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## Firm Heterogeneity and Regional Business Cycles Differentials

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# Firm Heterogeneity and Regional Business Cycles

## Differentials

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*This study represents a first attempt to empirically analyze the role of firm heterogeneity in regional business cycle behaviour. Working with monthly Italy's firms data and estimating a random effects ordered probit model, we first document sizable asymmetries in Northern and Southern firms business cycles positively related to the intensity of the national cycle: firms located in the South are more likely to reduce production levels than firms located in the North in periods of business cycle expansion and viceversa. Then, we explore the role of sectoral mix and several firm-specific factors (firm size, export propensity, liquidity constraints, demand conditions, capacity utilization and expectations) in explaining regional disparities in business cycle fluctuations. Results suggest that North-South differences in sectoral composition do not help explain the diverging behaviour of Southern firms, while by controlling for firm heterogeneity we are able to capture large part of regional business cycles differences.*

*JEL codes:* D21, E32, R10

*Keywords:* Regional business cycle, firm heterogeneity, random effects ordered probit

## **1. Introduction**

Regional business cycle analyses traditionally emphasize the role of regional differences in industrial structure as the major source of regional business cycle divergence. Following the export-base approach, many studies carried out for the United States and the United Kingdom argue that the region's link to the rest of the world is through its export-base activities so as income fluctuations in the rest of the world are transmitted to the region through a change in the latter's export (Domazlicky, 1980). Due to the high inter-industry heterogeneity in export propensity, regional differences in the industry mix are therefore the major responsible for regional differentials in business cycle intensity. The role of industry mix is also highlighted within the "interest rate channel view" of the monetary policy transmission theory (Carlino and DeFina, 1998; Dedola and Lippi, 2000): the output sensitiveness to a policy induced variation in the short-term interest rate varies significantly across industries, so as the monetary policy may have asymmetric effects on regions with large differences in the industrial structure. It is puzzling that, after controlling for industrial composition, these studies still find significant regional cyclical heterogeneity, so as the industry mix can only partially explain these differences.

More recent studies extend the analysis to European economies and question whether there is an asymmetric regional reaction to monetary policy shocks (Montoya and de Haan, 2007; Bradley *et al.*, 2004). Some authors also use advanced time series techniques to analyze co-movements and synchronizations in regional business cycles and to identify regional specific turning points (see, e.g., Hess and Shin, 1997; Clark and Shin, 1998; Carvalho and Harvey, 2002; Chen, 2007). With regard to the Italian case, Mastromarco and Woitek (2007) use annual data for the period 1950-2004 to

study the synchronization of Italian regions' business cycles. Their results show that regional co-movements vary considerably over time: they were strongest in the 1965–1975 period; after 1975, regional business cycles started to drift out of phase, with the North leading the South. The authors argue that North-South business cycle differentials can be explained with North-South differences in the economic activity (industry mix explanation) and with North-South differences in political business cycle. Using monthly data, Brasili and Brasili (2009) also analyze the characteristics and co-movements of Italian regions' business cycles to understand the consequences of the global crisis on the local economies. These authors interpret regional business cycles differentials in terms of regional product specialisation, regional financial markets development and regional research intensity.

We claim that all previous studies, focusing on macroeconomic data, disregard the effect of firm heterogeneity in business cycle behaviour and, thus, they do not clearly answer the question of why regional business cycles differ. Thus, we suggest to use microeconomic information in order to distinguish between *sector-* and *firm-specific* factors in determining regional differences in industrial firms' business cycle behavior. To this end, we build up a micro-econometric model so as to assess whether Northern and Southern firms in Italy show significant differences in cyclical behaviour, after having controlled for structural factors that alter the transmission mechanism of exogenous shocks.

Working with monthly Italy's firms data and estimating a random effects ordered probit model, we first document sizable asymmetries in Northern and Southern firms business cycles positively related to the intensity of the national cycle: firms located in the South are more likely to reduce production levels than firms located in the North in

periods of business cycle expansion and *viceversa* (Section 2). Results also suggest that North-South differences in sectoral composition do not help explain the lower volatility of Southern firms' industrial output. Then, we discuss some theoretical hypotheses on the role of firm specific variables (borrowing constraints, export propensity, liquidity constraints, idiosyncratic demand shocks, capacity utilization and expectations) in business cycle behaviour and single out proxies for these factors from a business cycle survey carried out in Italy (Section 3). According to our assumptions, firm heterogeneity has a role in explaining regional business cycle differentials only if some spatial contagion is at work. Empirical evidence corroborates the hypothesis that firm specific variables (mainly firm size, liquidity conditions and demand conditions) capture large part of regional business cycle differences (Section 4). Section 5 concludes.

The main contribution of the paper is three-fold. First, it offers a method to identify regional business cycle differentials (in terms of cyclical amplitude) in the absence of official regional statistical information. Secondly, this study represents a first attempt to empirically analyze the role of firm heterogeneity in regional business cycle behaviour based on micro-data. It allows to properly estimate the effect of different factors suggested by the theory. Finally, the relevance of the study stands also on its replicability in other European countries that collect the same kind of business cycle information through the European Commission harmonised questionnaire. The method proposed in the paper can also be extended to analyse inter-sectoral or even inter-country differentials in business cycle behaviour.

## 2. North-South differences in business cycle: evidence from micro data

### 2.1 Modelling firms' business cycle behaviour

To analyse regional differences along the cycle using firm-level information we first specify an empirical model of firms' business-cycle behaviour. We rely on monthly microeconomic data drawn from the business survey carried out by the Italian National Institute of Statistics (ISTAT). Data are longitudinal, information are available for a number of firms varying over time and for a period spanning from april 2003 to december 2010. The total number of firms is 6,629, corresponding to 308,042 observations. Qualitative assessment made monthly by each suveyed firm on its level of production is the dependent variable of the model. We label it as  $y_{it}$  for firm  $i = 1, \dots, N$  at time  $t = 1, \dots, T$ ; it takes values 1, 2 and 3 according to firm's evaluation of production as 'low', 'normal' and 'high', respectively. In addition to their self-reported evaluation of the production levels, the data set includes many individual characteristics for each monthly survey, some of which will be used as explanatory variables in our analysis.

Given the qualitative nature of the response variable, we use the Ordered Probit Model with individual random effects (RE-OPM). The basic notion underlying this model is the existence of a latent continuous variable,  $y_{it}^*$ , ranging from  $-\infty$  to  $+\infty$ , related to a set of explanatory variables by the standard linear relationship:

$$y_{it}^* = \beta' x_{it} + \gamma' z_i + u_{it} \quad (1)$$

where  $x_{it}$  is a vector of time-varying regressors,  $z_i$  is a vector of time-invariant covariates,  $\beta$  and  $\gamma$  are the associated parameter vectors and  $u_{it} = v_i + \varepsilon_{it}$  is a composite random error term including both time-invariant,  $v_i$ , and time-varying,  $\varepsilon_{it}$ , unobserved factors. In model (1) both error components are normally distributed and

orthogonal to the set of predictors. Since the underlying variance of the composite error,  $\sigma_u^2 = \sigma_v^2 + \sigma_\varepsilon^2$ , is not identified, we set  $\sigma_\varepsilon^2 = 1$ , so that the residual correlation term is  $\rho_{u_{it}, u_{is}} = \sigma_v^2(\sigma_v^2 + \sigma_\varepsilon^2)^{-1} = \sigma_v^2(\sigma_v^2 + 1)^{-1}$  and  $\sigma_v = [\rho/(1-\rho)]^{1/2}$ .

