Vasilev, Aleksandar

Preprint

Analysis of Sovereign Yield Spreads Behavior: The French Bonds Case

ANALYSIS OF SOVEREIGN YIELD SPREADS BEHAVIOR: THE FRENCH BONDS CASE

Aleksandar Vasilev

American University in Bulgaria

Abstract: The introduction of the Euro has led to price level stability and fostered growth within the European Union. Consequently, since its launch as a store of value and unit of account, there has been a clear convergence between the yield of France's sovereign debt and German benchmark. This paper tries to estimate the effect of certain macroeconomic fundamentals on the yield spread of French 10-year bonds, relative to the German Bund of the same maturity for the period January 1999-March 2003. It reaches the conclusion that staying in line with Maastricht criteria decreases the risk premium of external debt.

Key words: French bonds, yield spreads, macroeconomic fundamentals

JEL classification: G12, G15

I. Introduction

The motivation behind writing this research paper is the author's academic interest in European economic and monetary integration. The topic is also important for the Bulgarian National Bank because about 90% of the bank's exposition is in Euro-denominated bonds. Additional revenue can be realized by carefully choosing the exposition by country. Moreover, possible entry in EMU for Bulgaria in 2007 would pose the question what determines the dynamics Bulgarian spread. Our point is that there is room for an investor, especially a conservative institutional one such as the Bulgarian National Bank, to invest the money from the fiscal reserve and generate a little bit more of revenue from these safe and liquid assets. The extra money collected would be directed to the Ministry of Finance and could be used for transfer payments for unemployed, aged, handicapped, etc.

This Monetary Union is an ambitious project that lots of people wait to come true. The idea of European States is based on economic stability, which would spur political integration further on. One of the aspects of monetary integration is efficient credit markets. In this way yield spreads provide a simple measure of the market's assessment of the risk of default and the extent of

financial integration between EMU member States. Also, these spreads capture the degree of financial integration.

European Union, however, is still far off from the benchmark model of US with its fully integrated states. That is because national feelings are hard to be overruled. Politicians are still afraid to give up the sovereignty of the country they manage in the hands of supranational organizations.

France, for example, is one of the building blocks of the United European States. But starting with De Gaul, nationalism has been inspired in French citizens. Thus, economic concerns often succumb to political whims of different interest groups in this member state. Such leaks first show up in financial markets. As all the external debt of the countries in the Euro zone is denominated in the single currency – the Euro, the exchange rate component is eliminated from the risk premium. So, in this situation there is place for generating higher revenue at almost no additional risk. That is because structural differences, especially in the labor markets, which are still rigid in France, can give way to increased budget deficits. The strikes in the past few months are a clear leading indicator for that. Subsequently, the country has to pay a higher yield relative to the rest of the Euro zone. In the case of France, however, the credit risk is insignificant. Refuse to pay back would mean an immediate default for France and exit from the European Union.

The presence of France in the European Union creates the necessity for the country to comply with the Maastricht criteria, established by the Stability and Growth Pact. The Pact requires certain level of macroeconomic stability to be sustained in the long run. The idea, shared by many economists, is that member states should achieve nominal convergence through time, nominal convergence being the source of EU sustainability. France has had no problem in keeping its budget deficit and external debt within the limits, 3% and 60% of GDP, respectively. The only red light in front of France is the lack of political will to counteract the power of labor unions. Wages are negotiated at different times for different industries, which unleashes an inflation spiral. Moreover, the generous unemployment benefits that are paid to laid-off workers are a license to stay unemployed. Such a labor policy puts a pressure on the budget, which is already in the danger of exceeding the benchmark level.

French sovereign yield spread, represented by the 10-year French bond, has decreased significantly after the launching of Euro in January 1999. Using the Spread of the French debt yield over the German benchmark Bund of the same maturity and currency denomination allows on one hand a more adequate risk measure of the financial instrument. On the other hand, the yield spread measures more carefully the security performance compared to the development of the Eurozone. The 10-year bond was particularly chosen because enough time is provided for a policy targeting macroeconomic fundaments to show results.

The paper is structured further as follows: Part II provides a review of the relevant literature. Part III describes the model and the data. Part IV explains the results. Part V states the relevant conclusions. Part VI lists works cited and Part VII shows the regression results.

