for instance, can shed light on the extent to which privatization programs and market-based policies could be effective in such economies. Moreover, utilizing the integration and cointegration properties of the data employing a CVAR model such as the one employed in this thesis could be used to make inferences based on the theoretically motivated long-run relationships between market-based economic determinants of investment, its outcome rests on the idiosyncrasies of such economies.

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APPENDICES

APPENDIX 2A: IRANIAN BANKS AND INVESTMENT INSTITUTIONS

<u>Name</u>	<u>Year of establishment</u>	<u>Privatization Year</u>
<u>State-owned Banks</u>		
<i>Commercial banks</i>		
Sepah Bank	1925	
Melli Bank	1928	
Post Bank	1996	
<i>Specialized Banks</i>		
Keshavarzi Bank	1933	
Sanat-o-Madan	1957	
Maskan Bank	1979	
Toseye-o-Saderat	1991	
Toseye-Taavon	2009	
<u>Private Banks</u>		
Saderat Bank	1952	2008
Refah e Karegaran Bank	1960	
Tejarat Bank	1978	2008
Mellat Bank	1980	2008
Sina Bank	1985	2007
Eghtesad e Novin Bank	2001	
Karafarin Bank	2001	
Parsian Bank	2001	
Saman Bank Corp	2001	
Sarmayeh Bank	2001	
Pasargad Bank	2005	
Tat Bank	2009	
Ansar Bank	2009	
Garzol-Hasaney e Mehr Irar	2009	
Day Bank	2010	
Cyrus Bank	2010	
Tourism Bank	2010	
Hekmat Iranian Bank	2010	
City Bank	2010	
<u>Investment Institutions</u>		
Firuzeh	2005	
Amin	2008	
Sarmayeh Novin	2008	
Pasargard	2008	

Source: Collected by the author from various data sources.

APPENDIX 2B: EXPECTED RATE OF RETURN ON FACILITIES (%)

Expected Rates of Return on Facilities (%)					
	Exports	Trade and Services	Construction and Housing	Manufacturing and Mining	Agriculture
1973	13	13	8-11	8-11	5-11
1974	9	13	8-11	8-11	5-11
1975	9	13	8-11	8-11	5-11
1976	9	13	9-11	9-11	5-11
1977	9	14	9-12	9-12	5-12
1978	9	14	9-12	9-12	5-12
1979	8-12	8-12	4-8	6-10	4-8
1980	8-12	8-12	4-8	6-10	4-8
1981	8-12	8-12	4-8	6-10	4-8
1982	8-12	8-12	4-8	6-10	4-8
1983	8-12	8-12	4-8	6-10	4-8
1984	8-12	8-12	8-12	6-12	4-8
1985	8-12	8-12	8-12	6-12	4-8
1986	8-12	8-12	8-12	6-12	4-8
1987	8-12	8-12	8-12	6-12	4-8
1988	8-12	8-12	8-12	6-12	4-8
1989	8-12	8-12	8-12	6-12	4-8
1990	17-19	17-19	12-14	11-13	6-9
1991	18=<	18=<	12-16	11-13	6-9
1992	18=<	18=<	12-16	13	9
1993	18	18-24	12-16	16-18	12-16
1994	18	18-24	15	16-18	12-16
1995	18	22-25	15-16	17-19	13-16
1996	18	22-25	15-16	17-19	13-16
1997	18	22-25	15-16	17-19	13-16
1998	18	22-25	15-16	17-19	13-16
1999	18	22-25	15-16	17-19	13-16
2000	18	22-25	15-16	17-19	13-16
2001	18	23=<	15-16	16-18	14-15
2002	17	22=<	14-15	15-17	13-14
2003	15	21=<	15	16	13,5
2004	14	21=<	15	15	13,5
2005	16	16=<	15	16	16
2006	14	14	13	14	14
2007	12	12	11	12	12
2008	12	12	11	12	12
2009	12	12	11	12	12
2010	12,14	12,14	11,14	12,14	12,14
2011	14,15	14,15	11,15	14,15	14,15
2012	14,15	14,15	11,15	14,15	14,15

Source: Central Bank of Iran (Economic Time-series Data-base).

APPENDIX 2C: TERM-INVESTMENT DEPOSIT RATE (%)

	Short-Term	One-Year	Two-Year	Three-Year	Four-Year	Five-Year
1973	8	9	9	9	9	9
1974	8	9	9	9	9	9
1975	8	9	9	9	9	9
1976	8	9	9	9	9	9
1977	9	10	10	10	10	10
1978	9	10	10	10	10	10
1979	7	8.5	8.5	8.5	8.5	8.5
1980	7	8.5	8.5	8.5	8.5	8.5
1981	7	8.5	8.5	8.5	8.5	8.5
1982	7	8.5	8.5	8.5	8.5	8.5
1983	7	8.5	8.5	8.9	8.5	8.5
1984	7.2	9	9	9	9	9
1985	6	8	8	8	8	8
1986	6	8.5	8.5	8.5	8.5	8.5
1987	6	8.5	8.5	8.5	8.5	8.5
1988	6	8.5	8.5	8.5	8.5	8.5
1989	6	8.5	8.5	8.5	8.5	8.5
1990	6.5	9	10	11	11	13
1991	6.5	9	10.5	11.5	11.5	14
1992	7.5	10	11.5	13	13	15
1993	8	11.5	13.5	14.5	14.5	16
1994	8	11.5	13.5	14.5	14.5	16
1995	8	14	15	16	16	18.5
1996	8	14	15	16	16	18.5
1997	8	14	15	16	16	18.5
1998	8	14	15	16	16	18.5
1999	8	14	15	16	16	18.5
2000	8	14	15	16	17	18.5
2001	7	13	13-17	13-17	13-17	17
2002	7	13	13-17	13-17	13-17	17
2003	7	13	13-17	13-17	13-17	17
2004	7	13	13-17	13-17	13-17	17
2005	7	13	13-17	13-17	13-17	17
2006	7	7-16	7-16	7-16	7-16	16
2007	7	7-16	7-16	7-16	7-16	16
2008	9=<	15=<	16=<	17=<	18=<	19=<
2009	9	14.5	15.5	16	17	17.5
2010	6	14	14.5	15	16	17
2011	7-15	17	18-18.5	18.5-19	19-19.5	20
2012	7-15	17	18-18.5	18.5-19	19-19.5	20

Source: Central Bank of Iran (Economic Time-series Data-base).

APPENDIX 2D: FINANCING CAPITAL FORMATION IN REAL TERMS (BILLION RIALS)

Year	GFCF	Gross domestic savings	Non-oil income	Oil income	Net factor income from	Year	GFCF	Gross domestic savings	Non-oil income	Oil income	Net factor income from
1965	19926.45	22556	6817.35	8253.45	-1161	1987	58428.08	82614	14070.64	9106.48	-1027
1966	20441.24	24205	8665.80	7929.71	-742	1988	46936.32	35428	11423.12	7244.52	-1522
1967	25255.59	25133	8908.82	9025.82	-754	1989	50418.33	45549	12671.70	11569.08	-1377
1968	28012.53	31315	10834.58	10206.96	-1368	1990	57400.64	73543	14297.07	21375.94	-1410
1969	30051.18	33178	12109.99	11644.86	-1431	1991	84016.03	77402	17122.98	17959.37	-2655
1970	34369.23	37470	14307.54	13833.89	-1732	1992	81090.17	79139	18720.47	20329.56	-2332
1971	41346.47	46887	15242.48	22982.12	-1928	1993	72729.37	108507	14379.75	37923.81	-2464
1972	50038	63554	17228.79	24779.43	676	1994	62389.86	99837	15313.55	42361.74	-4010
1973	56305.82	85192	15711.04	31862.20	99	1995	59560.22	101853	17264.93	41841.18	-1319
1974	67451.53	146043	12556.01	79981.51	2826	1996	74465.36	118346	21622.94	43491.19	-1675
1975	97352.98	138756	21145.52	78628.78	3034	1997	83764.5	110407	25931.41	36446.71	-491
1976	129524.1	176517	22898.30	78452.46	4334	1998	86485.12	94217	28409.51	20583.55	-129
1977	112238.9	158102	24835.35	69348.22	2128	1999	91505.34	120469	33798.35	31007.95	-803
1978	92248.32	114448	25742.60	44532.01	-4173	2000	95267.39	124330	25090.76	33005.80	-490
1979	64238.75	117951	16600.91	42192.40	5752	2001	108761.5	113877	26620.65	35789.59	485
1980	66839.12	61348	12363.05	25139.05	3861	2002	123776.3	134415	24474.07	40167.50	-2522
1981	61553.75	50069	15873.38	23495.36	2778	2003	139032.8	150647	27346.97	43965.15	-2755
1982	66111.26	69886	15450.60	32131.70	1032	2004	151806.1	160435	29488.08	42408.71	-3306
1983	95297.07	75192	17018.05	30455.51	788	2005	164954	177125	47642.13	44096.16	-3167
1984	88222.59	58226	20101.84	21648.97	664	2006	169837	190536	48033.73	37649.44	-3089
1985	70880.82	46580	21494.24	17822.41	-218	2007	181020	230804	51388.40	29774.91	-3434
1986	59916.55	37299	16773.39	5729.52	-189						

Note: Constructed based on data in billion Rials at constant 2004/05 prices. GFCF stands for gross fixed capital formation. Net factor income includes receipts minus payments related to profit of investment and compensation of employees in public and private sectors. Source: Central Bank of Iran (Economic Time-series Data-base).

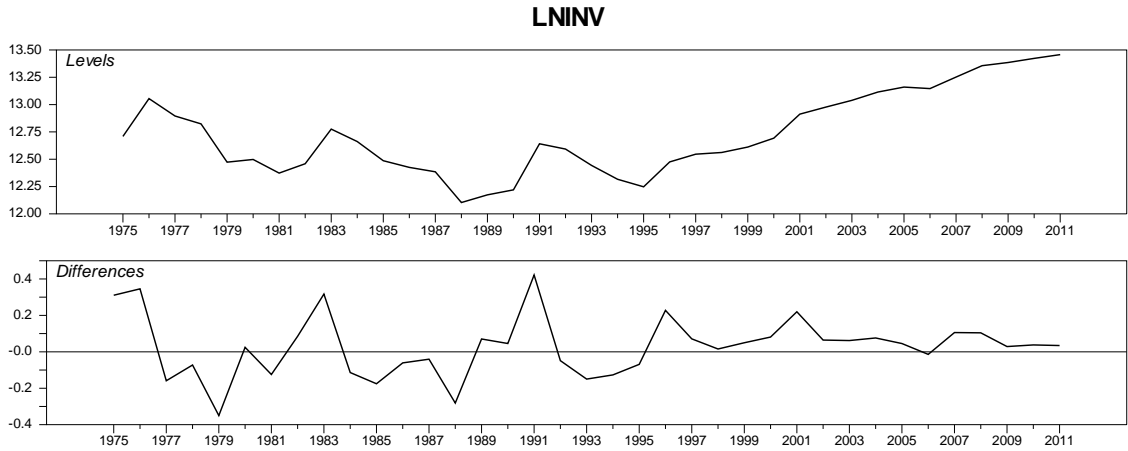
APPENDIX 5A: DESCRIPTION OF THE VARIABLES

VARIABLES	DESCRIPTION	SOURCES
i_t	Gross fixed capital formation (in billion Rials at constant 2004/05 prices) in natural logarithmic form	Data are collected from the CBI's annual national accounts.
y_t	Gross domestic product (in billion Rials at constant 2004/05 prices) in natural logarithmic form	Data are collected from the CBI's annual national accounts.
c_t	The user cost of capital calculated as [(1 minus tax rates) multiplied by ([weighted average of expected rates of return on facilities/100] minus [changes in natural log of the implicit deflator of gross domestic product]) + (the rate of capital stock depreciation)]	Constructed by the author. Data on corporate tax, total revenues, expected rates of return on facilities and implicit deflator of GDP are collected from the CBI's annual national accounts.
$\ln(g^k + \delta)_t$	Constructed employing equations (5.6) and (5.7) and explained in Chapter Five Section (5.4.3) and presented in details in Appendix 5L	Constructed by the author. Data on capital stock are collected from the CBI's annual national accounts.
dp_t	Changes in natural log of the implicit deflator of gross domestic product (GDP)	Constructed by the author. Data on the implicit deflator of GDP are collected from the CBI's annual national accounts.
po_t	Real oil prices in logarithmic form	Monthly, quarterly, and annual data on real (imported) crude oil prices are collected from energy information administration's (EIA) short-term energy outlook (February 2013); data during 1959-1973 represent real spot oil prices collected from the British Petroleum (BP) statistical review of world energy; data from EIA are cross-checked with data from BP. ¹¹⁴
dpo_t	Changes in logarithm of real oil prices employing Hamilton's (1983) specification	Constructed by the author.
$volo_t$	Realized annual volatility of logarithm of real oil prices employing Mohaddes' and Pesaran's (2013) method	Constructed by the author.
$voloi_t$	Realized annual volatility increase of logarithm of real oil prices	Constructed by the author.

¹¹⁴ The quarterly data for crude oil exports in thousands barrels per day (collected from CBI) during 1973/Q2-1978/Q1 and 1986/Q3-1988/Q2 reflect the annual figures of the respective years. The quarterly data for nominal and real imported crude oil (collected from EIA) during 1973/Q2-1973/Q4 reflect the annual figures of the respective years. Also, where the unified exchange rates regime was in place, the figures on official and market exchange rates (collected from CBI) are the same.

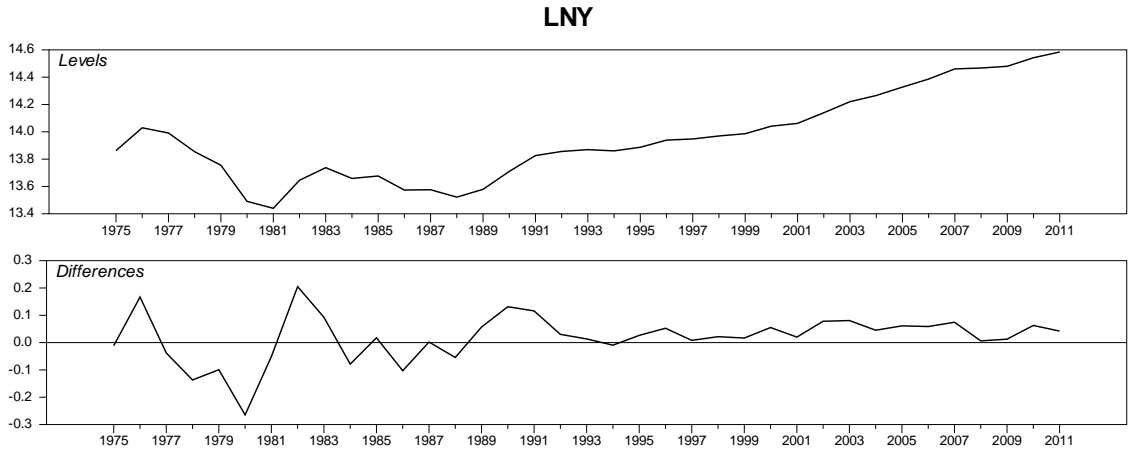
volod_t	Realized annual volatility decrease of logarithm of real oil prices	Constructed by the author.
orev_t	Real oil revenues are calculated as: $orev_t = norev_t - p_t$, where $orev_t$, $norev_t$ and p_t refer to real oil revenues, nominal oil revenues and implicit deflator of gross domestic in (natural) logarithmic forms	Calculated by the author; data on Iran's nominal oil revenues are collected from the CBI time-series database.
dorev_t	Changes in logarithm of real oil revenues	Constructed by the author.
dorevi_t	Logarithm of real oil revenue increase employing Mork's (1989) asymmetric specification	Constructed by the author.
dorevd_t	Logarithm of real oil revenue decrease employing Mork's (1989) asymmetric specification	Constructed by the author.

APPENDIX 5B: GRAPHS OF THE IRANIAN DATA IN LEVELS
FIGURE 5B1: LOG AGGERGATE INVESTMENT
(IN BILLION RIALS AT CONSTANT 2004/05 PRICES)



Source: Central Bank of Iran (Economic Time-series Data-base).

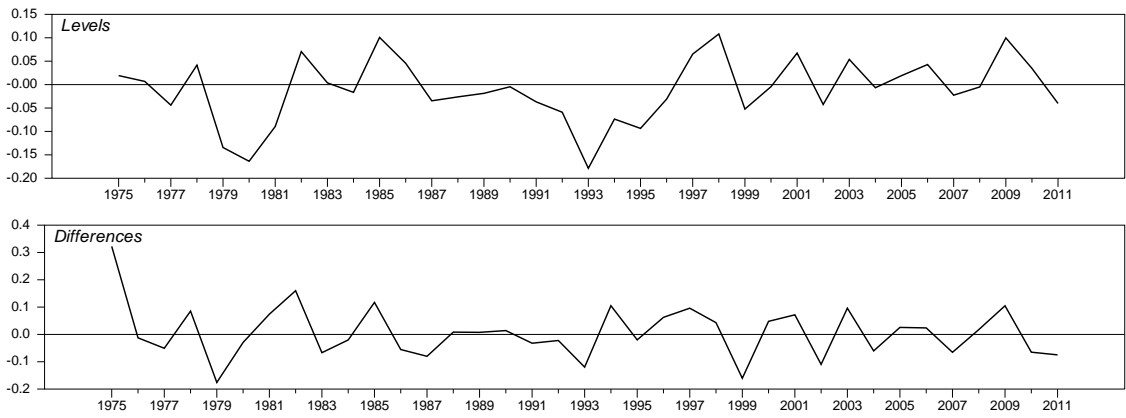
FIGURE 5B2: LOG AGGERGATE OUTPUT
(IN BILLION RIALS AT CONSTANT 2004/05 PRICES)



Source: Central Bank of Iran (Economic Time-series Data-base).

FIGURE 5B3: THE REAL USER COST OF CAPITAL

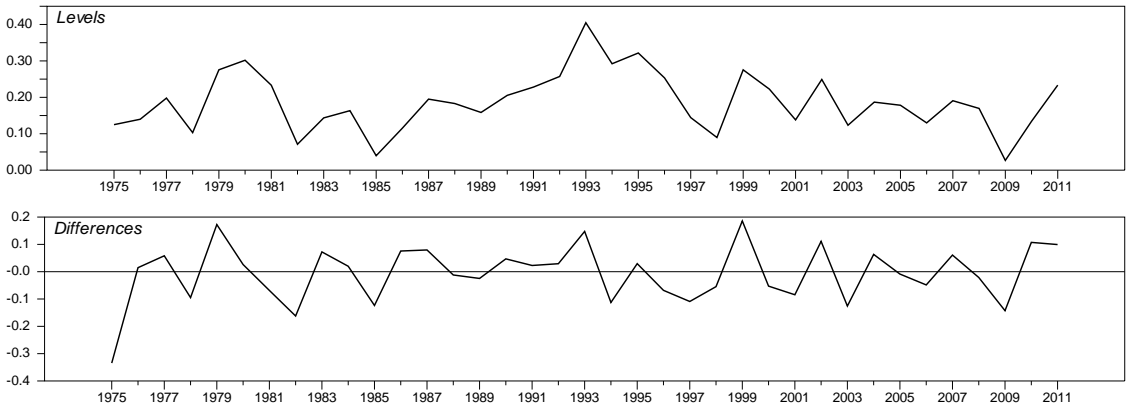
C



Source: Author's calculation.

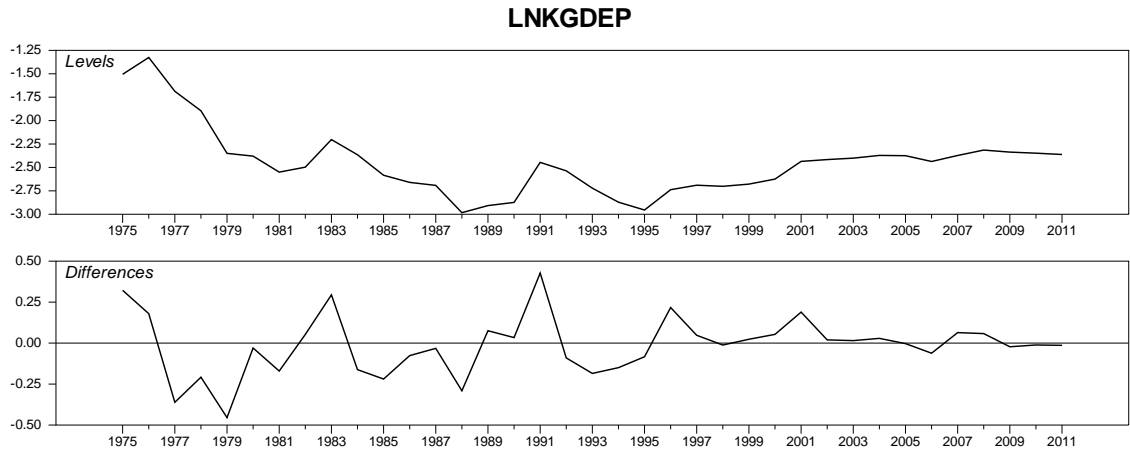
FIGURE 5B4: INFLATION

DP



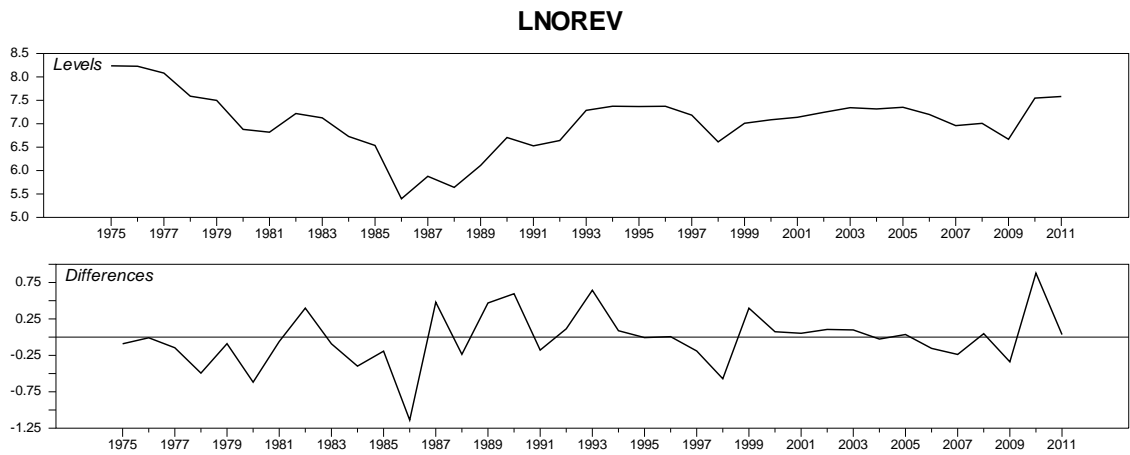
Source: Central Bank of Iran (Economic Time-series Data-base)

FIGURE 5B5: LOG SUM OF CAPITAL DEPRECIATION AND CAPITAL GROWTH



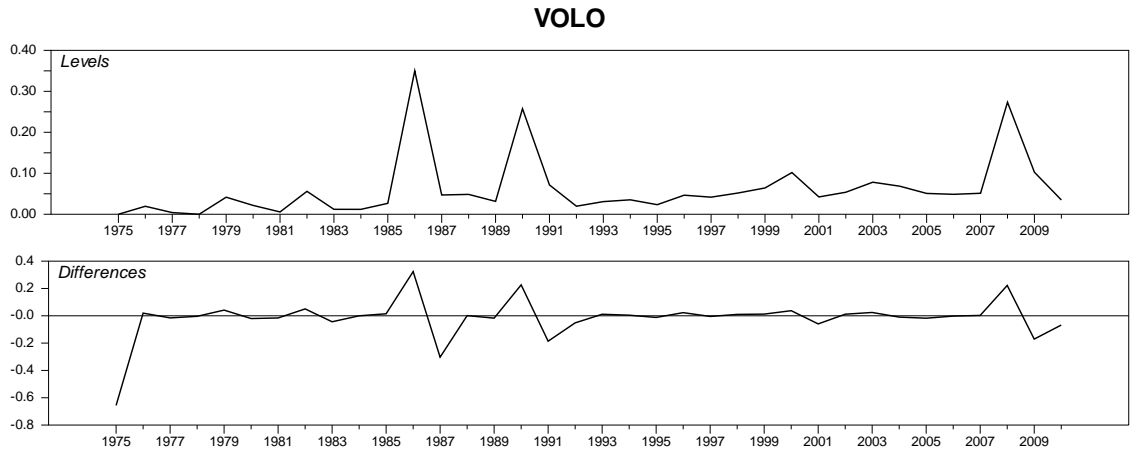
Source: Author's calculation.

FIGURE 5B6: REAL ANNUAL OIL REVENUES



Source: Central Bank of Iran (Economic Time-series Data-base) and author's calculation.

FIGURE 5B7: REALIZED ANNUAL VOLATILITY OF OIL PRICES



Source: Author's calculation.

FIGURE 5B8: DIFFERENCED OIL REVENUE INCREASE

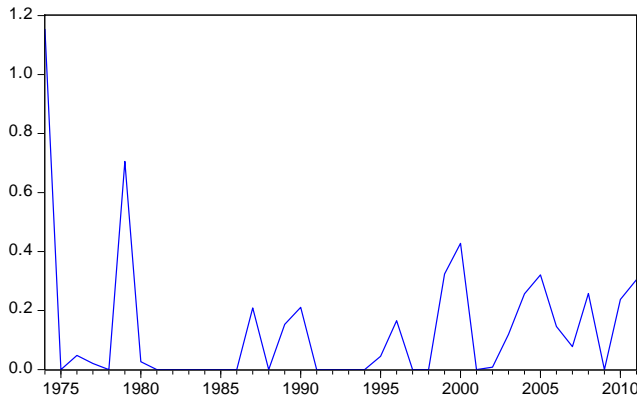


FIGURE 5B9: DIFFERENCED OIL REVENUE DECREASE

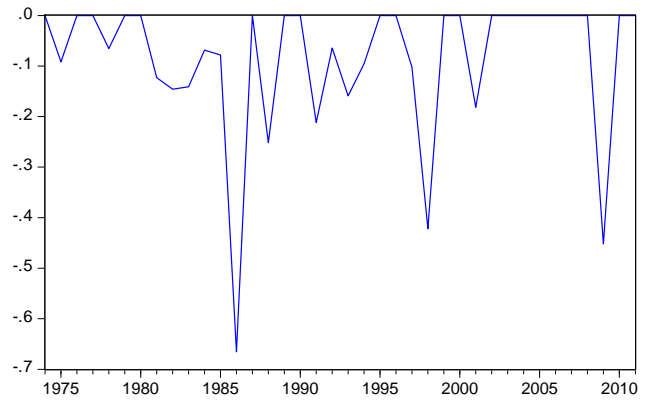


FIGURE 5B10: REALIZED ANNUAL OIL VOLATILITY INCREASE

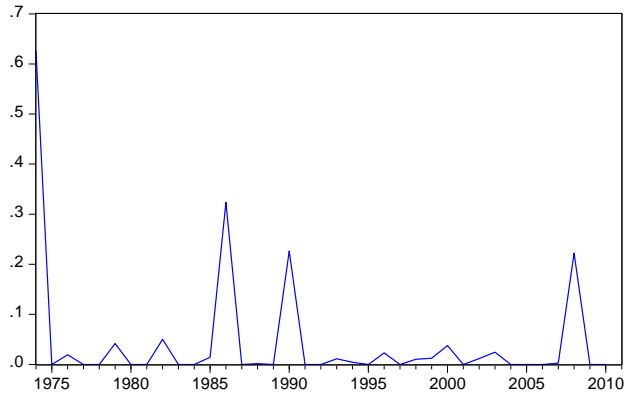
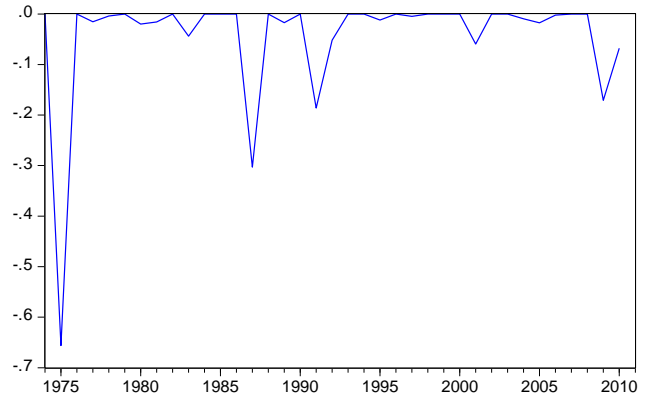


FIGURE 5B11: REALIZED ANNUAL OIL VOLATILITY DECREASE



Source: Author's calculation.

APPENDIX 5C: LAG LENGTH DETERMINATION

HI.1: BASELINE MODEL AUGMENTED WITH OIL REVENUES MEASURE								
	p	T	regr	Log-Lik	SC	H-Q	LM(1)	LM(p)
VAR(2)	2	35	15	696.357	-32.173	-34.356	0.571	0.149
VAR(1)	1	35	9	649.676	-32.553	-33.863	0.007	0.007

HI.2: BASELINE MODEL AUGMENTED WITH OIL PRICE VOLATILITY MEASURE								
	p	T	regr	Log-Lik	SC	H-Q	LM(1)	LM(p)
VAR(2)	2	34	15	670.779	-31.679	-33.898	0.891	0.493
VAR(1)	1	34	9	621.319	-31.881	-33.212	0.134	0.134

Note: the analysis is conducted employing WinRATS Pro8.1 software. SC: Schwarz Criterion. H-Q: Hannan-Quinn Criterion. LM(p): Lagrange Multiplier for autocorrelation of order (p) and p is the number of lags.

APPENDIX 5D: MISSPECIFICATION TESTS

H1.1: BASELINE MODEL AUGMENTED WITH OIL REVENUES MEASURE

Multivariate tests

Norm. $\chi^2(10) = 4.825$ [0.903]

Univariate tests

	$\hat{d}i_t$	$\hat{d}y_t$	$\hat{d}c_t$	$\hat{d}(\ln(\delta + g^k)_t)$	$\hat{d}dp_t$
ARCH (2)	1.185 [0.553]	1.380 [0.502]	3.378 [0.185]	1.147 [0.564]	3.685 [0.158]
Norm.	2.117 [0.347]	2.045 [0.360]	0.234 [0.889]	2.073 [0.355]	0.839 [0.657]

H1.2: BASELINE MODEL AUGMENTED WITH OIL PRICE VOLATILITY MEASURE

Multivariate tests

Norm. $\chi^2(10) = 8.534$ [0.577]

	$\hat{d}i_t$	$\hat{d}y_t$	$\hat{d}c_t$	$\hat{d}(\ln(\delta + g^k)_t)$	$\hat{d}dp_t$
ARCH (2)	1.195 [0.550]	2.590 [0.274]	0.692 [0.708]	1.225 [0.542]	0.382 [0.826]
Norm.	1.365 [0.505]	1.073 [0.585]	0.313 [0.855]	1.161 [0.560]	0.477 [0.788]

Note: the analysis is conducted employing WinRATS Pro8.1 software. P-values are in brackets.

APPENDIX 5E: RANK DETERMINATION

HI.1: BASELINE MODEL AUGMENTED WITH OIL REVENUES MEASURE							
p - r	r	λ_i	Trace	Trace*	Frac95	p-value	p-value*
5	1	0.917	178.965	132.262	100.127	0.000	0.000
4	2	0.735	91.771	67.540	73.128	0.001	0.128
3	3	0.504	45.238	36.613	50.075	0.132	0.467
2	4	0.350	20.701	17.452	30.912	0.444	0.670
1	5	0.149	5.650	4.846	15.331	0.733	0.818

HI.2: BASELINE MODEL AUGMENTED WITH OIL PRICE VOLATILITY MEASURE							
p - r	r	λ_i	Trace	Trace*	Frac95	p-value	p-value*
5	0	0.950	185.485	140.452	100.127	0.000	0.000
4	1	0.740	83.568	63.383	73.128	0.006	0.229
3	3	0.458	37.717	30.658	50.075	0.412	0.768
2	4	0.300	16.917	13.346	30.912	0.706	0.902
1	5	0.132	4.814	3.879	15.331	0.821	0.904

Note: the analysis is conducted employing WinRATS Pro8.1 software. Critical/P-values correspond to the 'Basic Model'. The Bartlett Corrections correspond to the 'Basic Model'.

APPENDIX 5F: EIGENVALUES OF THE COMPANION MATRIX

HI.1: BASELINE MODEL AUGMENTED WITH OIL REVENUES MEASURE

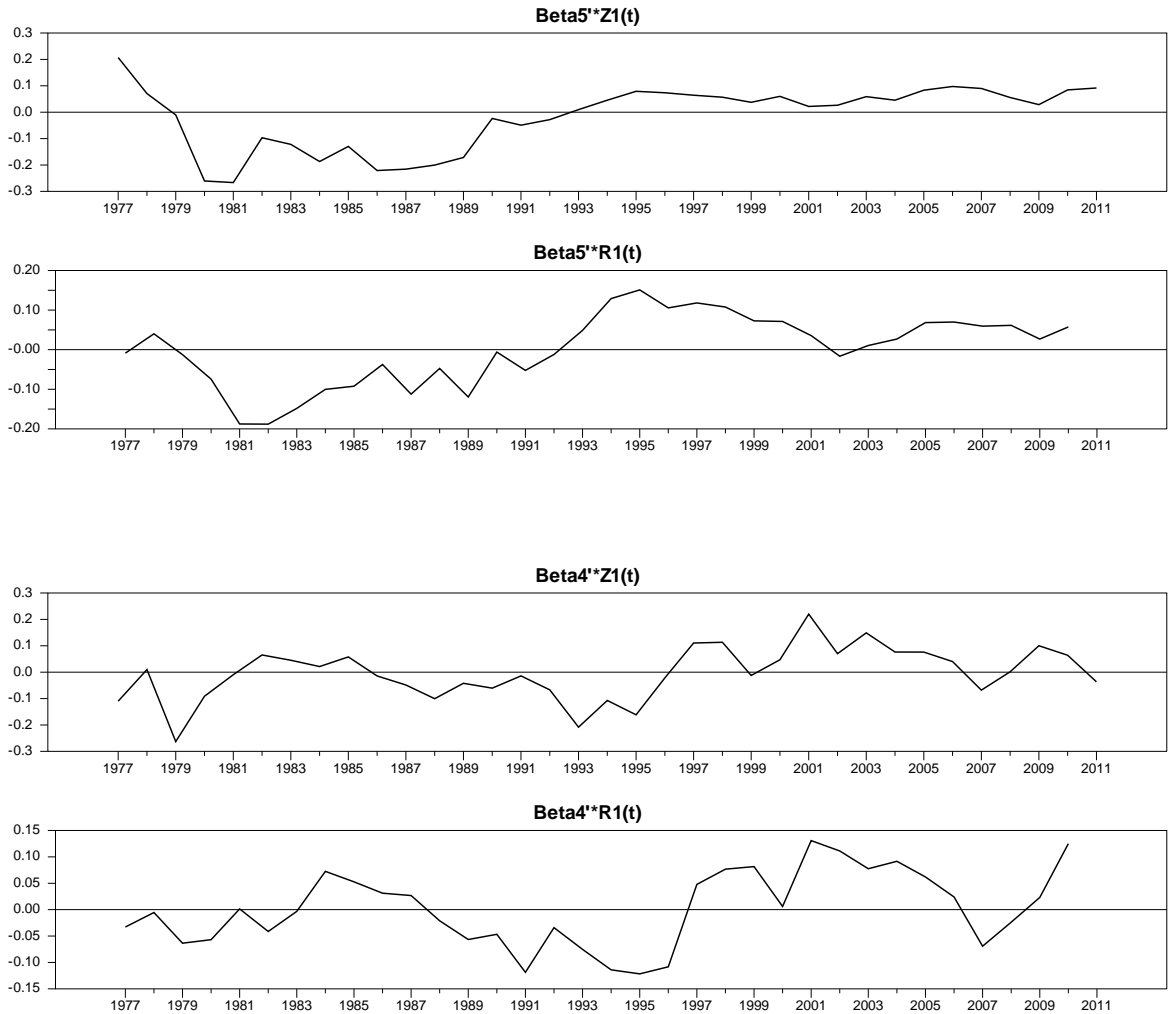
	Root 1	Root 2	Root 3	Root 4	Root 5
Rank = 5	0.907	0.768	0.768	0.611	0.611
Rank = 4	1.000	0.735	0.735	0.662	0.662
Rank = 3	1.000	1.000	0.725	0.725	0.532
Rank = 2	1.000	1.000	1.000	0.741	0.741
Rank = 1	1.000	1.000	1.000	1.000	0.687

HI.2: BASELINE MODEL AUGMENTED WITH OIL PRICE VOLATILITY MEASURE

	Root 1	Root 2	Root 3	Root 4	Root 5
Rank = 5	0.995	0.784	0.784	0.610	0.610
Rank = 4	1.000	0.795	0.795	0.711	0.711
Rank = 3	1.000	1.000	0.806	0.806	0.687
Rank = 2	1.000	1.000	1.000	0.721	0.721
Rank = 1	1.000	1.000	1.000	1.000	0.586

Note: the analysis is conducted employing WinRATS Pro8.1 software.