Although  $y_{it}^*$  is unobserved, the integer index  $y_{it}$  is observed and related to  $y_{it}^*$  by the following relationship:  $y_{it} = j$  (with  $j=1,2,3$ ) iff  $\mu_{j-1} \leq y_{it}^* \leq \mu_j$  where  $\mu_j$  are unobserved standardized thresholds defining the boundaries between different levels of  $y_{it}$ . In particular, we assume that  $\mu_0 = -\infty$  and  $\mu_J = \infty$ . Given the relationship between  $y_{it}$  and  $y_{it}^*$ , conditional cell probabilities are expressed as:

$$\begin{aligned} \Pr(y_{it} = j | x_{it}, z_i) &= \Pr \mu_{j-1} \leq y_{it}^* \leq \mu_j \\ &= \Pr \left( \frac{\mu_{j-1} - \beta' x_{it} - \gamma' z_i}{\sqrt{1 - \sigma_v^2}} \leq \frac{v_i + \varepsilon_{it}}{\sqrt{1 - \sigma_v^2}} \leq \frac{\mu_j - \beta' x_{it} - \gamma' z_i}{\sqrt{1 - \sigma_v^2}} \right) \end{aligned} \quad (2)$$

Estimations are performed using maximum likelihood. Individual heterogeneity is unobserved; therefore to obtain the unconditional log-likelihood we need to integrate the conditional log-likelihood. The integration is done with the Gauss-Hermite quadrature (25 points were chosen) (Greene, 2005). Since the parameters of a latent model do not have a direct interpretation *per se*, we refer to marginal probability effects (*mpe*) evaluated at the sample average of the predictors. For inference purposes, we also compute standard errors of *mpe* using the Delta method.

## 2.2 Capturing national business cycle

We first apply the RE-OPM to monthly firm-level qualitative data to draw estimates of the quarterly national business cycle. Specifically, we include in the set of regressors only quarterly dummies. The marginal effects of these dummies on  $\Pr y = 3$  (the

probability that the level of production is ‘high’), on  $Pr\ y=2$  (‘normal’) and on  $Pr\ y=1$  (‘low’) change over time according to business-cycle movements. They are plotted in **Figure 1** (continuous red lines) along with the confidence intervals (dashed lines). For comparison purposes, this figure reports also the cyclical component of the quarterly index of Italian industrial production (continuous black line) (source: ISTAT) extracted through the Baxter e King (BK, 1999) filter. This is the so-called deviance business cycle and is used as benchmark to track business cycle turning points (peaks and troughs) (see also Figure A1 in Appendix).<sup>1</sup> The contemporaneous correlation between the series is rather high (0.67), although the *mpe* on  $Pr\ y=3$  tend to lead the cyclical component of industrial production as the correlation peak is at lead 1 (Table A1 in Appendix). Overall, these results encourage us to use the *mpe*’s of quarterly dummies as good proxy of the deviance business cycle.

### Figure 1

Looking at the cyclical component of the industrial production index in Figure 1 we learn that the business cycle stagnated up to the 2005:3 (*trough*) before experiencing a real expansion up to 2008:3 (*peak*). This period represents the first expansionary phase in the considered time span. The following period is characterized by a diminishing activity up to 2009:4 (*peak to trough*). This trough terminates the marked decline caused by the global financial crisis and inaugurates a recovery.

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<sup>1</sup> It is worthwhile observing that the chronology used here may differ from the one based on the classical approach to dating the business cycle. The latter considers the levels of the time series to identify the dates of peaks and troughs that frame economic recession or expansion.



### 2.3 Measuring the Southern effect

In order to identify the North-South difference in firms' business cycle behaviour, we include in the RE-OPM the interactions between the dummy variable *South*, indicating whether the firm is located in one of the Southern regions,<sup>2</sup> and each quarterly dummy,  $South \times q_t$  (Model 1). The red and the blue lines in **Figure 2a** indicate the marginal effect of each variable  $South \times q_t$  on  $Pr\ y=1$  and  $Pr\ y=3$ , respectively. For example, the marginal effect on  $Pr\ y=1$  computed for the interaction term  $South \times q_{2009-3}$  would indicate the increase/decrease of the probability of a low level of production in 2009:3 for the firms located in the South with respect to the Northern firms: it estimates the difference in business cycle amplitude between North and South.

#### Figure 2

On average, over the whole sample period, the marginal effect of *South* on  $Pr\ y=1$  is positive (2.3 per cent), while that on  $Pr\ y=3$  is negative (-0.8 per cent). Therefore, on average, being located in the South influences more the probability of having a low level of production. However, the deviation of Southern firms' business cycle behaviour varies greatly during the period, confirming that the degree of regional "cohesion" along the cycle changes over time (Brasili and Brasili, 2009): standard deviations of the marginal effect of *South* on  $Pr\ y=1$  and on  $Pr\ y=3$  are indeed much higher than the mean (4.5 and 2.0, respectively). These findings do not change significantly if estimated over the period 2005:3-2010:4 (**Figure 2b**), signaling the poor informative content (in terms of business cycles frequencies) of the initial part of the

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<sup>2</sup> Namely, Abruzzo, Campania, Apulia, Basilicata, Molise, Calabria, Sicily and Sardinia.

sample. Estimates presented below are therefore carried out over the time-span 2005:3-2010:4, including a well-defined characterization of business-cycle phases.

More specifically, **Figures 2a-2b** show that the *South* effect on  $\Pr y = 1$  is negligible (-0.3 percent on average) over the period from 2003:2 to 2005:3, while it is highly positive (6.9 percent on average, see **Table 1** first row) in the expansion period 2005:4-2008:3, indicating a difficulty of Southern firms to participate to the recovery. During the recession period (2008:4-2009:4), the marginal effect of *South* on  $\Pr y = 1$  becomes strongly negative (-3.7 percent on average), indicating a lower penalization of Southern firms with respect to Northern ones. Finally, in the upturn started on 2010:1 the *South* effect on  $\Pr y = 1$  is again highly positive (7 percent on average), confirming the lower capacity of Southern firms to join the positive cycle.

### **Table 1**

It is worth noticing that if regional business cycles were not synchronized, a significant marginal effect of *South* could not be correctly interpreted as evidence of regional difference in business cycle amplitude. However, this is not the case: evidence on the high degree of regional cyclical co-movements is provided in terms of cross-correlations between the relative frequencies of firms' assessment on production levels to be low ( $y=1$ ), normal ( $y=2$ ) or high ( $y=3$ ) in the North and in the South (Table A2 and Figure A2 in Appendix).

#### *2.4 The role of industry mix*

In this section we discuss the results of an analysis aimed to test whether North-South differences over the cycle depend on heterogeneous specialization of the two regions. Among the regressors of the model we include sector dummies (using the 2-digit NACE

Rev. 1 classification), besides the quarterly dummies and the interaction variables  $South \times q_t$  (Model 2).<sup>3</sup> **Table 2** shows the contribution of sector heterogeneity in explaining firms' business cycle behavior: the log-likelihood moderately increases with respect to Model 1 (including only quarterly dummies and  $South \times q_t$ ); the AIC slightly decreases, but the BIC to some extent increases and the goodness of fit does not considerably improve.

### **Table 2**

**Figure 2c** displays the marginal effects of  $South \times q_t$ , while Table 1 reports their mean values and test for their statistical difference against Model 1. The effect of *South* on  $Pr\ y=1$  is again highly positive for both expansion periods (2005:4-2008:3 and 2010:1-2010:4) and highly negative in the recession period (2008:4-2009:4). However, with respect to Model 1, the marginal effects of *South* on  $Pr\ y=1$  in expansion periods increase contrary to the assumption of the industry mix view (see *t*-tests in parenthesis in Table 1). This means that if North and South had the same industrial structure, the regional difference in business cycle amplitude would be higher. A slight improvement against Model 1 is observed for the marginal effects of  $South \times q_t$  on  $Pr\ y=3$  (1 against 1.3) and on  $Pr\ y=1$  (-2.9 against -3.7) during recession, although this difference is not statistically significant. Similar findings are obtained using more detailed sector specification (3 *digit* level) (Figure A3.1 in Appendix). This evidence suggests that the industry mix does not help explain regional differences in

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<sup>3</sup> All manufacturing sectors, defined according to the international standard classification NACE\_rev1 (Subsections 15-36), are included.

business cycle. More inspection is therefore needed taking stocks of the rich firm-level information characterizing the dataset.