II. Literature overview

There are three risks that are typically incorporated in the spreads, as quoted by researchers and academicians. The market risk has to do with the volatility of the exchange rate movements. Also, the price of the securities may fluctuate in secondary markets. If the change in ER is expected, that will be included in the interest rate. But in the surrounding world of at least some uncertainty, investors would require some backup for the risk they are undertaking by putting their money into

foreign currency-denominated bonds. That is also due to the fact that changes in the other asset prices would affect the opportunity cost of holding the security. In the Eurozone, however, there is no change in the exchange rate because of the presence of a single currency. The removal of foreign exchange risk within the Euro area since the start of Monetary Union has eliminated one of the elements that previously differentiated existing securities and, consequently should have altered trading strategies and relative prices. From the BNB perspective, however, it matters. The Bank has its most part in Euro-denominated assets, which can be invested in different countries in the Euro area.

Another risk is the credit risk. It tries to measure the probability of the borrower to suspend interest payments, that is, both the country's ability and willingness to repay. When applied to a country, this risk is connected to the macro fundaments, debt levels and Balance of Payment account. This risk is also irrelevant to a great extent because of the Maastricht criteria imposed by the Stability and Growth Pact. As it was noted earlier, it seems highly unlikely that a country from the Euro area to refuse to repay its debt. A state, however, must always compensate in some way bondholders for the presence of higher inflation or budget deficit than the average rates in the Eurozone.

And the last risk discussed in the economic literature on the subject is the liquidity risks. It reflects the difficulty measured in time and effort employed by an investor in selling the asset without putting a downward pressure on it. This risk is important for the laggard countries' securities such as Ireland, Finland, Spain, Italy, and Portugal. It is not met in the case of France, which is highly liquid because of the big emissions of foreign debt.

In addition, Hong Kong Monetary Authority researchers have found out that the three abovementioned risks are not independent of one another. Moreover, they are under the influence of the same forces. Interest rate spreads, they believe, are related to the broad systematic risks in the economy (2001).

Almost all of the articles and studies in the economic literature that we came across while researching the subject, were dealing to a great extent with the emerging bond markets. The reason behind that is investment analysts are more than interested to understand which debt securities will go up in prices relative to their respective benchmark. Such facts are an important part of their investment strategies. One of the topic that global financial research is interested in, is what makes certain bond buyers pay more for a security instrument. Such investors, however, are willing to tolerate some risk for the sake of a greater return, following the axiom from finance 'no pain, no gain.'

Bulgarian National Bank/BNB/, however, as a typical central bank, falls into the category of very conservative institutional investors. People in Bulgaria are extremely risk-averse even nowadays, six years after the banking crisis in 1997. People still choose very carefully the place where to put their money. Similar to these people's behavior, Bulgarian central bank invests the money from the fiscal reserve only in risk-free assets, such as sovereign bonds for external debt.

Cantor and Packer (1996) take the fundamental approach for the construction of an econometric model foe the determinants of sovereign credit ratings. The demand for such ratings has increased dramatically. Researchers are interested how clear the criteria are, because the grade poses borrowing costs on the sovereign country. Authors include per capita income, GDP growth, inflation, fiscal balance, external balance, external debt, level of development and default history. Cantor and Packer found out that GDP growth, fiscal balance and external balance lack a clear relation to ratings. The explanation for the growth variable individual insignificance is that many developing economies tend to grow faster than mature economies. More interesting is their finding

that fiscal and external balances are not correlated with ratings. This finding reflects the fact that countries trying to improve their credit rating may adopt more conservative fiscal policies. Some low-rated countries may even restrict the supply of international capital. On the other hand, qualitative social and political considerations are important determinants, and they are hard to be estimated.

In his study, Min (1998) performs empirical analysis on the determinants of yield spreads of emerging market bonds, using a log linear model. The set of explanatory variables is divided into four general categories: liquidity and solvency, macroeconomic fundamentals, external shocks and dummies. Most of the variables prove to be significant and have the expected signs. Min's the empirical analysis finds liquidity and solvency variables and most of the macro variables to be significant for determining the yield spread. On the other hand, external shocks, proxied by the real oil price and international interest rate seem insignificant. The author concludes that for developing countries to gain better access to international bond markets, they should pursue sound management of macroeconomic fundamentals and keep their bonds' liquidity at the necessary level.