APPENDIX 5G: GRAPHS OF COINTEGRATING RELATIONS
FIGURE 5G1: H1.1 - BASELINE MODEL AUGMENTED WITH OIL REVENUES MEASURE



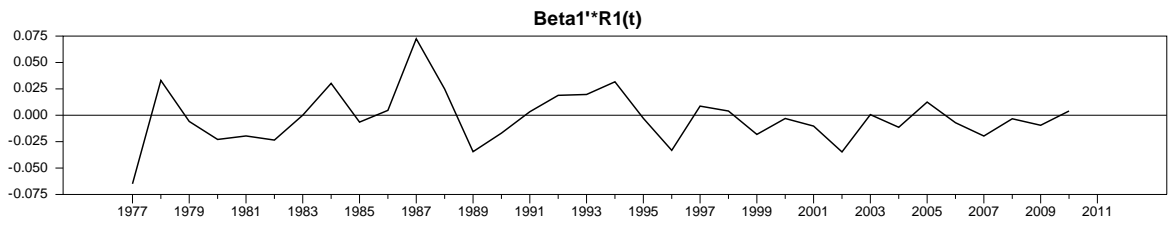
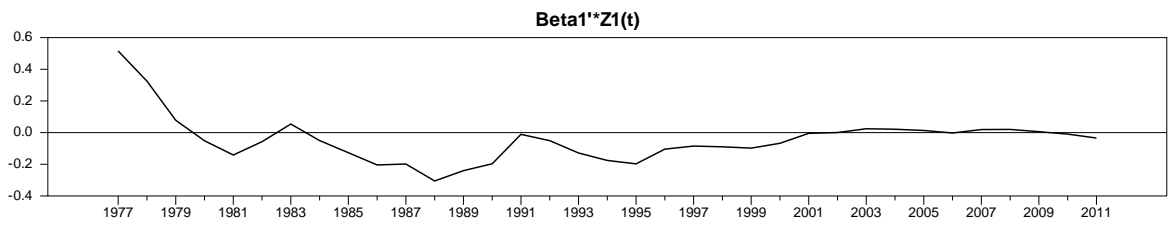
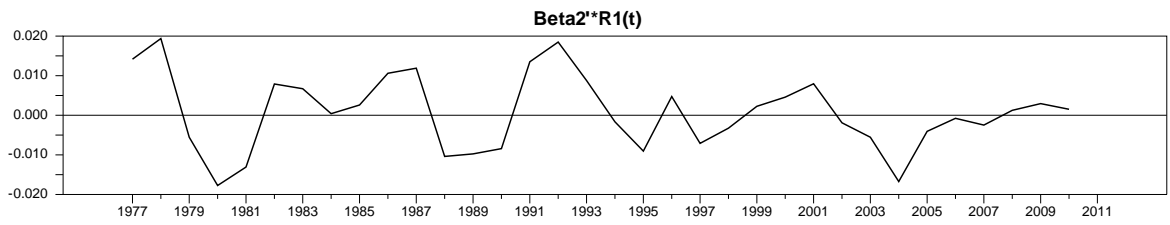
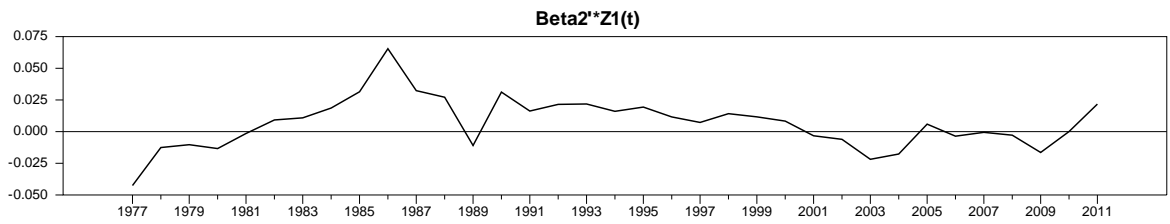
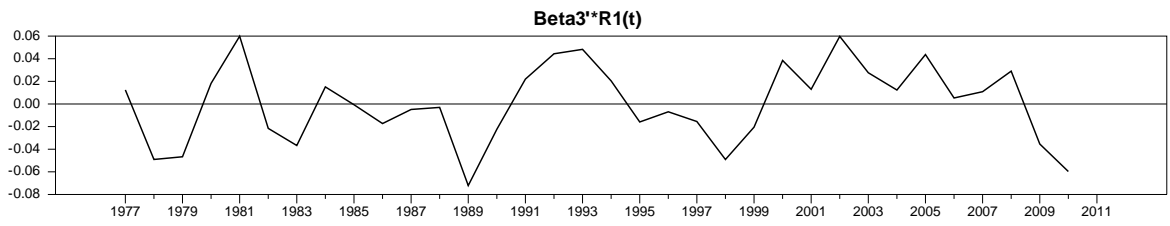
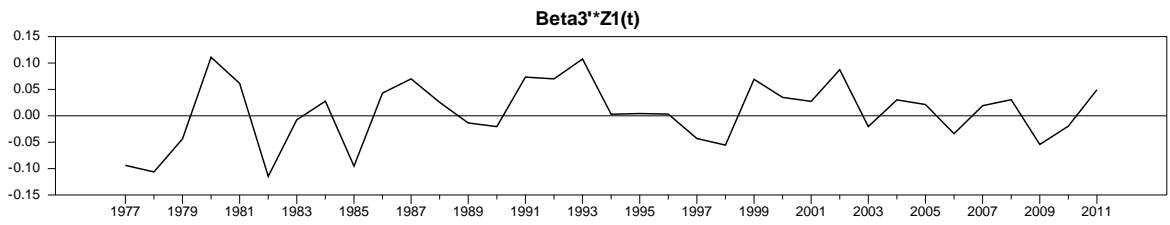
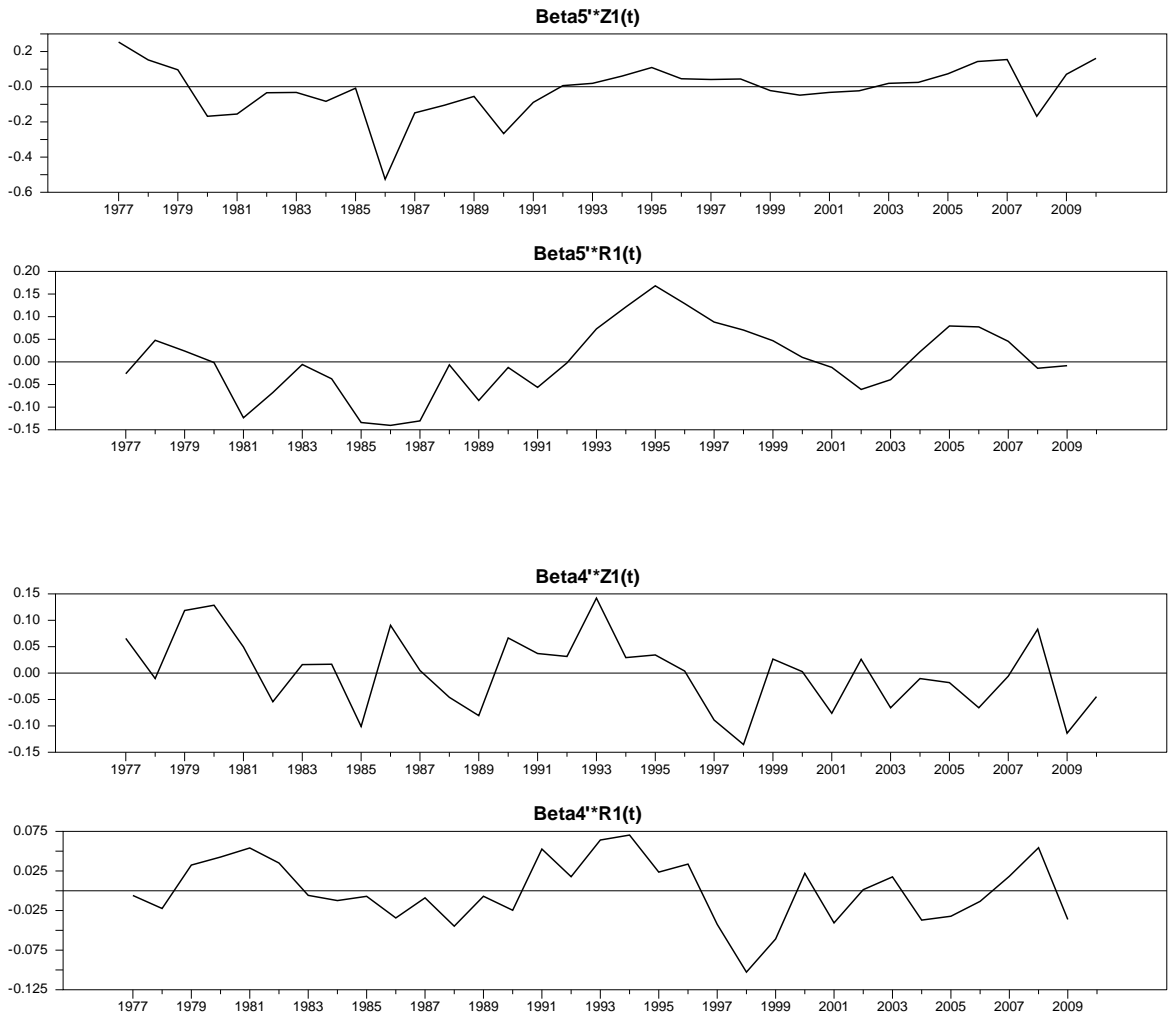
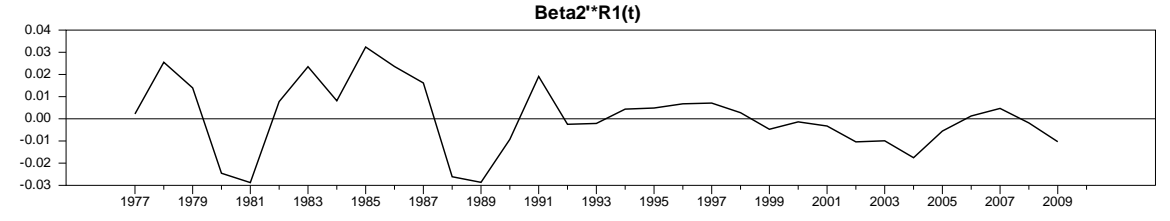
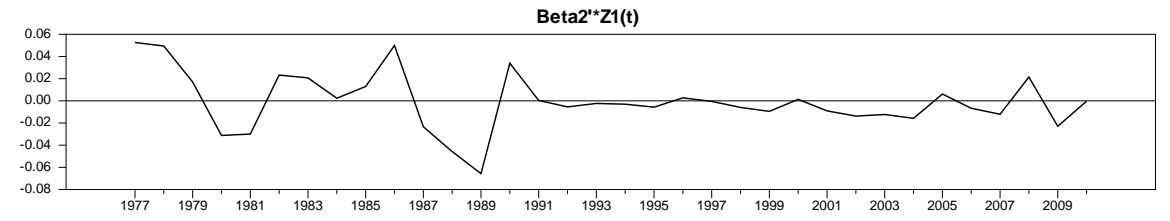
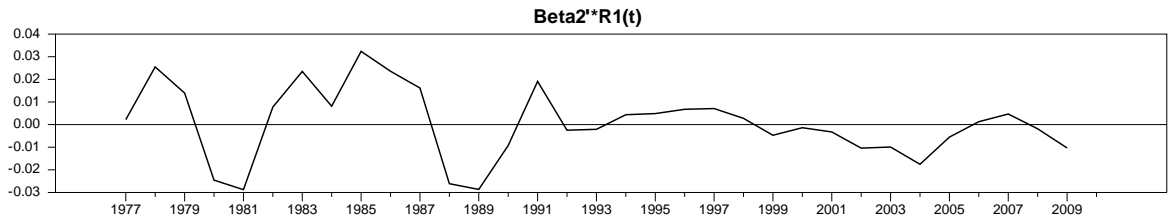
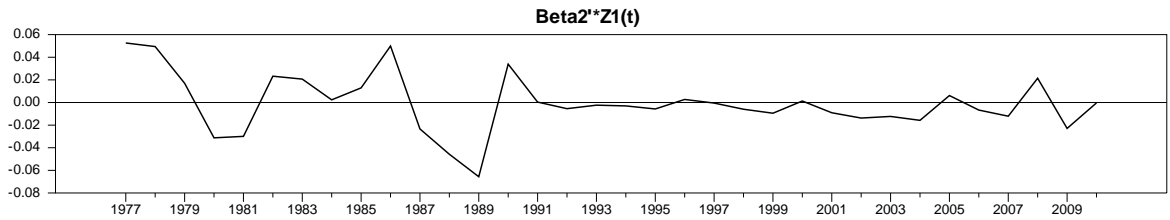
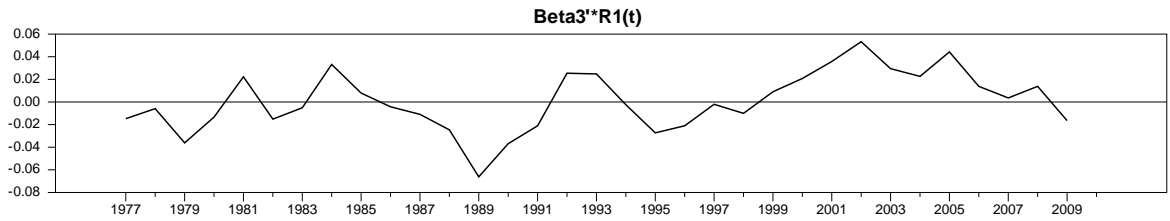
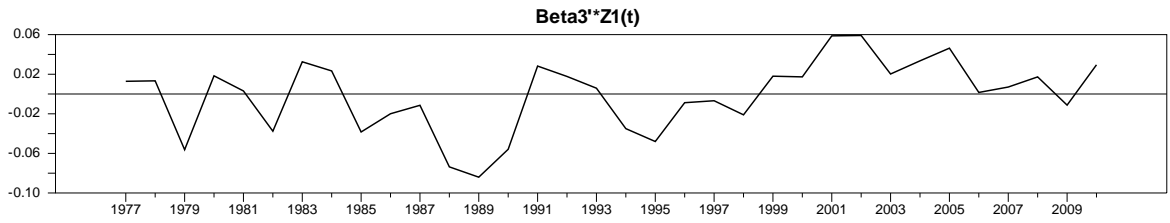


FIGURE 5G2: H1.2 - BASELINE MODEL AUGMENTED WITH OIL PRICE VOLATILITY MEASURE





Note: the analysis is conducted employing WinRATS Pro8.1 software.

APPENDIX 5H: RECURSIVE STABILITY TESTS

FIGURE 5H1: H1.1 - BASELINE MODEL AUGMENTED WITH OIL REVENUES MEASURE

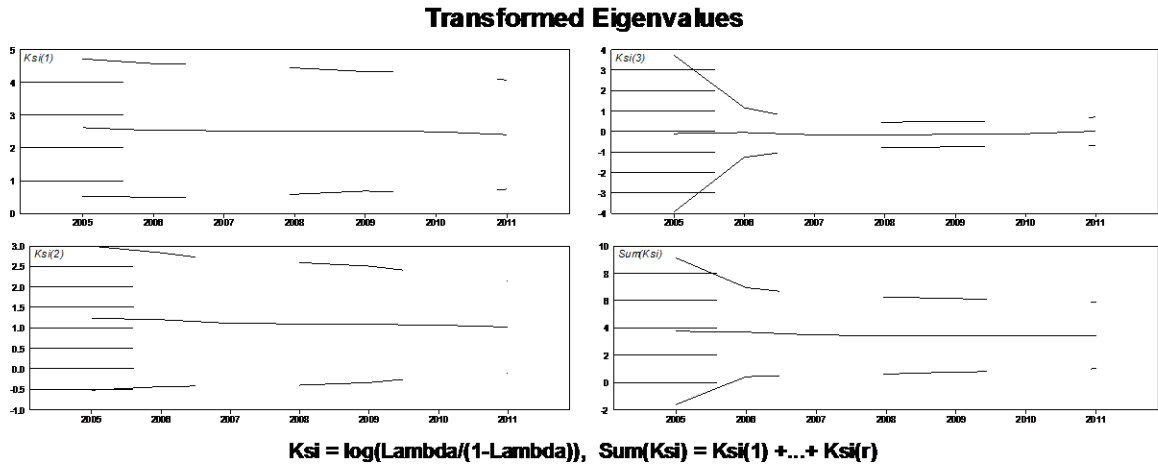
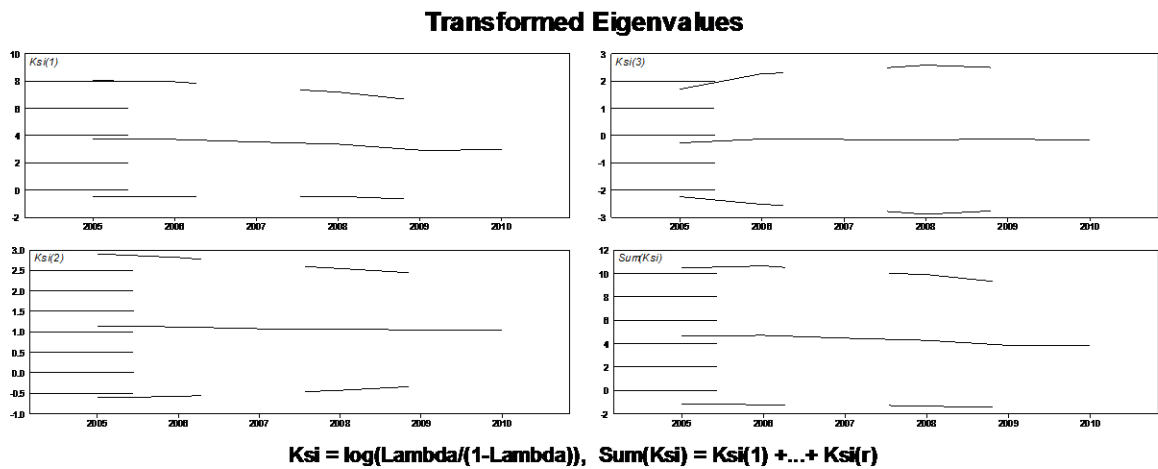


FIGURE 5H2: H1.2 - BASELINE MODEL AUGMENTED WITH OIL PRICE VOLATILITY MEASURE



Note: the recursively calculated tests statistics are for log transformed eigenvalues. The x-axis plots the recursive sample period and the y-axis plots the significance level (the 95% confidence bands). The analysis is conducted employing WinRATS Pro8.1 software.

APPENDIX 5I: TEST OF STATIONARITY - ECONOMY-LEVEL DATA

TESTING A UNIT VECTOR IN β (STATIONARITY)

H1.1: BASELINE MODEL AUGMENTED WITH OIL REVENUES MEASURE*

$r = 3$	i_t	y_t	c_t	$\ln(\delta + g^k)_t$	dp_t
$\chi^2(2)$	18.582 [0.000]	12.700 [0.000]	5.735 [0.057]	18.961 [0.000]	7.604 [0.022]

H1.2: BASELINE MODEL AUGMENTED WITH OIL PRICE VOLATILITY MEASURE**

$r = 2$	i_t	y_t	c_t	$\ln(\delta + g^k)_t$	dp_t
$\chi^2(3)$	8.685 [0.013]	8.632 [0.013]	10.622 [0.005]	7.179 [0.028]	9.823 [0.007]

TESTING A UNIT VECTOR IN β (stationarity)

Note: the analysis is conducted employing WinRATS Pro8.1 software. P-values in brackets. *: Restricted Trend and W. Exogenous variables included in the cointegrating relation(s). **: Restricted Trend and W. Exogenous variables included in the cointegrating relation(s).

APPENDIX 5J: TESTS OF STATISTICAL SIGNIFICANCE FOR DUMMY VARIABLES

HI.1: BASELINE MODEL AUGMENTED WITH OIL REVENUES MEASURE

	DOREV (t-0)	DOREV (t-1)	CONSTANT
di	-0.038 (-1.050)	-0.210 (-3.831)	4.263 (0.636)
dy	0.068 (3.831)	-0.051 (-1.907)	9.353 (2.858)
dc_t	-0.103 (-3.825)	-0.057 (-1.398)	10.078 (2.028)
d(ln($\delta + g^k$))	-0.041 (-1.104)	-0.213 (-3.810)	1.050 (0.154)
ddp	0.132 (4.392)	0.074 (1.640)	-10.583 (-1.922)

HI.2: BASELINE MODEL AUGMENTED WITH OIL PRICE VOLATILITY MEASURE

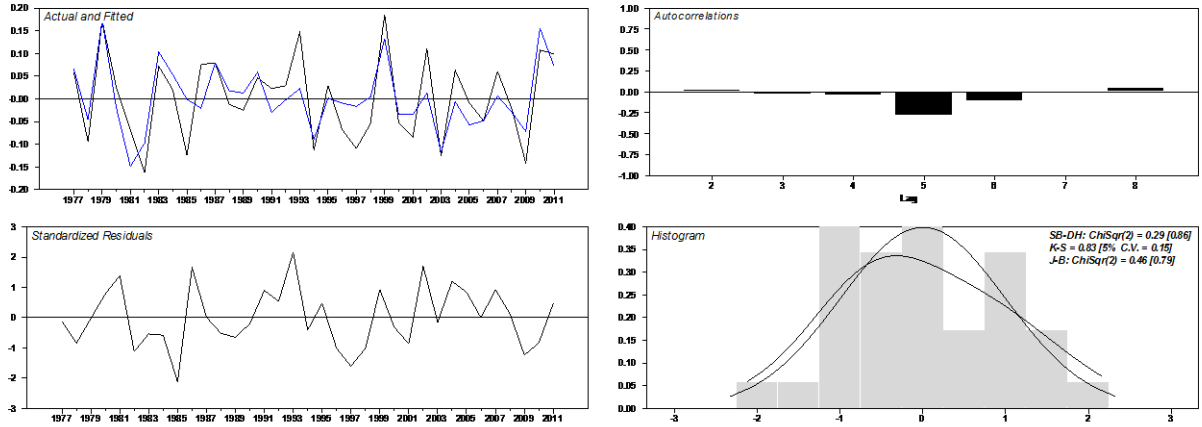
	DVOLO (t-0)	DVOLO (t-1)	CONSTANT
di	-0.487 (-3.143)	0.419 (2.556)	-9.483 (-1.727)
dy	-0.211 (-2.549)	0.153 (1.748)	13.643 (4.665)
dc_t	0.091 (0.692)	0.048 (0.343)	-0.123 (-0.026)
d(ln($\delta + g^k$))	-0.491 (-3.156)	0.407 (2.474)	-12.553 (-2.280)
ddp	-0.058 (-0.383)	-0.093 (-0.584)	1.206 (0.225)

Note: Statistically significant coefficients with absolute t-values (in parentheses) greater than 2.00 are in bold. The analysis is conducted employing WinRATS Pro8.1 software.

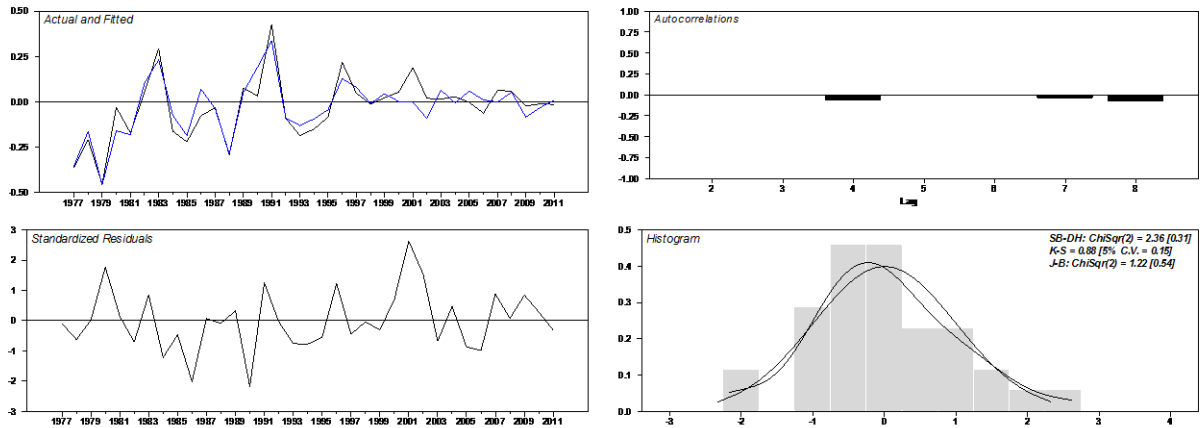
APPENDIX 5K: GRAPHS OF THE RESIDUALS

FIGURE 5K1: H1.1 - BASELINE MODEL AUGMENTED WITH OIL REVENUES MEASURE

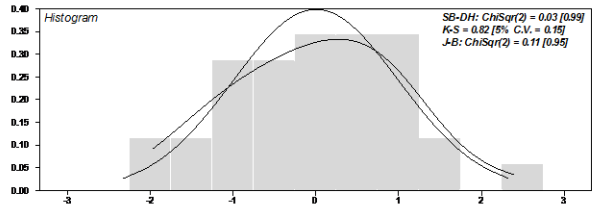
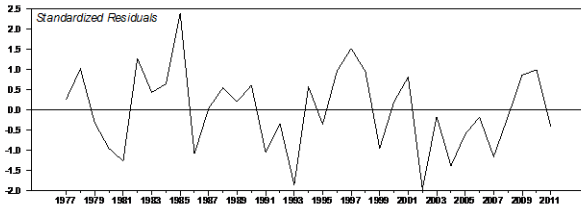
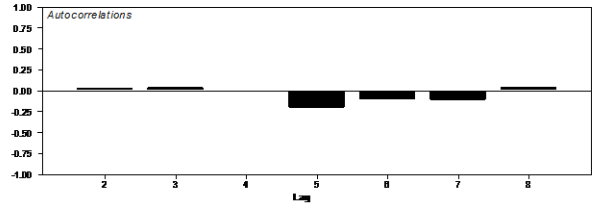
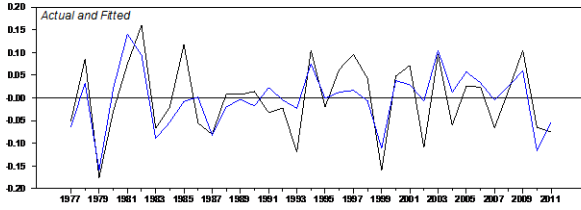
DDP



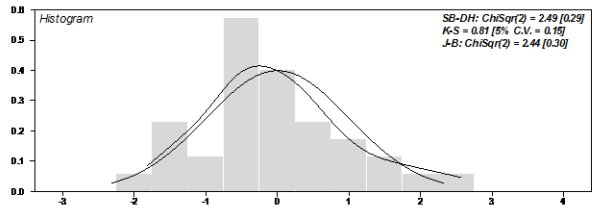
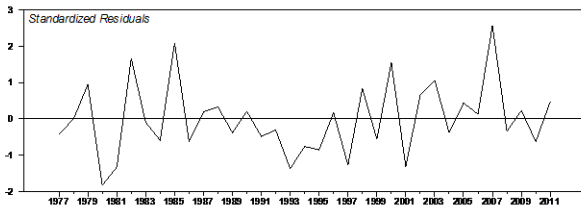
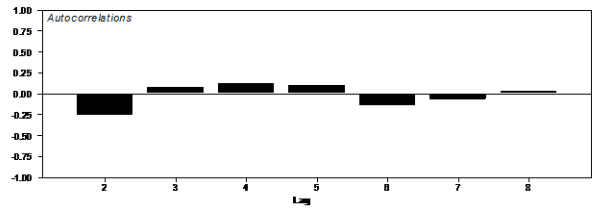
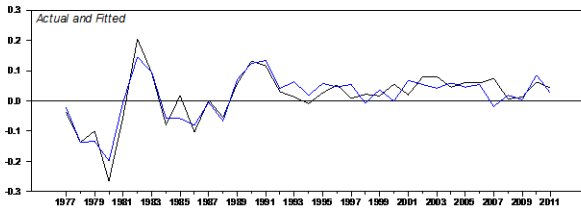
DLNGDEP



DC



DLNY



DLNIN

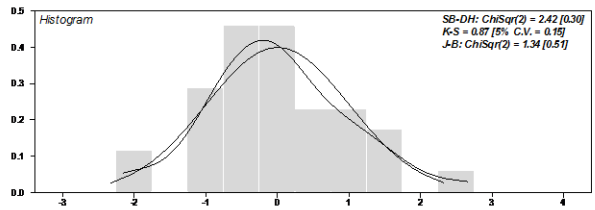
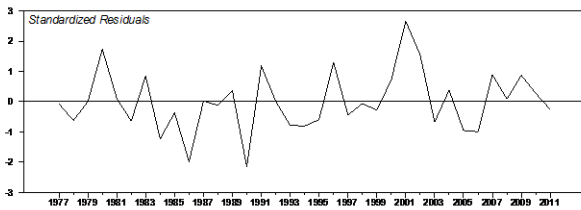
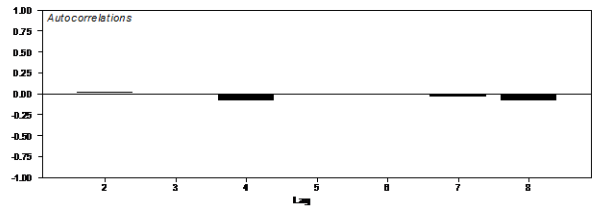
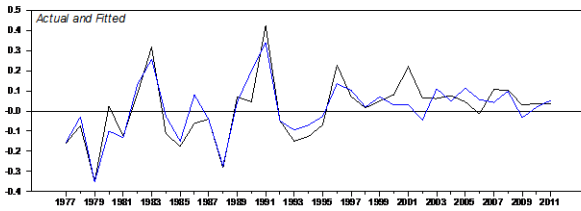
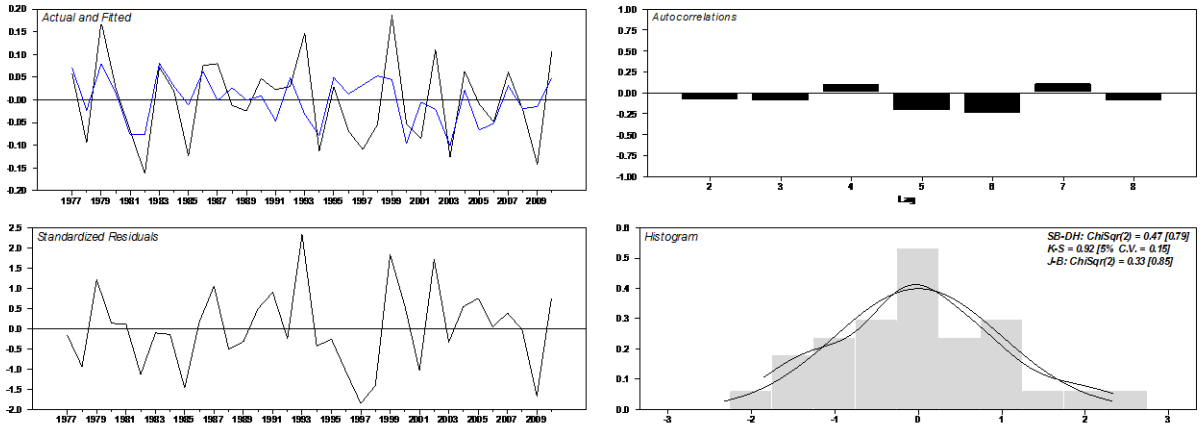
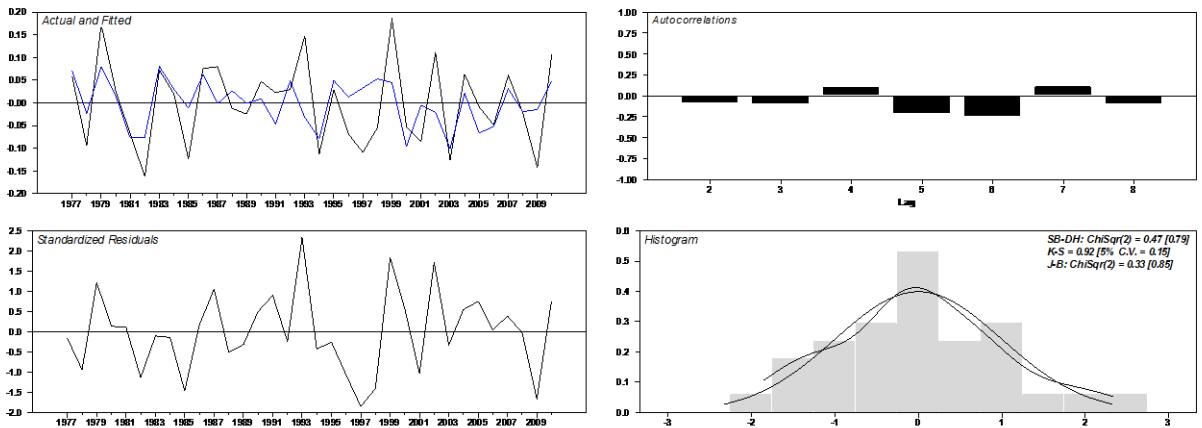


FIGURE 5K2: H1.2 - BASELINE MODEL AUGMENTED WITH OIL PRICE VOLATILITY MEASURE

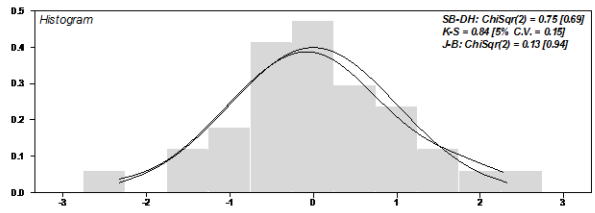
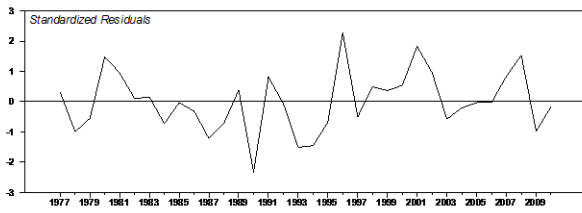
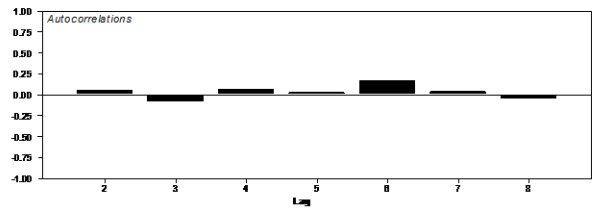
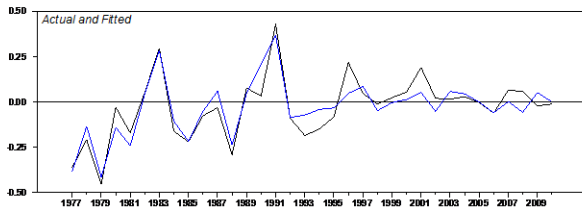
DDP



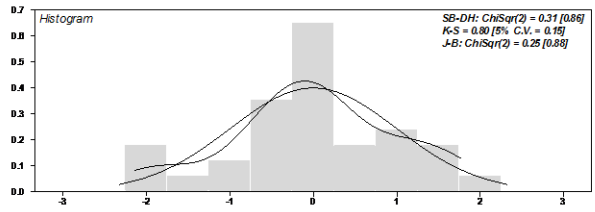
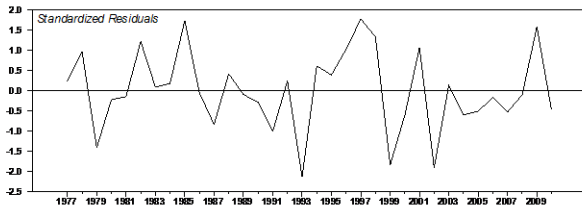
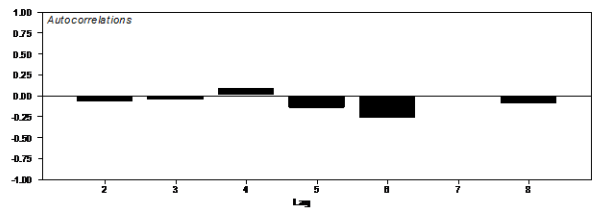
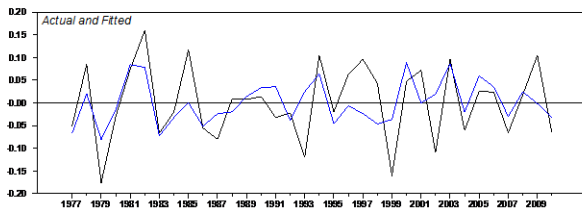
DDP



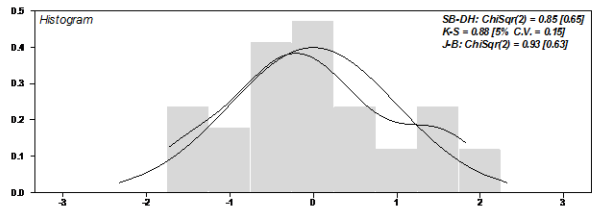
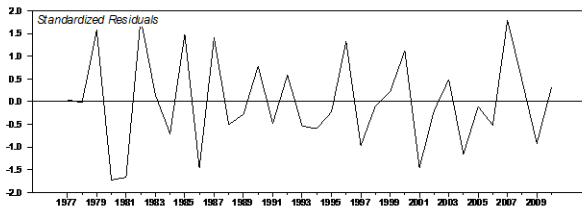
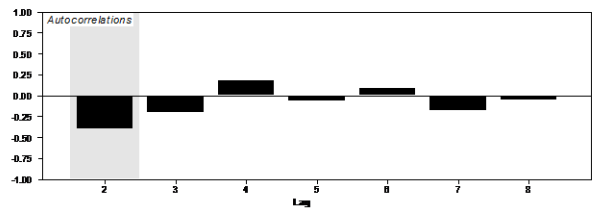
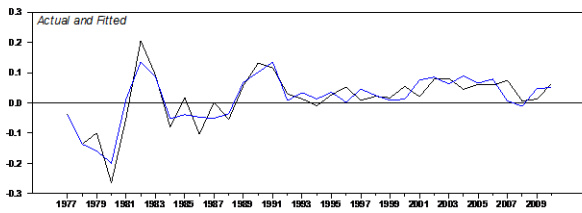
DLNGDEP



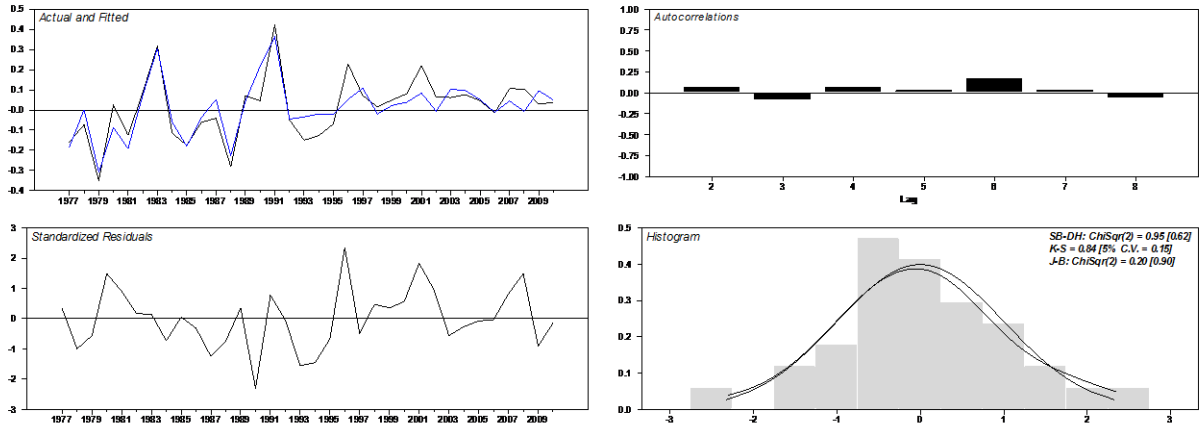
DC



DLNY



DLNIV



Note: Panels on the top left plots the fitted and the actual values; panels on bottom left plot the residuals scaled by their standard deviation; panel on the top right plots the autocorrelation of the residuals; and panel on the bottom right plots the histogram.