### **3. Working hypotheses**

In 1966 Siegel posed a relevant issue: “The really interesting question ... is whether or not regions differ from each other in cyclical performance for reasons other than industry mix” (Siegel, 1966, p. 44). Results discussed so far show that this is still an open issue and an effort is required to explain regional business-cycle differences in terms of entrepreneurial composition (*firm heterogeneity*). Various strands of literature act as guide for selecting the firm-specific variables able to affect, in our model, the ordinal indicator for the level of production. In what follows, we describe them, with brief discussion of theoretical underpinnings.

#### *3.1 Borrowing constraints (firm size)*

The role of microeconomic heterogeneity along the cycle has been firstly emphasized in theories of monetary transmission. Specifically, firm size may be responsible for the transmission of monetary shocks through the so called “balance-sheet” and the “bank-lending” channels (Bernanke and Gertler, 1995; Carlino and DeFina, 1998; Guiso *et al*, 2000; Ehrmann, 2000; Dedola and Lippi, 2000). In the balance-sheet view, given asymmetric information, access to credit depends on the value of firms’ assets, acting as collateral. A monetary tightening can reduce the latter by deteriorating balance sheets. Firms of different size are differently exposed to credit squeeze: given lower value of assets and higher amount of required collateral, small firms are likely to be more credit constrained than large ones.

Size matters also for the bank-lending view. A tighter monetary policy reduces the amount of credit for borrowers when the central bank has a leverage over the volume of intermediated credit. Small firms, more dependent on intermediated credit, are adversely affected; large firms can instead rely on easier access to other forms of external finance (Christiano *et al.*, 1996; Ehrmann, 2000; Dedola and Lippi, 2000).

Moreover, Carlino and DeFina (1998) have found evidence for the US that asymmetric spatial distribution of small firms is partially responsible for different output effects of monetary policy shocks across regions.<sup>4</sup> This is relevant for our investigation as it is possible to hypothesize that *North-South differences in firm size composition are partly responsible for North-South business cycle differentials (H.1)*.

We use the logarithm of the number of employees ( $\ln emp$ ) as proxy for capital market access (ability to borrow), so as we expect a positive effect of firm size on the probability to produce a high level of output,  $\Pr y = 3$ , and a negative effect on the probability to produce a low level of output,  $\Pr y = 1$ . Uncertainty remains for the effect of firm size on the probability to produce a normal level of output,  $\Pr y = 2$ . We

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<sup>4</sup> The analyses of the effect of firm size on the transmission of monetary policy shock carried out by Christiano *et al.* (1996), Ehrmann (2000), Dedola and Lippi (2000) and Carlino and DeFina (1998) are based on the use of Structural VAR approaches. The authors first identify either sectoral or regional differences in the output effect of unanticipated monetary policy shocks by means of impulse response functions and then use aggregated size composition measures (either at sectoral or regional level) as determinants of the monetary policy impacts. The spirit of our analysis is partially different from these studies since we are essentially interested in assessing the existence of regional disparities in business cycle fluctuations after controlling for most of the firm level factors affecting the mechanism of real and monetary shocks transmission. Moreover, we want to exploit all firm heterogeneity, avoiding to use aggregated size composition measures.

might also expect time heterogeneity in the influence of firm size, as suggested by the studies quoted above. Thus, we include in our model interactions between firm size and temporal dummy variables indicating whether the economy is in boom or recession. We also control for possible nonlinearities by introducing the square term of  $\ln emp$ . **Table 3** reports descriptive statistics of the firm-level variables included in our models: on average Southern firms are smaller than Northern ones.

### **Table 3**

#### *3.2 Liquidity constraints*

Liquidity constraints are a further possible cause of firm heterogeneity over the cycle. Against borrowing limitations, entrepreneurs may finance their investments partly by selling their holdings of money and equity. In this case, different liquidity degrees of equities may affect differently entrepreneurs' investments (Kiyotaki and Moore, 2008). An example of a liquidity shock which reduces re-saleability of equity persistently is represented by the recent financial turmoil that made assets that used to be liquid scantily re-saleable. Naes *et. al.* (2010) also document that, in the US case, measures of stock market liquidity contain leading information on the real economy at least since 2<sup>nd</sup> World War.

It is reasonable to assume that the effect of firms' liquidity constraints on the real economy are not randomly diffused over space, at least for two reasons: *first*, firms located nearby have relatively denser vertical input-output linkages than those located further apart, so that the consequences of an adverse liquidity shock on an entrepreneur propagates to other firms with a distance decay effect; *second*, adverse liquidity conditions may have a regional dimension especially if they are induced by specific

difficulties of the local banking sector. On the grounds of these considerations one may hypothesize *firms' liquidity conditions as possible source of regional business cycle differentiation (H.2)*.

Liquidity conditions are captured by two dummy variables indicating whether the firm considers its liquidity as *good*, *mediocre* or *bad* (reference category). We expect a positive (negative) effect of good liquidity conditions on  $Pr y = 3$  ( $Pr y = 1$ ). Table 3 shows that the percentage of firms with good liquidity conditions is higher in the North than in the South.

Since firms' production decisions are forward looking, it is also important to take expectations into account in our analysis. Business opinion surveys collect information on firms' expectations about liquidity conditions. We exploit this information by introducing dummy variables indicating whether the firm expects for the next period *better*, *equal* or *worse* (reference category) liquidity conditions.

### 3.3 *Export propensity*

Even within the export-base approach it is not reasonable to assume that regional differences in industry mix properly capture regional differences in export propensity. As shown in many studies, indeed, within each industry there is a huge firm heterogeneity in export propensity (e.g., Basile, 2001; Bernard and Jensen, 2004; Melitz and Ottaviano, 2008).

Obviously, if exporters were randomly distributed over space, intra-industry firm heterogeneity in export propensity would not help explain regional differentials in the diffusion of international business cycle. Yet, there is evidence of asymmetric spatial

distributions of exporters reflecting substantial local spillovers: individual decisions to export are influenced by the presence of nearby exporters (Koenig *et al.*, 2010).

We test the *effect of firms' export propensity on North-South business cycle divergences (H.3)*, by including in our model incidence of firm's exports on total turnover (available only at a quarterly base). We expect a positive impact of this variable on  $\Pr(y=3)$  and a negative effect on  $\Pr(y=1)$ : in a small open economy like Italy, where the domestic cycle has a close link with the world one, to be an intense exporter gives more opportunities to raise production in booming time and provides more possibilities to smooth production fall in recession (courtesy of market diversification). Again, we allow for the possibility of time heterogeneity by interacting export propensity with temporal dummy variables for booms and recessions. As indicated in Table 3, Northern firms are, on average, more intense exporters than Southern ones.

### *3.4 Idiosyncratic demand shocks*

Heterogeneity of firms along the cycle may also be caused by idiosyncratic demand shifts (Foster *et al.* 2008). Different factors may cause demand variations across producers. Vertical and horizontal product diversifications are a possible cause: negative aggregate demand shocks may distribute unevenly across varieties and different-quality goods for the mere fact that consumers with different tastes experiment heterogeneous demand variations.

Firm-level idiosyncratic demand shifts may induce regional differences in the business cycle if agglomeration externalities are at work. The latter favour spatial concentration of firms producing similar varieties (e.g. industrial districts) or of firms



that are tied by vertical input-output links. Moreover, within spatial clusters of small firms it is more likely the formation of persistent customer-supplier relationships. In all these cases a variety-specific demand shock may end up by diffusing to a whole territory with a distance decay effect.