In their investigation, d'Isasca and Ginebri (1998) regress the long-term interest rate differential between Italy (a country with a high debt/GDP ratio) and Germany (a country with relatively low debt/GDP ratio). The dependent variables express on one hand, the different monetary policies followed by the two countries, on the other hand, the size and the maturity of Italian public debt. The results of their regression suggest that both public debt/GDP ratio and effective maturity have a significant influence on yield differentials. An increase in the amount of debt enlarges yield differentials; an increase of the effective maturity reduces yield differentials.

Codogno, Favero and Missale (2002) state in their draft that contrary to market perceptions, yield differentials on Euro-zone bonds are mostly due to credit risk as opposed to liquidity factors. Monthly data point to economic fundamentals, such as debt and deficit to GDP ratios to account for default risk, corporate spreads as proxies for the risk appetite and the ratio of the stock outstanding government securities to the total outstanding securities. German data is considered to extract a potentially common European factor, by assuming that Germany plays within Europe the role that is played by the US in the world.

A study of Hong Kong Monetary Authority uses factor analysis to decompose determinants of the yield spread into currency, credit, liquidity risk and structural factors. Their results show a negative relationship between spreads and real GDP growth and Hang Seng Index and positive influence of aggregate balance and emerging market yield spreads. A research by Beck (2001) concludes that emerging market yield spreads can be explained by expectations of macroeconomic fundamentals and international interest rates. The author is concerned about the lag in the macroeconomic data quarter or annual releases. Such a delay has a sluggish effect on the yield spreads.

All the materials listed here and in the bibliography give us a hint what variables may contribute to the spreads we are researching. Some of the potential candidates are: per- capita GDP, growth differential, budget deficit/GDP differential, debt/GDP differential, inflation differential, oil price, current account (exports, imports), corporate yield spread, etc.

III. Model and data

The structural model will try to capture both macro fundamental and technical factors over the yield spread.The Econometric Model that we plan to test empirically is the following:

$$LOGSPRD10 = \alpha + \beta_1 LOGSPRD10(-1) + \beta_2 INFLDIF + \beta_3 DIFCORP + \beta_4 EXPORTS + \beta_5 DIFCORPEXPORTS + \beta_6 INFLDIFCORP + \beta_7 DIFCORP(-1) + u_t$$

The explanation behind the logarithm sign used by different researchers in the economic literature is that they are testing bigger spreads and the log sign is used to make matters more comprehensible because using smaller coefficients is easier.

Period: January 1999 – March 2003; monthly data

Number of observations: 49, after using the TSLS procedure

SPRD10 – this variable is defined as the difference between mid yield to maturity on French 10Yr Bonds and generic yield on 10-year German benchmark bund. Both securities are EURO denominated and are of the same maturity. The monthly measure of yield spread is approximated as a simple average of daily readings of the spread for every single month.

EXPORTS –when exports increase, the CA will become more positive, or at least less negative. France will generate more Euro. There will be no need for such big emissions of bonds. Subsequently, as the supply of bonds decreases, their price will do up, and the yield will be curtailed, relative to Germany securities.

Inflation rate differential (INFLDIF) – we define it as the difference in CPI of France and the European Union.

DIFCORP = 10 Yr. BBB vs. 10Yr AAA yield spread of Euro denominated corporate bonds (data from Merill Lynch. This variable acts as a proxy for risk aversion.

DIFCORPEXPORTS = DIFCORP*EXPORTS

INFLDIFCORP = INFLDIF*DIFCORP

The sources of all the data are Bloomberg and Merrill Lynch

IV. Explanation of the results

The spread between the yield on French bonds and the German 10Yr Bund benchmark is the risk premium that an investor would require in order to invest in a riskier financial instrument. The premium for French 10Yr securities may be decomposed into roughly two types of risk – market and credit ones.

The overall fit of the model is very good, with F-statistic significant at 1%. Moreover, the model explains 83% of the variation in the dependent variable. The actual and fitted residuals move closely together, meaning the predictive power of the model is very good (see the appendix).