APPENDIX 5L: DETAILED CALCULATION OF THE DATA

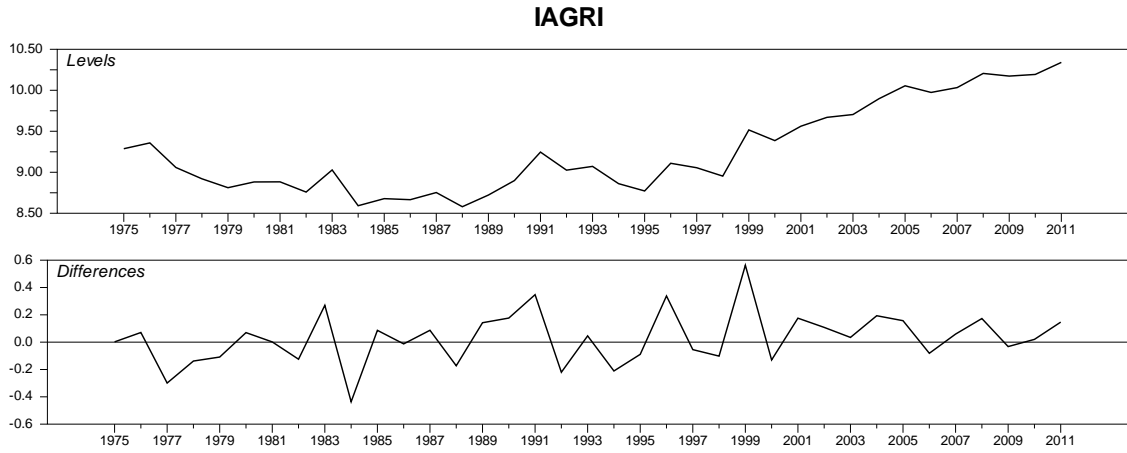
t	Investment (Constant 2004/2005 Prices - Billion Rials)	Natural Log Investment	Capital stock (Constant 2004/2005 Prices - Billion Rials)	Capital Stock		Growth Rate of Capital + δ	GDP at Basic Prices (Constant 2004/2005 Prices - Billion Rials)		Natural Log GDP at Basic Prices	Revenues (Current Prices - Billion Rials)	Corporate Tax (Current Prices - Billion Rials)	Tax Rate: Corporat e Tax / Revenues	Weighted Average Rates of Return on Facilities /100	Implicit Deflator of GDP (Base Year 2004/05)	Natural Log Implicit Deflator of GDP	Changes in In Implicit Deflator of GDP	User Cost of Capital
				Growth Rate of Capital ($\delta = (I_t - (K_t - K_{t-1})) / K_{t-1}$)	Natural Log (Growth Rate of Capital + δ)												
1974/75	242424,6361	12,398446	1490454	0,041237075	0,041237075	0,22188	1060038,816	13,8738	1394,40	44,90	0,03	0,105276729	0,2914217	-1,232984	0,459511	-0,3029	
1975/76	330707,9638	12,708991	1759700	0,180647	0,041237075	0,22188	1048237,727	13,8626	1582,10	113,30	0,07	0,104521191	0,3302208	-1,1079939	0,1249901	0,0193	
1976/77	467306,0544	13,05474	2154205	0,224189	0,041371287	0,26556	1132591421	1238378,831	14,0293	1836,40	0,07	0,105783002	0,3797811	-0,9681603	0,1398336	0,0068	
1977/78	398657,8864	12,895859	2467287	0,145335	0,039725043	0,18506	1192312,134	13,9914	2034,20	160,20	0,08	0,110631143	0,4629069	-0,7702294	0,1979309	-0,0438	
1978/79	370791,4187	12,823395	2738353	0,109864	0,040419059	0,15028	1189523475	1039931,512	13,8547	1598,90	0,13	0,110154206	0,5131774	-0,6671337	0,1030957	0,0415	
1979/80	261264,8968	12,47329	2891706	0,056002	0,039407592	0,09541	1194703,2584	13,7554	1699,60	143,00	0,08	0,089544406	0,676011	-0,391546	0,2755878	-0,1343	
1980/81	267743,7442	12,497786	3027262	0,046878	0,045712719	0,09259	122812,7499	13,4909	1325,90	45,90	0,03	0,086561992	0,9141785	-0,0897294	0,3018166	-0,1637	
1981/82	236392,934	12,373251	3126699	0,032847	0,045240859	0,07809	1254991846	13,4399	1770,10	227,60	0,13	0,085332227	1,1543683	0,1435533	0,2332827	-0,0895	
1982/83	257430,1876	12,458504	3198708	0,02303	0,059302538	0,08233	1249698453	13,645	2501,90	173,90	0,07	0,087606101	1,2394792	0,2146913	0,071138	0,0705	
1983/84	353474,0745	12,775565	3355789	0,049108	0,061397625	0,11051	1220269211	13,7376	2773,70	208,30	0,08	0,086116356	1,4307679	0,3582113	0,14352	0,0037	
1984/85	315436,9825	12,661714	3505982	0,044756	0,04924147	0,094	1236448327	13,6589	2714,80	257,70	0,09	0,095937815	1,6847099	0,5215934	0,1633821	-0,0165	
1985/86	264690,396	12,486316	3559568	0,015284	0,06021263	0,0755	1258366511	13,6767	2666,20	357,70	0,13	0,095883727	1,7530163	0,5613379	0,0397445	0,1007	
1986/87	249055,2204	12,42543	3530435	-0,00818	0,078152242	0,06997	1265971983	13,5738	1707,30	373,50	0,22	0,095533967	1,9675073	0,6767674	0,1154295	0,0455	
1987/88	239201,0635	12,38506	3564523	0,009655	0,058098524	0,06775	126918719	13,5759	2171,50	374,40	0,17	0,09511811	2,3911789	0,8717865	0,1950191	-0,0346	
1988/89	180555,588	12,103794	3545968	-0,00521	0,055858971	0,05065	1298274683	13,5216	2085,40	392,50	0,19	0,094856443	2,8713348	1,054777	0,1829905	-0,0262	
1989/90	193728,7001	12,174214	3588509	0,011997	0,04263651	0,05463	1290710774	13,5787	3174,60	340,10	0,11	0,094845497	3,3640561	1,2131474	0,1583704	-0,0187	
1990/91	202753,1559	12,219745	3568450	-0,00559	0,062090455	0,0565	1287350282	13,7101	5632,50	495,60	0,09	0,138254149	4,1309666	1,4185114	0,205364	-0,0046	
1991/92	309129,5054	12,641516	3720992	0,042747	0,043881098	0,08663	1244612631	10,10601,408	6933,50	774,60	0,11	0,142803369	5,189201	1,68465797	0,2280683	-0,0368	
1992/93	294528,8841	12,593132	3854575	0,0359	0,043253488	0,07915	125363685	10,41570,021	9884,50	1297,30	0,13	0,146107817	6,7117921	1,903866	0,2572863	-0,059	
1993/94	253581,5425	12,443441	3943487	0,023067	0,042720544	0,06579	127213306	10,55689,679	20250,70	1601,00	0,08	0,168041232	10,060763	2,3088643	0,404777	-0,1787	
1994/95	223373,0915	12,316599	4000791	0,014531	0,042112245	0,05664	1287097721	10,45963,407	29244,50	2398,30	0,08	0,169907158	13,474529	2,6008012	0,2921582	-0,0736	
1995/96	208495,4566	12,247673	4043842	0,010761	0,041352937	0,05211	1295433012	10,74044,239	41575,40	3296,20	0,08	0,178722569	18,586428	2,9224316	0,3216305	-0,0935	
1996/97	261803,5729	12,475535	4139621	0,023685	0,041056147	0,06474	1273735601	11,31945,929	57121,90	5378,30	0,09	0,178171841	23,945572	3,1757834	0,2533518	-0,0309	
1997/98	281059,3569	12,546321	4253212	0,02744	0,040454997	0,06789	1268979364	11,41305,29	62378,10	6857,80	0,11	0,177017954	27,663862	3,3201269	0,1443435	0,0651	
1998/99	285439,9395	12,561787	4366981	0,026749	0,040362658	0,06711	127013981	11,66376,014	53626,00	7923,60	0,15	0,176236532	30,259151	3,4097987	0,0896717	0,1082	
1999/00	300025,9997	12,611624	4489635	0,028087	0,040616618	0,0687	1267795807	11,86177,388	92315,70	10048,40	0,11	0,176145	39,853677	3,6852147	0,275416	-0,0523	
2000/01	325362,2555	12,692694	4630609	0,0314	0,041069765	0,07247	1262458749	12,53472,419	104640,80	11295,50	0,11	0,176512554	49,788904	3,9077921	0,2225775	-0,0045	
2001/02	405406,4981	12,912646	4843668	0,046011	0,041538272	0,08755	1243555341	12,79192,984	125479,50	12371,90	0,10	0,171182469	57,16036	4,0458606	0,1380685	0,0673	
2002/03	432467,5834	12,977263	5073888	0,04753	0,041755047	0,08929	1241592019	13,83116,287	165156,70	17152,30	0,10	0,160049059	73,325134	4,2949034	0,2490428	-0,0423	
2003/04	460022,3002	13,03903	5318709	0,048251	0,04241349	0,09066	124005877	14,99527,855	207867,50	20375,70	0,10	0,140576192	82,957413	4,4183274	0,1234239	0,0537	
2004/05	496354,9967	13,115047	5583078	0,049705	0,043616975	0,09332	1237169449	15,69066,175	255000,30	26027,50	0,10	0,135863855	99,999998	4,6051702	0,1868428	-0,0066	
2005/06	519449,9297	13,160526	5855058	0,048715	0,044325	0,09304	1237472509	16,68186,119	387669,40	64459,90	0,17	0,156838479	119,51092	4,7834078	0,1782376	0,0191	
2006/07	512184,7815	13,146441	6102945	0,042337	0,045140079	0,08748	1243637572	17,69425,961	413928,00	72861,70	0,18	0,136777229	136,08683	4,9132931	0,1298854	0,0429	
2007/08	569217,635	13,252018	6391414	0,047267	0,046002157	0,09327	1237226387	19,06446,692	472995,00	92610,80	0,20	0,116651946	164,68365	5,1040264	0,1907332	-0,0226	
2008/09	631738,1724	13,35623	6727578	0,052596	0,046245506	0,09884	1231423506	19,18680,955	595975,20	127794,20	0,21	0,116768896	195,09955	5,2735099	0,1694836	-0,0051	
2009/10	650329,9009	13,385235	7067326	0,050501	0,046165485	0,09667	123364907	19,42989,543	625159,40	167299,90	0,27	0,11678944	200,39731	5,3003019	0,026792	0,0997	
2010/11	675347,0457	13,422982	7416106	0,049351	0,046208006	0,09556	1234801077	20,68911,853	820068,20	116500,20	0,14	0,128385348	229,17294	5,4344769	0,134175	0,0347	
2011/12	699061,9894	13,457495	7770045	0,047726	0,046536955	0,09426	1236166998	21,57934,131	1114379,10	157892,60	0,14	0,140038834	289,43264	5,6679226	0,2334456	-0,0402	

Note: Constructed based on data in billion Rials at constant 2004/05 prices.

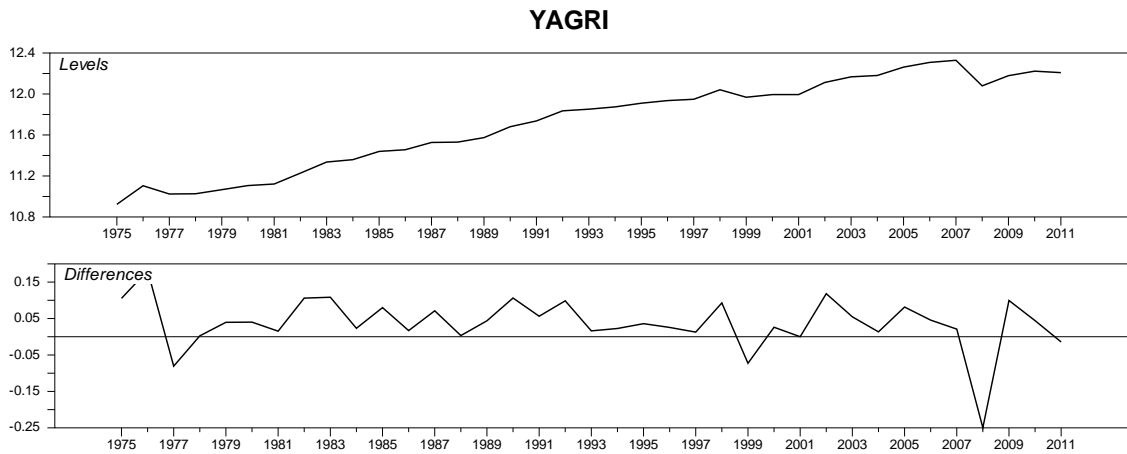
APPENDIX 6A: DESCRIPTION OF THE VARIABLES

VARIABLES	DESCRIPTION	SOURCES
$i_t^{\text{sector-level}}$	Sectoral gross fixed capital formation (in billion Rials at constant 2004/05 prices) in natural logarithmic form	Data are collected from the CBI's annual national accounts.
$y_t^{\text{sector-level}}$	Sectoral gross domestic product (in billion Rials at constant 2004/05 prices) in natural logarithmic form	Data are collected from the CBI's annual national accounts.
$c_t^{\text{sector-level}}$	The sectoral user cost of capital calculated as [(1 minus tax rates) multiplied by ([average of expected rates of return on facilities/100] minus [changes in natural log of the implicit deflator of gross domestic product]) + (the rate of sectoral capital stock depreciation)]	Constructed by the author. Data on corporate tax, total revenues, expected rates of return on facilities and implicit deflator of GDP are collected from the CBI's annual national accounts.
$\ln(g^k + \delta)_t^{\text{sector-level}}$	Constructed employing equations (5.6) and (5.7) as explained in Chapter Five Section (5.4.3) and presented in details in Appendix 6P	Constructed by the author. Data on capital stock are collected from the CBI's annual national accounts.

**APPENDIX 6B: GRAPHS OF THE IRANIAN SECTOR-LEVEL DATA IN LEVELS
FIGURE 6B1 – AGRICULTURE LOG REAL INVESTMENT**



**FIGURE 6B2 – AGRICULTURE LOG REAL OUTPUT
(IN BILLION RIALS AT CONSTANT 2004/05 PRICES)**



**FIGURE 6B3 – AGRICULTURE USER COST OF CAPITAL
(IN BILLION RIALS AT CONSTANT 2004/05 PRICES)**

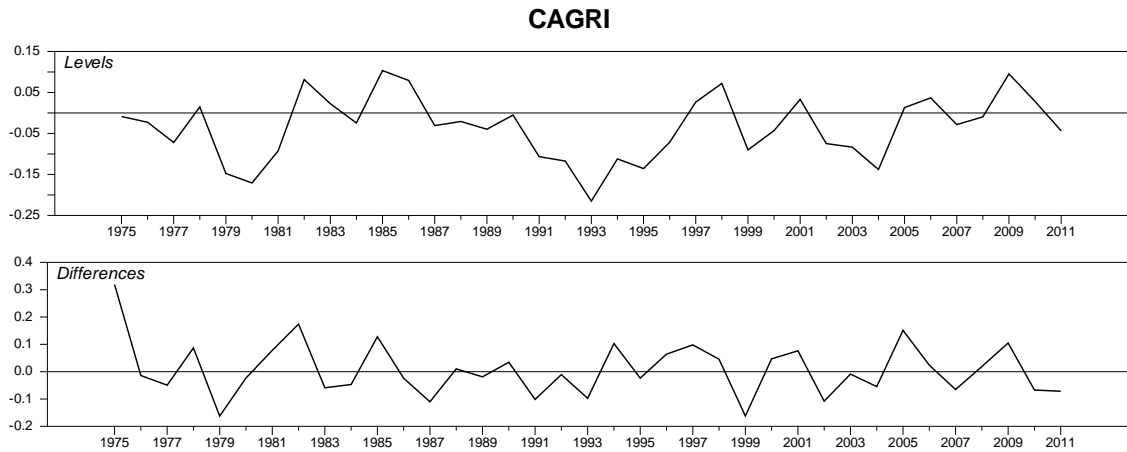


FIGURE 6B4 – AGRICULTURE $\log (g^k + \delta)_t$

KGDAGRI

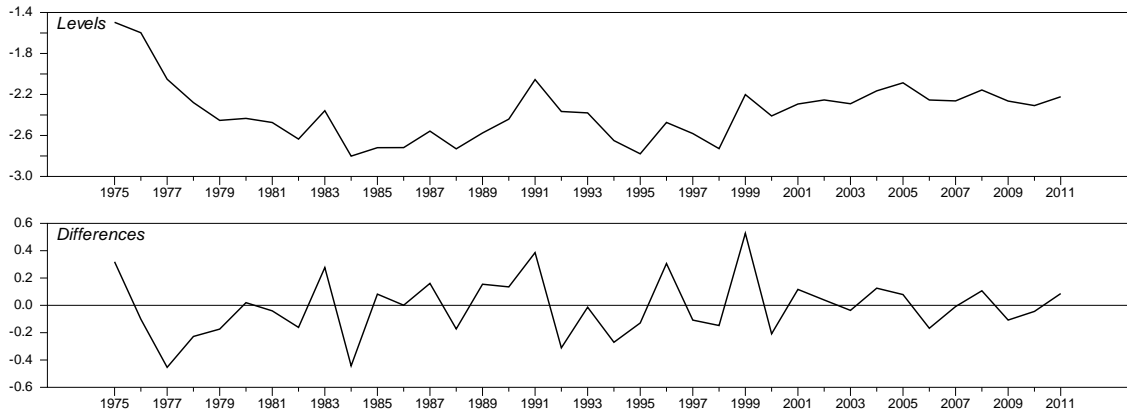


FIGURE 6B5 – AGRICULTURE DP2008

DP2008

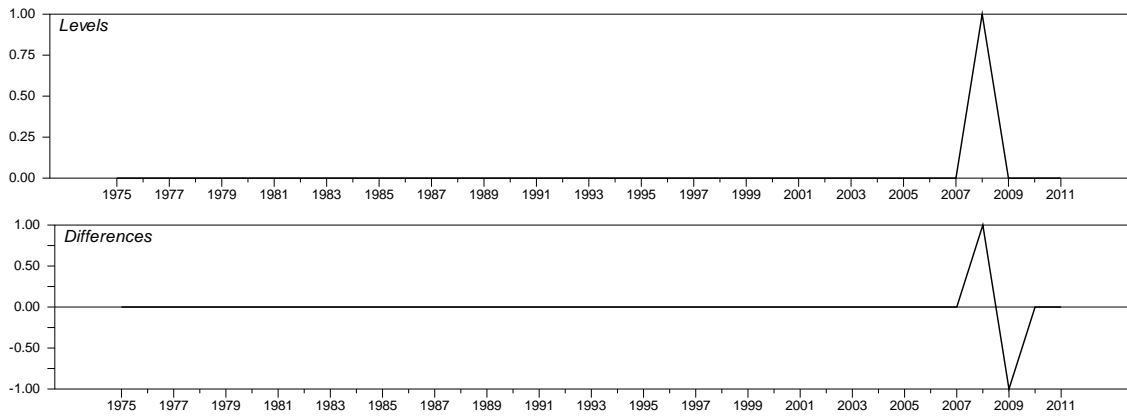
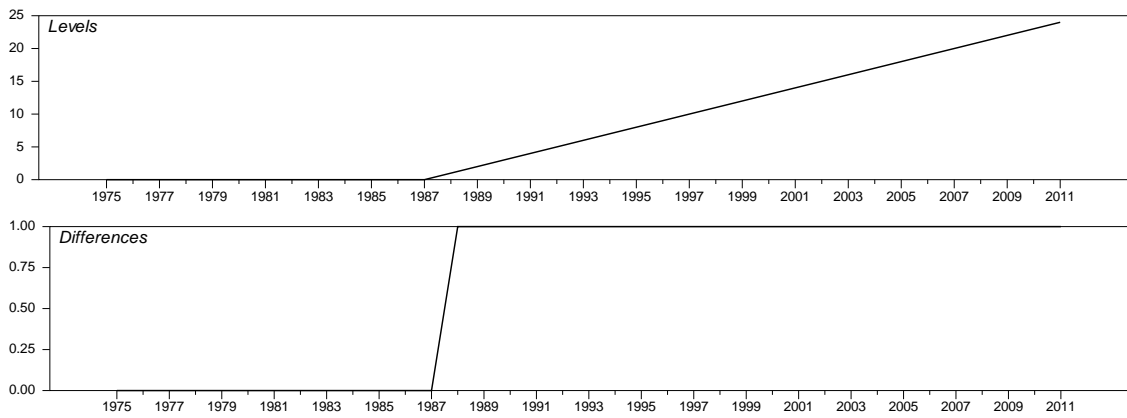
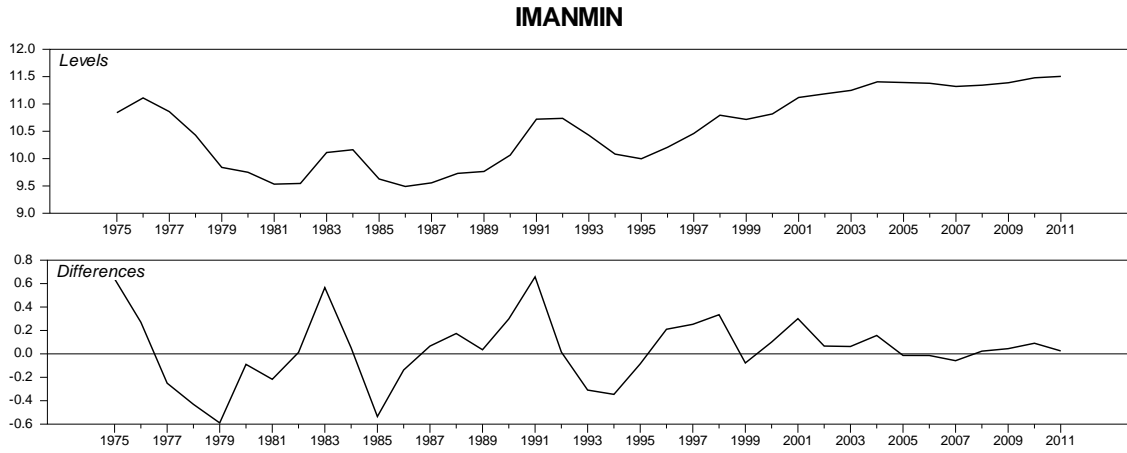


FIGURE 6B6 – AGRICULTURE T(1988:01)

T(1988:01)



**FIGURE 6B7 – MANUFACTURING LOG REAL INVESTMENT
(IN BILLION RIALS AT CONSTANT 2004/05 PRICES)**



**FIGURE 6B8 – MANUFACTURING LOG REAL OUTPUT
(IN BILLION RIALS AT CONSTANT 2004/05 PRICES)**

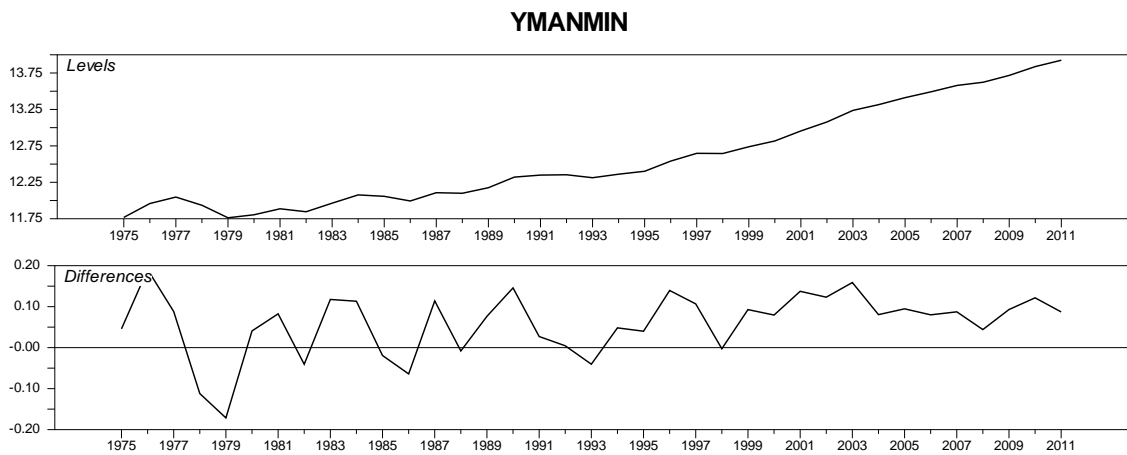


FIGURE 6B9 – MANUFACTURING USER COST OF CAPITAL

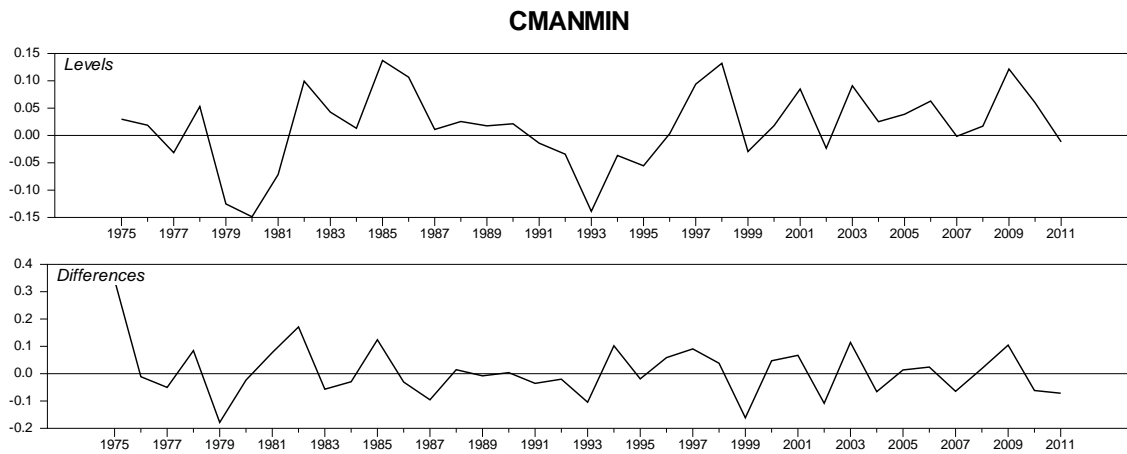


FIGURE 6B10 – MANUFACTURING $\log(g^k + \delta)_t$

KGDMANMIN

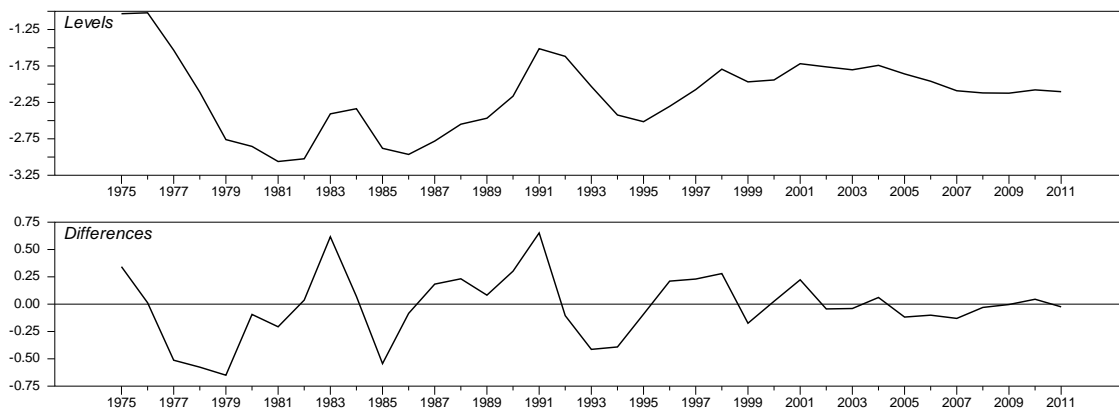
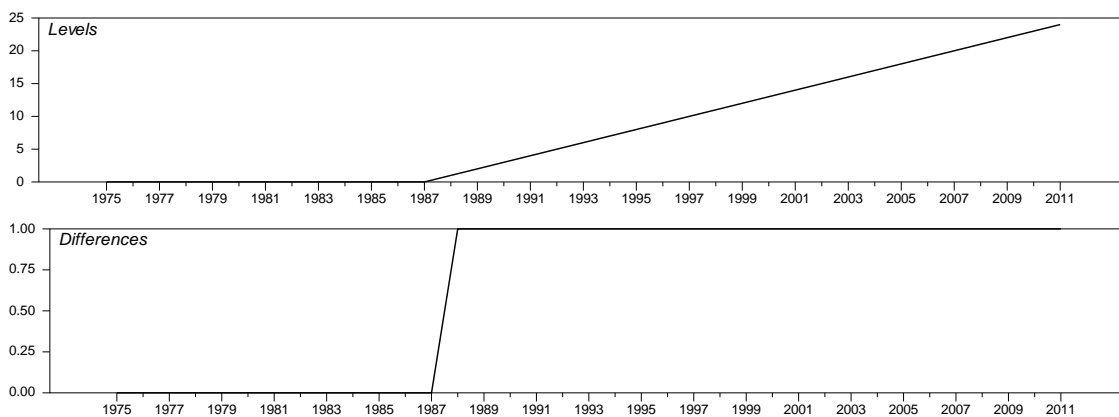
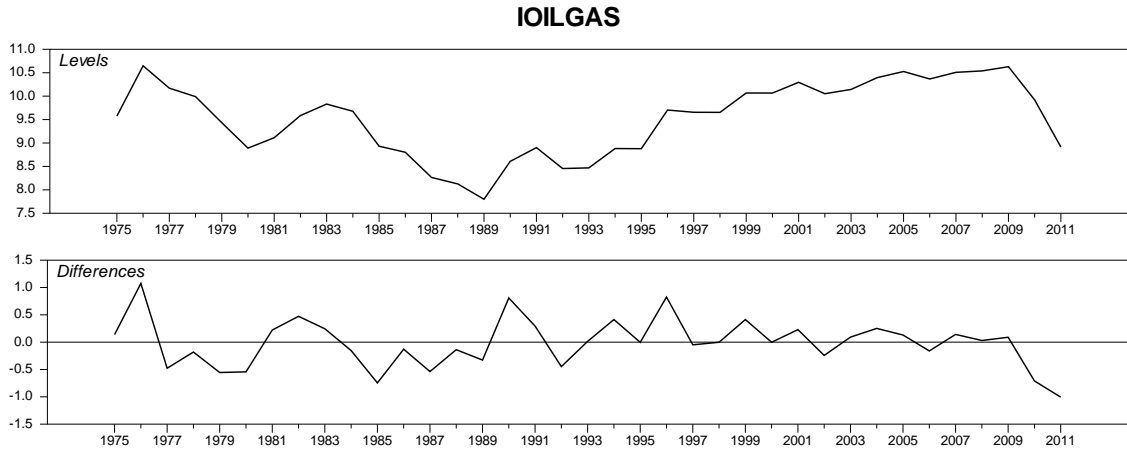


FIGURE 6B11 – MANUFACTURING $T(1988:01)$

$T(1988:01)$



**FIGURE 6B12 – OIL LOG REAL INVESTMENT
(IN BILLION RIALS AT CONSTANT 2004/05 PRICES)**



**FIGURE 6B13 – OIL LOG REAL OUTPUT
(IN BILLION RIALS AT CONSTANT 2004/05 PRICES)**

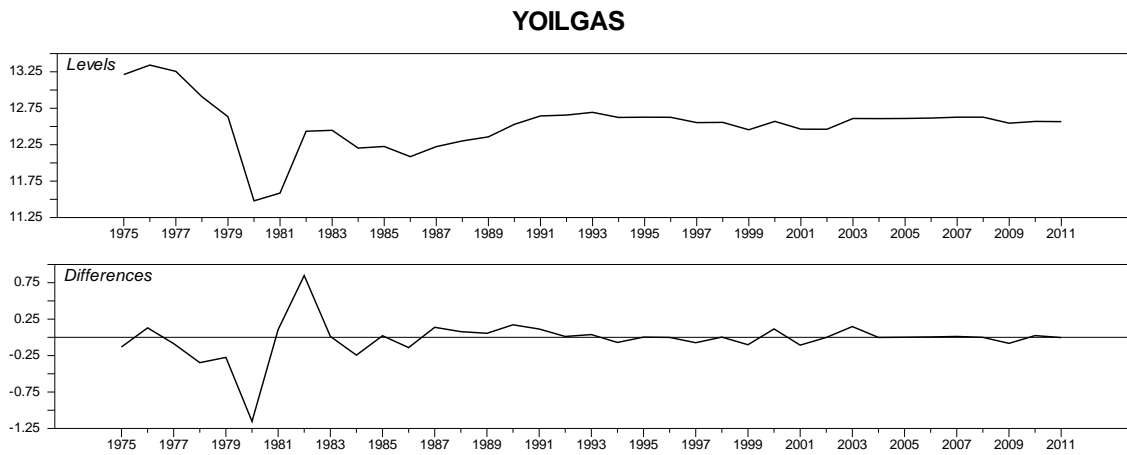


FIGURE 6B14 – OIL log (g^k + δ)_t

KGDOILGAS

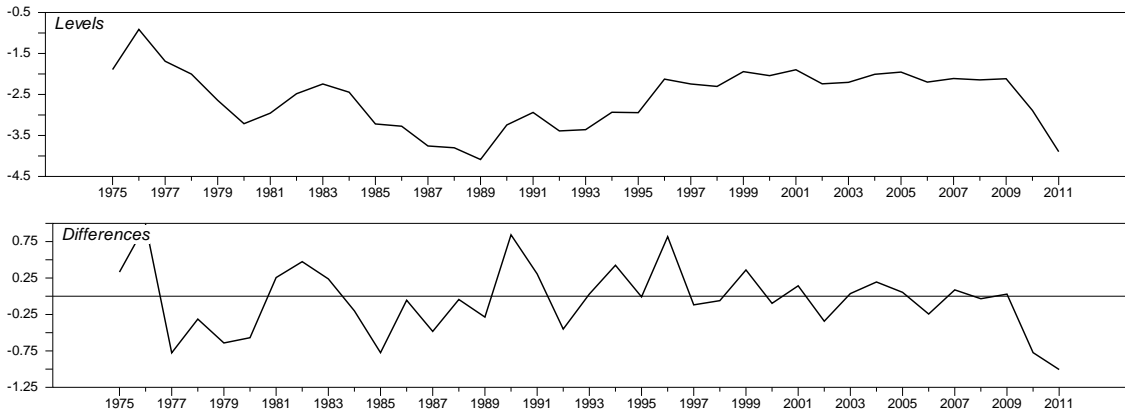
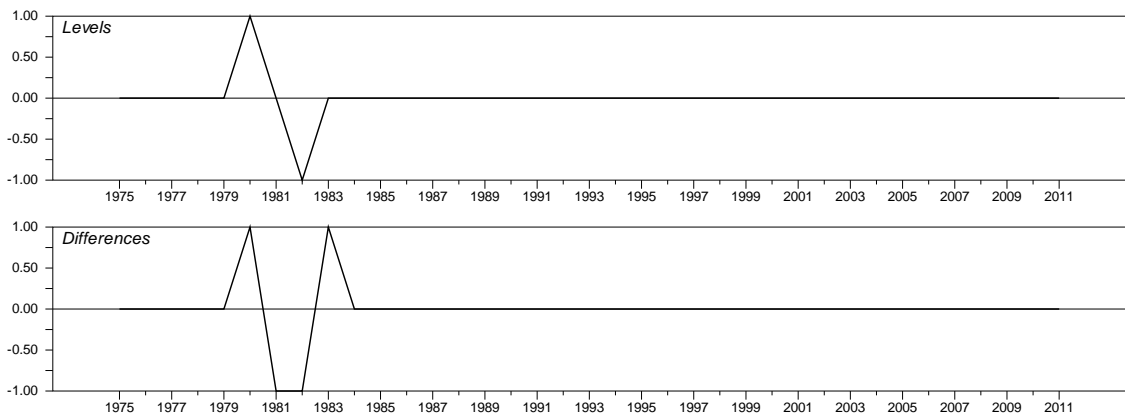