These considerations lead us to introduce in empirical testing *firm-level demand conditions as a further potential source of regional business cycle differentiation (H.4)*. Specifically, we control for the cyclical demand conditions at home and abroad, proxing them by domestic and foreign orders. Firms are asked to indicate whether the domestic and foreign demand level is *high*, *normal* or *low* over the reference period. Thus, we introduce four dummy variables (low levels are used as reference categories) and expect a positive effect of these dummies on the dependent variable. We also exploit information on demand expectations and introduce dummy variables indicating, respectively, whether the firm expects for the next period an *increase*, a *stationarity* or a *decrease* (reference category) of its demand level. Table 3 signals that the percentage of firms with high demand conditions is, on average, higher in the North than in the South.

### *3.5 Capacity utilization*

The issue of firm heterogeneity is also remarked in recent contributions to the real business cycle literature analyzing the role of idle productive capacities in propagating technological shocks (Fagnart et al., 1999). Given limited input substitution in the short run, demand uncertainty at the time of capacity choices can explain why the installed productive equipments of the economy are usually underutilized in equilibrium. Moreover, idiosyncratic demand uncertainty can explain why some firms produce at full

capacity while others face excess capacities. In these models, the proportion of firms with excess capacity plays an important role in magnifying and propagating aggregate technological shocks.

We observe that firm heterogeneity in capacity utilization may also cause regional differences in the business cycle when the proportion of firms with excess capacity is not homogenous over space. These arguments suggest to test the *role of capacity utilization as another potential source of regional business cycle differentiation (H.5)*. Information on firm's capacity utilization are captured in the survey through three dummy variables indicating if over the reference period firms's productive capacity is in *excess, normal* and *below normal* levels (reference category). We expect a negative effect of *excess capacity* on  $Pr\ y=3$  and a positive effect of this variable on  $Pr\ y=1$ . As pointed out by Table 3, the percentage of Southern firms with excess or normal capacity utilization is not so different from that in the North.

### *3.6 Local externalities*

Up to now, we have considered the role of various microeconomic factors as potential determinants of regional business cycle differentials. In the definition of our theoretical assumptions, we have often mentioned the relevance of spatial contagion. For example, we have said that the foreign and domestic demand conditions of each firm can help explain regional business cycle differences if a spatial contagion in demand conditions is at work, that is if demand conditions are characterized by a certain degree of spatial autocorrelation. Now, we observe that, insofar as firm-level variables are able to capture regional business cycle differentials, they will also allow us to partly control for spatial dependence in firms' business cycle behavior, that is spatial autocorrelation in the

decision of firms to increase or decrease production levels. Obviously, residual spatial dependence is unavoidable in presence of “residual” local externalities which affect the probability of high, low or normal levels of output. Thus, we introduce a further hypothesis concerning the role of local externalities, that is *we hypothesize that, ceteris paribus, the individual decision to raise or to reduce the production level is influenced by the production decision of nearby firms (H6)*. Specifically, we consider the possibility of local externalities at a fine geographical level corresponding to the province (103 in Italy).<sup>5</sup>

Technological externalities are not only very likely to be localized, but they are also very likely to depend on the degree of agglomeration of firms in the same area that is by the density of economic activity within the province. We therefore measure local externalities by multiplying the employment density in the province where firm *i* is located and the balance of the production level in the same province, i.e. the difference between the percentage of firms (excluding firm *i*) which evaluate the production level as ‘high’ and the percentage of firms (excluding firm *i*) which evaluate the production level as ‘low’.

Combining *H.1-H.6*, we can say that *regional differences in the entrepreneurial mix (in terms of size, liquidity conditions, export intensity, demand shifts, capacity utilization and expectations) may contribute to explain regional differences in business cycles along with the industry mix and local externalities*.

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<sup>5</sup> Obviously, we might control for a number of local specific factors. This is beyond the scope of the present paper, however.

## 4. Evaluating the effects of firm heterogeneity in explaining North-South business cycle differentials

### 4.1 Econometric issues

In section 2.4 we have discussed the role of sectoral composition in capturing North-South business cycle differentials. The model was specified by including sectoral and time dummies and the interactions between the dummy South and time dummies. We now progressively extend that model by including the firm level variables listed above. The aim is to verify whether controlling for the firm-specific variables leads to an abatement of regional disparities in business cycle fluctuations. Before presenting the results of this analysis, however, some methodological issues have to be discussed.

In describing the RE-OPM in section 2.1 we have assumed orthogonality between error components and the set of predictors. However, if the explanatory variables and the individual specific effects are correlated, the RE-OPM may lead to inconsistent estimates. According to Wooldridge (2002), a possible route to overcome this issue consists of including time averages of the time-varying variables ( $\bar{x}_i$ ) as additional time-invariant regressors. Modelling the expected value of the firm-specific error as a linear combination of the elements of  $\bar{x}_i$  -  $E(v_i | x_{it}, z_i) = \psi' \bar{x}_i$  - so that  $v_i = \psi' \bar{x}_i + \xi_i$ , we may recast model (1) as:

$$y_{it}^* = \beta'(x_{it} - \bar{x}_i) + (\psi + \beta)' \bar{x}_i + \gamma' z_i + \xi_i + \varepsilon_{it} \quad (3)$$

where  $\psi$  is a conformable parameter vector and  $\xi_i$  is an orthogonal error with respect to  $\psi' \bar{x}_i$ . Also, we assume both errors  $\xi_i$  and  $\varepsilon_{it}$  to be normally distributed conditionally on  $x_{it}$ 's and  $z_i$ 's. In (3), the deviations from the averages per individual capture *shock* effects (*within-effect*), while the means identify *level* effects (*between* effects).

Including within and between effects aims at introducing dynamics in the model, because the mean value changes gradually when months pass by (Van Praag et al., 2003).

A further issue is a possible endogeneity problem affecting equation (3). While the information provided by the survey possess the desirable property of being internally consistent (it is the “same” individual firm providing all the requested information on its activity), it is likely to expect that the variables involved may be “intrinsically” endogenous. Many problems of reverse causality and of simultaneity may indeed arise. For example, an entrepreneur anticipating positive (or negative) demand shocks on either domestic or foreign markets could hire (or lay off) employees to adapt its supply capacity to demand. Moreover, higher production levels raise ex-post employment growth rates. Direction of causality between firms' size and their production behavior is consequently not clearly determined. Parallel issues can be raised on the variable measuring local externalities. If firm  $i$ 's production behavior depends on the surrounding firms' behavior, the latter is itself impacted by firm  $i$ 's production performance, which induces a reverse causality problem. Further, simultaneity may be an issue, since unobserved supply-side or demand-side shocks could affect both the production performance of firm  $i$  and the performance of its neighbors. To control for the potential circularity and simultaneity problems, we lag all right-hand side variables three periods (i.e. one quarter).

#### *4.2 Estimation results*

We have estimated six nested specifications of equation 3 progressively introducing firm size (Model 3), export intensity (Model 4), liquidity conditions and their

expectations (Model 5), demand conditions and their expectations (Model 6), capacity utilization (Model 7) and local externalities (Model 8). **Table 2** shows that the full specification encompasses all the others, as the AIC and BIC measures reach their lowest values, while  $R^2$  measures achieve their highest values with Model 8. However, the highest improvements in the goodness of fit are observable when the role of *liquidity conditions and demand conditions* are included (in models 5 and 6; see respectively 5<sup>th</sup> and 6<sup>th</sup> row of Table 2).

**Table 4** reports marginal probability effects (*mpe*) of the firm-specific variables for the full Model (8).<sup>6</sup> As mentioned above, we have estimated both the “Shock effect” and the “Level effect”: the first refers to *mpe* of the deviations from the individual average, while the *mpe* for the “Level effect” denote the differences between individuals (between effect). In the discussion of the results we focus on the “Shock effects”, as they mimic the within firm effects obtained from a fixed effects estimation.<sup>7</sup>

#### **Table 4**

*Firm size* has a positive and significant effect in all three sub-periods, while its squared term is significant and enters negatively, depicting an inverted U-shaped relationship, only in the third period. The *mpe* indicate that for an increase of 1% in firm size, the predicted probability of having a low level of production,  $\Pr(y_{it} = 1)$ , lowers by 12-15% in the expansion periods, while it decreases by 8% in the recession period. Conversely, the probability of having a high level of production,  $\Pr(y_{it} = 3)$ , increases by 4% in the expansion periods and by 2.5% in the recession period. We can

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<sup>6</sup> The results of the other intermediate models are available upon request.