Initially, the model suffered from heteroscedasticity. We performed White's test and it found that there are some variables that can be included in the model: **DIFCORPEXPORTS, INFLDIFCORP, DIFCORP (-1)**. That was judged by their low p-values, which were less than 0.05.

All the three variables are individually significant. The composite terms have p-values of less than 1%, which means they are very important in explaining the volatility in spreads. The

lagged DIFCOPR is significant individually at 8%. After the inclusion of the abovementioned variables, we performed the White's test once again: the hypothesis of heteroscedasticity presence is strongly rejected.

Further empirical investigation revealed the problem of serial correlation. As we are trying to construct a structural model, inclusion of ARMA structures will definitely improve our results but will not provide any story behind it. So the remedy was to use TSLS way of estimation with a list instruments, that is including lags of the independent and the dependent variables on the right side of our equation. It turns that the inclusion of LOGSPRD (-1) eliminates the serial correlation problem, when performing Breush-Godfrey LM test for the second time. The logic behind including lags in the regression equation is that with bonds, there is period adjustment and every period closes part of the spread.

Further on, as a crosscheck, a pure ARMA model was tested and turned out to be worse than the structural one. That clearly indicates that economic theory and macroeconomic fundamentals are better at explaining spreads than residual volatility.

The **constant** is very significant. Its p-value is close to zero. This proves the economic theory that says there is a drift in the spread. There will always be some difference with the risk-free Bund. That is why we encounter the expected positive sign.

Export growth is important for the spread model. It is significant at 1%. The model predicts that increased export will decrease the spreads on French vs. German 10Yr government securities. This is an important policy implication. When exports increase, the CA will become more positive, or at least less negative. France will generate more Euro. There will be no need for such big emissions of bonds. Subsequently, as the supply of bonds decreases, their price will do up, and the yield will be curtailed, relative to Germany securities. The expected sign is negative, as was expected.

The problem is that usually exports are exogenously determined. French governments can boost their exports by increasing the competitiveness of French companies by establishing a favorable business climate. Paul Krugman is an advocate of intra-industry trade. That is the new trade theory, as compared to the old idea of comparative advantage.

Export growth captures the effect of GDP growth. Behind this stays the story of globalization. After the establishment of Free Trade Areas, this fostered intra-area trade and most of the growth in the Economic Union was export-led. Also, exports act as a proxy for French level of integration and openness of the economy. The competition of the companies increases because subsidies and tariffs are eliminated to a great extent after the establishment of FTA.

Inflation differential has a very low p-value. It is individually significant at 1%. This proves it is maybe the most important indicator of the volatility in spreads. A high level of inflation in France relative to Germany suggests some structural problems in the way government finances were managed. Resorting to money printing is not an option in the Euro zone with the single currency. Inflation differential drives up the yield spread. That is why we face the expected positive sign. Subsequently, there will be a need for French issuers to increase the interest rate.

DIFCORP gives us a hint about risk aversion. Corporate debt yields act as a substitute to holding bonds issued by sovereign countries. Players will stay probably in the same market. As investors' risk aversion increases, subsequently their demand for government debt increases, which drives down the spread we are interested in.

The interaction terms **DIFCORPEXPORTS** and **INFLDIFLCORP** are also individually statistically significant; their p-values are both less than 0.01. Their signs conform to our expectations, but the coefficients are rather small.

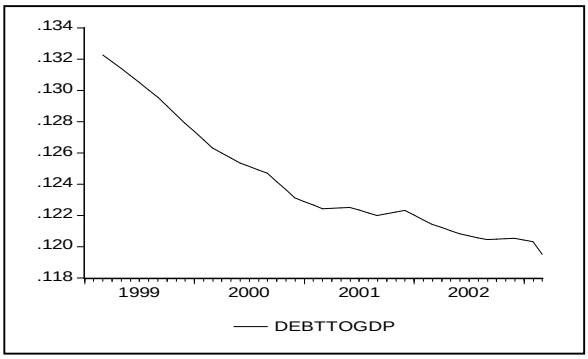
An interesting result of our study is that deficit/GDP ratio is not significant in the period we are researching. We broke down the variable into revenue and expenditure side to grasp individual effects, but the significance of the model was not improved. The explanation behind those phenomena is that France has pursued a prudent fiscal policy and has not borrowed excessive amounts in the period 1999 – 2002. The contemporary tendency, however, is not rosy: The 2002 budget deficit was 49.3 billion euros ($52.1 billion), or 3.1 percent of GDP. Associated Press reported on April 7 that France's budget deficit ballooned by 22 percent in the first two months of this year, suggesting the government's 2003 forecast was too optimistic and that the public debt would surpass European Union limits. France has forecasted that its budget deficit would widen to 3.4 percent of gross domestic product for 2003, but the early budgetary woes for this year suggested the final figure could exceed that.The European Union estimated last week that France's deficit will hit 3.7 percent of GDP.