FIGURE 6B15 – OIL DP1980

DP1980



**FIGURE 6B16 – SERVICES LOG REAL INVESTMENT
(IN BILLION RIALS AT CONSTANT 2004/05 PRICES)**

ISERVICE

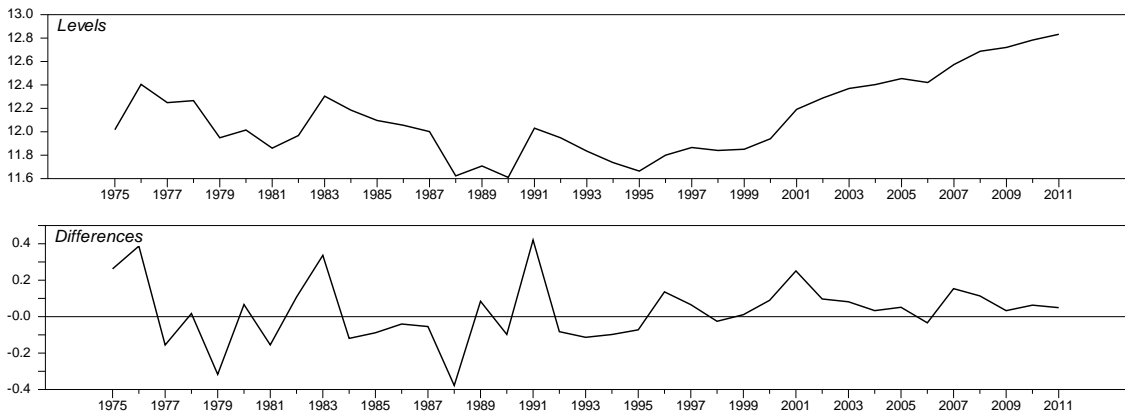


FIGURE 6B17 – SERVICES LOG REAL OUTPUT
(IN BILLION RIALS AT CONSTANT 2004/05 PRICES)

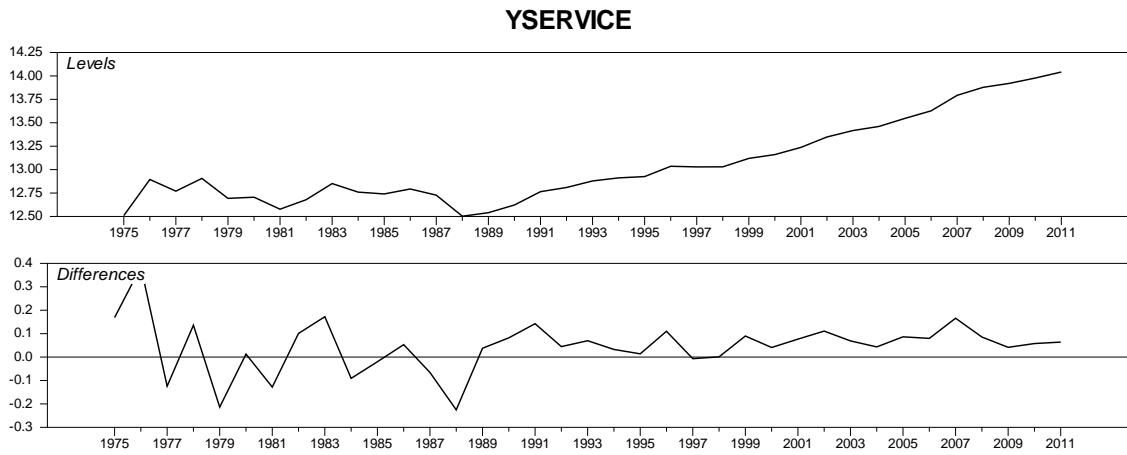


FIGURE 6B18 – SERVICES USER COST OF CAPITAL

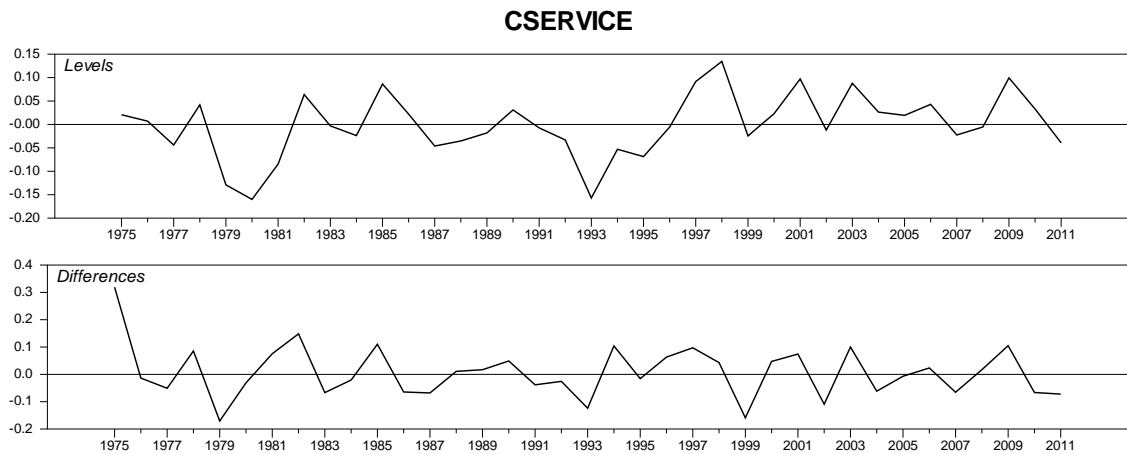


FIGURE 6B19 – SERVICES $\log (g^k + \delta)_t$

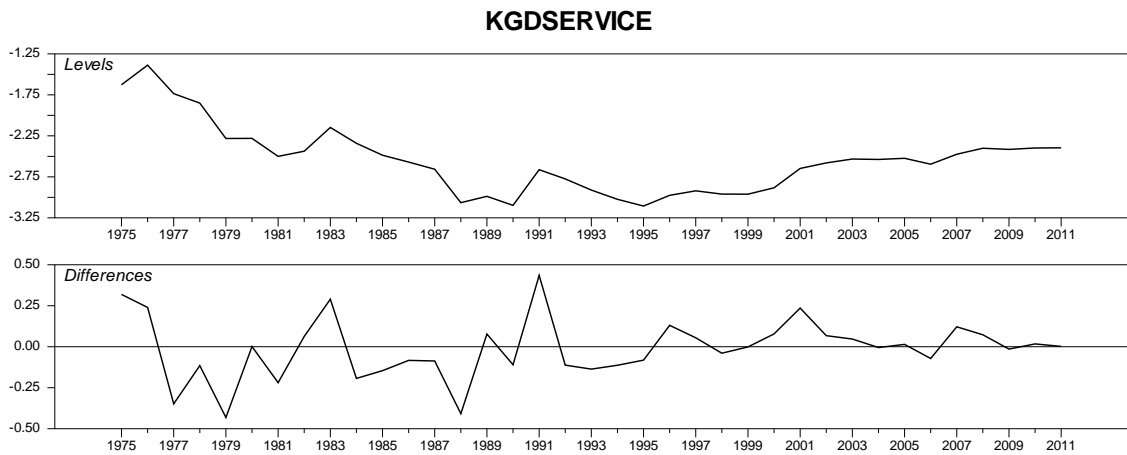
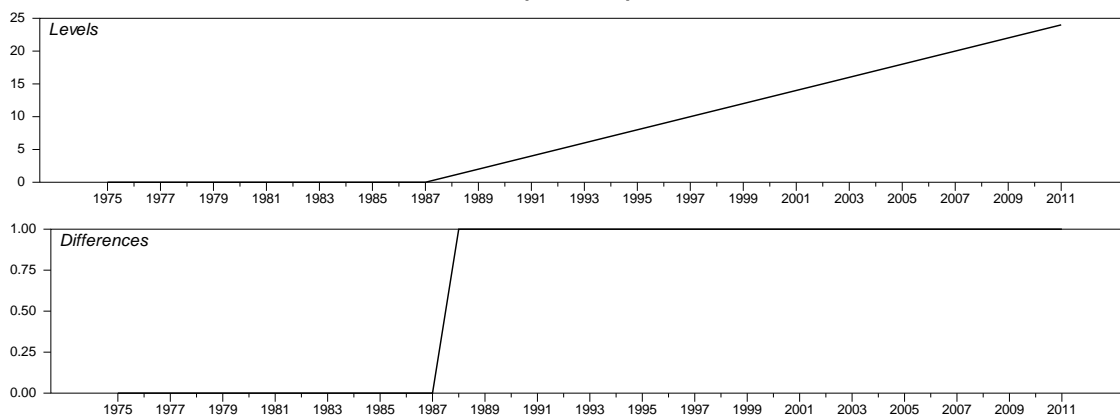


FIGURE 6B20 – SERVICES T(1988:01)

T(1988:01)



Source: Central Bank of Iran (Economic Time-series Data-base) and author's calculation.

APPENDIX 6C: LAG LENGTH DETERMINATION

AGRICULTURE SECTOR (1974-2011)								
	p	T	regr	Log-Lik	SC	H-Q	LM(1)	LM(p)
VAR(2)	2	35	18	593.492	-24.772	-27.390	0.349	0.062
VAR(1)	1	35	12	564.930	-26.187	-27.933	0.499	0.499
MANUFACTURING AND MINING SECTORS (1974-2011)								
	p	T	regr	Log-Lik	SC	H-Q	LM(1)	LM(p)
VAR(2)	2	35	17	645.454	-28.249	-30.722	0.052	0.233
VAR(1)	1	35	11	595.784	-28.458	-30.058	0.003	0.003
OIL GROUP (1974-2011)								
	p	T	regr	Log-Lik	SC	H-Q	LM(1)	LM(p)
VAR(2)	2	35	16	573.160	-24.626	-26.953	0.028	0.319
VAR(1)	1	35	10	541.463	-25.862	-27.317	0.310	0.310
SERVICES (1974-2011)								
	p	T	regr	Log-Lik	SC	H-Q	LM(1)	LM(p)
VAR(2)	2	35	16	677.170	-30.569	-32.897	0.127	0.420
VAR(1)	1	35	10	631.741	-31.020	-32.475	0.007	0.007

Note: the analysis is conducted employing WinRATS Pro8.1 software. SC: Schwarz Criterion. H-Q: Hannan-Quinn Criterion.

APPENDIX 6D: MISSPECIFICATION TESTS

AGRICULTURE SECTOR (1974-2011)

Univariate tes

	$\hat{d}_t^{\text{Agriculture}}$	$\hat{d}y_t^{\text{Agriculture}}$	$\hat{d}c_t^{\text{Agriculture}}$	$\hat{d}(\ln(\delta + gk))_t^{\text{Agriculture}}$	$\hat{d}dp_t$
ARCH (1)	0.056 [0.813]	9.246 [0.002]	1.809 [0.179]	0.020 [0.887]	0.014 [0.907]
Norm.	2.019 [0.364]	3.945 [0.139]	1.878 [0.391]	3.856 [0.145]	1.727 [0.422]

MANUFACTURING AND MINING SECTORS (1974-2011)

Univariate tes

	$\hat{d}_t^{\text{Manufacturing}}$	$\hat{d}y_t^{\text{Manufacturing}}$	$\hat{d}c_t^{\text{Manufacturing}}$	$\hat{d}(\ln(\delta + gk))_t^{\text{Manufacturing}}$	$\hat{d}dp_t$
ARCH (2)	0.079 [0.961]	0.170 [0.919]	1.556 [0.459]	0.135 [0.935]	2.837 [0.242]
Norm.	0.032 [0.984]	8.472 [0.014]	1.097 [0.578]	0.204 [0.903]	0.882 [0.643]

OIL GROUP (1974-2011)

Univariate tes

	\hat{d}_t^{Oil}	$\hat{d}y_t^{\text{Oil}}$	$\hat{d}c_t$	$\hat{d}(\ln(\delta + gk))_t^{\text{Oil}}$	$\hat{d}dp_t$
ARCH (1)	0.030 [0.861]	2.970 [0.085]	0.458 [0.498]	0.148 [0.700]	0.301 [0.583]
Norm.	2.701 [0.259]	0.925 [0.630]	0.051 [0.975]	3.100 [0.212]	0.955 [0.620]

SERVICES (1974-2011)

Univariate tes

	$\hat{d}_t^{\text{Services}}$	$\hat{d}y_t^{\text{Services}}$	$\hat{d}c_t^{\text{Services}}$	$\hat{d}(\ln(\delta + gk))_t^{\text{Services}}$	$\hat{d}dp_t$
ARCH (2)	1.242 [0.537]	2.886 [0.236]	1.947 [0.378]	1.252 [0.535]	3.158 [0.206]
Norm.	3.274 [0.195]	2.326 [0.313]	0.128 [0.938]	3.486 [0.175]	0.430 [0.807]

Note: the analysis is conducted employing WinRATS Pro8.1 software. P-values are in brackets.

APPENDIX 6E: RANK DETERMINATION

AGRICULTURE SECTOR (1974-2011)

p - r	r	λ_i	Trace	Trace*	Frac95	p-value	p-value*
5	0	0.928	177.633	163.089	88.554	0.001	0.000
4	1	0.558	83.009	77.870	63.659	0.024	0.098
3	2	0.452	53.621	51.315	42.770	0.163	0.345
2	3	0.421	31.964	31.158	25.731	0.585	0.513
1	4	0.290	12.316	12.209	12.448	0.619	0.732

MANUFACTURING AND MINING SECTORS (1974-2011)

p - r	r	λ_i	Trace	Trace*	Frac95	p-value	p-value*
5	0	0.865	173.390	136.173	88.554	0.000	0.000
4	1	0.709	103.271	84.050	63.659	0.000	0.033
3	2	0.564	60.056	50.303	42.770	0.039	0.313
2	3	0.400	30.984	27.010	25.731	0.364	0.675
1	4	0.313	13.120	12.444	12.448	0.281	0.462

OIL GROUP (1974-2011)

p - r	r	λ_i	Trace	Trace*	Frac95	p-value	p-value*
5	0	0.943	179.374	164.688	100.127	0.000	0.000
4	1	0.659	76.199	71.481	73.128	0.000	0.035
3	2	0.492	37.418	35.809	50.075	0.015	0.201
2	3	0.195	13.065	12.735	30.912	0.392	0.699
1	4	0.136	5.253	5.207	15.33	0.771	0.885

SERVICES (1974-2011)

p - r	r	λ_i	Trace	Trace*	Frac95	p-value	p-value*
5	0	0.888	163.096	112.800	69.611	0.000	0.063
4	1	0.591	86.416	60.804	47.707	0.000	0.092
3	2	0.542	55.101	38.396	29.804	0.025	0.577
2	3	0.426	27.784	20.189	15.408	0.239	0.761
1	4	0.213	8.381	6.245	3.841	0.640	0.853

Note: the analysis is conducted employing WinRATS Pro8.1 software. Critical/P-values correspond to the 'Basic Model'. The Bartlett Corrections correspond to the 'Basic Model'.

APPENDIX 6F: EIGENVALUES OF THE COMPANION MATRIX

AGRICULTURE SECTOR (1974-2011)

	Root 1	Root 2	Root 3	Root 4	Root 5
Rank = 5	0.784	0.505	0.505	0.184	0.036
Rank = 4	1,000	0.838	0.266	0.266	0.033
Rank = 3	1,000	1,000	0.846	0.217	0.045
Rank = 2	1,000	1,000	1,000	0.820	0.036
Rank = 1	1,000	1,000	1,000	1,000	0.815

MANUFACTURING AND MINING SECTORS (1974-2011)

	Root 1	Root 2	Root 3	Root 4	Root 5
Rank = 5	0.790	0.790	0.782	0.782	0.728
Rank = 4	1,000	0.796	0.796	0.777	0.777
Rank = 3	1,000	1,000	0.771	0.771	0.653
Rank = 2	1,000	1,000	1,000	0.751	0.751
Rank = 1	1,000	1,000	1,000	1,000	0.666

OIL GROUP (1974-2011)

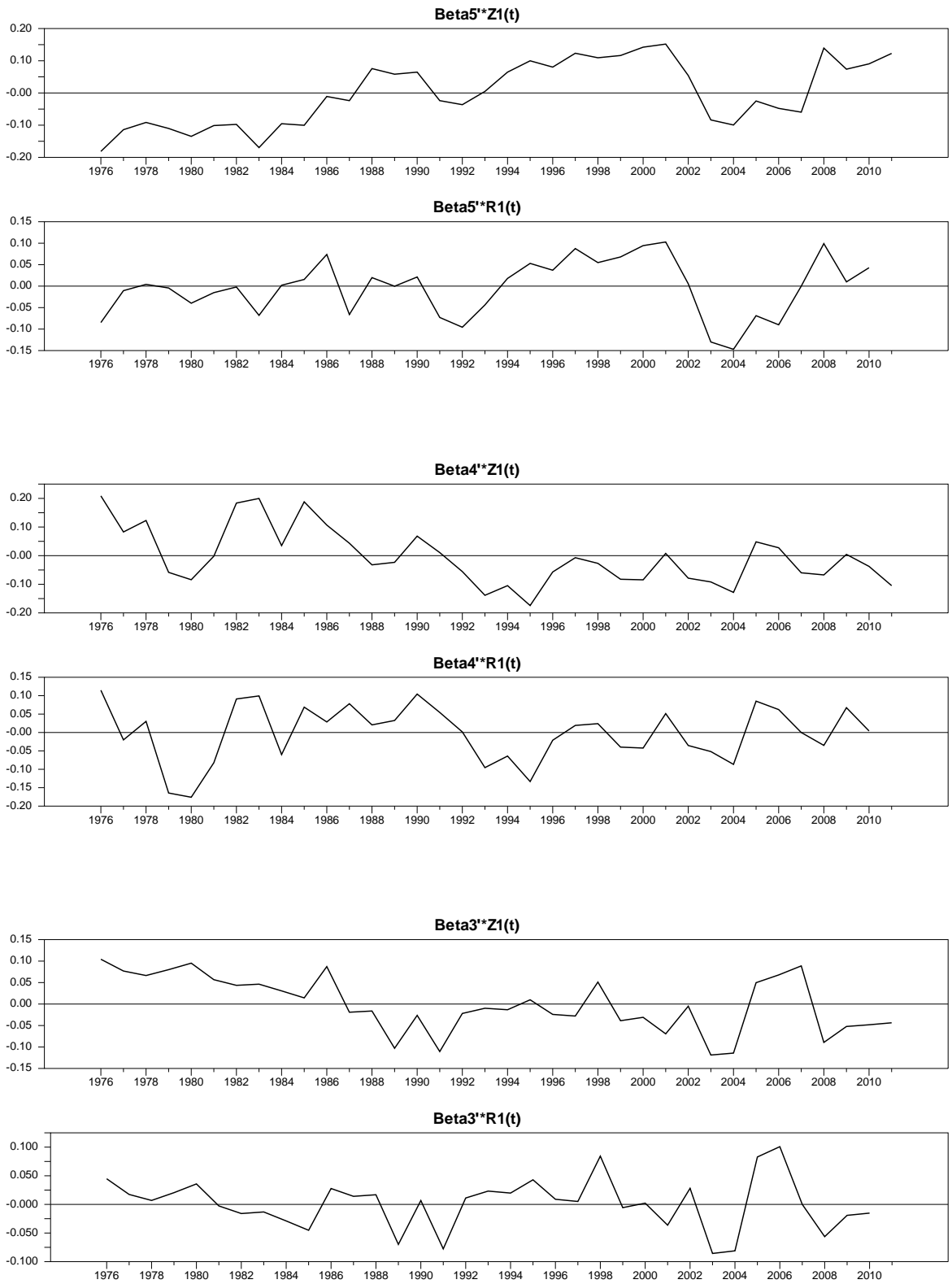
	Root 1	Root 2	Root 3	Root 4	Root 5
Rank = 5	0.904	0.780	0.780	0.489	0.014
Rank = 4	1,000	0.853	0.853	0.531	0.047
Rank = 3	1,000	1,000	0.760	0.760	0.068
Rank = 2	1,000	1,000	1,000	0.793	0.067
Rank = 1	1,000	1,000	1,000	1,000	0.756

SERVICES (1974-2011)

	Root 1	Root 2	Root 3	Root 4	Root 5
Rank = 5	0.822	0.822	0.720	0.720	0.604
Rank = 4	1,000	0.835	0.706	0.706	0.630
Rank = 3	1,000	1,000	0.788	0.629	0.629
Rank = 2	1,000	1,000	1,000	0.795	0.628
Rank = 1	1,000	1,000	1,000	1,000	0.767

Note: the analysis is conducted employing WinRATS Pro8.1 software.

APPENDIX 6G: GRAPHS OF COINTEGRATING RELATIONS
FIGURE 6G1: AGRICULTURE INVESTMENT EQUATION



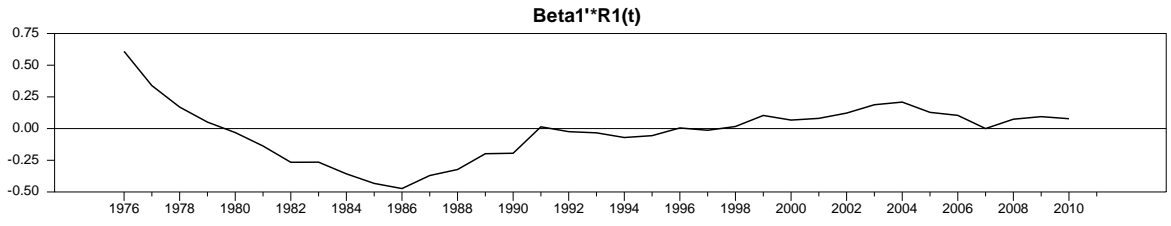
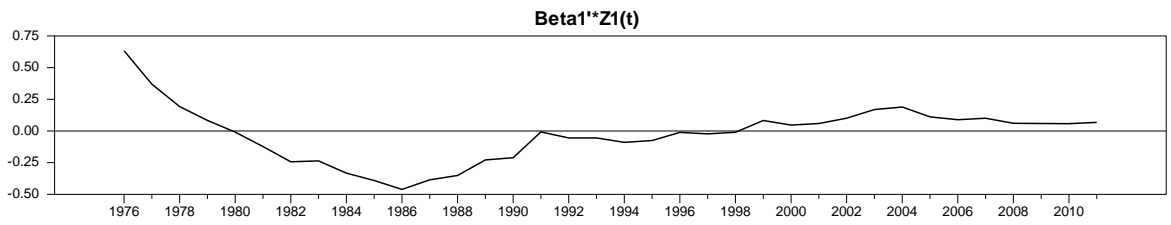
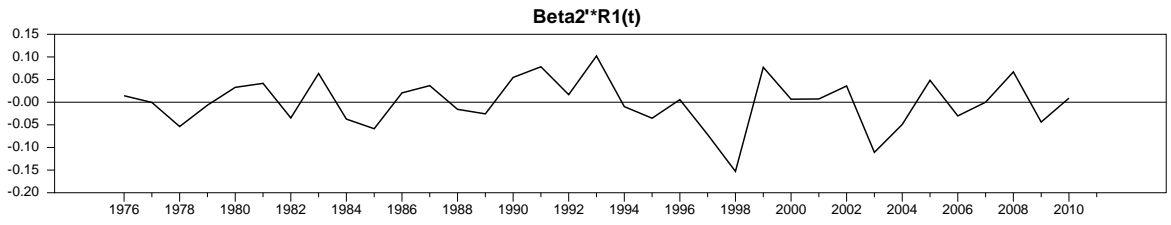
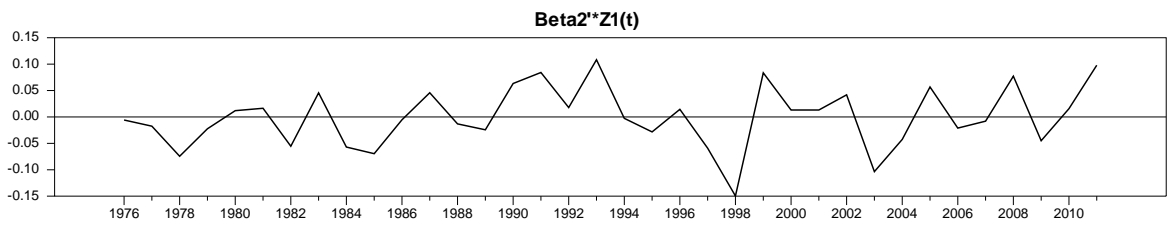
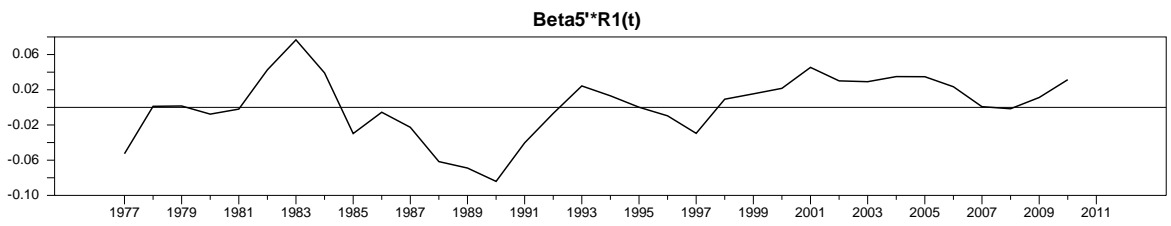
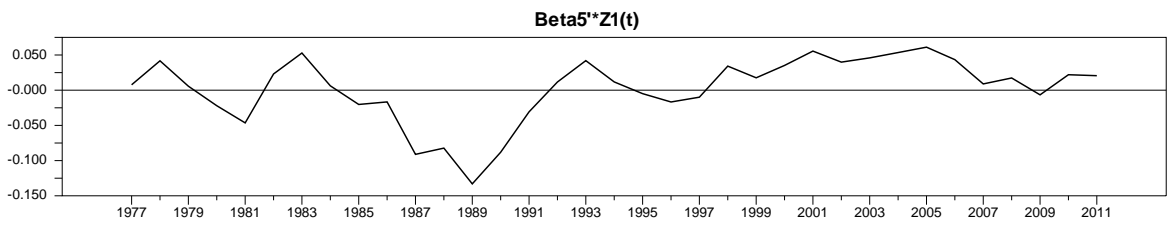
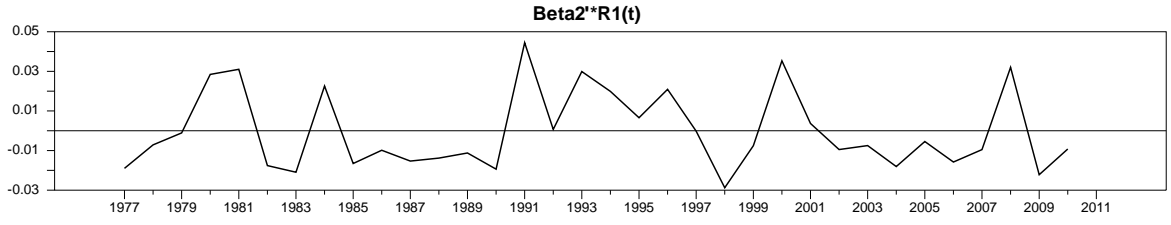
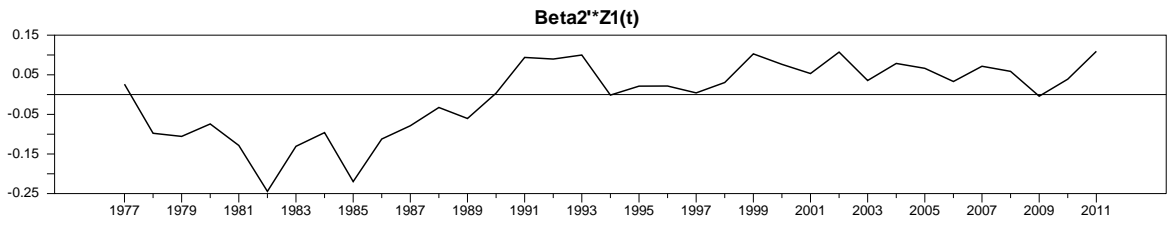
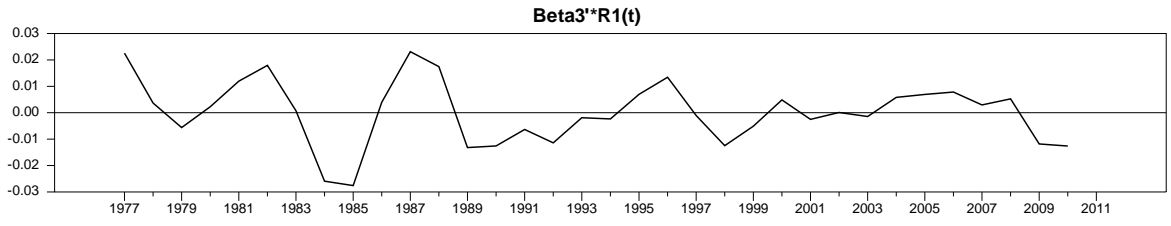
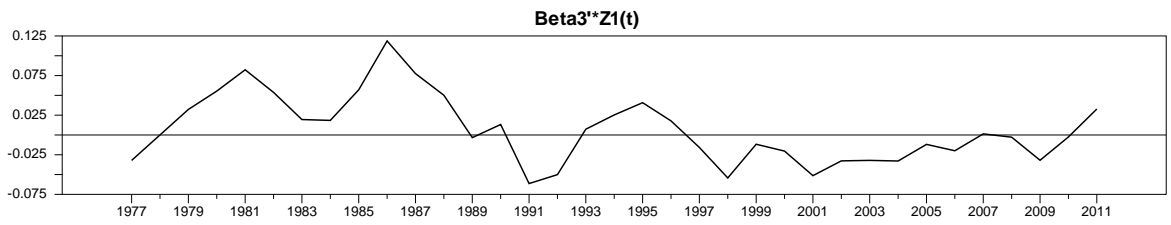
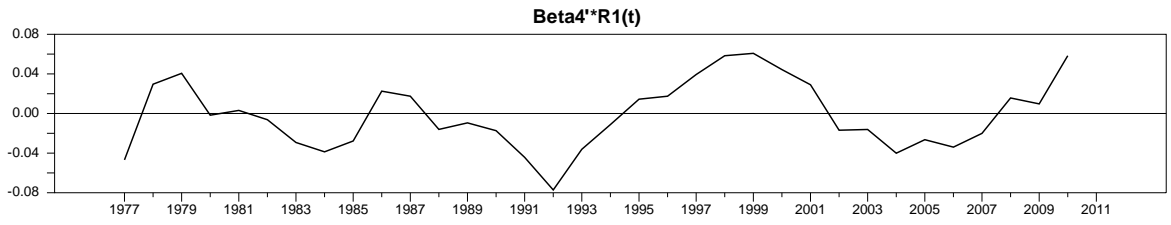
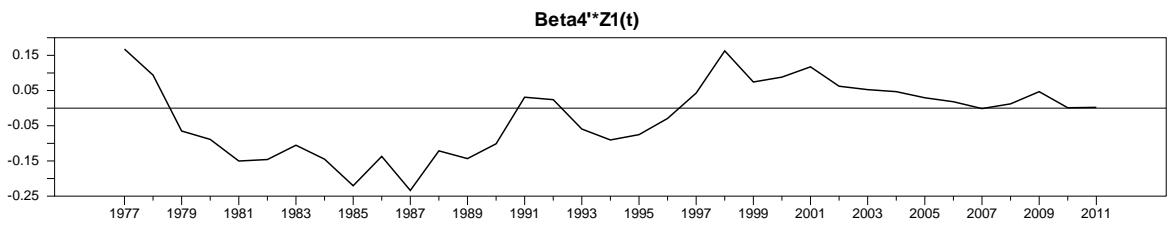


FIGURE 6G2: MANUFACTURING AND MINING INVESTMENT EQUATION





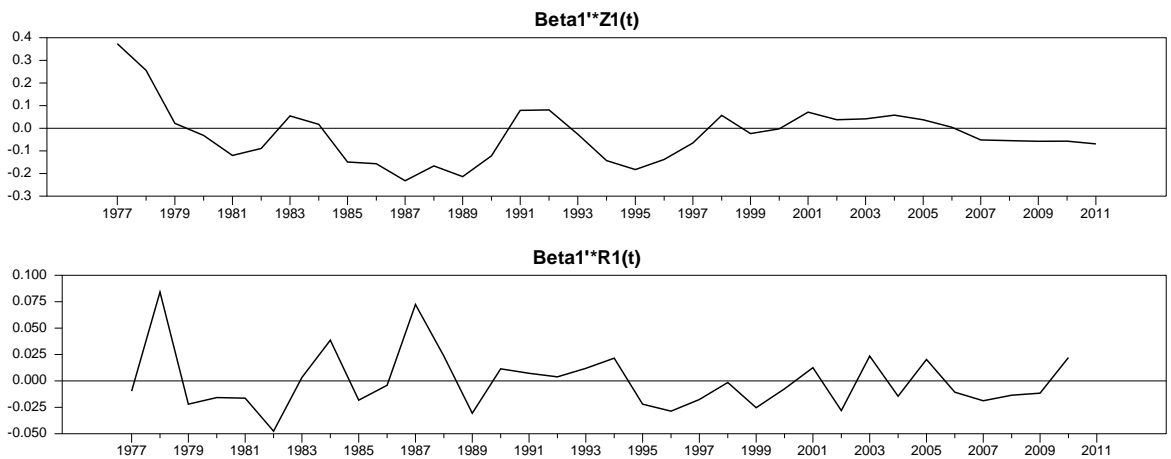
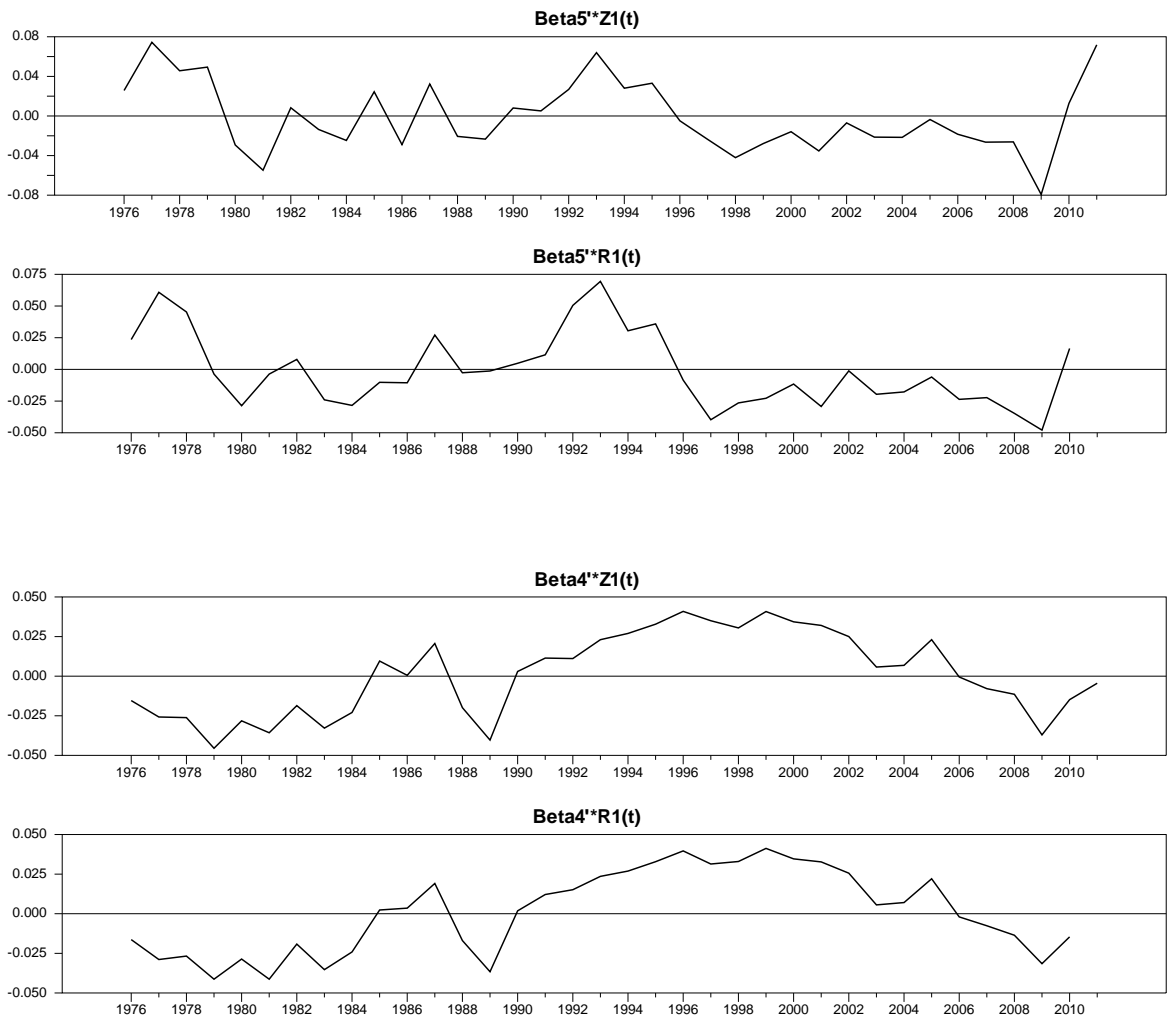