<sup>7</sup> The fixed thresholds,  $\mu_1$  and  $\mu_2$ , are statistically significant at the 1 percent level and different from 1, pointing out that the three ordinal categories are not equally spaced, refraining us to use OLS techniques.

therefore conclude that the effect of firm size is higher in the expansion periods rather than in recession. Considering that interest rates move in the upside during a boom (and downside in a recession), this result is in line with the theoretical underpinnings depicted above.<sup>8</sup> Moreover, firm size affects more the probability that the level of production is low, rather than the probability that it is normal or high.

*Export intensity* has a positive impact on the response variable in all three sub-periods: the *mpe* on  $\Pr(y_{it} = 3)$  are positive and the *mpe* on  $\Pr(y_{it} = 1)$  are negative both in the expansion and recession periods. This suggests that the greater is firm's export intensity the better is its resilience during downturns (the firm can smooth production exploiting different-market business cycles) and the higher is its capacity to raise production in the upturn (it can benefit from a larger expanding market).<sup>9</sup> These effects

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<sup>8</sup> Imagine, for example, an intervention of the Central Bank that raises the interest rate during an expansion period. According to both the balance-sheet and bank-lending views, the monetary policy shock is likely to increase more the probability of a low level of production in the case of small firms than in that of the large firms. The opposite would happen when the Central Bank loosens monetary policy in a downturn. Notice that Italian lending rates to non-financial companies actually rose by about 200 and 100 basis points during the expansion phases 2005:4-2008:3 and 2010:1-2010:4, while they fell by more than 300 basis points during the recession period 2008:4-2009:4. Following theory suggestions, interest rate shifts adversely affected small firms more than large ones in the two expansion periods (and benefited small firms more than large ones in the recession).

<sup>9</sup> In an intermediate specification of the model (specified with firm size, sectoral dummies and export intensity), we observe a negative between (level) effect of export intensity for the recession period, indicating that more international market oriented firms tend to suffer heavily from the deteriorated economic climate in the world economy during the last years. In the full model, the coefficient associated to this variable turns out to be not significant.

have been increasing over time, signalling the driving role of world recovery in shaping the exiting from last recession.

*Domestic and foreign demand conditions* affect positively firms' production levels confirming the role played by firm-level idiosyncratic demand shocks. A high (either domestic or foreign) demand reduces the probability to have a low production level and increases the probability to have a high production level with respect to the reference variable (firms with low demand). However, the *mpe* associated to  $\Pr(y_{it} = 1)$  are substantially larger than those related to  $\Pr(y_{it} = 3)$  suggesting that firm-specific demand shocks differentiate the business-cycle behaviour between high- and low-demand firms mainly through the modality of 'low level of production'. Notice that firm-specific demand captures idiosyncratic shocks: this means that even for firms of the same sector, facing the same aggregate demand, there are more or less opportunities to change production, with respect to other producers, according to the variety they produce, the market where they sell and, possibly, the long-run relationship they have with their clients. Estimation results also point out that production levels are affected by *expectations* on future demand in a similar, although less intense, way as for current demand.

*Liquidity conditions* turn out to be statistically significant in explaining output dynamics for Italian manufacturing firms. In line with expectations, the *mpe*'s of good liquidity conditions on  $\Pr(y_{it} = 1)$  is negative and the one on  $\Pr(y_{it} = 3)$  is positive. Again the negative probability effect on the 'low level of production' is larger (in absolute terms) than the positive marginal effect on the 'high level of production', signalling also for this effect that the 'low production' modality is the one that mainly discriminates firm-by-firm cyclical behaviour. Interestingly, *expectations* on future



liquidity conditions seem to play a more relevant role than assessment on current conditions. Considering liquidity constraints on entrepreneurs' investments as a source of firm-level differentiation of the business cycle, these findings would indicate that it is the evaluation of liquidity on a long time span that affects current investment decisions and production levels.

*Capacity utilization* has proved to play a significant role in detecting individual production behaviour over the business cycle. As predicted on the ground of theory, excess capacity has a positive *mpe* on  $\Pr(y_{it} = 1)$  and a negative *mpe* on  $\Pr(y_{it} = 3)$ , with the former effect (also in this case) being larger than the latter: firms with underutilized capacity are more likely to reduce production (and less likely to increase it) than firms with a normal rate of capacity utilization.

Finally, our results corroborate the hypothesis that *local externalities* affect short term firms' output decisions. Our measure of local externalities has indeed a positive and significant effect on  $\Pr(y_{it} = 1)$  and a negative *mpe* on  $\Pr(y_{it} = 3)$ : firms located in provinces with higher employment density and diffused high production levels are more likely to increase production (and less likely to reduce it).

#### 4.3 Firm heterogeneity and the North-South divide

To check whether the consideration of firm-specific variables reduces the evidence of North-South difference in business-cycle amplitude, we have to control for changes in the dimension of the marginal effects of  $South \times q_t$  following the inclusion of such variables in the model. **Figure 2d** shows the marginal effects of  $South \times q_t$  after having controlled for sectoral mix, firm heterogeneity and local externalities (Model 8). Comparing Figure 2d (Model 8) with Figures 2b (Model 1, where there are no other

controls than quarterly dummies) and 2c (Model 2, where the only control for industry mix is added), it appears quite clear that North-South differences in entrepreneurial composition (in terms of size and export propensity) and firm behavior (in terms of demand, liquidity conditions and capacity utilization) as well as in local externalities are mostly responsible for the deviation of Southern firms' from the cyclical behavior of Northern firms. Indeed, with reference to Model 8, confidence intervals of the marginal effects contain the horizontal zero line 10 out of 21 times.

From **Table 1** we also learn that the probability of a low level of production,  $\Pr y = 1$ , is still higher when the firm is located in the South during the expansion period 2005:4-2008:3 (2.6 per cent, see last row of Table 1) and in the most recent period of slow recovery (3 per cent). However, these percentages are much lower than those computed with Model 1 (6.9 and 7.0 per cent, respectively) and Model 2 (7.9 and 7.8 per cent, respectively), indicating that firm heterogeneity and local externalities are responsible for more than 60 per cent of the deviation of Southern firms' from the cyclical behavior of Northern firms during the periods of boom. This value raises up to 70 per cent when considering the probability of high level of production,  $\Pr y = 3$ . When we consider instead the recession period 2008:4-2009:4, the negative effect of *South* on  $\Pr y = 1$  with model 8 (-1.8 per cent) is 50 percent lower than in Model 1, but only 37 percent lower than in Model 2. Moreover, the difference between the average of marginal effects of  $South \times q_t$  computed with Model 8 and those computed with Model 1 (used as the benchmark) turns out to be statistically significant in almost all sub-periods (with the exception of the recession period on  $\Pr y = 2$  and of the period 2010:1-2010:4 on  $\Pr y = 3$ ; see t-statistics in square brackets in Table 1).

Going from Model 2 to 8, it is possible to learn that during the expansion periods (2004:4-2008:3 and 2010:1-2010:4) the most influent firm-level variables in affecting the marginal effect of  $South \times q_t$  are *firm size*, *liquidity conditions* and *demand conditions* (see also Figures A3 in Appendix). The formal testing of the statistical difference between the marginal effects of  $South \times q_t$ , computed for each of the several nested models against the benchmark Model 1, is reported in Table 1 (see t-statistics in square brackets in Table 1).