Repeated breaches of the 3 percent limit imposed by the EU Stability and Growth Pact can lead to sanctions, and a month ago the EU Commission began disciplinary action against France for breaching the limit in 2002. It warned that France risks exceeding the limit again this year and next unless it changes policy.The 3 percent limit is a condition for membership in the euro currency bloc.

Far more intriguing was the external debt/GDP ratio. Economic theory says that long-term bonds will be mostly sensitive to the level of the foreign debt, and especially its proportion to the overall production. The variable, however, does not turn out to be individually significant for our model, as it was in Codogno, Favero and Missale (2002) and d'Isasca and Ginebri (1998), but it fits the Cantor and Packer's (1996) findings. The latter explain the absence of both fiscal and external balances as determinants of yield spreads with the endogeneity of the financial flows. Certain emerging market countries consciously adopt restrictive policies in order to improve their rating.

The level of foreign borrowing in France was kept relatively stable in the period of our interest, while the economy experienced annual growth of 3-3.4%, thus decreasing the debt/GDP ratio. Moreover, the compliance with the Maastricht criteria started much earlier than the beginning of our research period, meaning that debt/GDP had almost converged before the period 1999 – March 2003

The graph provided below shows the dynamics of the variable throughout the period. The negative trend is clearly seen: the proportion falls from 13.2% in 1999 to 11.9% in 2003.



Data: Bloomberg

Generated by Eviews4.1

We tried to incorporate the rigidities in French labor market. We tested the unemployment level and monthly wage rate for individual significance but they did not prove to be important in explaining the French spread. In spite of the current strikes, organized by the labor unions, the French government does not succumb to political pressure. Its popularity decreases but the policy of

deregulating the market for labor services continues its convergence towards the American benchmark. A dummy variable for political stability, which tried to account for the strikes was tested but it was not individually statistically significant.

VI. Conclusion

Our empirical study found out that in the past couple of years sovereign yield spreads on French 10Yr bonds have significantly decreased. Countries in the European Union are becoming more and more similar and are expected to reach nominal convergence soon. The current empirical study finds both external factors, such as France level of exports and internal macroeconomic fundamentals, such as inflation are significant for the spread movement direction. The low levels and downward direction of the bond-spread dynamics are sustainable in the long run in case the current level of macroeconomic stability is preserved, thus decreasing the room for arbitrage opportunities.

Our study is consistent with most of the studies on the subject. The total debt/GDP variable, however, does not turn out to be individually significant for our model, as it was in Codogno, Favero and Missale (2002) and d'Isasca and Ginebri (1998), but it fits the Cantor and Packer's (1996) findings. The latter explain the absence of both fiscal and external balances as determinants of yield spreads with the endogeneity of the financial flows. Certain emerging market countries consciously adopt restrictive policies in order to improve their rating.

The level of foreign borrowing in France was kept relatively stable in the period of our interest, while the economy experienced annual growth of 3-3.4%, thus decreasing the debt/GDP ratio. Moreover, the compliance with the Maastricht criteria started much earlier than the beginning of our research period, meaning that debt/GDP had almost converged before the period 1999 – March 2003.

Of course, our model has some shortcomings: the time series data that we use to form our structural model is relatively short. The results may capture some temporary trends that are not persistent. So we can improve our estimates by including longer series in the equation. This, however, is impossible at that level. Most of the macroeconomic fundamentals that we tested for individual importance are released quarterly or yearly. Through the conversion into monthly data we lost some of the precision in our estimates, giving room for some bias to enter our equation.