FIGURE 6G3: OIL GROUP INVESTMENT EQUATION



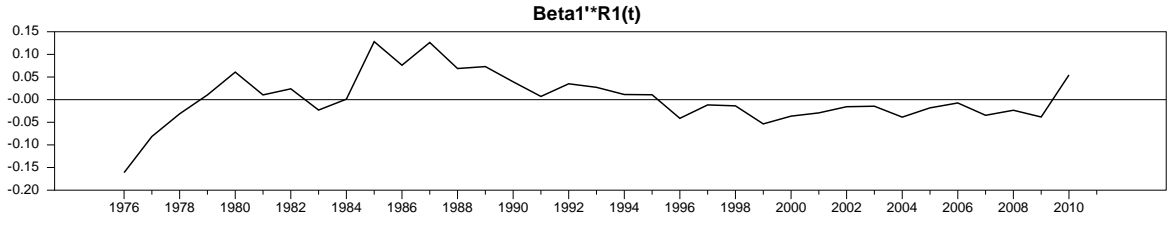
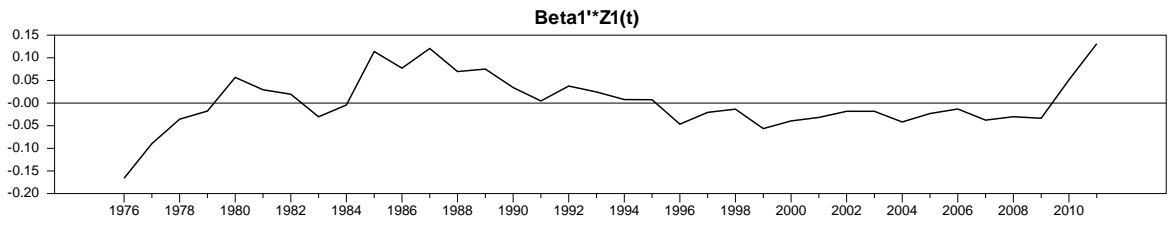
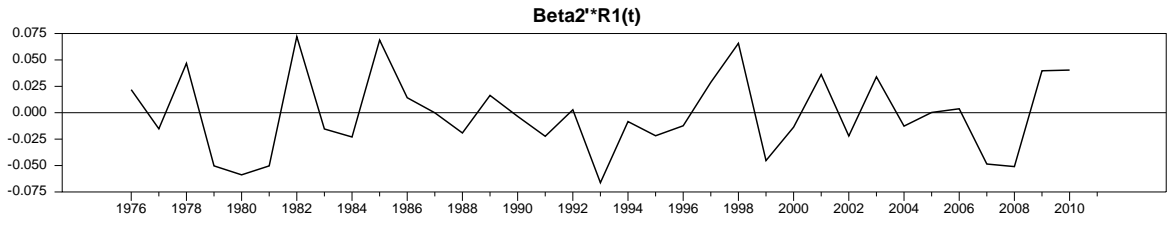
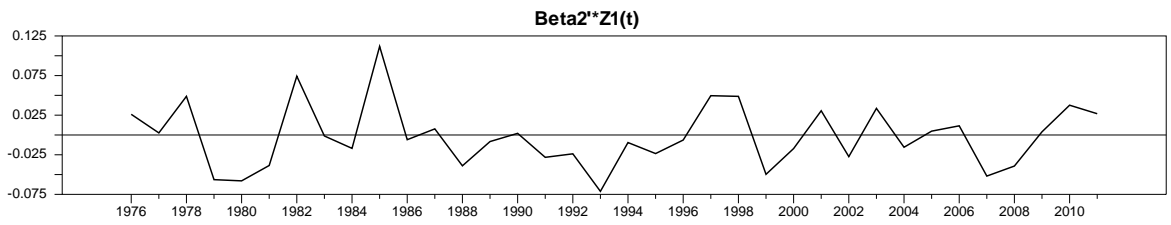
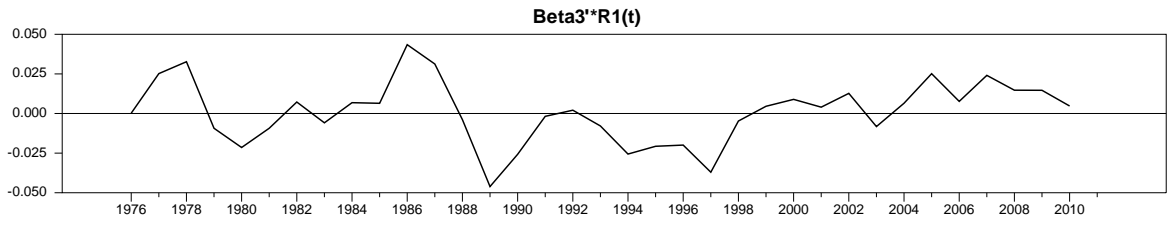
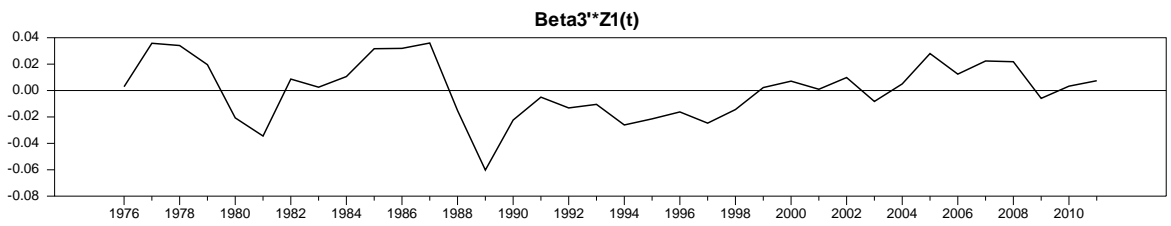
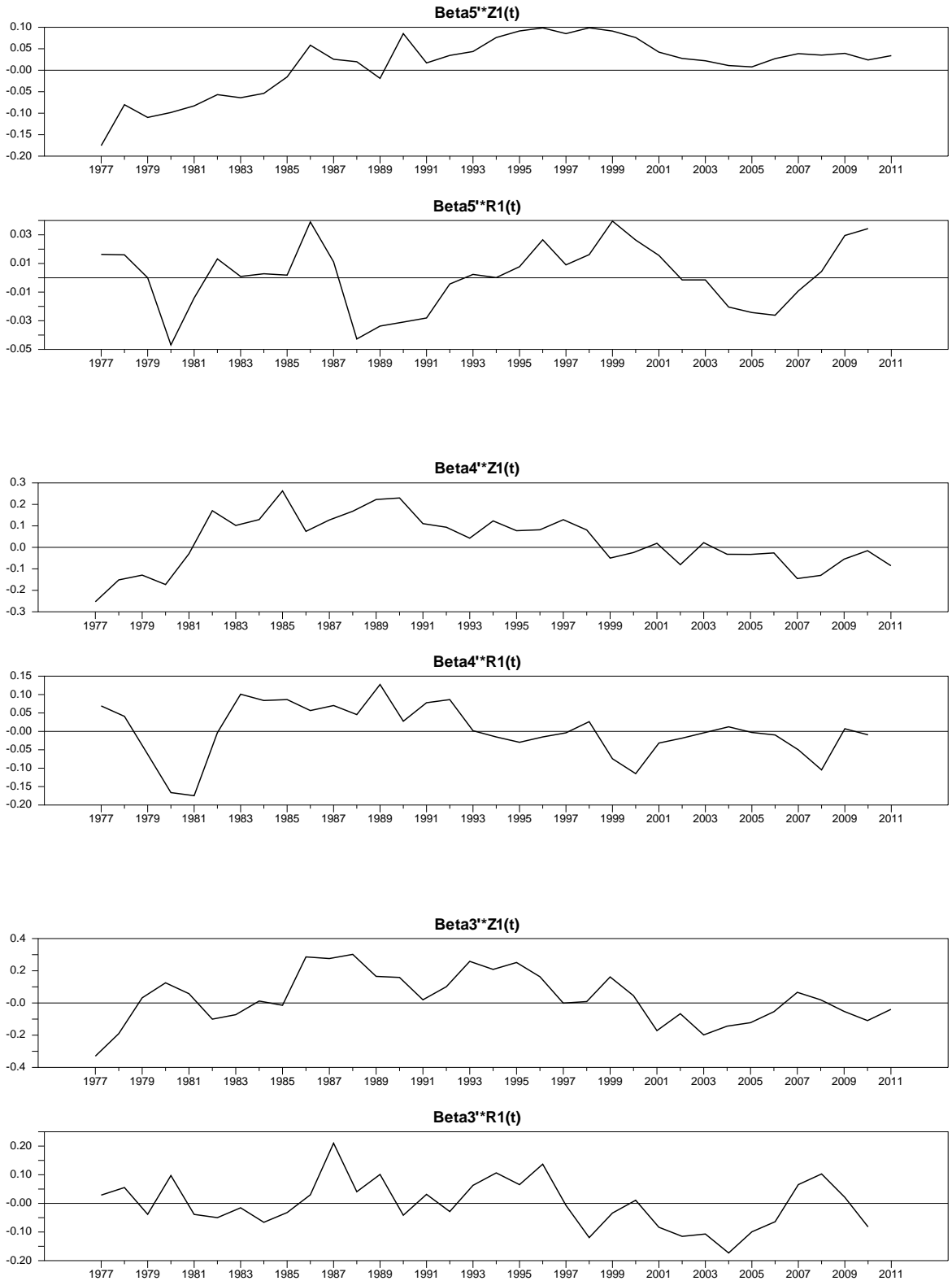
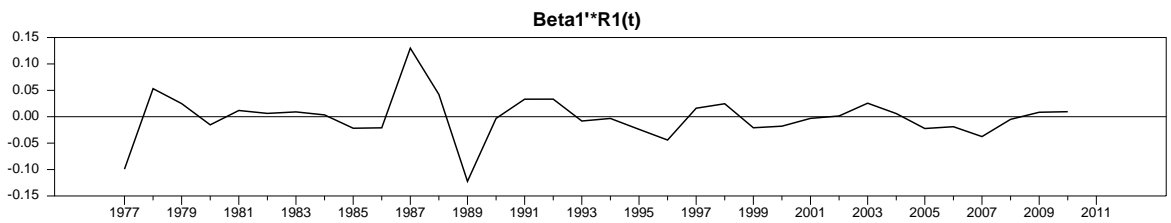
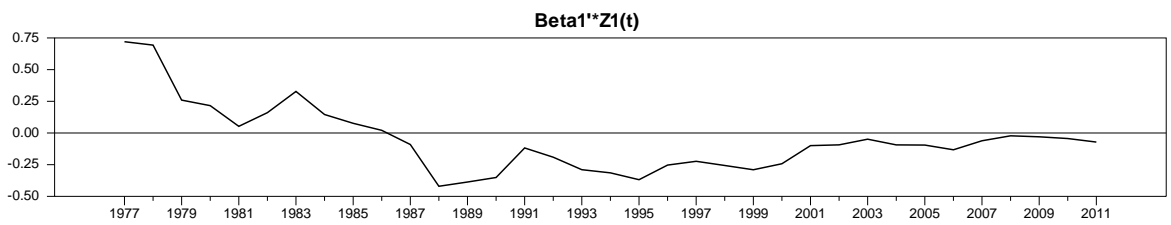
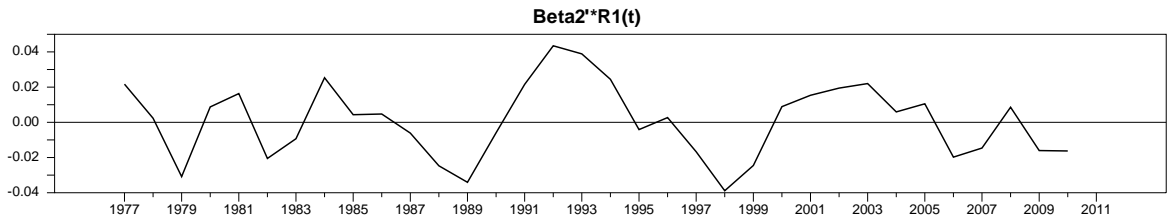
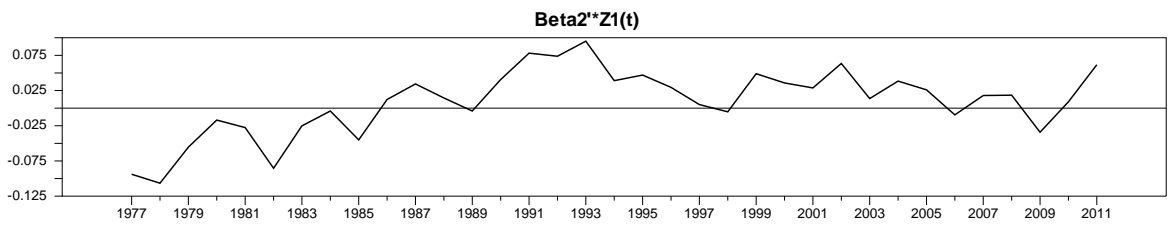


FIGURE 6G4: SERVICES INVESTMENT EQUATION

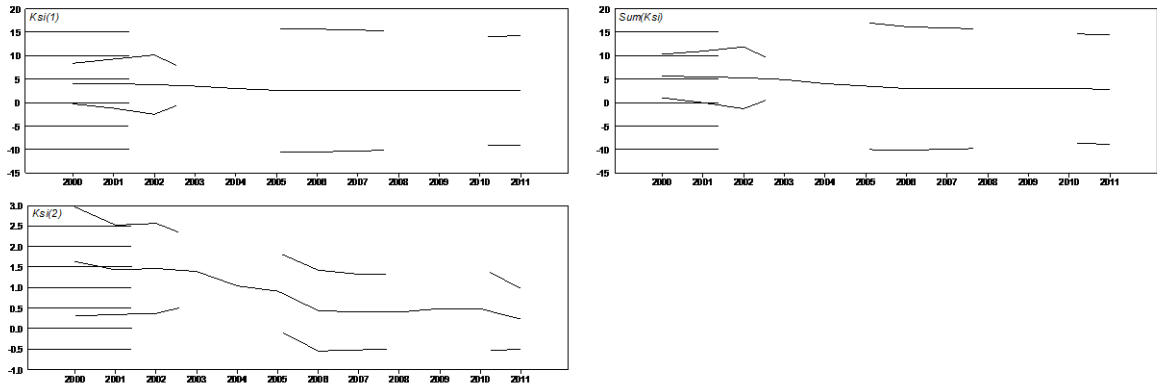




APPENDIX 6H: RECURSIVE STABILITY TESTS

FIGURE 6H1: AGRICULTURE INVESTMENT EQUATION

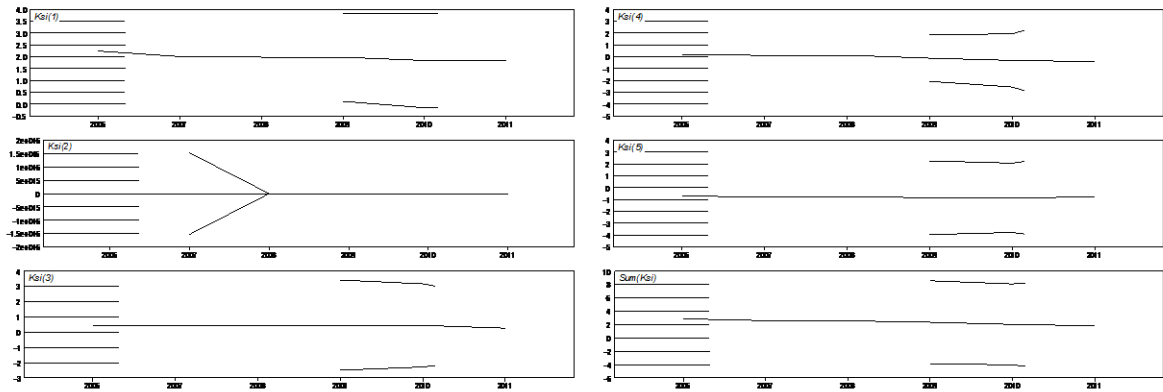
Transformed Eigenvalues



$K_{si} = \log(\text{Lambda}/(1-\text{Lambda})), \text{ Sum}(K_{si}) = K_{si}(1) + \dots + K_{si}(r)$

FIGURE 6H2: MANUFACTURING AND MINING INVESTMENT EQUATION

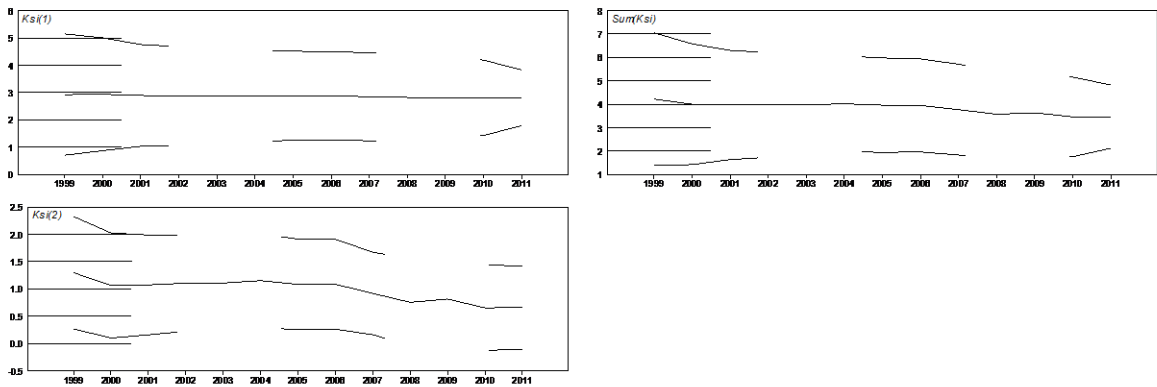
Transformed Eigenvalues



$K_{si} = \log(\text{Lambda}/(1-\text{Lambda})), \text{ Sum}(K_{si}) = K_{si}(1) + \dots + K_{si}(r)$

FIGURE 6H3: OIL GROUP INVESTMENT EQUATION

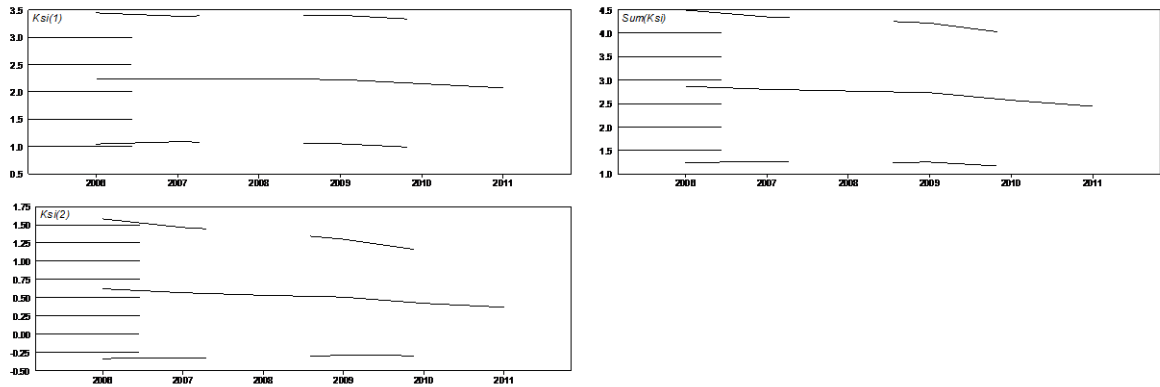
Transformed Eigenvalues



$K_{si} = \log(\text{Lambda}/(1-\text{Lambda})), \text{ Sum}(K_{si}) = K_{si}(1) + \dots + K_{si}(r)$

FIGURE 6H4: SERVICES INVESTMENT EQUATION

Transformed Eigenvalues



$K_{si} = \log(\text{Lambda}/(1-\text{Lambda})), \text{ Sum}(K_{si}) = K_{si}(1) + \dots + K_{si}(r)$

APPENDIX 6I: STATIONARITY TESTS - SECTOR-LEVEL DATA

AGRICULTURE SECTOR (1974-2011)					
$r = 2$	$i_t^{\text{Agriculture}}$	$y_t^{\text{Agriculture}}$	$c_t^{\text{Agriculture}}$	$(\ln(\delta + gk))_t^{\text{Agriculture}}$	$dp_t^{\text{Agriculture}}$
TESTING A UNIT VECTOR IN β (stationarity)					
$\chi^2(3)$	6.820 [0.078]	8.350 [0.039]	9.708 [0.021]	4.437 [0.218]	6.844 [0.077]
MANUFACTURING AND MINING SECTORS (1974-2011)					
$r = 2$	$i_t^{\text{Manufacturing}}$	$y_t^{\text{Manufacturing}}$	$c_t^{\text{Manufacturing}}$	$(\ln(\delta + gk))_t^{\text{Manufacturing}}$	$dp_t^{\text{Manufacturing}}$
TESTING A UNIT VECTOR IN β (stationarity)					
$\chi^2(3)$	24.161 [0.000]	28.431 [0.000]	15.041 [0.002]	23.355 [0.000]	12.65 [0.005]
OIL GROUP (1974-2011)					
$r = 2$	i_t^{Oil}	y_t^{Oil}	c_t	$(\ln(\delta + gk))_t^{\text{Oil}}$	dp_t^{Oil}
TESTING A UNIT VECTOR IN β (stationarity)					
$\chi^2(3)$	23.494 [0.000]	29.548 [0.000]	1.785 [0.618]	15.872 [0.001]	9.533 [0.013]
SERVICES (1974-2011)					
$r = 2$	i_t^{Services}	y_t^{Services}	c_t^{Services}	$(\ln(\delta + gk))_t^{\text{Services}}$	dp_t^{Services}
TESTING A UNIT VECTOR IN β (stationarity)					
$\chi^2(3)$	11.453 [0.010]	7.123 [0.068]	9.598 [0.022]	15.435 [0.001]	6.760 [0.080]

Note: the analysis is conducted employing WinRATS Pro8.1 software. P-values in brackets. Restricted Trend included in the cointegrating relation(s). For models with exogenous variables, Restricted Trend and W. Exogenous variables included in the cointegrating relation(s).

APPENDIX 6J: TESTS OF SIGNIFICANCE FOR DUMMY VARIABLES

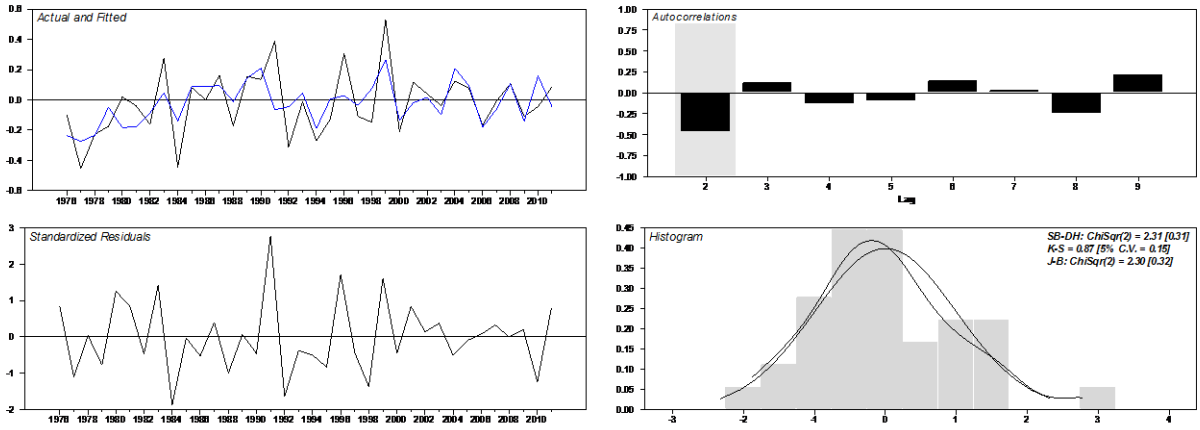
AGRICULTURE SECTOR (1970-2010)				
	DOREV (t-0)	DT(1988:01)	DP2008{0}	CONSTANT
$\hat{\alpha}^{\text{Agriculture}}$	0.063 (1.022)	-0.001 (-0.015)	0.150 (0.994)	11.477 (1.646)
$\hat{\alpha}_y^{\text{Agriculture}}$	0.016 (0.857)	-0.105 (-3.901)	-0.188 (-4.208)	8.639 (4.180)
$\hat{\alpha}_c^{\text{Agriculture}}$	-0.051 (-1.756)	-0.109 (-2.550)	0.056 (0.780)	5.586 (1.690)
$\hat{\alpha}(\ln(\delta + gk))^{\text{Agriculture}}$	0.061 (0.935)	-0.012 (-0.123)	0.149 (0.937)	10.047 (1.359)
$\hat{\alpha}_{dp}^{\text{Agriculture}}$	0.070 (2.318)	0.098 (2.209)	-0.040 (-0.551)	-5.656 (-1.664)
MANUFACTURING AND MINING SECTORS (1970-2010)				
	DOREV (t-0)	DOREV (t-1)	DT(1988:01)	CONSTANT
$\hat{\alpha}^{\text{Manufacturing}}$	-0.085 (-1.518)	0.243 (2.907)	-0.102 (-0.590)	4.570 (0.918)
$\hat{\alpha}_y^{\text{Manufacturing}}$	0.046 (2.058)	0.050 (1.497)	-0.165 (-2.399)	3.081 (1.547)
$\hat{\alpha}_c^{\text{Manufacturing}}$	-0.038 (-1.914)	0.126 (4.217)	-0.426 (-6.943)	-2.735 (-1.543)
$\hat{\alpha}(\ln(\delta + gk))^{\text{Manufacturing}}$	-0.078 (-1.387)	0.219 (2.608)	-0.060 (-0.344)	2.359 (0.472)
$\hat{\alpha}_{dp}^{\text{Manufacturing}}$	0.063 (2.698)	-0.133 (-3.821)	0.419 (5.828)	4.363 (2.102)
OIL GROUP (1970-2010)				
	DOREV (t-0)	DT(1980:01)	CONSTANT	
$\hat{\alpha}^{\text{Oil}}$	-0.184 (-0.968)	-0.395 (-1.473)	24.191 (2.669)	
$\hat{\alpha}_y^{\text{Oil}}$	0.092 (1.882)	-0.853 (-12.322)	4.961 (2.122)	
$\hat{\alpha}_c$	-0.128 (-4.834)	-0.143 (-3.846)	2.885 (2.291)	
$\hat{\alpha}(\ln(\delta + gk))^{\text{Oil}}$	-0.190 (-0.985)	-0.382 (-1.399)	23.184 (2.517)	
$\hat{\alpha}_{dp}^{\text{Oil}}$	0.156 (5.575)	0.172 (4.354)	-2.280 (-1.711)	
SERVICES (1970-2010)				
	DOREV (t-0)	DOREV (t-1)	DT(1988:01)	CONSTANT
$\hat{\alpha}^{\text{Services}}$	-0.018 (-0.369)	0.011 (0.166)	-0.332 (-3.195)	13.356 (2.973)
$\hat{\alpha}_y^{\text{Services}}$	0.009 (0.372)	0.007 (0.200)	-0.196 (-3.529)	3.371 (1.407)
$\hat{\alpha}_c^{\text{Services}}$	-0.061 (-2.312)	0.051 (1.369)	-0.143 (-2.473)	0.443 (0.178)
$\hat{\alpha}(\ln(\delta + gk))^{\text{Services}}$	-0.020 (-0.412)	0.012 (0.173)	-0.351 (-3.331)	12.624 (2.774)
$\hat{\alpha}_{dp}^{\text{Services}}$	0.094 (3.033)	-0.042 (-0.968)	0.144 (2.125)	-1.792 (-0.614)

Note: Statistically significant coefficients with absolute t-values (in parentheses) greater than 2.00 are in bold. The analysis is conducted employing WinRATS Pro8.1 software.

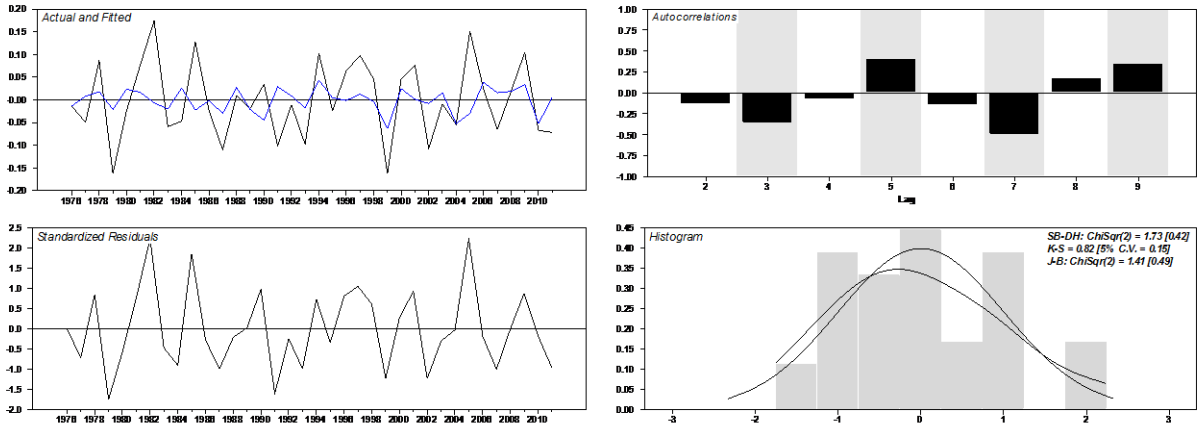
APPENDIX 6K: GRAPHS OF THE RESIDUALS

FIGURE 6K1: AGRICULTURE INVESTMENT EQUATION

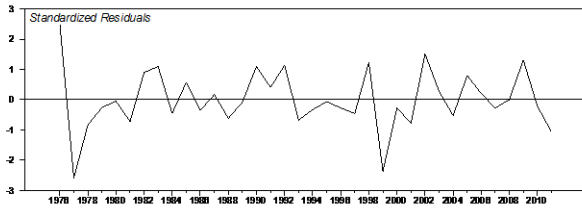
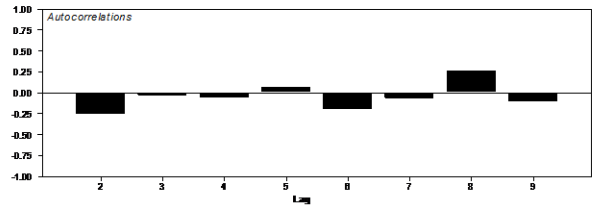
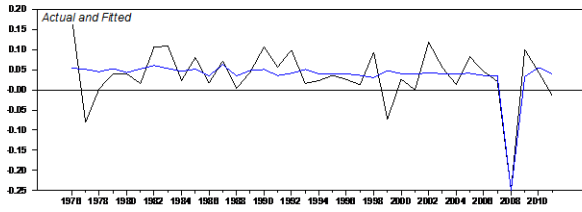
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DCAGRI



DYAGRI



DIAGRI

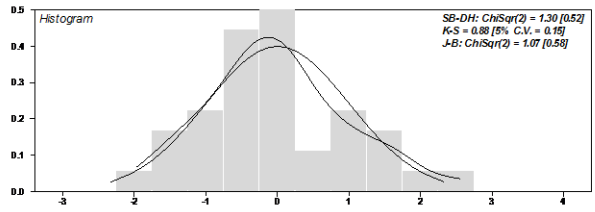
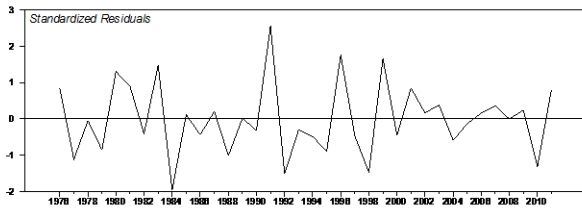
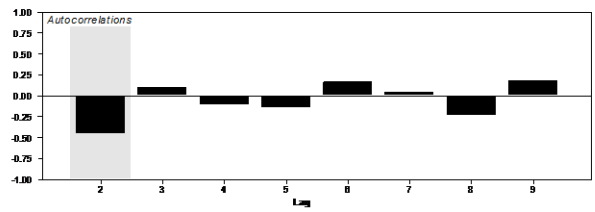
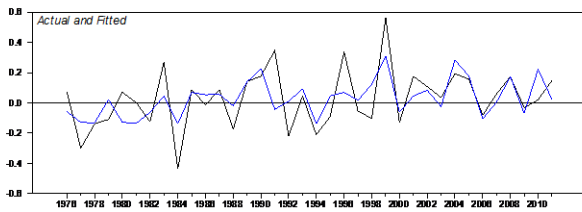
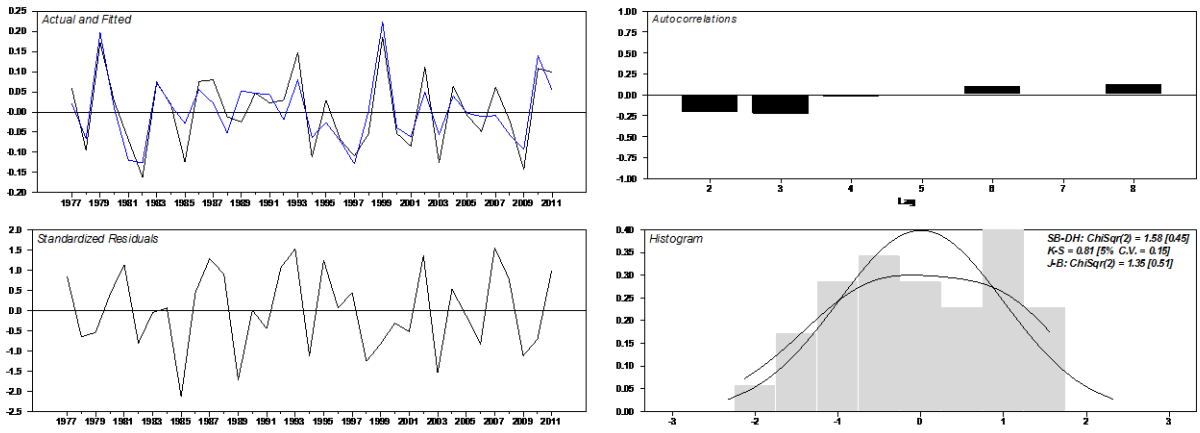
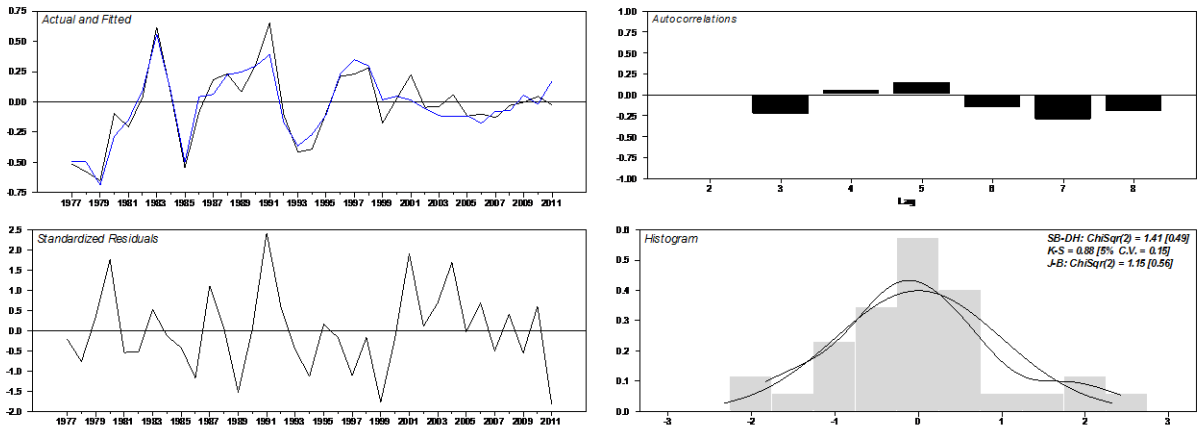


FIGURE 6K2: MANUFACTURING AND MINING INVESTMENT EQUATION

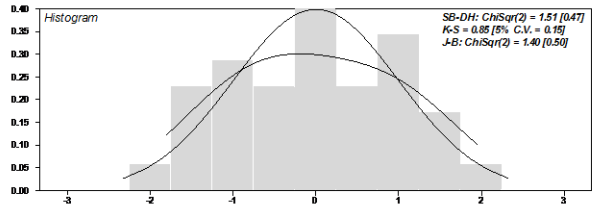
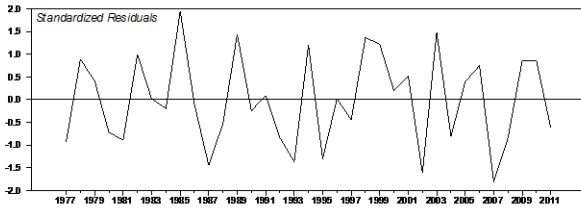
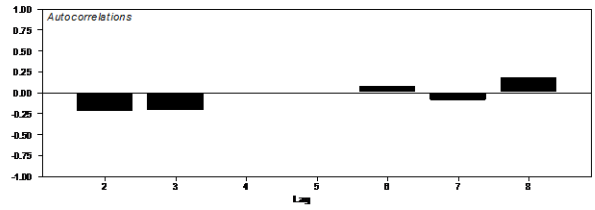
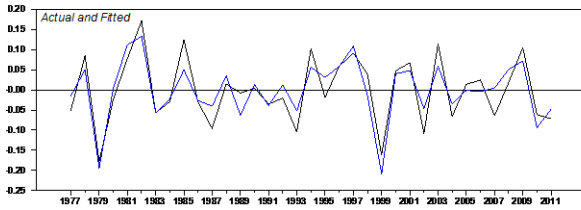
DDP



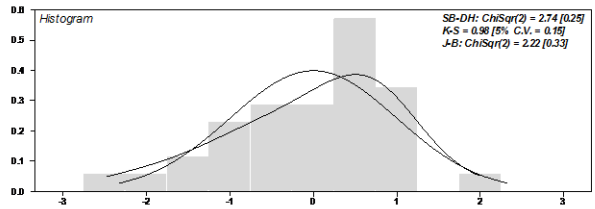
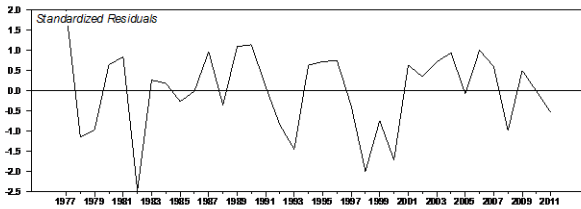
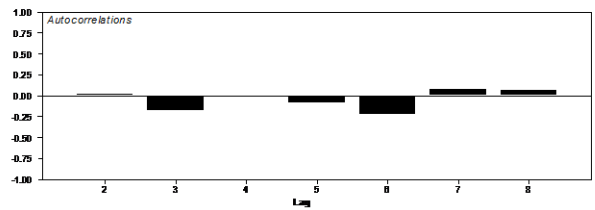
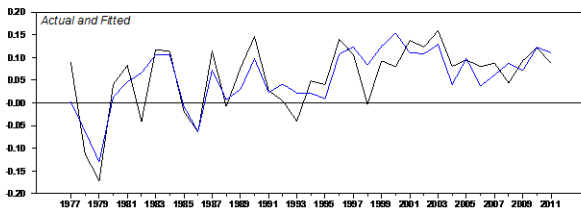
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DCMANMN