Specifically, it comes out that for the Models from 5 to 8 the difference of the mean of marginal effects is statistically significant for both expansionary periods (respectively, 2004:4-2008:3 and 2010:1-2010:4) for whatever level of output, signaling that this group of variables is able to capture North-South differences during the recovery phases. Additionally, *demand conditions* show a higher ability to capture business cycle differentials during recovery phases, as Model 6 is the only specification for which the null of equality of the mean of marginal effects with respect to those estimated from the previous Model (Model 5 in this specific case) is rejected (see t-tests in parenthesis in Table 1). A similar finding also concerns the role of *firm size*, as the average of marginal effects of Model 3 is significantly different from that of Model 2; by contrast, the null is accepted in testing hypothesis about differences between the mean of marginal effects (by sub-periods) of Model 3 and Model 1 (*benchmark* model).

In the recession period (2008:4-2009:4), the difference between the means of marginal effects (in terms of the *benchmark* Model 1) is statistically significant only on  $Pr y=1$  (at the 95 per cent probability level) for the specifications that include *demand conditions* and *capacity utilization* (respectively, Model 6 and Model 7; see t-tests in square brackets in Table 1). For Model 8, the discrepancy of average marginal

effects with respect to Model 1 is significantly different from zero at the 10 per cent confidence interval also for  $Pr\ y = 2$  and  $Pr\ y = 3$ . The empirical findings reported in Table 1 do not show any additional significant contribution of the other explanatory variables to ease the regional differentials in business cycle amplitude during the recession period. As a result, such discrepancies can only be explained by the joint effects of all the variables.

All in all, these findings suggest that microeconomic characteristics of Italian firms have considerable predictive power regarding North-South differences in cyclical fluctuations. However, these firm-level characteristics together with the consideration of sector composition and local externalities do not explain the entire observed amplitude divide. In other words, despite the control for local externalities, firms with similar individual characteristics and belonging to the same industrial sector, but located in different regions, continue to show a different business cycle behaviour.

## **5. Conclusions**

This study represents a first attempt to empirically analyze the role of firm heterogeneity in regional business cycle behaviour. Previous studies based on macroeconomic data have tried to explain business cycle differentials across regions in terms of differences in the sectoral mix, disregarding the potential role of different firm level variables that various strands of business cycle theory have identified as mechanisms of transmission of real and monetary shocks (firm size, liquidity constraints, export orientation, firm specific demand conditions, capacity utilization and expectations).

Using business survey monthly data for a sample of Italy's manufacturing firms spanning the years from 2003 to 2010, we try to assess whether Southern firms' business cycle behaviour is different in amplitude from that of the rest of the country. The results obtained can be read subdividing the time span in four periods: the first one (from the second quarter of 2003 until the third quarter of 2005) is characterized by a stagnation of economic activity; the second one (from the fourth quarter of 2005 until the third quarter of 2008) is a period of boom; the third period (from the fourth quarter of 2008 to the fourth of 2009) is characterized by an economic recession; in the last period there are signs of recovery. Our results suggest that Southern firms are more likely to reduce production levels than firms located in the North in periods of business cycle expansion and viceversa. Finally, we assess whether, after controlling for several firm- and sectoral specific factors as well as for local externalities, there are still regional disparities in business cycle fluctuations. Results suggest that regional differences in the sectoral composition do not explain the diverging behaviour of Southern firms, while various firm specific variables (specifically firm size, demand conditions and liquidity conditions) capture large part of regional business cycles differences both during periods of recession and boom.

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**Table 1**  
*Marginal effects ( $\times 100$ ) of  $South \times q_t$  on  $\Pr y = 1$  ,  $\Pr y = 2$  and  $\Pr y = 3$   
Mean values and  $t$ -statistics. Sub-period 2005:4 - 2010:4*

Model	Period	$\Pr y = 1$	$\Pr y = 2$	$\Pr y = 3$
1 = Quarterly dummies and $South \times q_t$ only	2005:4-2008:3	6.9	-4.5	-2.4
	2008:4-2009:4	-3.7	2.4	1.3
	2010:1-2010:4	7.0	-4.5	-2.4
2 = 1 + Sectoral dummies	2005:4-2008:3	7.9 (1.1)	-5.3 (-1.3)	-2.6 (-0.6)
	2008:4-2009:4	-2.9 (0.8)	1.9 (-0.7)	1.0 (-0.0)
	2010:1-2010:4	7.8 (0.7)	-5.2 (-0.9)	-2.6 (-0.4)
3 = 2 + Firm size	2005:4-2008:3	5.8 (-2.4) [-1.3]	-3.8 (2.4) [1.1]	-2.1 (2.2) [1.5]
	2008:4-2009:4	-3.6 (-0.9) [-0.1]	2.3 (0.9) [0.2]	1.3 (1.0) [1.0]
	2010:1-2010:4	6.3 (-1.6) [-0.9]	-4.1 (1.9) [0.8]	-2.2 (1.4) [1.0]
4 = 3 + Export intensity	2005:4-2008:3	5.7 (-0.1) [-1.4]	-3.8 (0.1) [1.2]	-1.9 (0.2) [1.7]
	2008:4-2009:4	-3.2 (0.6) [0.5]	2.1 (-0.6) [-0.4]	1.1 (-0.6) [0.4]
	2010:1-2010:4	5.7 (-0.3) [-1.1]	-3.8 (0.2) [1.0]	-1.9 (0.3) [1.3]
5 = 4 + Liquidity conditions	2005:4-2008:3	4.9 (-0.9) [-2.4]	-3.3 (0.8) [2.1]	-1.6 (1.1) [2.8]
	2008:4-2009:4	-2.6 (0.5) [1.0]	1.8 (-0.5) [-0.9]	0.9 (-0.6) [-0.3]
	2010:1-2010:4	5.2 (-0.5) [-1.7]	-3.5 (0.4) [1.5]	-1.7 (0.6) [2.0]
6 = 5 + Demand conditions	2005:4-2008:3	3.0 (-2.7) [-5.1]	-2.1 (2.4) [4.6]	-0.9 (3.3) [6.1]
	2008:4-2009:4	-2.1 (0.6) [1.7]	1.5 (-0.4) [-1.4]	0.6 (-0.9) [-1.2]
	2010:1-2010:4	3.0 (-2.2) [-3.9]	-2.1 (2.0) [3.5]	-0.9 (2.7) [4.8]
7 = 6 + Capacity utilization	2005:4-2008:3	2.9 (-0.2) [-5.3]	-2.1 (0.2) [4.7]	-0.8 (0.2) [6.3]
	2008:4-2009:4	-2.0 (0.2) [1.9]	1.4 (-0.2) [-1.6]	0.6 (-0.2) [-1.3]
	2010:1-2010:4	3.1 (0.1) [-3.8]	-2.2 (-0.2) [3.3]	-0.9 (-0.1) [4.7]
8 = 7 + local externalities (Full model)	2005:4-2008:3	2.6 (-0.6) [-5.7]	-1.8 (0.5) [5.1]	-0.7 (0.6) [6.7]
	2008:4-2009:4	-1.8 (0.2) [2.1]	1.3 (-0.3) [-1.8]	0.5 (-0.3) [-1.6]
	2010:1-2010:4	3.0 (-0.2) [-4.0]	-2.1 (0.2) [3.5]	-0.9 (0.2) [4.9]

Notes: The table reports the average of  $mpe$  for the interaction  $South \times q_t$  computed for each sub-period  $T$  ,  $m_j = \sum_t mpe_t / T$  , where  $j = 1, \dots, 8$  indicates a model specification. The variance of the mean of marginal effects for Model  $j$  ,  $m_j$  , is obtained as  $V_j = \sum_r \sum_c Cov mpe_r, mpe_c / T^2$  ,  $r, c = 1, \dots, T$  . The test of the difference of the average marginal effects from two different models ( $k$  and  $j$ ) is performed through an independent two-sample  $t$ -test assuming inequality of standard errors and using the following statistics:  $t = m_k - m_j / \sqrt{V_k + V_j}$  . This statistics is distributed as Student's  $t$  with  $\nu$  degrees of freedom, where  $\nu$  is given by Satterthwaite's (1946) formula.  $t$ -statistics of the differences of marginal effects of each model with respect to the former one are reported in parenthesis;  $t$ -statistics of the differences of marginal effects of each model with respect to Model 1 are reported in square brackets.