A possible further development of the paper is to elaborate more on the laggard countries in the European Union. This would provide a more detailed and clear picture for the bank's 3-month investment strategy in Euro-denominated government bonds. The cases of Spain, Ireland, Portugal, etc may prove to be much more interested cases that deserve more attention from central bankers wishing to invest in those countries. The abovementioned member states currently face harsher problems with their integration in EMU. Moreover, their emissions are smaller, making the market for such bonds more illiquid.

The Bulgarian National Bank can benefit from a more thorough research in this area. In this way it can increase its expertise in the Euro zone. In addition, a better picture about the market for Bulgarian government debt will be obtained.

References

Beck, Ronald. *Do Country Fundamentals Explain Emerging Market Bond Spreads*. Center for Financial Studies Working Paper No.02, 2001.

Cantor, Richard and Frank Packer. *Determinants and Impact of Sovereign Credit Ratings*. Federal Reserve Bank of New York Economic Policy Review: October 1996.

Codogno, Lorenzo, Carlo Favero and Alessandro Missale. Yield Spreads on EMU Government Bonds. Bank of America, London; IGIER, Universita Bocconi and CEPR; Universita di Milano. Third Draft. March 31, 2003.

Cunnigham, Alastair. *Emerging Economy Spread Indices and Financial Stability*. Financial Stability Review: November 1999.

_____, Liz Dixon and Simon Hayes. *Analysing Yield Spreads on Emerging Market Sovereign Bonds.* Financial Stability Review: December 2001.

d'Isasca, Alfonso Della Chiesa and Sergio Ginebri. *Interest Rate Differentials and Maturity of the Public Debt in Italy: an Econometric Investigation.* March 1998

Eichengreen, Baring and Ashoka Mody. *What Explains Changing Spreads on Emerging-market Debt: Fundamentals or Market Sentiment.* National Bureau of Economic Research Working Paper No. 6408, 1998.

France's Budget Deficit Balloons 22 Pct**.** Story from AP. Monday, 07-Apr-2003 5:20 AM PDT. <http://quickstart.clari.net/qs_se/webnews/wed/av/Afrance-deficit.RiLb_DA7.html>

Hong Kong Monetary Authority. *Interest Rate Spreads.* Hong Kong: March 2001.

Izvorski, Ivailo. *Brady Bonds and Default Probabilities.* International Monetary Fund Working Paper No.16, 1998.

Kanin, Steven B.and Karsten von Kleist. *The Evolution and Determinants of Emerging Market Credit Spreads in the 1990s*. Board of Governors of the Federal Reserve System. International Finance Discussion Papers No. 653, November 1999.

Mauro, Paolo, Nathan Sussman and Yishay Yafeh. *Emerging Market Bond Spreads: Then vs. Now.* International Monetary Fund Working Paper No. 190, 2000.

Min, Hong G. *Determinants of Emerging Market Bond spread: Do Economic Fundamentals Matter*. Discussion Paper World Bank, 1998.

Prokopieva, Silvia. *The Effect of Macroeconomic factors on the Yield Spread of Bulgarian Brady Bonds.* Unpublished paper. Issue department, Bulgarian National Bank.

Sy, Amadou N.R. Emerging Market Bond Spreads and Sovereign Credit Ratings: Reconciling Market Views with Economic Fundamentals. International Monetary Fund Working Paper No.165, 2001.

Part VIII: Regression Output

Dependent Variable: LOGSPRD10

Method: Two-Stage Least Squares

Date: 06/19/03 Time: 15:55

Sample(adjusted): 1999:03 2003:03

Included observations: 49 after adjusting endpoints

Instrument list: C LOGSPRD10(-1) INFLDIF DIFCORP EXPORTS DIFCORPEXPORTS INFLDIFCORP DIFCORP(-1) EXPORTS(-1) INFLDIFCORP(-1) INFLDIF(-1) DIFCORPEXPORTS(-1) LOGSPRD10(-2)

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	315.7287	86.50495	3.649834	0.0007
LOGSPRD10(-1)	0.333060	0.134506	2.476165	0.0175
INFLDIF	3.274381	1.095893	2.987864	0.0047
DIFCORP	-4.002261	1.176468	-3.401930	0.0015
EXPORTS	-4.580598	1.338880	-3.421216	0.0014