DYMANMN



DIMANMN

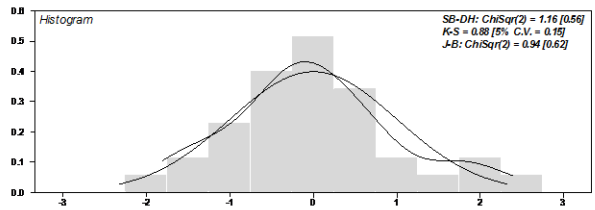
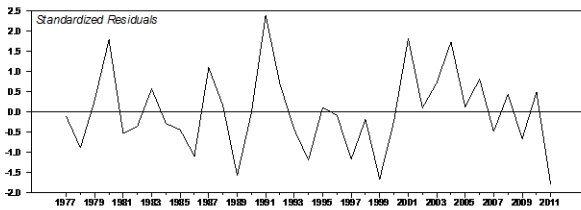
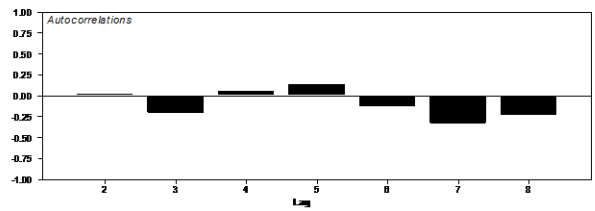
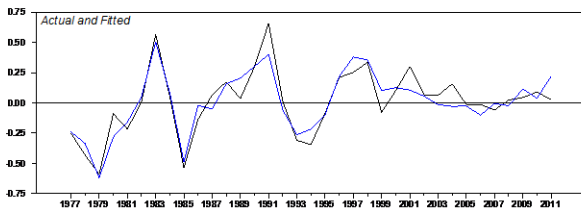
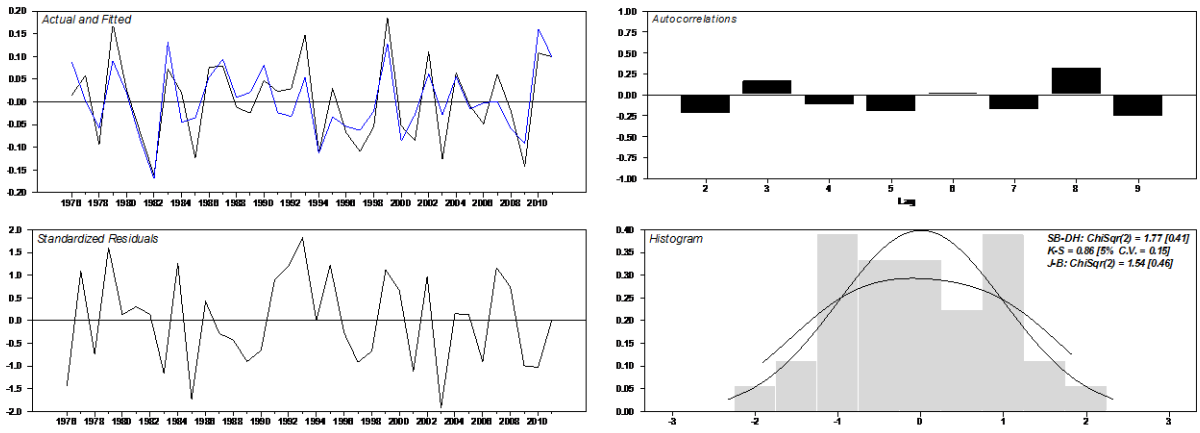
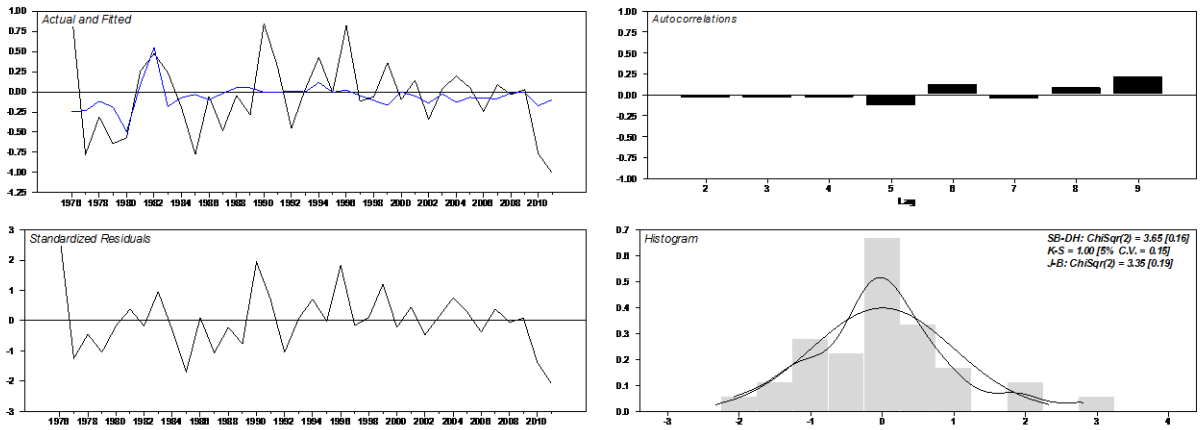


FIGURE 6K3: OIL GROUP INVESTMENT EQUATION

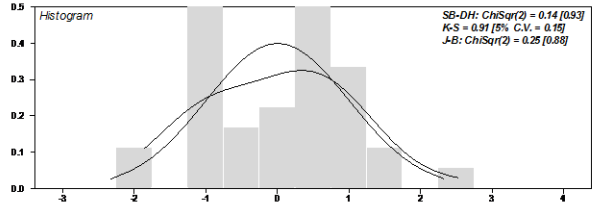
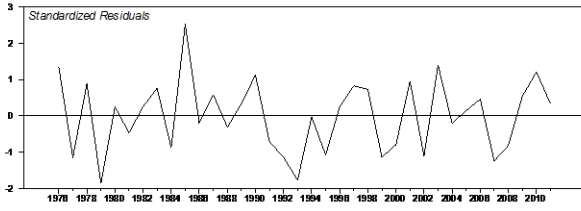
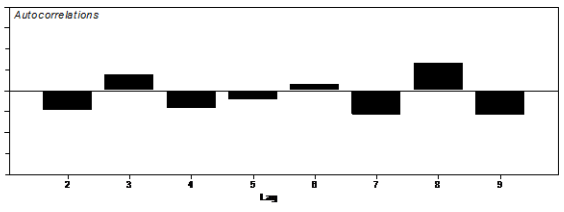
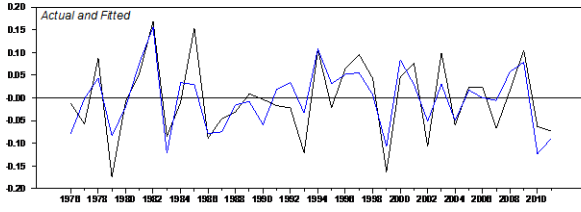
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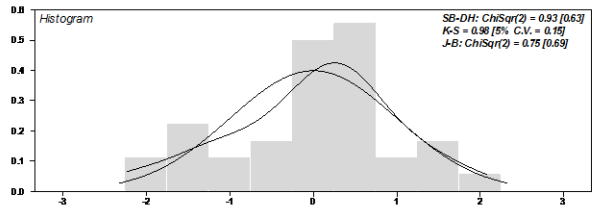
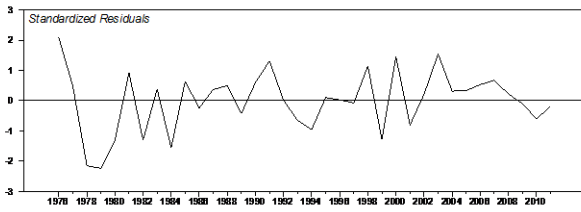
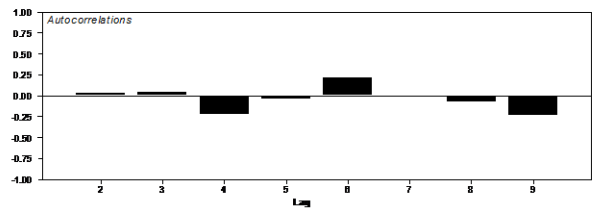
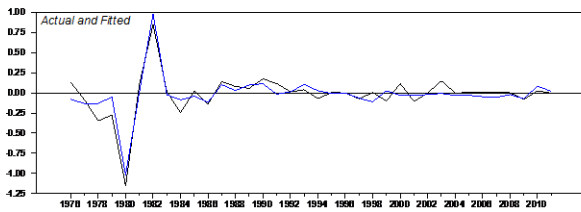
DKGDOLGAS



DC



DYOLGAS



DIOLGAS

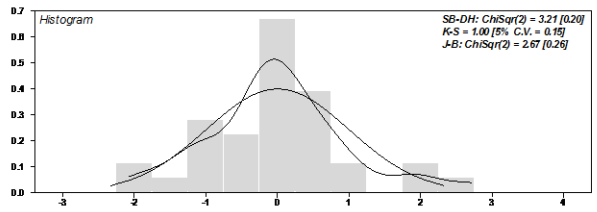
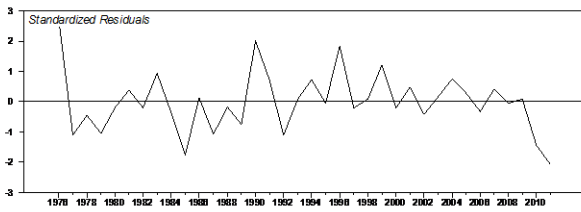
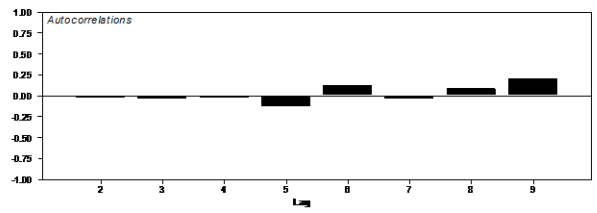
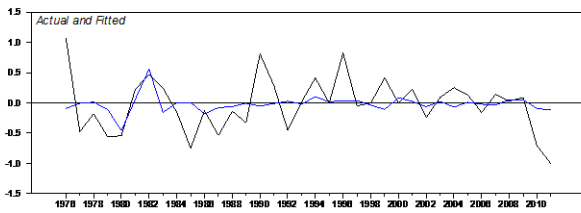
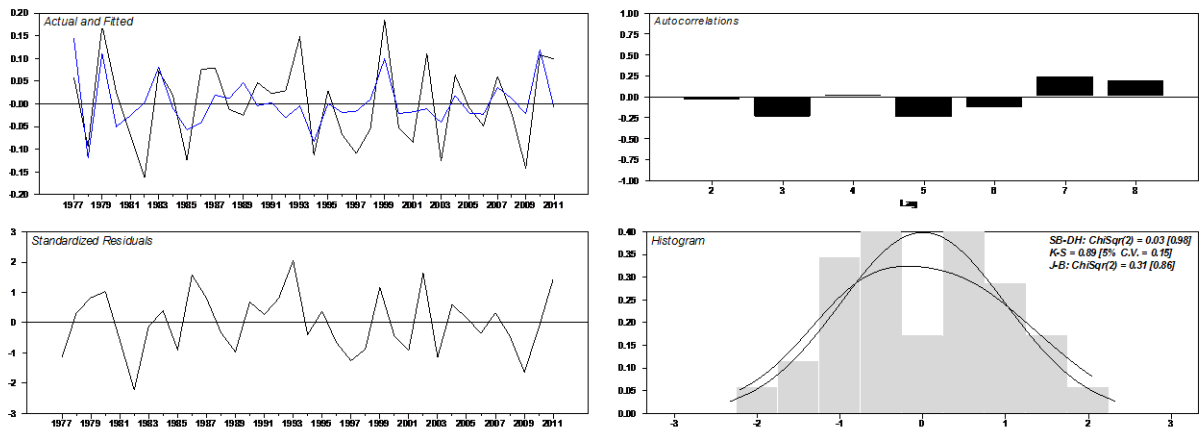
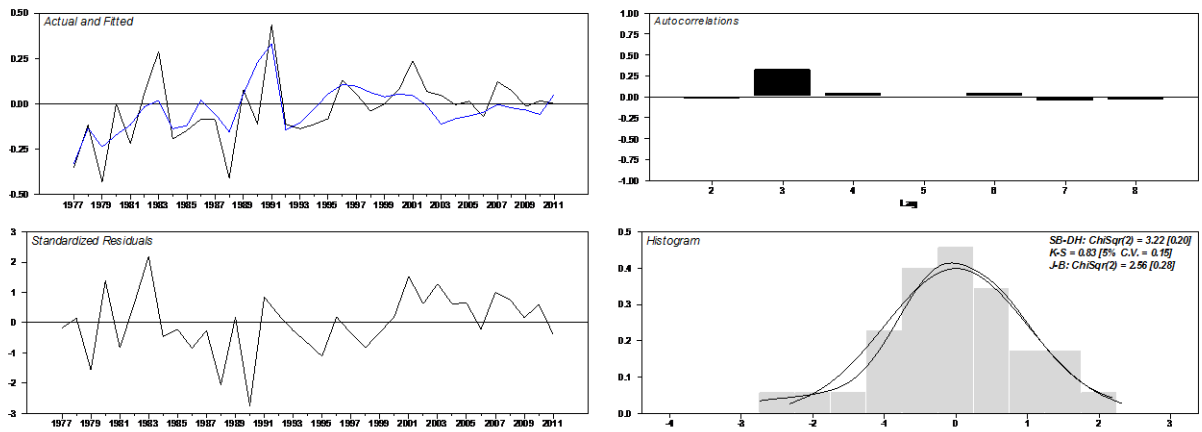


FIGURE 6K4: SERVICES INVESTMENT EQUATION

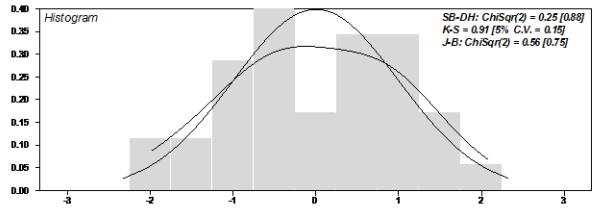
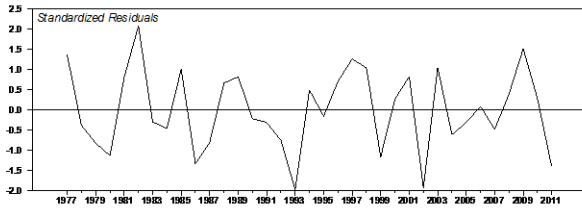
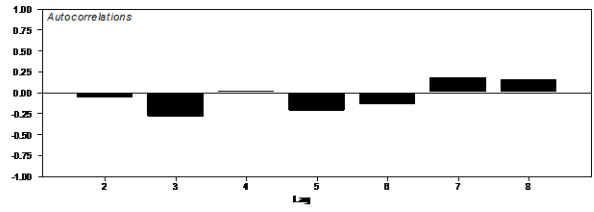
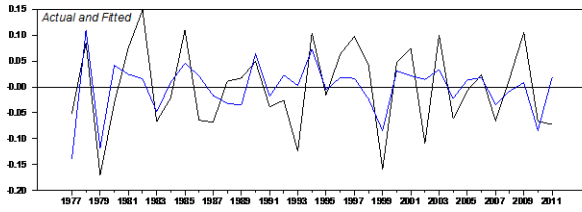
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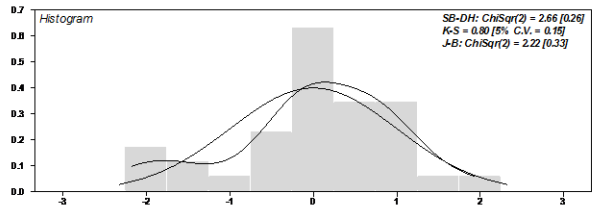
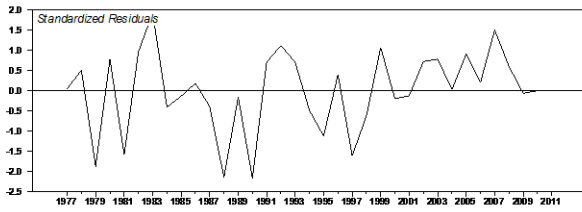
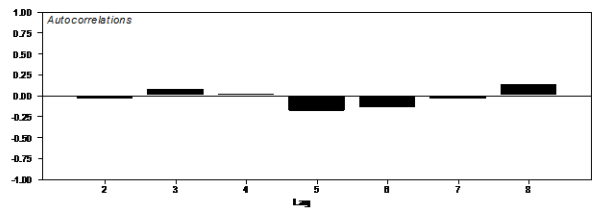
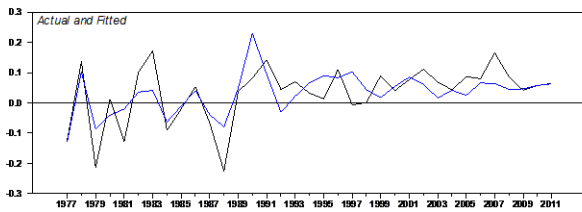
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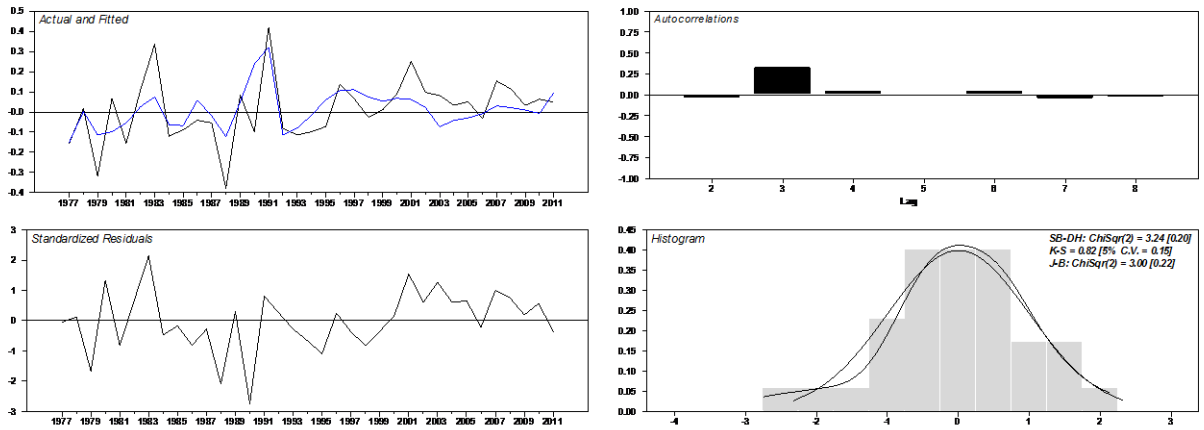
DCSERVICE



DYSERVICE



DISERVICE



Note: Panels on the top left plots the fitted and the actual values; panels on bottom left plot the residuals scaled by their standard deviation; panel on the top right plots the autocorrelation of the residuals; and panel on the bottom right plots the histogram.

APPENDIX 6L: THE AGRICULTURE SECTOR**TABLE 6L1: OUTSTANDING FACILITIES EXTENDED BY BANKS AND CREDIT INSTITUTIONS TO PUBLIC AND NON-PUBLIC AGRICULTURE SECTORS (deflated by GDP-deflator)**

Year	Facilities extended by banks and credit institutions	
	Total (Billion Rials)	% Change
1999	15881	-
2000	16464	4
2002	24990	52
2003	22665	-9
2004	23335	3
2005	26552	14
2006	33160	25
2007	35786	8
2008	32327	-10
2009	35676	10
2010	36197	1
Annual average growth rate (%)		10

Note: Constructed based on data in billion Rials at constant 2004/05 prices. Source: Ministry of Economic Affairs, Finance and Budget Laws (various years).

TABLE 6L2: GUARANTEED PURCHASING PRICE OF AGRICULTURAL CROPS (deflated by GDP-deflator)

Year	Wheat (Rial per kilogram)	Barley (Rial per kilogram)	Suger beets (Rial per kilogram)
1999	472	376	123
2000	486	385	125
2001	522	398	125
2003	515	384	122
2004	479	352	110
2005	485	360	109
2006	424	315	95
2007	386	283	86
2008	410	242	73
2009	437	386	89
2010	413	326	94
Annual average growth rate (%)			-1

Note: Constructed based on data in billion Rials at constant 2004/05 prices. Source: Central Bank of Iran, Economic Reports and Balance Sheets (various years).

FIGURE 6L3: SUBSIDY PAID BY THE GOVERNMENT (deflated by GDP-deflator)

Years	Total subsidy to all economic sectors (Billion Rials)	Subsidy to agriculture sector (Billion Rials)	% Share of subsidy to agriculture sector from total
1999	4830.72323	4748.167165	98.29102059
2000	4658.403985	4229.345574	90.78958346
2001	5206.510779	4639.902346	89.1173099
2002	5147.828246	4742.146894	92.11936894
2003	6628.981141	5222.756697	78.78671828
2004	7764.393066	6045.836249	77.86617959
2005	12267.53988	9918.835266	80.8543144
2006	11929.70989	8948.079368	75.00668039
2007	9383.418784	7245.540837	77.2164283
2008	12523.19265	10145.04711	81.0100698
2009	9898.331504	7659.570243	77.38243805
2010	10802.89127	5270.344714	48.78642747
Annual average growth (%)	9.864630246	4.222813416	

Note: Constructed based on data in billion Rials at constant 2004/05 prices. Source: Statistical Centre of Iran (various years).

TABLE 6L4: GOVERNMENT DEVELOPMENT EXPENDITURES FOR EXPANSION OF AGRICULTURE AND WATER RESOURCES (deflated by GDP –deflator)

Year	Total (Billion Rials)	Agriculture and natural resources			Total % change	Agriculture % change	Water resources % change
		(Billion Rials)	Water resources (Billion Rials)	% Share of water resources from total			
1999	2482.7192	831.10651	1651.6127	66.524345	-	-	-
2000	3032.7789	1004.6341	2028.1449	66.874142	22.155535	20.879098	22.79785
2002	3401.1088	644.4717	2756.6371	81.051129	12.144961	-35.850104	35.919139
2003	4345.5732	871.86602	3473.7072	79.936685	27.769309	35.283833	26.012495
2004	3335.8944	676.02639	2659.868	79.734778	-23.234652	-22.462124	-23.428549
2005	4447.5405	869.08602	3578.4545	80.459177	33.323782	28.558001	34.535042
2006	3015.7649	610.60912	2405.1557	79.752761	-32.192526	-29.741234	-32.787863
2007	3031.3873	575.87093	2455.5164	81.003057	0.5180276	-5.689103	2.0938635
2008	3851.7374	640.38046	3211.3569	83.374244	27.061868	11.20208	30.781326
2009	4022.5476	435.95	3,586.60	89.16229	4.4346272	-31.922962	11.684737
2010	2751.7163	471.83	2,279.89	82.85341	-31.592698	8.2287642	-36.433012
Annual average growth rate (%)					4.038823	-2.15138	7.117503

Note: Constructed based on data in billion Rials at constant 2004/05 prices. Source: Ministry of Economic Affairs, Finance and Budget Laws (various years).

TABLE 6L5: PRODUCTION AND AREA UNDER CULTIVATION OF MAJOR FARMING AND HORTICULTURAL CROPS

		Wheat	Barley	Suger beet	Suger cane	Potatoes	Onions	Pistachio
1999	Area (1000 hectares)	4739	1403	186	26	161	56	256
	Production (1000 tons)	8673	1999	5548	2236	3433	1677	131
2000	Area (1000 hectares)	5101	1194	163	26	169	44	275
	Production (1000 tons)	8088	1686	4332	2367	3658	1344	304
2001	Area (1000 hectares)	5553	1487	172	37	175	47	281
	Production (1000 tons)	9459	2423	4649	3195	3486	1419	112
2002	Area (1000 hectares)	6241	1670	192	43	166	45	295
	Production (1000 tons)	12450	3085	6098	3712	3756	1529	249
2003	Area (1000 hectares)	6409	1510	178	55	173	46	312
	Production (1000 tons)	13440	2908	5933	5196	4211	1574	235
2004	Area (1000 hectares)	6605	1600	156	61	184	48	327
	Production (1000 tons)	14568	2940	4916	5911	4454	1627	185
2005	Area (1000 hectares)	6951	1659	153	63	190	50	440
	Production (1000 tons)	14308	2857	4902	5530	4830	1685	230
2006	Area (1000 hectares)	6879	1567	186	67	164	59	444
	Production (1000 tons)	14664	2956	6709	4959	4219	2038	250
2007	Area (1000 hectares)	7222	1642	160	61	149	59	357
	Production (1000 tons)	15887	3104	5407	5315	4026	2014	280
2008	Area (1000 hectares)	5250	1070	54	62	177	50	431
	Production (1000 tons)	7957	1547	1829	3097	4707	1849	192
2009	Area (1000 hectares)	6647	1676	56	60	154	47	453
	Production (1000 tons)	13484	3446	2016	2823	4108	1512	302
2010	Area (1000 hectares)	7035	1584	99	68	146	56	463
	Production (1000 tons)	13500	3580	4096	5685	4274	1923	347
Annual average area % change		4.637957	6.590795	-2.18097	12.85405	2.04146	1.222421	13.74046
Annual average production % change		4.03742	1.075077	-3.89785	13.46154	-0.7764	0	6.738281

Source: Central Bank of Iran, Economic Reports and Balance Sheets (various years); Statistical Centre of Iran (various years).

TABLE 6L6: LIVESTOCK AND FISHERIES PRODUCTION

Years	Livestock				Fisheries
	Red meat (1000 tons)	Milk (1000 tons)	Poultry (1000 tons)	Eggs (1000 tons)	All types (1000 tons)
1999	721	5564	725	570	411.2
2000	729	5623	803	580	560.7
2001	743	5748	885	581	399
2002	742	5877	942	547	401.67
2003	752	6316	1104	629	441.871
2004	785	6720	1152	655	474.5
2005	800	7179	1237	759	522.051
2006	829	7741	1360	677	575.56
2007	866	8251	1468	703	562.4
2008	870	8772	1565	727	562.6
2009	902	9552	1610	751	599.8
2010	934	10242	1666	767	664
Annual average growth (%)	2.46185853	7.006350347	10.81609195	2.880116959	5.123216602

Source: Central Bank of Iran (Economic Time-series Data-base); Statistical Centre of Iran (various years).

TABLE 6L7: THE USAGE OF MODERN IRRIGATION SYSTEM

Years	Area under cultivation		Water		
	(hectare)	% Change	(cubic meter)	% Change	
1378	1999	796583	-	11601	-
1379	2000	822755	3.2855333	8506	-26.678735
1380	2001	778694	-5.3553002	7464	-12.250176
1382	2003	817850	5.0284194	11164	49.571275
1383	2004	802901	-1.8278413	8761	-21.524543
1384	2005	936981	16.699444	11966	36.582582
1385	2006	966395	3.1392312	11939	-0.2256393
1386	2007	1033513	6.9451932	13174	10.34425
Annual average growth (%)		3.987811		5.117002	

Source: Central Bank of Iran, Economic Reports and Balance Sheets (various years).

FIGURE 6L8: COMBATING DESERTIFICATION AND DUNE

Year	Nursery, plantation and seeding (hectares)	Plastic bag seedling (1000)
1991	521633	6259
1996	175505	3470
2001	94191	4290
2006	58812	7349

Source: Central Bank of Iran, Economic Reports and Balance Sheets (various years).

FIGURE 6L9: PERFORMANCE OF AGRICULTURAL INSURANCE FUND

Year	Insurance funds Area of insured farmlands (1000 hectares)
1999	1926.70
2000	1657.80
2002	3062.30
2003	4983.30
2004	5340.80
2005	5712.30
2006	5715.80
2007	5402.00
2008	3550.00
2009	4927.00
2010	4214.00

Source: Central Bank of Iran, Economic Reports and Balance Sheets (various years).

TABLE 6L10: AGRICULTURAL HOLDINGS BY HOLDER AND BY AGRICULTURAL MACHINERY AND EQUIPMENT AT PROVINCE LEVEL (2003)

	Total holdings (1000 holdings)		Private settled household holdings		Machinery and equipment (1000 units)		
	Total	of which without land	Total	of which without land	Tractors	Combines	Plough
		% Share		1000 Units			
Total country	4332423	851693	3471.9	802.3	2419.55	1014.94	2047.51
Province							
East Azarbayejan	5.63	3.12	6.25	3.16	169.88	36.96	153.74
West Azarbayejan	4.8	4.48	5.08	4.68	157.77	28.68	130.06
Ardebil	2.56	2.31	3.47	2.33	82.74	53.71	78.94
Esfahan	4.66	3.29	4.7	3.38	131.2	40.18	116.73
Ilam	1.33	1.26	1.19	1.26	45.1	15.55	43.69
Bushehr	1.08	1.87	1.13	1.8	24.2	10.85	13.3
Tehran	1.96	1.42	1.46	1.33	26.58	10.97	20.11
Chaharmahal & Bakhtiari	1.5	1.31	1.74	1.39	44.74	6.01	39.32
South Khorasan	1.17	1.66	1.12	1.63	23.24	1.91	20.15
Khrasan Razavi	9.16	8.66	8.91	8.97	242.86	72.73	221.73
North Khorasan	1.89	1.56	2	1.6	57.82	19.38	55.19
Khozestan	4.42	7.56	4.45	7.18	109.01	52.49	88.42
Zanjan	1.96	1.32	2.23	1.39	57.72	14.6	54.32
Semnan	0.89	0.81	0.72	0.76	19.32	8.64	17.84
Sistan & Baluchestan	3.91	10.26	4.33	10.28	37.9	2.04	32.13
Fars	6.39	8.43	6.22	7.75	155.74	107.89	139.81
Qazvin	1.84	0.88	1.91	0.92	38.76	12.07	35.79
Qom	0.36	0.63	0.34	0.52	5.43	3.28	4.89
Kordestan	2.6	1.85	2.76	1.95	81.06	42.7	75.26
Kerman	5.97	5.64	4.47	5.14	135.97	16.42	84.93
Kermanshah	3.3	2.62	2.96	2.41	109.39	76.58	106.39
Kohgiluyeh & Boyerahmad	1.38	1.39	1.49	1.38	39.37	7.83	29.96
Golestan	3.23	4.71	3.57	4.96	99.32	78.29	91.15
Gilan	7.32	3.68	7.36	3.82	48.14	11.21	17.1
Lorestan	3	2.21	2.94	2.03	106.52	57.19	103.37
Mazandaran	7.77	5.85	7.85	6.12	179.57	152.17	102.34
Markazi	2.11	1.46	2.25	1.51	55.67	20.92	53.29
Hormozgan	2.21	5.48	2.52	5.76	8.17	1.79	5.96
Hamedan	3.29	2.57	3.59	2.69	88.53	46.5	83.48
Yazd	1.96	1.64	1.59	1.66	37.98	4.64	26.99

Source: Statistical Centre of Iran (various years).

TABLE 6L11: EMPLOYEES AT MODERN CATTLE AND CHICKEN FARMS

Years	Total number of employees (1000 persons)	unpaid employees (1000 persons)	Share of total(%)	paid employees (1000 persons)	Share of total (%)
1989	25413	10979	43.20229804	14434	56.79770196
1993	36018	21042	58.42078961	14976	41.57921039
1995	29843	14823	49.66993935	15020	50.33006065
1999	32916	17893	54.35958197	15023	45.64041803
2003	41865	16664	39.80413233	25201	60.19586767

Source: Statistical Centre of Iran (various years).

TABLE 6L12: NUMBER OF CITIES AND VILLAGES

Years	Number of cities	Number of villages
1986	496	1583
1991	520	2093
1992	520	2093
1993	578	2182
1994	591	2191
1995	612	2212
1996	678	2227
2001	889	2305
2003	939	2353
2004	982	2378
2005	1015	2400
2006	1016	2400
2007	1016	2430

Source: Statistical Centre of Iran (various years).

APPENDIX M: THE MANUFACTURING AND MINING SECTORS

TABLE 6M1: OUTPUT AND VALUE-ADDED IN MANUFACTURING AND MINING

Year	Manufacturing and Mining		Manufacturing		Mining		Manufacturing and Mining		Manufacturing		Mining		Manufacturing and Mining	Manufacturing	Mining
	Output share		Output share		Output share		Value-added share		Value-added share		Value-added share		Investment (billion Rials)		
	Output (billion Rials)	in total GDP (%)	Output (billion Rials)	in total GDP (%)	Output (billion Rials)	in total GDP (%)	Value-added (billion Rials)	in total GDP (%)	Value-added (billion Rials)	in total GDP (%)	Value-added (billion Rials)	in total GDP (%)			
1970	21329.1	17.3988	20963.6	17.1007	365.506	0.29816	6363	5.19051	6039.0	4.92622	324.0	0.2643	4404.35468	4101.1086	303.246079
1971	24429.3	17.54	24031.1	17.2541	398.217	0.28592	7364	5.28727	7013.0	5.03525	351.0	0.25201	5024.17887	4694.36435	329.814521
1972	28213.7	17.3562	27731.6	17.0596	482.127	0.29659	8624	5.30522	8196.0	5.04192	428.0	0.26329	5309.65198	4826.95635	482.695635
1973	32474.6	18.5922	31884.4	18.2543	590.215	0.33791	10184	5.83049	9699.0	5.55282	485.0	0.27767	6732.96239	6120.8749	612.08749
1974	39420.8	20.0532	38829.2	19.7522	591.637	0.30096	11802	6.00363	11280.0	5.73809	522.0	0.26554	7987.47359	7267.60116	719.872426
1975	41265.5	20.0207	40535.9	19.6667	729.591	0.35397	12844	6.2315	12204.0	5.921	640.0	0.31051	15061.5465	13725.6077	1335.93877
1976	49926.5	20.6031	49016.3	20.2274	910.211	0.37561	16673	6.8804	15869.0	6.54862	804.0	0.33178	19930.5169	18202.3918	1728.12507
1977	54516.8	23.0374	53545.5	22.6269	971.365	0.41047	17514	7.40096	16659.0	7.03966	855.0	0.3613	15533.246	14193.0832	1340.1628
1978	48740.6	22.2366	47841.8	21.8265	898.833	0.41007	15709	7.16681	14918.0	6.80594	791.0	0.36087	10292.5746	9394.13256	898.44206
1979	41059	19.5595	40218.5	19.159	840.523	0.4004	13730	6.54062	12995.0	6.19048	735.0	0.35014	5882.07743	5363.47187	518.605561
1980	42769.9	24.008	41891	23.5146	878.922	0.49336	15361	8.62256	14594.0	8.19202	767.0	0.43054	5261.40085	4790.26137	471.139473
1981	46439.9	27.2725	45526.8	26.7363	913.055	0.5362	16558	9.72393	15767.0	9.2594	791.0	0.46453	4115.99208	3743.23864	372.753439
1982	44587.8	23.2632	43491.3	22.6911	1096.52	0.5721	16004	8.3499	15077.0	7.86625	927.0	0.48365	4229.44343	3832.15298	397.290452
1983	50149.7	23.5581	48947.9	22.9935	1201.76	0.56453	17881	8.39969	16871.0	7.92523	1010.0	0.47445	7386.67833	6668.14767	718.530658
1984	56155.9	26.9312	54898.7	26.3283	1257.23	0.60294	19997	9.59015	18943.0	9.08467	1054.0	0.50548	7797.62634	7033.97306	763.653279
1985	55087.9	25.901	53864.8	25.326	1223.1	0.57507	19562	9.1976	18544.0	8.71896	1018.0	0.47864	4537.94163	4078.72879	459.212846
1986	51674.3	26.7417	50603.3	26.1875	1070.92	0.55421	18251	9.44498	17365.0	8.98647	886.0	0.45851	4063.07959	3613.61475	449.464843
1987	57909	30.2694	56789.8	29.6844	1119.27	0.58505	20228	10.5733	19296.0	10.0861	932.0	0.48716	4416.66634	3908.2657	508.400648
1988	57491.6	31.7944	56350.7	31.1635	1140.83	0.63091	20497	11.3354	19692.0	10.8902	805.0	0.44519	5029.222	4432.75944	596.462563
1989	62070.3	32.4122	60905.5	31.8039	1164.81	0.60825	21190	11.0651	20371.0	10.6374	819.0	0.42767	5199.15548	4583.15258	616.002895
1990	71727.8	32.8215	70295.5	32.1661	1432.24	0.65537	27166	12.4307	26160.0	11.9704	1006.0	0.46033	6653.26612	5854.37273	798.893391
1991	73628.5	30.048	71952.3	29.364	1676.21	0.68407	32973	13.4564	31804.0	12.9793	1169.0	0.47707	12135.99	10465.4556	1670.53442
1992	73878.4	28.9921	72065.2	28.2806	1813.22	0.71156	32758	12.8552	31508.0	12.3647	1250.0	0.49054	12395.0695	10680.6655	1714.404
1993	70986.3	27.4501	69104.2	26.7223	1882.09	0.7278	31149	12.0452	29852.0	11.5437	1297.0	0.50154	9260.17952	7876.81268	1383.36684
1994	74670.2	28.733	72418.8	27.8667	2251.39	0.86633	32408	12.4706	30837.0	11.866	1571.0	0.60452	6580.42671	5576.83826	1003.58845
1995	77680.7	29.0358	75494.6	28.2187	2186.02	0.8171	32328	12.0837	30810.0	11.5163	1518.0	0.5674	6396.12839	5448.24581	947.882574
1996	89363.6	31.4874	86960.9	30.6409	2402.67	0.84659	38168	13.4486	36485.0	12.8556	1683.0	0.59301	7690.61087	6619.67953	1070.93134
1997	99378.2	34.0606	97066.1	33.2681	2312.13	0.79245	42352	14.5156	40751.0	13.9669	1601.0	0.54872	9829.80437	8595.43289	1234.37148
1998	100125	33.3596	97740.6	32.565	2384.92	0.7946	40728	13.5697	39076.0	13.0193	1652.0	0.55041	14793.509	13216.5332	1576.97578
1999	108024	35.4247	105280	34.5247	2744.36	0.89997	44145	14.4766	42265.0	13.8601	1880.0	0.61651	14078.075	12782.8649	1295.21011
2000	114706	35.838	112015	34.9973	2690.86	0.84071	48710	15.2186	46881.0	14.6472	1829.0	0.57144	15716.58	14423.8978	1292.68213
2001	129638	39.2172	126439	38.2494	3199.1	0.96777	54625	16.5247	52459.0	15.8695	2166.0	0.65524	20788.2096	18877.0225	1911.18716
2002	148339	41.4735	144522	40.4064	3816.81	1.06713	60847	17.012	58256.0	16.2876	2591.0	0.72441	24211.0897	21889.4983	2321.5914
2003	176425	45.7499	172417	44.7106	4008.06	1.03935	68648	17.8015	65931.0	17.097	2717.0	0.70456	27071.0924	24207.6358	2863.45662
2004	209223	50.9767	205021	49.9528	4202.15	1.02384	76304	18.5913	73493.0	17.9064	2811.0	0.68489	32053.8141	28358.7595	3695.05455
2005	232001	52.8596	227593	51.8552	4407.97	1.00432	86431.6	19.6928	83514.5	19.0281	2917.1	0.66464	32979.895	28901.7341	4078.16083
2006	250686	53.5734	245601	52.4866	5085.48	1.0868	95846.6	20.4831	92484.7	19.7646	3361.9	0.71846	33432.8521	29109.037	4323.81514
2007	241343	49.1436	236597	48.177	4746.72	0.96655	96897	19.7307	93128.0	18.9632	3769.0	0.76746	37444.7944	32923.131	4521.66337
2008	246015	49.6732	241099	48.6806	4916.1	0.99262	99510.5	20.0923	95323.0	19.2468	4187.5	0.84551	36653.5678	34232.2348	2421.33301
2009	243679	47.79	238848	46.8425	4831.41	0.94753	104550	20.5043	99510.5	19.5159	4193.2	0.82237	41830.1582	38682.4253	3147.73291
2010	244847	45.4077	239973	44.5038	4873.76	0.90385	115037	21.334	104550	19.3892	4615.2	0.8559	29198.039	27077.6977	2120.3413

Note: Constructed based on data in billion Rials at constant 2004/05 prices. Source: CBI (Economic Time-series Database).