**Table 2**  
*Model comparison. AIC, BIC and R<sup>2</sup> measures. Sub-period 2005:4 - 2010:4*

<b>Model</b>	<b>AIC</b>	<b>BIC</b>	<b>R<sup>2</sup>_AN</b>	<b>R<sup>2</sup>_M</b>
1 = Quarterly dummies and <i>South</i> × <i>q<sub>t</sub></i> only	322,245	322,706	0.088	0.093
2 = 1 + Sectoral dummies	322,061	322,717	0.089	0.094
3 = 2 + Firm size	320,872	321,650	0.094	0.099
4 = 3 + Export intensity	320,632	321,473	0.095	0.100
5 = 4 + Liquidity conditions and expectations	291,161	292,076	0.122	0.130
6 = 5 + Demand conditions and expectations	270,227	271,364	0.199	0.220
7 = 6 + Capacity utilization	269,447	270,525	0.201	0.223
8 = 7 + local externalities (Full model)	265,035	266,132	0.202	0.224

Notes: R<sup>2</sup>\_AN is Aldrich and Nelson (1984) R<sup>2</sup> measure, R<sup>2</sup>\_M is Maddala (1983) R<sup>2</sup> measure

**Table 3**  
*Descriptive statistics*  
*Sub-period 2005:4 - 2010:4*

*North*

	<b>Min</b>	<b>Q(25%)</b>	<b>median</b>	<b>Q(75%)</b>	<b>Q(90%)</b>	<b>Max</b>	<b>mean</b>	<b>Std. dev.</b>	<b>Skew.</b>
Firm size	5	10	20	55	170	20,048	85.3	333.1	20.3
Export intensity	0	0	0	33	70	100	19.0	27.8	1.3

*South*

	<b>Min</b>	<b>Q(25%)</b>	<b>Median</b>	<b>Q(75%)</b>	<b>Q(90%)</b>	<b>Max</b>	<b>mean</b>	<b>Std. dev.</b>	<b>Skew.</b>
Firm size	5	9	15	32	85	7,545	49.3	253.5	20.5
Export intensity	0	0	0	3	30	100	8.2	19.6	2.7

*Percentage of firms*

		<b>North</b>	<b>South</b>
Liquidity conditions	Good	30.7	23.5
	Mediocre	55.2	56.3
	Bad	14.0	20.3
Expectations on liquidity conditions	Better	11.6	14.8
	Equal	72.2	69.2
	Worse	16.2	16.0
Domestic demand conditions	High	9.7	8.4
	Normal	54.6	56.8
	Low	35.7	34.8
Foreign demand conditions	High	6.0	3.0
	Normal	28.7	17.3
	Low	19.9	12.5
Expected demand conditions	Increase	24.5	31.3
	Stationarity	60.0	54.8
	Decrease	15.5	13.8
Capacity utilization	Excess	32.6	30.8
	Around normal	60.8	62.4
	Below normal	6.6	6.9
Total number of firms		149,139	49,086

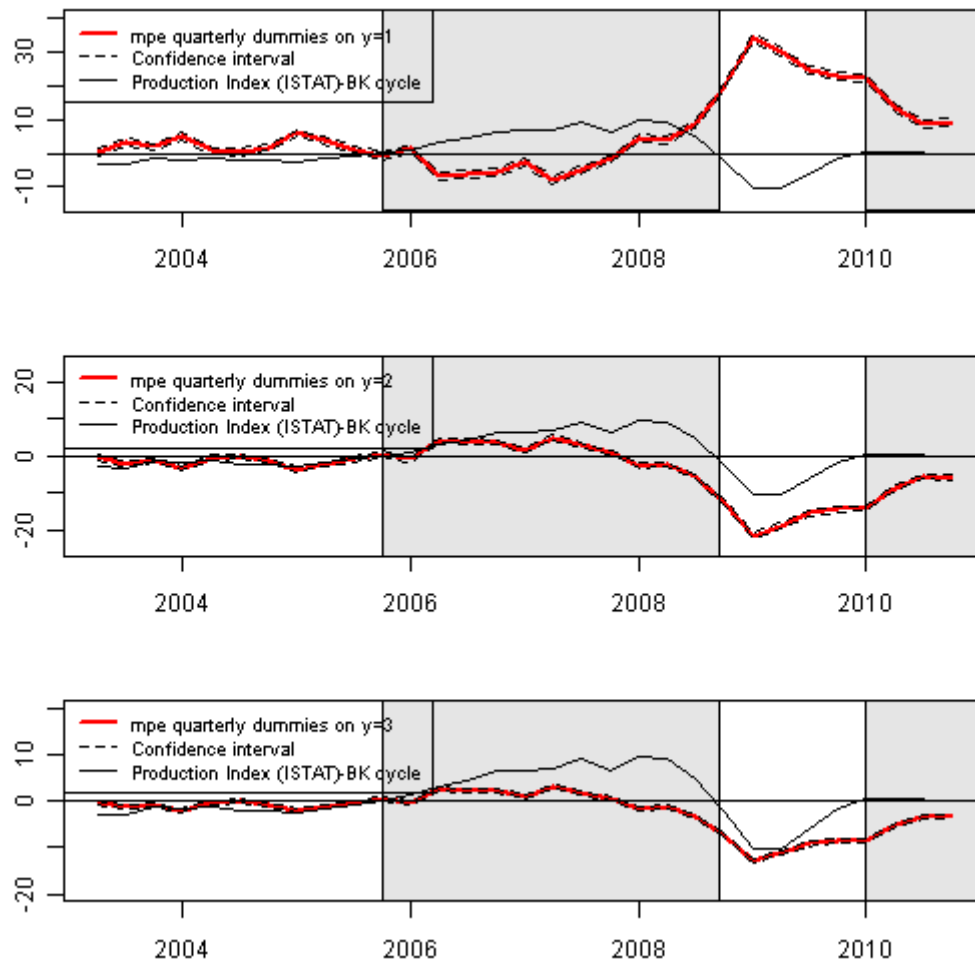
**Table 4***mpe* ( $\times 100$ ) of “shock and level effects” RE-ORM (Full Model 8). Sub-period 2005:4 - 2010:4

		y	Level effect	se	Shock effect	Se
Firm size	Ln emp (2005:4-2008:3)	1	-4.399***	0.665	-12.700***	2.330
		2	3.132***	0.474	9.044***	1.660
		3	1.266***	0.192	3.656***	0.672
	Ln emp <sup>2</sup> (2005:4-2008:3)	1	0.423***	0.091	0.478	0.364
		2	-0.288***	0.062	-0.326	0.248
		3	-0.135***	0.029	-0.152	0.116
	Ln emp (2008:4-2009:4)	1	-1.173	0.924	-8.821***	2.933
		2	0.836	0.658	6.282***	2.089
		3	0.338	0.266	2.540***	0.845
	Ln emp <sup>2</sup> (2008:4-2009:4)	1	0.344***	0.117	-0.020	0.420
		2	-0.245***	0.083	0.014	0.299
		3	-0.099***	0.034	0.006	0.121
	Ln emp (2010:1-2010:4)	1	-2.599***	1.002	-15.139***	3.150
		2	1.851***	0.714	10.781***	2.245
		3	0.748***	0.289	4.358***	0.908
	Ln emp <sup>2</sup> (2010:1-2010:4)	1	0.441***	0.134	1.400***	0.431
		2	-0.314***	0.089	-0.997***	0.307
		3	-0.127***	0.036	-0.403***	0.124
Export intensity	2005:4-2008:3	1	-0.055***	0.010	-0.072***	0.012
		2	0.039***	0.007	0.051***	0.009
		3	0.016***	0.003	0.021***	0.003
	2008:4-2009:4	1	-0.011	0.013	-0.088***	0.019
		2	0.008	0.009	0.063***	0.013
		3	0.003	0.004	0.025***	0.005
	2010:1-2010:4	1	-0.073***	0.014	-0.105***	0.020
		2	0.052***	0.010	0.075***	0.014
		3	0.021***	0.004	0.030***	0.006
Liquidity conditions	Good	1	-3.730***	0.956	-6.332***	0.418
		2	2.656***	0.681	4.509***	0.299
		3	1.074***	0.276	1.823***	0.121
	Mediocre	1	-3.615***	0.994	-3.645***	0.337
		2	2.574***	0.708	2.595***	0.241
		3	1.041***	0.287	1.049***	0.097
Expectations on liquidity conditions	Better	1	-6.246***	1.682	-17.214***	0.413
		2	4.448***	1.199	12.259***	0.309
		3	1.798***	0.485	4.956***	0.127
	Equal	1	-1.776	1.262	-11.517***	0.307
		2	1.265	0.899	8.201***	0.228
		3	0.511	0.363	3.315***	0.093