DIFCORPEXPORTS	0.058442	0.018170	3.216491	0.0025
INFLDIFCORP	-0.042456	0.014796	-2.869432	0.0065
DIFCORP(-1)	-0.012058	0.006698	-1.800093	0.0792

R-squared	0.830012	Mean dependent var	-2.201270
Adjusted R-squared	0.800990	S.D. dependent var.	0.335832
S.E.of regression	0.149817	Sum squared resid	0.920246
F-statistic	28.59908	Durbin-Watson stat	1.642794
Prob.(F-statistic)	0.000000		

Breusch-Godfrey Serial Correlation LM Test:

Obs*R-squared	2.597975	Probability	0.272808

White Heteroskedasticity Test:

F-statistic	1.347690	Probability	0.235142
Obs*R-squared	28.12842	Probability	0.254660

ARCH Test:

F-statistic	0.004999	Probability	0.943943
Obs*R-squared	0.005215	Probability	0.942429

Pure ARIMA model

Dependent Variable: LOGSPRD10

Method: Least Squares

Date: 06/19/03 Time: 16:07

Sample(adjusted): 1999:02 2003:03

Included observations: 50 after adjusting endpoints

Convergence achieved after 20 iterations

Backcast: 1998:10 1999:01

Variable	Coefficient	Std. Error	t-Statistic	Prob.

AR(1)	1.006855	0.002995	336.2043	0.0000
MA(1)	-0.518354	0.098967	-5.237665	0.0000
MA(4)	-0.475523	0.106761	-4.454105	0.0001

R-squared	0.692657	Mean dependent var.	-2.201029
Adjusted R-squared	0.679578	S.D. dependent var.	0.332392
S.E. of regression	0.188153	Akaike info criterion	-0.444996
Sum squared resid	1.663876	Schwarz criterion	-0.330275
Log likelihood	14.12491	Durbin-Watson stat	1.859865

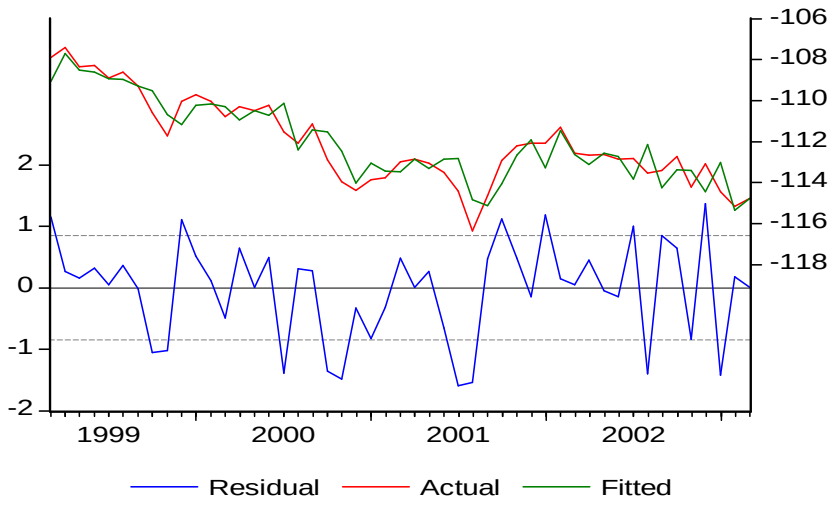
Inverted AR Roots	1.01			
	Estimated AR process is nonstationary			
Inverted MA Roots		.12		-.73
	1.00	-.80i	.12+.80i	