TABLE 6M2: PRODUCTION OF SELECTED INDUSTRIES

Year	Steel Production		Petrochemical Production	
	Thousand tons	% Change	Thousand tons	% Change
1998	5608	-	11139	-
1999	6303	12.39300999	11001.4	-1.235299399
2000	6604	4.775503728	11807.9	7.33088516
2001	6927	4.890975167	12542.9	6.224646211
2002	7477.1	7.941388769	13110	4.521282957
2003	7991	6.872985516	13969	6.552250191
2004	8989.6	12.49655863	12517	-10.39444484
2005	9603.6	6.830114799	15757.6	25.88959016
2006	9989.5	4.01828481	17993.8	14.1912474
2007	9944.4	-0.451474048	23869	32.65124654
2008	10483.2	5.418124774	30040	25.85361766
2009	11126.9	6.140300672	34433	14.62383489
2010	12728	14.38945259	40175	16.67586327

Sources: CBI, Economic Reports and Balance Sheets (various years); Statistical Centre of Iran (various years).

TABLE 6M3: TABLE 6X: GOVERNMENT DEVELOPMENT EXPENDITURE IN MANUFACTURING AND MINING SECTORS

Year	Manufacturing and mining			Industrial research			Total credits		
	Nominal (billion Rials)	Real (billion Rials)	% Change	Nominal (billion Rials)	Real (billion Rials)	% Change	Nominal (billion Rials)	Real (billion Rials)	% Change
1998	276.4	252.52082	-	37.9	34.625684	-	314.3	287.14651	-
1999	260.4	182.80272	-27.608854	211.3	148.33415	328.39342	471.7	331.13687	15.319833
2000	502.8	279.15446	52.70805	263	146.01755	-1.5617477	765.8	425.17201	28.397666
2001	374.255	186.1447	-33.318388	236.396	117.57722	-19.477338	610.651	303.72192	-28.564932
2002	747.324	292.49919	57.135387	358.305	140.23894	19.273901	1105.629	432.73813	42.4784
2003	3642.365	1249.5688	327.20421	384.612	131.94701	-5.9127125	4026.977	1381.5159	219.24986
2004	2736	771.40936	-38.265958	318.8	89.884979	-31.877972	3054.8	861.29434	-37.655849
2005	2903.7	687.13312	-10.92497	83.7	19.806813	-77.964269	2987.4	706.93993	-17.921215
2006	2696.4	558.15527	-18.77043	18.8	3.8916033	-80.352198	2715.2	562.04688	-20.495808
2007	2522.5	432.84697	-22.450438	23.5	4.0324693	3.6197422	2546	436.87944	-22.269928
2008	2668.2	391.11478	-9.6413271	27.4	4.0163949	-0.3986237	2695.6	395.13117	-9.5560154
2009	1886.9	270.08501	-30.944821	18.2	2.6050915	-35.138562	1905.1	272.6901	-30.987449
2010	2311	289.51192	7.1928884	18.9	2.3677089	-9.1122549	2329.9	291.87963	7.0371204

Note: Constructed based on data in billion Rials at constant 2004/05 prices. Source: Central Bank of Iran, Economic Reports and Balance Sheets (various years); Statistical Centre of Iran (various years).

TABLE 6M4: FACILITIES EXTENDED BY BANKS AND CREDIT INSTITUTIONS TO MANUFACTURING AND MINING SECTORS

Year	Non-public sector			Public sector			Total		
	Nominal (billion Rials)	Real (billion Rials)	% Change	Nominal (billion Rials)	Real (billion Rials)	% Change	Nominal (billion Rials)	Real (billion Rials)	% Change
1998	23285.2	21273.509	-	10023.7	9157.717	-	33308.9	30431.226	-
1999	30259.2	21242.181	-0.1472622	11073.1	7773.3977	-15.116424	41332.3	29015.579	-4.6519556
2000	39913.2	22159.801	4.3198009	15258	8471.2387	8.9772969	55171.2	30631.04	5.567564
2001	58190.8	28942.59	30.608527	17729.9	8818.3909	4.0980098	75920.7	37760.98	23.276849
2002	81470.6	31887.22	10.174038	20845.9	8158.9898	-7.4775671	102316.5	40046.209	6.0518263
2003	121267.4	41602.63	30.46804	18243.8	6258.8137	-23.289354	139511.2	47861.444	19.515542
2004	172642.3	48676.128	17.002524	21238.8	5988.2343	-4.3231745	193881.1	54664.362	14.213775
2005	228133.2	53985.562	10.907676	24170.6	5719.7437	-4.4836361	252303.8	59705.306	9.2216271
2006	293126.7	60677.278	12.395381	18730.7	3877.2582	-32.212728	311857.4	64554.536	8.1219427
2007	373560.4	64100.887	5.6423242	9533.3	1635.8613	-57.808813	383093.7	65736.748	1.8313382
2008	403639.3	59166.965	-7.6971201	7366.6	1079.8239	-33.990496	411005.9	60246.789	-8.3514316
2009	456470.7	65337.799	10.429527	7601	1087.9836	0.7556467	464071.7	66425.783	10.256139
2010	600814.4	75267.388	15.19731	4795.1	600.70905	-44.786936	605609.5	75868.097	14.214832

Note: Constructed based on data in billion Rials at constant 2004/05 prices. Source: Central Bank of Iran, Economic Reports and Balance Sheets (various years); Statistical Centre of Iran (various years).

TABLE 6M5: NUMBER OF MANUFACTURING ESTABLISHMENTS AND WORKERS

Year	Number of manufacturing establishments	Number of workers					
		Production line			Others		
	Total	Total	Skilled	% Share to total	Unskilled	% Share to total	
1986	718	42295	19324		17888	42.293415	5083
1991	1920	50322	30170	59.953897	13047	25.92703	7105
1996	2704	53046	23259	43.84685	16372	30.863779	13415
2001	2892	55560	28013	50.419366	14939	26.888049	12608
2003	3125	56554	28046	49.591541	16722	29.5682	11786

Source: Central Bank of Iran, Economic Reports and Balance Sheets (various years); Statistical Centre of Iran (various years).

TABLE 6M6: NUMBER, INVESTMENT AND EMPLOYMENT OF INDUSTRIAL PERMITS

Operation permits				
Year	Number	% Change	Employment	% Change
1998	2615	-	54349	-
1999	3387	29.52198853	67144	23.54229149
2000	3264	-3.631532329	56493	-15.86292148
2001	3550	8.762254902	74578	32.01281575
2002	4147	16.81690141	77296	3.644506423
2003	4482	8.078128768	113372	46.67253157
2004	4926	9.906291834	129834	14.52034012
2005	6025	22.31019082	121319	-6.55837454
2006	6746	11.96680498	126200	4.023277475
2007	8731	29.42484435	167000	32.3296355
2008	7689	-11.93448631	146000	-12.5748503
2009	7684	-0.065027962	146300	0.205479452
2010	6661	-13.31337845	140600	-3.896103896

Source: Central Bank of Iran, Economic Reports and Balance Sheets (various years); Statistical Centre of Iran (various years).

TABLE 6M7: NUMBER OF MINES AND WORKERS

Year	Number of mines	Number of workers					
		Production line		% Share		% Share	
	Total	Total	Skilled	to total	Unskilled	to total	Others
1991	1920	50322	30170	59.953897	13047	25.92703	7105
1996	2704	53046	23259	43.84685	16372	30.863779	13415
2001	2892	55560	28013	50.419366	14939	26.888049	12608
2006	3582	60062	31107	51.791482	16146	26.882222	12809

Note: Others include number of workers employed in the administrative, financial and services sections. Source: Source: Central Bank of Iran, Economic Reports and Balance Sheets (various years); Statistical Centre of Iran (various years).

APPENDIX N: THE OIL AND GAS SECTORS

TABLE 6N1: SUBSIDIARIES OF THE NATIONAL IRANIAN OIL COMPANY

NIOC subsidiary	Main activities
National Iranian South Oil Company (NISOC)	Controls oil and gas upstream activities in the south and southwest of the country; produces approximately 80 percent of all crude oil produced in Iran covering the provinces of Khuzestan, Bushehr, Fars, and Kohkiluyeh and Boyer Ahmad
Iranian Central Oil Fields Company (ICOFC)	Oversees oil and gas production in the south and central areas of Iran; is the largest natural gas producer in Iran
Iranian Offshore Oil Company (IOOC)	Controls all upstream activities in offshore fields, including Salman, Sirri, Doroud, and Balal
Khazar Exploration and Production Company (KEPCO)	In charge of exploration and production in the Caspian Sea region; has recently undertaken drilling at the Sardare Jangal offshore gas discovery
Pars Oil and Gas Company (POGC)	develops South and North Pars gas fields as well as the Golshan and Ferdowsi fields
Pars Special Economic Energy Zone (PSEEZ)	Promotes the use of South Pars oil and gas resources; established in 1998
Karoon Oil and Gas Production Company (KOGPC)	Operates in Khouzestan; delivers natural gas to NIGC
Petroleum Engineering and Development Company (PEDEC)	Carries out all engineering and development projects conducted by NIOC
National Iranian Drilling Company (NIDC)	Conducts most of the onshore and offshore drilling in Iran ; handles related technical services and well control operations
North Drilling Company (NDC)	Aims at developing internal expertise needed for complex oil and gas drilling
Kala Naft Company	Manufactures equipment for the oil, gas and petrochemical sectors; distributes equipment to operational centres
Naftiran Intertrade Company (NICO)	Invests in and finances Iran's oil, gas and petrochemical trade
Iranian Oil Terminals Company (IOTC)	Accepts deliveries and stores crude oil, petroleum products and condensates for exports
National Iranian Oil Refining and Distribution Company (NIORDC)	Oversees the subsidiaries that control the refining sector, pipelines, telecommunications, and oil products distribution; Engages in exports of petroleum products; controls the refining and domestic distribution networks
Iranian Fuel Conservation Organization (IFCO)	Aims at optimizing energy consumption, protecting the environment and increasing energy efficiency; established in 2000
NIGC subsidiary	Main activities
Iran Gas Engineering and Development Company (IGEDC)	Processes, delivers and distributes gas for domestic use
Iran Gas Transmission Company (IGTC)	Processes, delivers and distributes gas for domestic use
Iran Gas Storage Company (IGSC)	Processes, delivers and distributes gas for domestic use
Iran Gas Distribution Company (IGDC)	Processes, delivers and distributes gas for domestic use
Iran Gas Commercial Company (IGCC)	Sells natural gas plant liquids as NIGC's trading company

National Iranian Gas Exports Company (NIGEC)	Controls new pipeline and liquefied natural gas (LNG) projects
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Source: US EIA (2014), National Iranian Oil Company (2014).

TABLE 6N2: SELECTED FIGURES AND GROWTH RATES

Year	Oil investment (constant 1997 prices)	Oil value-added (constant 1997 prices)	Oil reserves	Oil output	Oil export	Oil product import	Oil consumption	Oil refinery capacity	Oil refinery OPEC quota	Natural Gas reserves	Natural Gas output	Natural gas consumption	Natural gas imports	Natural gas exports	Oil value-added/GDP (constant 1997 prices)
	(billion Rials)	(billion Rials)	(1000 barrels)	(1000 barrels daily)	(1000 barrels daily)	(1000 barrels daily)	(1000 barrels daily)	(1000 barrels daily)	(1000 barrels daily)	(trillion cubic meters)	(billion cubic feet daily)	(billion cubic meters)	(billion cubic meters)	(billion cubic meters)	(billion Rials)
1970	2033.71	57138.4	-	3847.66	-	-	343.633	594	-	-	1.24628	0.8941	-	-	46.6097
1971	3030.51	65807.4	-	4572.42	-	-	381.091	605	-	-	1.38141	0.93732	-	-	47.2489
1972	3364.44	74576.3	-	5058.96	-	-	421.24	605	-	-	1.57683	0.90581	-	-	45.877
1973	3096.39	82173.1	-	5907.38	5320	-	491.239	660	-	-	1.72112	0.99763	-	8.6	47.0453
1974	3830.71	81804.5	-	6060.3	5244	-	530.554	690	-	-	1.99901	1.25703	-	9.2	41.6136
1975	4369.08	71885.2	-	5386.62	4607	-	605.694	810	-	-	1.96236	1.19027	-	9.6	34.8764
1976	13287.2	81440.7	-	5918.19	5280	-	625.007	810	-	-	1.92944	1.18391	-	9.3	33.6079
1977	8116.03	74867.2	-	5713.96	4816	-	669.973	1050	-	-	1.824	1.06288	-	9.2	31.6369
1978	7196.64	53168.9	-	5302.05	3455	10.7	727.615	1080	-	-	1.63974	0.97935	-	5.3	24.2569
1979	3864.93	41296.9	-	3217.59	2632	10.1	764.618	1080	-	-	1.73316	1.25047	-	3.5	19.6728
1980	2414.09	13497.4	58.296	1478.96	770	8.2	661.909	1085	-	14.101	0.68871	0.66748	-	0	7.57647
1981	2834.53	14432.4	57.02	1321.03	791	56.6	591.315	590	-	14.085	0.57568	0.55095	-	0	8.47564
1982	4426.27	32927.1	56.148	2396.92	1686	83	641.033	590	1200	14.069	0.69662	0.69662	-	0	17.1793
1983	5411.48	33587.8	55.257	2453.58	2045	154.7	771.171	632	2400	14.045	1.06428	1.06428	-	0	15.778
1984	4298.59	26686.5	58.874	2042.54	1607	101.9	830.245	680	2300	14.016	1.30259	1.30259	-	0	12.7983
1985	2335.2	27164.1	59	2205.21	1460	165.4	919.253	685	2300	13.986	1.41259	1.41259	-	0	12.7719
1986	2373.51	23431.3	92.86	2054.24	1250	148.4	884.236	685	2317	13.955	1.47064	1.47064	-	0	12.1258
1987	1367.28	26815.4	92.86	2342.44	1546	191.2	924.919	715	2312	13.922	1.54804	1.54804	-	0	14.0166
1988	1181.14	29165.9	92.86	2349.48	1647	183	805.062	735	2369	14.2	1.92976	1.92976	-	0	16.1296
1989	819.113	31247.9	92.86	2894.34	1823	131.4	943.903	825	2783	17	2.14791	2.14791	-	0	16.3172
1990	1823.99	37367.2	92.85	3270.18	2224	123.9	1016.61	865	314	17.003	2.23982	2.19628	-	2.1	17.0987
1991	2175.18	42609.9	92.86	3499.56	2460	121.4	1075.37	980	3217	19.8	2.49138	2.20058	-	2.9	17.3893
1992	1632.11	42622.4	92.86	3523.02	2397	171.1	1119.97	1050	3184	20.7	2.4122	2.4122	-	0.5	16.7264
1993	1697.65	44757.6	92.86	3712.16	2184	155.3	1105.83	1145	3415	20.7	2.61909	2.56932	-	0	17.3076
1994	2595.8	42116	94.3	3730.03	2220	114.5	1157.69	1280	3600	20.764	3.07673	3.07673	-	0.1	16.2062
1995	2537.05	42729.2	93.7	3743.77	2290	78	1245.24	1290	3600	19.35	3.41536	3.40569	-	0	15.9715
1996	5194.61	43044.6	92.6	3758.58	2441	76.7	1290.32	1290	3600	23	3.76304	3.75339	-	0	15.1668
1997	5160.88	40763.5	92.6	3776.46	2342	67.9	1294.84	1345	3600	23	4.54737	4.55704	1.6	0	13.9712
1998	5072.26	41736	93.7	3854.75	2300	23.9	1262.27	1495	3650.5	24.1	4.83762	5.00694	1.9	0	13.9055
1999	7121.29	39515.4	93.1	3603.36	2079	21.4	1292.21	1597	3359	25	5.45297	5.64648	2.1	0	12.9584
2000	5562.6	42795	99.53	3852.32	2345	33.3	1365.73	1597	2872	26	5.81245	6.06814	3.3	0	13.3706
2001	6684.66	38053.3	99.08	3825.38	2208	49.1	1392.39	1597	3552	26.1	6.38566	6.78138	4.5	0.5	11.5116
2002	3583.59	39463.8	130.69	3579.82	2021	65.4	1479.88	1597	3186	26.69	7.25644	7.6657	5.3	1.3	11.0336
2003	3828.31	45579.3	133.25	4002.37	2396	95	1574.78	1607	3575	27.57	7.88533	8.02078	5.7	3.4	11.8194
2004	4901.24	47405.9	132.74	4201.47	2548	142.8	1633.02	1642	3743.75	27.5	8.19184	8.35008	5.9	3.5	11.5503
2005	5752.15	47543.8	137.49	4183.54	2602	155.9	1695.62	1642	4073.5	27.58	10.0139	10.1571	5.2	4.8	10.8325
2006	5137.45	49248.9	138.4	4260.24	2433	213	1806.56	1727	4000.5	26.85	10.5073	10.517	6.3	5.7	10.5248
2007	5394.32	57570.4	138.22	4302.69	2480.5	157.8	1842.94	1772	4000.5	28.13	10.8266	10.9369	6.2	5.6	11.7228
2008	4315.55	58665	137.62	4396.04	2370.8	158.4	1905.96	1805	3801.5	29.61	11.2216	11.5101	-	-	11.8451
2009	4444.49	47665.5	137.01	4248.54	2056	141.8	1922.54	1860	3801.5	29.61	12.6901	12.7094	-	-	9.3481
2010	4667.72	61112.4	151.17	4338.46	2021	100.3	1886.82	1860	3801.5	33.09	14.1404	13.9885	-	-	11.3335

Source: Central Bank of Iran (Economic Time-series Data-base); Statistical Centre of Iran (various years).

TABLE 6N3: GEOGRAPHICAL DISTRIBUTION OF CURDE OIL EXPROTS (%)

Years	West		Asia and		Others
	Europe	Japan	Far East	Africa	
1966	42.2	31.1	11.8	6.8	8.1
1971	27.2	46.4	9.3	7	10.1
1976	52.8	23.1	2.9	6.6	14.6
1981	47.3	14.5	23.5	-	14.7
1986	51.6	17.2	18.1	-	13.1
1991	38.5	17.7	16	-	27.8
1996	49.5	20	27.6	-	2.9
2001	14	23.7	41.8	6.9	13.6
2006	33.5	20	39.4	7.1	-

Source: Central Bank of Iran (Economic Time-series Data-base).

TABLE 6N4: REFINERIES AND ACTIVITIES (% SHARE IN TOTAL)

Refinery	1986	1991	1996	2002	2007
Abadan	-	24.27	28.8	27.78	26.22
Arak	-	-	12.62	10.01	11.21
Isfahan	42.07	36.59	26.68	17.7	14.95
Bandar-Abbas	-	-	-	15.85	17.35
Tabriz	15.17	8.72	8.11	7.48	8.22
Tehran	31.89	23.56	16.8	15.2	16.45
Shiraz	6.06	2.46	3.2	2.66	2.99
Kermanshah	2.02	2.27	1.69	1.99	1.12
Lavan	2.79	2.13	2.1	1.33	1.49

Source: Central Bank of Iran, Economic Reports and Balance Sheets (various years).

TABLE 6N5: SELECTED NEW UPSTREAM OIL PROJECTS IN IRAN

Project	Recoverable Reserves (billion barrels)	Developer	Status
South Azadegan	6.0 to 7.0	The National Iranian Drilling Company will drill wells ¹¹⁵	Came online in 2007; phase I targets 150000 bbl/d and Phase II targets 110000 bbl/d
North Azadegan		CNPC	Phase I is underway and expected to be completed by 2015-16 (75,000 bbl/d); phase II expected to be completed by 2020 (75,000 bbl/d)
Yadavaran	3.2 (and 2.7 tcf of recoverable gas reserves)	Sinopec	Expected to increase to 85,000 bbl/d in 2015; phase II is expected to add 50,000 to 100,000 bbl/d in 2018; phase III is expected to add more than 100,000 bbl/d after 2020
Yaran	1.1 (oil in place)	PEDEC (South Yaran) and Persian Energy (North Yaran)	North Yaran is expected to produce 30,000 bbl/d in 2015 and South Yaran 50,000-60,000 bbl/d in 2018
Azar (Badra)	NA	Iranian consortium	Iran-Iraq shared oil field; operated by Gazprom Neft; drilling set to resume in 2015 with initial target production of 30,000 bbl/d at Azar to increase to 65,000 bbl/d
South Pars (oil layer)	1.3	PEDCO	Initial capacity is expected to be 35,000 bbl/d; a floating production, storage and offloading unit needs to be installed before production can start
Zagheh	3 (oil in place)	Iran is looking for a new developer	Production potential is estimated at 55,000 bbl/d of heavy crude; in 2014, Iran cancelled the MOU2 signed with Tatneft Iran Oil
Bushgan, Kuh-e-Kaki, Kuh-e-Mond	1.1 (oil in place)	Iran is looking for a new developer	Total production potential is estimated at 22,000 bbl/d; in 2014, Iran cancelled the MOU signed with joint Iranian-Russian and Iranian-Ukrainian companies (Gazprom Pars Kish International)

Source: US EIA, 2014, p.15. Oil in place is the amount of oil estimated to exist in naturally occurring reservoirs of which a portion is typically not technically and/or economically recoverable. MOU stands for memorandum of understanding. Sinopec, CNPC, PEDEC and PEDCO refer to China Petroleum and Chemical Corporation, China National Petroleum Corporation, Petroleum Engineering and Development Company, and Petroiran Development Company, respectively. bbl/d and tcf are billion barrels per day and trillion cubic feet, respectively.

¹¹⁵ In 2004, a consortium of NIOC (25%) and Japan's INPEX (75%) signed an agreement to develop the field. INPEX has since halted its activities. In 2009, CNPC signed an MOU with NIOC to develop the field in 2011. In 2014, NIOC cancelled this contract due to project delays; the National Iranian Drilling Company will drill wells.

TABLE 6N6: SOUTH PARS NATURAL GAS FIELD DEVELOPMENT

Phase	Natural gas capacity (bcf/d)	Condensate capacity (bbl/d)	Developer	Start Year
1	1	40,000	PetroPars, Petronas	2004
2	2	80,000	Total, Petronas, Gazprom	2002
3				
4				
5	3.9	156,000	Statoil, PetroPars	2009
6				
7				
8				
9	2	80,000	PetroPars	2011
10				
11	2	80,000	PetroPars	2020+
12	3	120,000	POGC, NIOC, PDVSA	2014
13	2	80,000	Mapna, Sadra, Pedro Pidar	2020+
14	2	77,000	IDRO, IEOCC, NIDC	2017
15	2	80,000	POGC, ISOICO	2015
16				
17	2	80,000	PetroPars, OIEC, IOEC	2016
18				
19	2	77,000	PetroPars, IOEC	2018
20	2	75,000	OIEC	2017
21				
22	2	77,000	Petro Sina Arian, Sadra	2016
23				
24				

Source: US EIA, 2014, p.26. Notes: POGC, PDVSA, IDRO, NIDC, ISOICO, OIEC, IOEC refer to Pars Oil and Gas Company, Petroleos de Venezuela S.A., Industrial Development and Renovation Organization of Iran, National Iranian Drilling Company, Iran Shipbuilding and Offshore Industries Complex Company, Oil Industries Engineering Construction Company, Iranian Offshore Engineering and Construction Company, respectively. Total, ENI, and Statoil are currently not participating in South Pars.

APPENDIX O: THE SERVICE SECTOR
TABLE 6O1: SERVICES VALUE-ADDED AND OUTPUT

Year	Value-added			Output					
	Electricity, gas and water	Construction	Transport and communications	Real estate	Electricity, gas and water	Construction	Transportation	Communications	Real estate
1970	177	5188	4931	2981	296.4175	17731.2	7427.981	178.7232	910.6841
1971	264	5688	5571	3366	421.7499	19579.81	8800.511	238.2556	1070.059
1972	331	6072	8104	3832	532.3346	20904.35	12088.5	391.2702	934.4178
1973	450	8250	9591	4574	696.7141	25032.17	13640.8	559.6468	1195.325
1974	582	8983	12817	6024	940.1247	30339.11	18233.66	489.9416	1767.026
1975	611	10027	15593	9074	1113.926	34433.88	21662.72	581.2915	3458.303
1976	631	17180	16490	10731	1092.788	59131.24	23118.91	634.1745	2480.043
1977	682	13963	16640	11980	1143.7	48175.18	22177.75	788.6767	2474.607
1978	683	17408	15479	10963	1051.31	60629.6	21053.42	813.7404	1822.942
1979	726	13384	16954	10364	1100.67	43711.52	21816.54	755.6244	987.9021
1980	640	13088	17191	12304	1010.094	43483.11	22629.99	714.7954	830.3111
1981	734	10607	14004	14426	1057.113	35081.27	19687.9	659.6904	720.9173
1982	875	11807	14648	15800	1323.575	39402.21	20437.17	768.2319	883.2262
1983	911	14476	16930	18306	1335.57	48213.5	23297.29	818.6142	1075.231
1984	1023	11710	17247	20590	1942.14	38882.04	23664.4	830.0081	854.4047
1985	1119	10785	17259	21290	2128.998	36728.89	23784.45	861.3525	655.0569
1986	1200	12250	14948	18993	2154.691	43388.56	21591.99	779.0865	613.1789
1987	1336	11564	12234	18582	2228.439	40522.55	19763.64	708.8261	454.9531
1988	1288	7596	11412	18167	3059.318	26896.61	17560.84	901.9113	480.668
1989	1436	7409	12582	19626	3413.697	25958.06	19018.07	935.6138	488.798
1990	1608	9200	13753	24183	3786.42	27972.67	20923.83	1002.55	1004.035
1991	1748	11866	13952	28694	4085.939	34556.69	20846.29	1117.888	950.631
1992	1842	12883	14327	30524	4316.181	36690.93	21306.16	1348.134	969.039
1993	2077	14193	16735	31637	4858.933	42414.49	24533.2	1574.785	1055.751
1994	2302	13089	18458	33531	5344.502	38312.34	27283.53	1770.649	1249.145
1995	2476	12301	20330	36463	5696.3	35750.46	29623.12	2028.318	1048.637
1996	2673	13978	23476	37568	6124.435	39993.89	34230.73	2315.92	1476.587
1997	2833	13262	24033	40027	6510.95	38712.07	34902	2580.209	1297.159
1998	3011	12477	24737	41631	6877.035	37288.21	35376.04	2921.027	1271.12
1999	3211	14054	28115	44246	7336.816	40911.18	40032.35	3293.353	1556.726
2000	3396	15122	29647	44278	7782.652	42834.91	41992.3	3669.364	1531.632
2001	3591	15863	31291	46942	8246.192	45391.07	44368.53	4247.418	1382.325
2002	3887	18689	33855	49530	8908.509	52734.31	47947.72	5022.074	2455.033
2003	4228	18869	37187	49863	9658.173	56351.41	51478.68	6467.303	2540.194
2004	4608	19012	41484	52059	10474.94	57309.26	56445.25	8030.483	4003.59
2005	4899.2	20140.1	46182.5	53558.4	11122.3	65217.44	60958.46	10950.24	2982.927
2006	5331	20776.4	54027	55352.3	12077.15	67539.34	67859.23	15896.64	4149.512
2007	5725	23245.5	61910	56758	2967	38999	49954	18340	5555
2008	6019.3	27267.5	71744.4	56064.8	3333	55353	63314	19974	6896
2009	6060.9	25921	75128.9	55815.4	3153	53891	63700	22172	7572
2010	6348.2	27802.3	78575.9	55838.8	3747	62650	63611	23790	8215

Note: Constructed based on data in billion Rials at constant 2004/05 prices. Source: Central Bank of Iran (Economic Time-series Data-base); Statistical Centre of Iran (various years).

TABLE 6O2: SERVICES GROSS FIXED CAPITAL FORMATION

Gross Fixed Capital Formation					
Year	Electricity, gas and water	Construction	Transportation	Communications	Real estate
At constant 1997 prices (billion Rials)					
1970	2936.137279	2048.133504	4386.527241	1172.816707	7607.256499
1971	4191.186177	2593.153463	4953.060694	2187.254284	7432.150733
1972	5562.032456	3147.02154	5886.402914	2673.865062	8241.191565
1973	5118.545636	3635.278034	5685.469693	2816.7899	9125.462501
1974	5436.680537	3310.853047	7691.218219	2966.007741	12528.00548
1975	9222.816483	7695.924588	10549.27033	3390.603412	14274.88725
1976	14901.85122	5132.537356	11985.87775	4330.393641	23423.5617
1977	17040.91105	2091.67236	9911.30616	4523.175078	19353.63131
1978	10533.58351	986.8517339	8681.718795	4183.326812	23642.36484
1979	4560.114616	636.369034	5495.840425	944.6425809	21907.55123
1980	4755.537546	1182.237398	6566.791532	1554.044748	22676.34096
1981	6616.550356	2006.667446	6071.667175	1225.918077	17477.6201
1982	7285.639491	3070.062727	6387.369366	1440.141874	18962.95099
1983	9095.802573	3891.369135	9914.722832	1900.365282	28162.31958
1984	9007.330921	3829.042153	11120.58675	2550.535186	23134.91956
1985	6503.897359	3030.423298	9030.521859	1952.378589	22942.84491
1986	4718.54185	885.4896436	4704.667212	1316.337214	25288.48463
1987	4906.376738	731.415888	5398.543456	1482.178906	23289.68279
1988	4864.895153	731.6689993	5031.954898	499.9847829	14712.02441
1989	5980.229781	923.030937	6197.191594	671.9973257	14410.52046
1990	6916.49816	1023.615216	6172.172589	637.0770627	13325.99614
1991	9579.279591	3147.467451	10388.44049	1380.134993	17609.14501
1992	7688.179507	2109.700021	10611.70848	1287.888289	16980.4319
1993	11310.86646	989.9679044	8027.938672	786.638489	15325.96889
1994	8925.805392	469.8799837	7554.618875	647.9797982	13522.58171
1995	8523.163696	555.5522247	6416.429926	1035.675308	13063.30234
1996	8061.384828	1030.810461	8509.693734	1002.032321	14195.7151
1997	8737.780441	1034.416552	11102.03573	2479.242339	14122.42112
1998	6354.912064	523.0827922	13329.0699	3704.977825	13413.24858
1999	5654.661038	560.5986395	14539.32699	2601.007119	14093.70651
2000	5916.054221	581.0360439	15748.38196	2673.37229	15029.95596
2001	6320.227171	762.3899961	19970.05968	4039.196728	16859.9173
2002	7687.945794	769.1823637	26933.58537	3022.715632	19108.80884
2003	8014.994992	1377.199032	34810.25201	3352.094623	20109.9269
2004	7812.134342	2000.919083	35892.43086	4097.535	20714.85896
2005	10347.73957	2144.243889	37662.9069	4687.720276	22893.18351
2006	9603.656284	2052.973745	39635.53118	5089.422834	22539.18768
2007	10083.8391	2155.622432	43995.43961	5343.893976	37415.05155
2008	10588.03105	2263.403554	53674.43633	5611.088675	58367.48042
2009	10905.67198	2331.30566	86952.58685	5779.421335	84632.84661
2010	11450.95558	2517.810113	133906.9837	6068.392402	130334.5838

Note: Constructed based on data in billion Rials at constant 2004/05 prices. Source: Central Bank of Iran (Economic Time-series Data-base); Statistical Centre of Iran (various years).

TABLE 603: CONSTRUCTION PERMITS ISSUED BY MUNICIPALITIES IN URBAN AREAS

Year	Number				Total floor-space			
	Tehran	Other large cities	Other Urban Areas	All urban areas	Tehran (Thousand square meters)	Other large cities (Thousand square meters)	Other Urban Areas (Thousand square meters)	All urban areas (Thousand square meters)
1975	10803	23243	35541	69587	7615	4728.9	5035.7	17379.6
1976	12428	32116	53471	98015	8534.6	7468.5	8264.9	24268
1977	10078	20140	38304	68522	5093.2	5276.3	6231.3	16600.8
1978	10831	22632	38174	71637	5057.3	5119.3	6349	16525.6
1979	15073	38052	60896	114021	4598.4	8017.3	10177.1	22792.8
1980	13073	47054	91993	152120	4215.3	10049.7	14869.3	29134.3
1981	10198	50639	94706	155543	3221.2	9854.7	15619.3	28695.2
1982	11519	32943	72323	116785	3837.8	6854.4	12419	23111.2
1983	14437	37715	88674	140826	4955.1	8040.6	14136	27131.7
1984	12883	45652	89998	148533	4699.2	9308.5	15126.8	29134.5
1985	14939	40748	73983	129670	7815.1	8917.5	13847.9	30580.5
1986	11633	29576	71907	113116	6483.9	7074.5	13746.8	27305.2
1987	7098	33094	66935	107127	4554.7	8107.1	13010.2	25672
1988	7790	27672	57883	93345	5081.5	7244.2	11979.6	24305.3
1989	12801	36056	69659	118516	7986.5	9222.9	14733.7	31943.1
1990	10759	35698	59026	105483	5824.2	10133.6	12054.8	28012.6
1991	9294	35959	60103	105356	5126.3	10472.1	13081.9	28680.3
1992	8360	25637	60863	94860	5453.3	7995.9	12770.7	26219.9
1993	7469	27398	74012	108879	5236.4	7947.2	14719.6	27903.2
1994	8544	38811	75881	123236	6977.1	10296.4	15551.6	32825.1
1995	12028	44412	78975	135415	10378.2	12588.6	16273.3	39240.1
1996	13961	42666	82018	138645	12238.6	13418.2	16157.1	41813.9
1997	8209	39682	82619	130510	7443.7	11818.7	17044	36306.4
1998	6997	38243	87654	132894	5334.5	12354.3	18518.1	36206.9
1999	12119	40644	86080	138843	10120.4	15141.7	18861.5	44123.6
2000	21234	38487	76586	136307	17198	15312.6	17826.9	50337.5
2001	24215	45776	76042	146033	20867.7	19512.6	18174.2	58554.5
2002	20477	53002	87854	161333	15265.7	26776.4	23040.1	65082.2
2003	10876	49188	88877	148941	9531	29093.7	26790.9	65415.2
2004	12570	34681	88722	135973	11620.9	20084.4	29852.9	61558.2
2005	10833	31685	87211	129729	9968	17943.8	30014.1	57926
2006	14642	34914	123046	172602	13435.6	19528.2	37126.5	70090.3
2007	24930	50972	133020	208922	23397.2	30068	51740.8	105206
2008	20588	40427	115668	176683	20515	25770.8	53024.8	99310.6
2009	11964	30950	96544	139458	15406.6	22514.1	45676	83596.7
2010	19767	39839	121388	180994	27125.4	28252.9	58799.8	114178.1

Source: Central Bank of Iran, Economic Reports and Balance Sheets (various years); Statistical Centre of Iran (various years).

TABLE 6O4: RESIDENTIAL UNITS COMPLETED BY THE PRIVATE SECTOR IN URBAN AREAS

	Number	Total floor-space
Year	Units	(Thousand square meters)
1975	96120	13553
1976	101686	14439
1977	119172	16803
1978	150059	19057
1979	163779	21946
1980	180094	25754
1981	130598	19458
1982	131337	16681
1983	104698	14763
1984	149985	20998
1985	158834	23825
1986	145816	21726
1987	144840	22305
1988	128731	19824
1989	114638	17769
1990	93313	14650
1991	148636	22295
1992	182173	26233
1993	193716	26539
1994	201303	27579
1995	209853	29379
1996	204688	26609
1997	193641	24012
1998	210994	27218
1999	291046	36090
2000	339659	41438
2001	370736	44118
2002	445974	53071
2003	463127	55575
2004	402524	49510
2005	479153	57978
2006	448242	55582
2007	491385	60932
2008	601280	73356
2009	663307	82913
2010	550777	71050

Source: Central Bank of Iran, Economic Reports and Balance Sheets (various years).

TABLE 605: CONSTRUCTION SERVICE INDEX

Year	Daily Wage of Bricklayer	Daily Wage of Unskilled Constructi on Worker	Wage Paid for Painting	Wage Paid for Roof Asphalt ing	Wage Paid for Well Digging
1990	6.5	6.7	10.8	8.4	6.2
1991	8.4	8.1	11.3	10	7.2
1992	11.2	10.1	13.1	11.7	8.8
1993	13.5	12.3	15	13.8	11.1
1994	16.3	14.6	18.9	17.4	13.5
1995	21.3	19.6	27.3	24.1	18.1
1996	27	26.2	34	35.9	27.2
1997	31.8	30.3	40.5	42.4	30.9
1998	37.7	33.7	44.8	46.1	36.3
1999	43.9	38.1	51.1	49.6	43.3
2000	48.6	42	56.1	54.6	48
2001	53.7	46.5	62.3	57.7	51.3
2002	62.5	57.5	71.1	67.5	61
2003	78.8	77.3	83.4	80	79.1
2004	100	100	100	100	100
2005	116.9	116.6	117.9	118.6	118.7
2006	136.8	135.5	140.9	137.1	140.3
2007	181.9	193.8	184.1	178.2	187.1
2008	242.2	256.7	247.8	229.6	278.4
2009	259.3	265.5	275.7	241.2	309.9
2010	281.8	284	310	265.2	327.2

Source: Central Bank of Iran, Economic Reports and Balance Sheets (various years).

TABLE 6O6: TRANSPORT SECTOR PERFORMANCE

Year	Passengers					Goods				
	Land	Road	Rail	Air	Sea	Land	Road	Rail	Air	Sea
	Million persons	Million persons	Million persons	Million persons	Million persons	Million persons	Million persons	Million persons	Million persons	Million persons
1978	-	-	5.4	3.6	-	-	-	6.9	0.05	15.5
1979	-	-	6.1	2.6	-	-	-	6.1	0.06	9.6
1980	-	-	4.9	2.4	-	-	-	5.7	0.03	10.5
1981	-	-	4.3	1.8	-	-	-	6.8	0.02	11.4
1982	-	-	6.4	2.6	-	-	-	7.9	0.04	12.4
1983	-	-	6.4	4	-	-	-	10	0.07	17.3
1984	-	-	7.2	4.3	-	-	-	10.9	0.05	12.9
1985	-	-	7	3.7	-	-	-	11.6	0.06	13.1
1986	-	-	6.3	4.8	-	-	-	12.7	0.08	13.2
1987	-	-	5.3	5.3	-	-	-	14.8	0.1	16.6
1988	-	-	6.8	5.1	-	-	-	13	0.08	13.7
1989	-	-	6.7	5.9	-	-	-	12.3	0.06	17.6
1990	-	-	7.8	6.4	-	-	-	14.9	0.07	20.6
1991	-	-	8.1	6.6	-	-	-	17	0.07	23.6
1992	-	-	8.2	7.6	-	-	-	17.7	0.07	25.1
1993	-	-	9.2	8.3	-	-	-	19.8	0.07	27.6
1994	-	-	9.1	9.3	-	-	-	21.4	0.06	28.6
1995	-	-	9.7	10	-	-	-	21.4	0.05	31.6
1996	647.1	638.2	8.9	10.2	-	188.8	166.1	22.7	0.07	52.6
1997	655.9	646.4	9.5	11.6	-	215.9	191.5	24.4	0.07	60.3
1998	652.5	642.9	9.6	10.4	-	221.1	199.5	21.6	0.07	55.9
1999	667.7	657	10.7	11	-	249.4	226.4	23	0.07	75.4
2000	671.1	659.4	11.7	10.7	2.4	272	247	25	0.08	74.7
2001	660	646.9	13.1	11.6	2.4	294.9	268.5	26.4	0.08	75.3
2002	656.7	642.4	14.3	11.9	2.5	324.5	298	26.5	0.09	77
2003	669.1	653	16.1	13.2	3.7	376.9	348.1	28.8	0.1	85.6
2004	743.9	726.5	17.4	14.2	4.6	418.4	388.9	29.5	0.09	93.4
2005	781	761.6	19.4	15.6	3.9	437.1	406.8	30.3	0.13	97.5
2006	807.5	786.2	21.4	18.1	3.7	470.6	437.6	33	0.17	110.2
2007	819	794.5	24.5	19.6	3.9	516	485	31	0.16	107
2008	872	845.8	26.2	20.1	5.4	544.5	511.5	33	0.12	113.9
2009	925.7	898	27.7	21.8	6.3	548.5	515.7	32.8	0.12	130.9
2010	924.8	896	28.8	24	8.8	574.5	541	33.5	0.14	140.1

Source: Central Bank of Iran, Economic Reports and Balance Sheets (various years).

TABLE 607: COMMUNICATION SECTOR PERFORMANCE

Total telephone				Post			
Years	Installed	In use	Operating postal unit	Mails received and dispatched within the country (1000)	Mails dispatched abroad (1000)	Mails received and dispatched within cities (1000)	Overseas mail received (1000)
1986	-	-	-	-	-	-	-
1991	2902350	2456437	3909	58327	181558	21126	26067
1996	6690549	5824968	3240	47866	97094	10368	16716
2001	12170413	10896572	4629	227407	106791	7007	10357
2006	27143632	12934416	7641	764624	160481	2569	10785
Medium wave radio, television and F.M. stations and transmitters							
	Radio station	Radio main transmitter	TV station	TV main transmitter	F.M. station	F.M. main transmitter	
1986	-	-	-	-	-	-	
1991	70	90	713	942	62	64	
1996	77	99	1611	2302	87	121	
2001	93	124	3546	7509	639	926	
2006	93	128	4612	10845	778	2163	
	Inter-city		International channels				
	Inter-city automatic channels	Microwave transmissi on channels	Outgoing	Ingoing			
1986	11986	28864	670	1569			
1991	37878	74846	1854	2356			
1996	155254	240107	4277	7021			
2001	376618	471749	6289	9084			
2006	529940	1371712	11226	8182			

Source: Statistical Centre of Iran (various years).

TABLE 608: EXTENDED FACILITIES TO CONSTRUCTION AND HOUSING SECTOR

Year	By Maskan Bank			By other banks and credit institutions	
	Number	Amount		Amount	
	Thousand items)	Nominal (billion Rials)	Real (billion Rials)	Nominal (billion Rials)	Real (billion Rials)
1978	21.7	37.6	1652.58937	-	-
1979	43.1	49.5	1712.32594	-	-
1980	117.3	103.1	2916.10742	-	-
1981	126.6	117	2602.19371	-	-
1982	111.9	150.2	2856.57366	-	-
1983	119.4	185.1	3168.09902	-	-
1984	82.4	217.4	3343.38662	-	-
1985	45	143.7	2119.04688	-	-
1986	33.4	116.3	1532.88151	-	-
1987	30.7	96.6	1031.04259	-	-
1988	92.9	177	1584.43124	-	-
1989	118.7	360.4	2751.96213	-	-
1990	126.1	646	4091.39246	-	-
1991	108.7	736.1	3724.54223	-	-
1992	56.6	610.4	2411.46656	-	-
1993	68.1	617.6	1595.13899	-	-
1994	107.3	989.4	1951.27046	-	-
1995	134.3	1872.6	2662.20149	-	-
1996	147.9	2882.8	3286.14807	-	-
1997	175.7	3994.7	3994.70078	-	-
1998	285.8	6489.1	5928.4836	-	-
1999	258.2	9452.7	6635.86495	40656.2	28540.952
2000	217	10445.6	5799.39511	51949.4	28842.297
2001	239.5	12456.6	6195.58867	64959.7	32309.264
2002	372	15748.8	6164.00817	84084.4	32910.249
2003	334.8	14488.6	4970.53513	108068.8	37074.649
2004	208.8	17584.3	4957.85583	135670.3	38251.951
2005	299.4	43446.8	10281.2739	182559.4	43200.954
2006	432.4	73143.5	15140.7173	251951.8	52154.067
2007	393.3	69444.8	11916.3414	308274.6	52898.207
2008	334.1	65885.5	9657.74407	359179	52649.807
2009	477.6	107886	15442.4672	433654.5	62071.959
2010	909.5	325535	40781.5942	685164.3	85834.372

Source: Statistical Centre of Iran (various years).

TABLE 609: GOVERNMENT CREDITS FOR ACQUISITION OF NON-FINANCIAL ASSETS IN THE TRANSPORT SECTOR (BILLION RIALS)

	Nominal (billion Rials)	Real (billion Rials)
2003	9491.3	3256.135172
2004	9411.4	2653.52413
2005	14075.9	3330.928478
2006	12248.4	2535.420944
2007	13590.7	2332.088532
2008	16634.1	2438.28886
2009	27068	3874.42952
2010	26492.3	3318.838918

Source: Central Bank of Iran, Economic Reports and Balance Sheets (various years).

TABLE 6010: REAL INVESTMENT (CHANGES IN CAPITAL GOODS) IN MANUFACTURING ESTABLISHMENTS WITH 10 OF MORE WORKERS BY TYPE OF CAPITAL GOODS AND SIZE (MILLION RIALS)

Year and size of establishment	Total	Machinery	Office equipment	Vehicles	Building	Computer software
1996	392880053	300389383.7	12481909.4	18172090.48	104997867	0
2001	220303317	148180004.3	11078181.8	11202406.24	52164636.2	3204889.73
2002	301040272	199458570.2	10565684.9	9888135.917	89689699.3	1231015.55
2003	349946477	210968462.9	8852107.17	10541935.95	125627412	1085136.64
2004	387310819	259591842.7	13479191.6	20866424.88	97158921.8	1283328.28
2005	390141692	236832097.9	10346997.3	10922462.7	149238029	1207310.14
2006	580530868	293115087.7	12106452.5	13281882.07	272514339	1894460.35
10-49 workers	3853713	2685705	69117	179938	909008	9946
50-99 workers	1907238	1124551	57067	74719	644472	6429
100 and more workers	33606883	16066906	694796	646034	16087050	112096

Source: SCI, Annual Statistical Yearbook (2007). Data for year 1996 also includes figures related to manufacturing establishments with less than 10 workers.

TABLE 6O11: SELECTED INDUSTRIAL MANUFACTURING PRODUCTS

Year	Steel (thousand tons)	Petrochemi cal Products (thousand tons)	Cement (thousand tons)	Automobile (unit)	Year	Steel (thousand tons)	Petrochemi cal Products (thousand tons)	Cement (thousand tons)	Automobile (unit)
1981	470.1	211	9231	-	1996	5896	10374	17806	94400
1982	711.8	234	10224	49966	1997	6059.4	10817	19376	133900
1983	768.1	182	10912	53573	1998	5625.1	11140	20149	157000
1984	865.7	314	11767	57790	1999	6304.3	11001	22080	187800
1985	830.8	375	12357	29644	2000	6614.1	11809	23889	249100
1986	826.1	515	12439	22947	2001	6930.9	12543	26645	321300
1987	895.9	677	12661	14850	2002	7506	13109	28433	462000
1988	1003.6	884	12203	13673	2003	7991	13969	29783	660900
1989	1148	2421	12869	11200	2004	8990	15070	32199	791900
1990	1583.6	3005	15055	19700	2005	9604	15757	32633.7	841100
1991	2409.4	4342	15152	48800	2006	9990	17994	35268.2	919375
1992	3215.7	5701	15142	33200	2007	10144	23869	39975	943396
1993	3961.1	5428	16260	39500	2008	10903	30040	44397	1057633
1994	4708.1	7467	16836	52800	2009	11126.9	34434	52093	1187732
1995	4581	8723	17491	79500	2010	12728	40175	61619	1354257

Source: Central Bank of Iran, Economic Reports and Balance Sheets (various years).

APPENDIX 6P: SECTOR LEVEL DATA
APPENDIX 6P1: DATA FOR THE AGRICULTURE SECTOR

t	Investment (Constant 2004/2005 Prices - Billion Rials)		Capital stock (Constant 2004/200 Prices - Billion Rials)	Capital Growth Rate of Capital (kt-Kt- 1)/kt-1	Capital Stock Depreciation ($\delta = (It - (Kt - Kt-1)) / Kt-1$)	Capital Growth Rate of Capital + δ	Natural Log (Growth Rate of Capital + δ)	GDP at Basic Prices (Constant 2004/200 Prices - Billion Rials)	Natural Log GDP at Basic Prices	Average Rates of Return on Facilitie s /100	User Cost of Capital
	1974/75	10777,1892	9,28518707	48207		0,041237075		49909,421	10,818	0,08	-0,3274
1975/76	10798,9845	9,28720738	57281	0,18823	0,035782863	0,22401	-1,49605	55449,054	10,9232	0,08	-0,0085
1976/77	11593,2316	9,35817672	66844	0,16695	0,035443369	0,20239	-1,59755	66483,502	11,1047	0,08	-0,0227
1977/78	8594,03524	9,05882367	73117	0,09385	0,034723165	0,12857	-2,05129	61330,374	11,024	0,085	-0,072
1978/79	7485,99879	8,92078973	78046	0,06741	0,034971331	0,10238	-2,27903	61488,012	11,0266	0,085	0,01476
1979/80	6714,91695	8,81208674	82077	0,05165	0,034388911	0,08604	-2,45297	63970,772	11,0662	0,08	-0,1476
1980/81	7201,36289	8,88202558	85585	0,04274	0,044998756	0,08774	-2,43339	66586,643	11,1063	0,08	-0,1707
1981/82	7212,27962	8,88354036	88769	0,0372	0,047067589	0,08427	-2,47372	67616,103	11,1216	0,08	-0,0926
1982/83	6365,83867	8,75870127	88151	-0,007	0,078674297	0,07171	-2,63509	75182,261	11,2277	0,08	0,08145
1983/84	8335,79441	9,0283141	88735	0,00662	0,08793768	0,09456	-2,35849	83792,006	11,3361	0,08	0,02258
1984/85	5388,96722	8,59210903	89114	0,00427	0,056459877	0,06073	-2,8013	85760,219	11,3593	0,08	-0,0244
1985/86	5874,60439	8,678394	87934	-0,0132	0,079163817	0,06592	-2,71928	92896,194	11,4392	0,08	0,1034
1986/87	5802,28565	8,6660072	81691	-0,071	0,136980982	0,06598	-2,71833	94472,727	11,4561	0,08	0,07934
1987/88	6329,47267	8,75297221	81671	-0,0002	0,077725486	0,07748	-2,55773	101438,89	11,5272	0,08	-0,0309
1988/89	5324,60306	8,58009344	80668	-0,0123	0,077476743	0,0652	-2,73036	101773,83	11,5305	0,08	-0,0207
1989/90	6138,19573	8,72228612	84069	0,04216	0,033931618	0,07609	-2,57581	106323,95	11,5742	0,08	-0,0397
1990/91	7322,72181	8,89873737	80906	-0,0376	0,124727567	0,0871	-2,44066	118247,45	11,6805	0,075	-0,0051
1991/92	10365,1078	9,24620043	88594	0,09502	0,033089114	0,12811	-2,05484	125105,32	11,7369	0,075	-0,1066
1992/93	8315,84569	9,02591809	94055	0,06164	0,032223917	0,09386	-2,3659	138065,4	11,8355	0,09	-0,1173
1993/94	8707,54134	9,07194475	99809	0,06118	0,031402279	0,09258	-2,37969	140302,36	11,8516	0,14	-0,2149
1994/95	7052,75817	8,86117405	103857	0,04056	0,030105082	0,07066	-2,64984	143516,36	11,8742	0,14	-0,112
1995/96	6450,88807	8,77197309	107258	0,03275	0,029366225	0,06211	-2,7788	148760,4	11,9101	0,145	-0,1356
1996/97	9045,16769	9,10998594	113148	0,05491	0,029416619	0,08433	-2,47301	152608,51	11,9356	0,145	-0,0715
1997/98	8564,30609	9,05535839	118418	0,04658	0,029115018	0,07569	-2,58109	154552,56	11,9483	0,145	0,0265
1998/99	7733,50718	8,95331775	122691	0,03608	0,029222814	0,06531	-2,72866	169581,75	12,0411	0,145	0,07206
1999/00	13578,1599	9,51621789	132669	0,08133	0,029343309	0,11067	-2,20121	157670,38	11,9683	0,145	-0,0901
2000/01	11921,6288	9,38610958	140722	0,0607	0,029160006	0,08986	-2,4095	161831,53	11,9943	0,145	-0,0432
2001/02	14209,2936	9,56165151	150716	0,07102	0,029954759	0,10097	-2,29289	161844,02	11,9944	0,145	0,03325
2002/03	15829,3001	9,66961794	161914	0,0743	0,030728656	0,10503	-2,25353	182154,93	12,1126	0,135	-0,0747
2003/04	16387,8155	9,70429338	173301	0,07033	0,030885627	0,10121	-2,29053	192392,29	12,1673	0	-0,0835
2004/05	19886,7704	9,89780998	187444	0,08161	0,033143319	0,11475	-2,16498	194994,47	12,1807	0	-0,138
2005/06	23272,4393	10,0550251	204347	0,09018	0,033980492	0,12416	-2,08621	211550,37	12,2622	0,16	0,01313
2006/07	21455,8154	9,973751	218736	0,07041	0,034582428	0,105	-2,25382	221432,69	12,3079	0,14	0,03683
2007/08	22762,4594	10,0328679	233741	0,0686	0,035464941	0,10406	-2,26275	226115,98	12,3288	0,12	-0,0284
2008/09	27058,0638	10,2057403	252052	0,07834	0,037422035	0,11576	-2,15623	176172,02	12,0792	0,12	-0,0095
2009/10	26193,8862	10,1732813	268932	0,06697	0,036952241	0,10392	-2,26411	194594,83	12,1787	0,12	0,09533
2010/11	26732,9861	10,1936535	285721	0,06243	0,036975838	0,0994	-2,30856	203391,11	12,2229	0,13	0,02814
2011/12	30955,9745	10,3403213	305883	0,07057	0,037778023	0,10834	-2,22245	200496,84	12,2086	0,145	-0,0435

Note: Constructed based on data in billion Rials at constant 2004/05 prices.

APPENDIX 6P2: DATA FOR THE MANUFACTURING AND MINING SECTORS

t	Investment (Constant 2004/200 5 Prices - Billion Rials)		Capital stock (Constant 2004/200 5 Prices - Billion Rials)		Capital Stock Depreciati on ($\delta = (It - Kt - Kt-1) / Kt-1$) Growth Rate of Capital + δ		Natural Log (Growth Rate of Capital + δ)		GDP at Basic Prices (Constant 2004/200 5 Prices - Billion Rials)		Average Rates of Return on Facilities /100	User Cost of Capital
	Natural Log Investment			Rate of Capital Kt-1/Kt-1		Rate of Capital + δ			Natural Log GDP at Basic Prices			
1973/74	22567,68	10,024274			0,0412371			101622,01	11,529015	0,095	-0,1440821	
1974/75	26880,058	10,19914	143399		0,0412371			123382,61	11,723045	0,095	-0,3128644	
1975/76	51022,527	10,840023	185510	0,2936631	0,062145	0,3558081	-1,0333637	129164,34	11,768841	0,095	0,0298521	
1976/77	66851,382	11,110227	241227	0,300345	0,0600204	0,3603654	-1,0206368	156257,74	11,959262	0,1	0,0187699	
1977/78	52044,441	10,859853	279087	0,1569476	0,0588012	0,2157488	-1,5336404	170631,22	12,04726	0,105	-0,0314419	
1978/79	33831,517	10,429148	296529	0,0624966	0,0587255	0,1212221	-2,1101307	152540,08	11,935183	0,105	0,0530421	
1979/80	18764,165	9,8397042	297847	0,0044448	0,0588346	0,0632794	-2,7601961	128512,3	11,76378	0,08	-0,1252471	
1980/81	17158,321	9,7502385	294840	-0,0100958	0,0677036	0,0576078	-2,8540967	133859,99	11,80455	0,08	-0,1487779	
1981/82	13811,946	9,5332891	287681	-0,024281	0,0711265	0,0468456	-3,060899	145355,07	11,886935	0,08	-0,0715925	
1982/83	13983,95	9,5456655	273467	-0,0494089	0,0980181	0,0486092	-3,023942	139585	11,846429	0,08	0,0994511	
1983/84	24626,828	10,111592	268081	-0,0196952	0,1097494	0,0900541	-2,4073445	157003,09	11,964021	0,08	0,0427576	
1984/85	25918,15	10,162699	270431	0,008766	0,0879143	0,0966803	-2,3363457	175810,84	12,077164	0,09	0,0131528	
1985/86	15177,726	9,6275843	256334	-0,0521279	0,1082521	0,0561242	-2,880188	172467,99	12,057967	0,09	0,1372421	
1986/87	13226,779	9,4899987	228054	-0,1103248	0,1619246	0,0515998	-2,9642378	161769,89	11,99393	0,09	0,1066345	
1987/88	14132,941	9,5562636	215203	-0,0563507	0,1183226	0,0619719	-2,7810741	181289,05	12,107848	0,09	0,0110098	
1988/89	16815,548	9,7300592	205246	-0,0462679	0,124406	0,0781381	-2,5492779	179831,18	12,099774	0,09	0,0255027	
1989/90	17415,074	9,7650914	204586	-0,0032157	0,0880654	0,0848498	-2,4668731	194110,95	12,176185	0,09	0,0175851	
1990/91	23472,353	10,063579	205803	0,0059486	0,1087824	0,114731	-2,1651652	224563,33	12,321913	0,12	0,0213578	
1991/92	45320,663	10,721518	232139	0,127967	0,0922468	0,2202138	-1,5131563	230753,59	12,349106	0,12	-0,014054	
1992/93	46023,817	10,736914	257770	0,1104123	0,0878474	0,1982597	-1,6181773	231812,63	12,353685	0,13	-0,0342626	
1993/94	33798,709	10,428178	269883	0,0469915	0,0841281	0,1311196	-2,0316451	222647,76	12,313346	0,17	-0,1387387	
1994/95	23922,552	10,082577	271607	0,006388	0,0822525	0,0886405	-2,4231669	233652,16	12,361589	0,17	-0,0366331	
1995/96	21966,708	9,9972833	271475	-0,000486	0,0813628	0,0808768	-2,5148281	243201,18	12,401644	0,18	-0,0554895	
1996/97	27103,897	10,207433	277704	0,022945	0,0768944	0,0998394	-2,3041925	279595,55	12,541099	0,18	0,003209	
1997/98	34890,237	10,459962	293206	0,055822	0,0698162	0,1256382	-2,0743487	311068,38	12,647768	0,18	0,0938771	
1998/99	48735,977	10,794173	322991	0,1015839	0,0646337	0,1662175	-1,7944579	310252,98	12,645143	0,18	0,1320653	
1999/00	45102,034	10,716683	347915	0,0771662	0,0624724	0,1396387	-1,9686971	340407,97	12,7379	0,18	-0,0293577	
2000/01	49890,303	10,817582	376029	0,0808071	0,0625909	0,143398	-1,9421315	368578,12	12,817408	0,18	0,017853	
2001/02	67395,799	11,118338	419967	0,1168474	0,062383	0,1792303	-1,7190836	422851,82	12,954777	0,17	0,0850153	
2002/03	72051,281	11,185133	465553	0,1085466	0,0630175	0,1715641	-1,762798	478267,64	13,077926	0,16	-0,0233224	
2003/04	76741,861	11,248203	512383	0,1005901	0,0642502	0,1648402	-1,8027786	560642,93	13,236839	0,16	0,090943	
2004/05	89799,347	11,405333	568923	0,1103471	0,0649111	0,1752582	-1,7414947	607684,49	13,317411	0,15	0,0252034	
2005/06	88624,78	11,392167	620680	0,0909736	0,0648028	0,1557764	-1,8593336	668004,46	13,41205	0,16	0,0388225	
2006/07	87427,788	11,378568	666982	0,0745988	0,0662592	0,1408581	-1,9600025	723642,77	13,492053	0,14	0,0629302	
2007/08	82481,086	11,320324	703562	0,0548441	0,0688191	0,1236631	-2,0901941	789767,55	13,579494	0,12	-0,0015394	
2008/09	84434,665	11,343733	737926	0,0488429	0,0711674	0,1200103	-2,120178	825399,3	13,623623	0,12	0,0170342	
2009/10	88270,047	11,388156	772514	0,0468719	0,0727472	0,1196191	-2,1234427	905766,94	13,716537	0,12	0,1215437	
2010/11	96656,543	11,478919	811997	0,0511098	0,0740097	0,1251195	-2,0784862	1022775,4	13,838031	0,13	0,0599139	
2011/12	99142,326	11,504312	850349	0,0472317	0,0748652	0,1220969	-2,1029402	1115941,9	13,925209	0,145	-0,0116563	
2011/12	1390	99142,326	11,504312	850349	0,0472317	-3,05269	0,0748652	0,1220969	-2,1029402	1115941,9	13,925209	

Note: Constructed based on data in billion Rials at constant 2004/05 prices.

APPENDIX 6P3: DATA FOR THE OIL AND GAS SECTORS

t	Investment (Constant 2004/200 5 Prices - Billion Rials)	Natural Log Investment	Capital stock (Constant 2004/200 5 Prices - Billion Rials)	Growth Rate of Capital (kt- 1)/kt-1	Capital Stock Depreciati on ($\delta = (It - Kt - Kt-1) / Kt-1$)	Growth Rate of Capital + δ	Natural Log (Growth Rate of Capital + δ)	Value- added (Constant 2004/200 5 Prices - Billion Rials)	Natural Log GDP at Basic Prices	Average Rates of Return on Facilities /100	User Cost of Capital
1973/74	9918,5188	9,2021589			0,0412371					0,1204674	-0,1201927
1974/75	12511,529	9,4344058	95401		0,0412371		613793,61	13,327414	0,1052767	-0,3029186	
1975/76	14375,536	9,5732831	104828	0,0988145	0,0518709	0,1506854	-1,8925612	624338,47	13,344448	0,1045212	0,0291532
1976/77	42081,986	10,647375	141417	0,3490384	0,0524	0,4014384	-0,9127011	547098,9	13,212385	0,105783	0,0170615
1977/78	26120,693	10,170483	161457	0,1417086	0,0429983	0,1847069	-1,6889851	623080,73	13,342431	0,1106311	-0,0408126
1978/79	21801,498	9,989734	175819	0,0889525	0,0460773	0,1350298	-2,0022602	571436,42	13,255909	0,1101542	0,0464859
1979/80	12505,68	9,4339382	180327	0,02564	0,0454881	0,0711281	-2,6432721	403767,52	12,908595	0,0895444	-0,1287293
1980/81	7261,5759	8,8903521	174241	-0,0337498	0,0740187	0,0402689	-3,212175	306662,93	12,633504	0,086562	-0,1363465
1981/82	9067,7197	9,1124761	174037	-0,0011708	0,053212	0,0520413	-2,9557186	96743,812	11,479822	0,0853322	-0,0825569
1982/83	14552,982	9,5855512	175430	0,008004	0,075616	0,08362	-2,481472	107606,67	11,586238	0,0876061	0,0856836
1983/84	18603,013	9,8310788	183758	0,0474719	0,0585704	0,1060424	-2,2439165	251292,25	12,434372	0,0861164	0,0010792
1984/85	15941,572	9,6766856	189124	0,0292014	0,0575516	0,0867531	-2,4446894	254628,52	12,447561	0,0959378	-0,0089536
1985/86	7562,9764	8,9310201	175669	-0,0711438	0,1111333	0,0399895	-3,2191381	199522,86	12,203684	0,0958837	0,1448311
1986/87	6649,2554	8,8022602	166204	-0,0538797	0,0917308	0,037851	-3,2740967	203988,87	12,225821	0,095534	0,0561201
1987/88	3882,9346	8,2643465	151415	-0,088981	0,1123435	0,0233625	-3,7566247	177321,61	12,08572	0,0951181	0,0102972
1988/89	3384,5593	8,126979	145286	-0,0404782	0,062831	0,0223529	-3,8008007	203533,07	12,223584	0,0948564	-0,0205407
1989/90	2439,5441	7,7995665	140359	-0,0339124	0,0507037	0,0167913	-4,086893	220048,73	12,301604	0,0948455	-0,0114476
1990/91	5474,3807	8,6078344	138690	-0,0118909	0,0508936	0,0390027	-3,2441243	232659,18	12,35733	0,1382541	-0,0147894
1991/92	7344,836	8,9017528	139152	0,0033312	0,0496275	0,0529587	-2,9382437	276415,93	12,529662	0,1428034	-0,0316561
1992/93	4696,348	8,4545405	137030	-0,0152495	0,0489993	0,0337498	-3,3887817	309995,71	12,644314	0,1461078	-0,0540184
1993/94	4764,5301	8,4689542	135366	-0,0121433	0,0469133	0,03477	-3,359001	313737,07	12,656311	0,1680412	-0,1748153
1994/95	7199,1891	8,8817237	136158	0,0058508	0,0473323	0,0531831	-2,9340138	325817,03	12,694091	0,1699072	-0,0687747
1995/96	7178,0176	8,8787785	137229	0,0078659	0,0448524	0,0527183	-2,9427927	303702,58	12,623804	0,1787226	-0,0902814
1996/97	16385,083	9,7041266	147200	0,0726596	0,04674	0,1193996	-2,1252797	304697,75	12,627076	0,1781718	-0,0257622
1997/98	15611,904	9,655789	156044	0,0600815	0,0459776	0,1060591	-2,2437585	304450,26	12,626263	0,177018	0,0700051
1998/99	15577,526	9,6535845	164490	0,0541258	0,045702	0,0998278	-2,3043088	282864,76	12,552724	0,1762365	0,1127235
1999/00	23553,045	10,06701	181015	0,100462	0,0427263	0,1431883	-1,9435947	283887,63	12,556334	0,176145	-0,0503899
2000/01	23518,434	10,06554	197321	0,0900809	0,0398444	0,1299253	-2,0407953	256522,02	12,45497	0,1765126	-0,005549
2001/02	29580,931	10,294885	217988	0,104738	0,0451748	0,1499127	-1,8977019	287828,09	12,570119	0,1711825	0,0705697
2002/03	23198,549	10,051845	230491	0,0573564	0,0490649	0,1064212	-2,2403503	258649,66	12,46323	0,1600491	-0,0357821
2003/04	25441,875	10,144152	243732	0,0574469	0,0529343	0,1103812	-2,2038154	258251,07	12,461688	0,1405762	0,0632165
2004/05	32719,253	10,395719	263142	0,0796367	0,0546061	0,1342427	-2,0081056	299387	12,609492	0,1358639	0,0032569
2005/06	37281,456	10,526251	286071	0,0871355	0,0545426	0,1416781	-1,9541978	298959,24	12,608063	0,1568385	0,0276326
2006/07	31756,878	10,365865	302228	0,056479	0,0545315	0,1110105	-2,1981307	299517,43	12,609928	0,1367772	0,0506113
2007/08	36614,759	10,508207	322509	0,067105	0,0540445	0,1211495	-2,1107303	301107,64	12,615223	0,1166519	-0,0161137
2008/09	37757,675	10,538944	342772	0,0628293	0,0542455	0,1170748	-2,1449423	304768,1	12,627306	0,1167689	0,0012026
2009/10	41312,175	10,628913	365276	0,065653	0,0548708	0,1205238	-2,1159082	304858,9	12,627604	0,1167894	0,1060998
2010/11	20315,467	9,9191378	365335	0,0001615	0,0554552	0,0556168	-2,8892707	280739,46	12,545182	0,1283853	0,04261
2011/12	7432,6376	8,9136361	351457	-0,0379871	0,0583318	0,0203447	-3,8949339	287582,67	12,569266	0,1400388	-0,0301054
2011/12	1390	7432,6376	8,9136361	351457	-0,0379871	#NUM!	0,0583318	0,0203447	-3,8949339	287582,67	12,569266

Note: Constructed based on data in billion Rials at constant 2004/05 prices.

APPENDIX 6P4: DATA FOR THE SERVICES

t	Investment (Constant 2004/200 5 Prices - Billion Rials)		Capital stock (Constant 2004/200 5 Prices - Billion Rials)		Capital Stock Depreciati on ($\delta = (It - Kt - Kt-1) / Kt-1$)		Natural Log (Growth Rate of Capital + δ)		GDP at Basic Prices (Constant 2004/200 5 Prices - Billion Rials)		Average Rates of Return on Facilities /100	User Cost of Capital
	Natural Log Investment			Growth Rate of Capital Kt-1/kt-1		Growth Rate of Capital + δ			Natural Log GDP at Basic Prices			
1973/74	99520,978	11,508124			0,0412371				182513,81	12,114581	0,13	-0,1112508
1974/75	127419,47	11,75524	842727		0,0412371				228857,75	12,340856	0,11	-0,2983474
1975/76	165623,55	12,017473	976875	0,1591832	0,0373496	0,1965329	-1,6269256	270917,45	12,509569	0,11	0,0207583	
1976/77	243956,44	12,404745	1184308	0,2123434	0,037388	0,2497315	-1,387369	398207,77	12,894729	0,11	0,0070242	
1977/78	208789,33	12,249081	1351329	0,1410283	0,0352681	0,1762965	-1,7355882	351684,77	12,770491	0,115	-0,0439092	
1978/79	212333,42	12,265913	1515366	0,1213894	0,0357399	0,1571293	-1,850686	402958,8	12,90659	0,115	0,0416817	
1979/80	154667,62	11,949034	1617374	0,0673158	0,0347504	0,1020662	-2,2821339	325491,09	12,69309	0,1	-0,1289876	
1980/81	165260,28	12,015277	1724274	0,0660948	0,0360834	0,1021781	-2,2810374	329624,68	12,70571	0,1	-0,1599959	
1981/82	141541,31	11,860347	1803302	0,0458326	0,0362549	0,0820875	-2,4999697	290023,02	12,577716	0,1	-0,0845519	
1982/83	157618,84	11,967935	1889451	0,0477729	0,0396328	0,0874057	-2,437195	320861,44	12,678765	0,1	0,0637338	
1983/84	220643,37	12,304303	2034058	0,0765339	0,0402426	0,1167764	-2,1474939	381163,43	12,850984	0,1	-0,0030313	
1984/85	195833,5	12,18502	2154207	0,0590686	0,0372086	0,0962772	-2,3405233	348070,07	12,760159	0,1	-0,0236889	
1985/86	179235,85	12,096458	2248474	0,0437595	0,0394432	0,0832027	-2,4864754	341243	12,74035	0,1	0,086323	
1986/87	172119,55	12,055945	2322643	0,0329864	0,0435631	0,0765495	-2,5698178	359817,46	12,793352	0,1	0,0219789	
1987/88	163007,54	12,001552	2394437	0,0309105	0,0392714	0,0701819	-2,6566646	336957,05	12,727711	0,1	-0,0461359	
1988/89	111715,18	11,623708	2411335	0,0070572	0,0395989	0,0466561	-3,0649508	269028,18	12,502571	0,1	-0,0352247	
1989/90	121542,77	11,708021	2441228	0,0123969	0,0380079	0,0504048	-2,9876696	279339,26	12,540182	0,1	-0,018181	
1990/91	110242,99	11,610442	2406839	-0,0140868	0,0592456	0,0451588	-3,0975695	303260,61	12,622348	0,18	0,0309004	
1991/92	167891,07	12,031071	2479030	0,0299941	0,0397617	0,0697558	-2,6627542	349696,24	12,76482	0,18	-0,0073786	
1992/93	154592,27	11,948546	2536427	0,023153	0,039207	0,06236	-2,7748315	365661,84	12,809464	0,18	-0,0330815	
1993/94	138000,46	11,835012	2574583	0,0150432	0,0393642	0,0544074	-2,9112547	392076,44	12,879212	0,195	-0,1569401	
1994/95	125099,46	11,736864	2598082	0,0091273	0,0394629	0,0485902	-3,0243337	405047,77	12,911176	0,195	-0,0529638	
1995/96	116336,89	11,664245	2611785	0,0052743	0,0395037	0,044778	-3,1060386	410702,67	12,925625	0,2075	-0,0687102	
1996/97	133273,35	11,800158	2641390	0,0113352	0,0396925	0,0510277	-2,9753869	458574,27	13,035878	0,2075	-0,0055794	
1997/98	142352,18	11,866059	2678871	0,0141899	0,039703	0,0538929	-2,9207564	455488,56	13,029126	0,2075	0,0915512	
1998/99	138773,24	11,840596	2710572	0,0118337	0,0399692	0,0518029	-2,9603095	455884,15	13,029994	0,2075	0,1344818	
1999/00	140246,45	11,851157	2741131	0,011274	0,0404665	0,0517405	-2,9615137	498712,98	13,119786	0,2075	-0,0244616	
2000/01	153373,88	11,940634	2782742	0,0151802	0,0407725	0,0559528	-2,8832473	519508,43	13,160638	0,2075	0,0229214	
2001/02	197114,34	12,191539	2866267	0,0300154	0,0408192	0,0708346	-2,6474081	560863,7	13,237233	0,205	0,0971268	
2002/03	217204,19	12,288593	2966893	0,035107	0,0406725	0,0757795	-2,5799279	626714,14	13,348246	0,195	-0,0119818	
2003/04	235650,71	12,370106	3081432	0,0386057	0,0408211	0,0794268	-2,5329199	671539,03	13,417327	0,18	0,08785	
2004/05	243556,57	12,403105	3198094	0,0378597	0,0411804	0,0790401	-2,5378004	701392,6	13,460823	0,175	0,0263432	
2005/06	256381,06	12,45442	3321627	0,0386271	0,0415398	0,0801668	-2,5236454	764763,12	13,547321	0,16	0,0194276	
2006/07	247812,94	12,420429	3430177	0,0326798	0,0419261	0,0746059	-2,5955358	828215,18	13,627028	0,14	0,0428803	
2007/08	288938,78	12,57397	3572551	0,0415063	0,0427281	0,0842344	-2,4741523	977572,97	13,792828	0,12	-0,0225219	
2008/09	323722,72	12,687643	3744193	0,0480447	0,0425692	0,0906139	-2,4011478	1065001	13,878486	0,12	-0,0054317	
2009/10	334510,1	12,720422	3919428	0,0468018	0,0425392	0,089341	-2,4152943	1110290,6	13,920132	0,12	0,0994197	
2010/11	356244,16	12,783372	4108762	0,0483065	0,0425853	0,0908919	-2,3980847	1176210,4	13,977808	0,13	0,0329537	
2011/12	374209,03	12,83257	4307056	0,0482613	0,0428146	0,0910759	-2,3960625	1253865,5	14,041742	0,145	-0,0391657	

Note: Constructed based on data in billion Rials at constant 2004/05 prices.

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