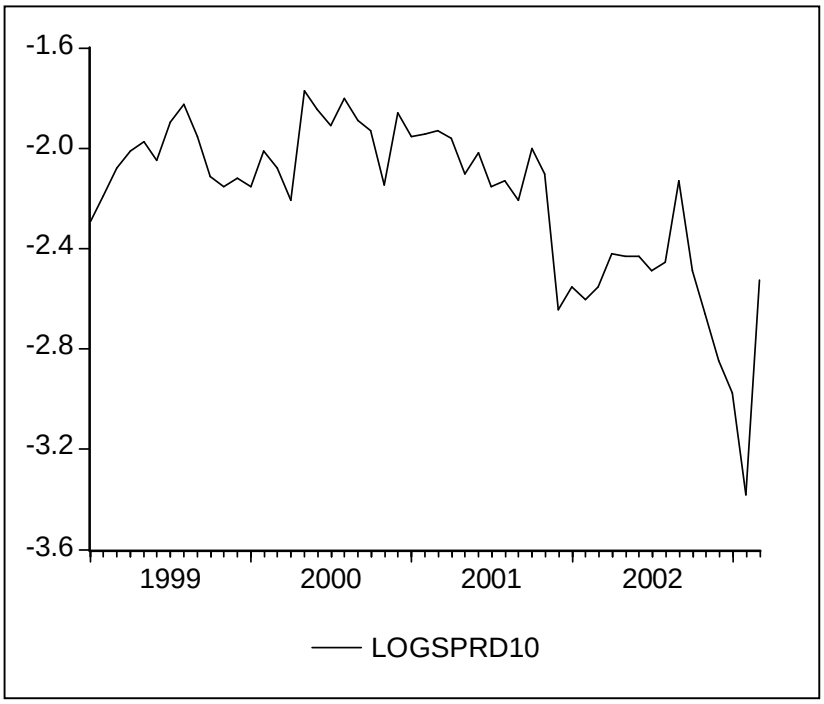
Breusch-Godfrey Serial Correlation LM Test:

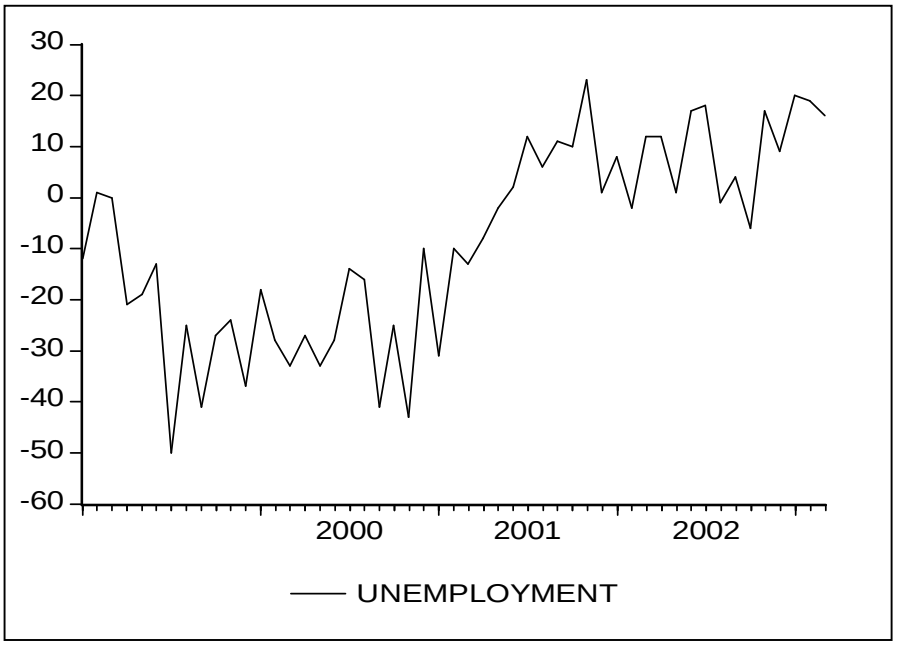
F-statistic	0.416960	Probability	0.661567
Obs*R-squared	0.665588	Probability	0.716918

Appendix

Behavior of the residuals – as we see from the graph below, the actual and fitted residuals follow closely each other. The other fact worth noting is the upward and downward movements in the residuals from the last months in the data are due to the volatility of the very market.


-106
-108
-110
-112
-114
-116
-118
2
1
0
-1
-2
1999
2000
2001
2002
Residual
Actual
Fitted


-1.6
-2.0
-2.4
-2.8
-3.2
-3.6
1999
2000
2001
2002
LOGSPRD10


30
20
10
0
-10
-20
-30
-40
-50
-60
2000
2001
2002
UNEMPLOYMENT