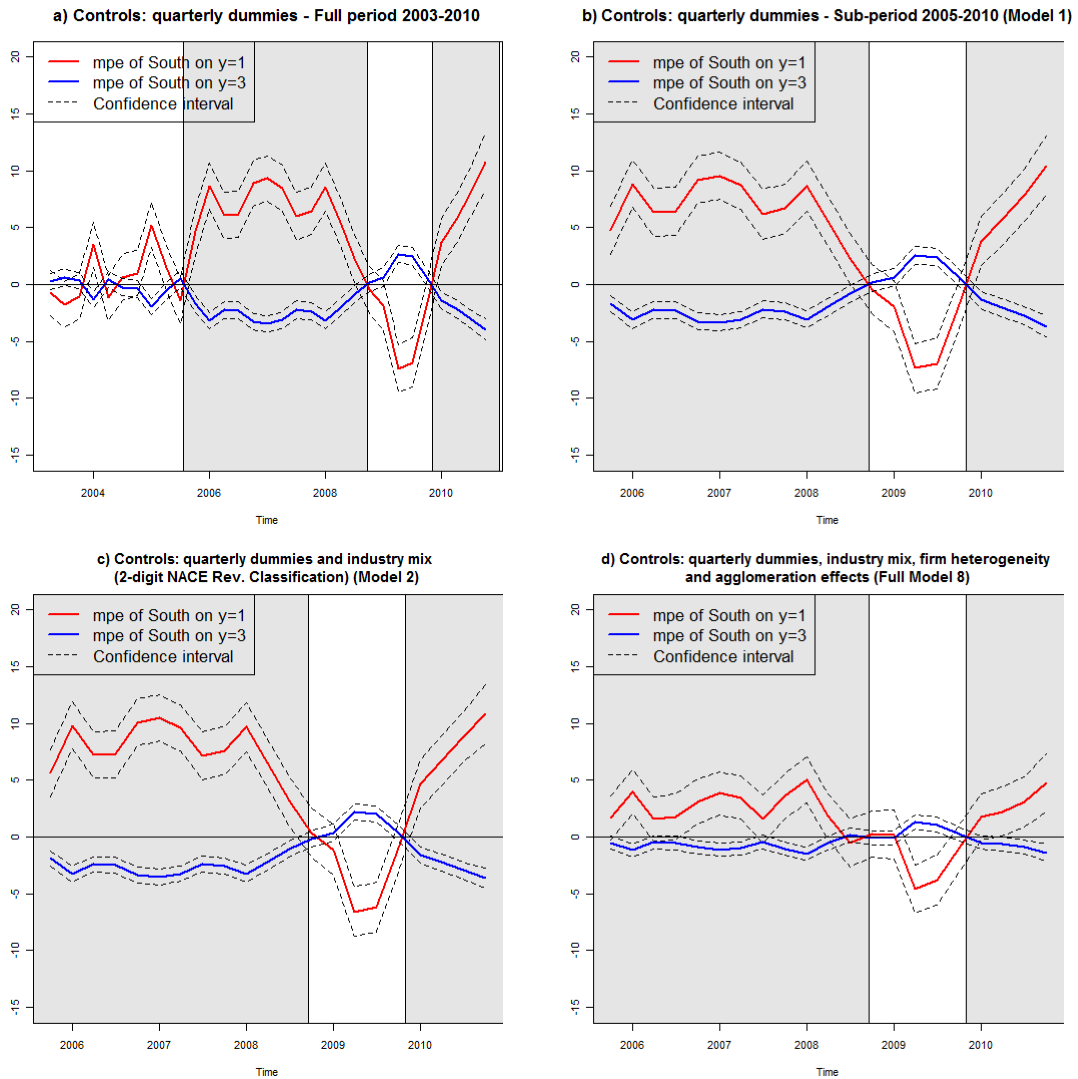
		y	Level effect	se	Shock effect	se
Domestic demand conditions	High	1	-122.404***	1.783	-35.370***	0.431
		2	87.165***	1.434	25.188***	0.362
		3	35.238***	0.602	10.183***	0.154
	Normal	1	-61.269***	1.045	-18.915***	0.267
		2	43.631***	0.817	13.469***	0.216
		3	17.638***	0.339	5.445***	0.092
Foreign demand conditions	High	1	-26.309***	2.045	-15.978***	0.562
		2	18.735***	1.463	11.378***	0.409
		3	7.574***	0.593	4.600***	0.167
	Normal	1	1.696**	0.748	-5.779***	0.342
		2	-1.208**	0.533	4.116***	0.245
		3	-0.488**	0.215	1.664***	0.099
Expected demand conditions	Increase	1	-4.619***	1.725	-9.597***	0.348
		2	3.289***	1.229	6.834***	0.254
		3	1.330***	0.497	2.763***	0.103
	Stationarity	1	-6.908***	1.626	-10.445***	0.308
		2	4.919***	1.159	7.438***	0.226
		3	1.989***	0.469	3.007***	0.093
Capacity utilization	Excess	1	-6.860***	1.521	0.951**	0.461
		2	4.885***	1.084	-0.677**	0.329
		3	1.975***	0.438	-0.274**	0.133
	Around normal	1	-8.834***	1.579	-5.236***	0.438
		2	6.291***	1.125	3.729***	0.313
		3	2.543***	0.455	1.507***	0.127
Local externalities		1	-0.359**	0.166	-0.806***	0.133
		2	0.255**	0.118	0.574***	0.095
		3	0.103**	0.048	0.232***	0.038
	□		0.058***			
	μ <sub>1</sub>		(0.002)			
			1.302***			
	μ <sub>2</sub>		(0.056)			
			3.668***			
			(0.056)			

Note. The table reports marginal effects of “Shock and level effects”. \*, \*\* and \*\*\* indicate significance at the 10, 5 and 1 percent levels, respectively. Standard errors (in parentheses) are computed using the Delta method.  $\mu_1$  and  $\mu_2$  are the estimated thresholds defining the boundaries between different classes of the response variable. The model also includes a full set of sectoral dummies, quarterly dummies and interactions between the dummy *South* and quarterly dummies.

**Figure 1 - Cyclical component of the industrial production index and marginal probability effects of quarterly dummies**



**Figure 2 - Marginal effects of South**



## Appendix

**Table A1**

*Cross correlations between the marginal probability effects ( $mpe \times 100$ ) of quarterly dummies on  $Pr\ y = 3$  and the BK cyclical component. Period: 2003-2010*

	<b>0</b>	<b>1</b>	<b>2</b>	<b>3</b>	<b>4</b>
<i>lead</i>	0.67	0.67	0.57	0.45	0.34
<i>lag</i>		0.54	0.30	0.05	-0.19

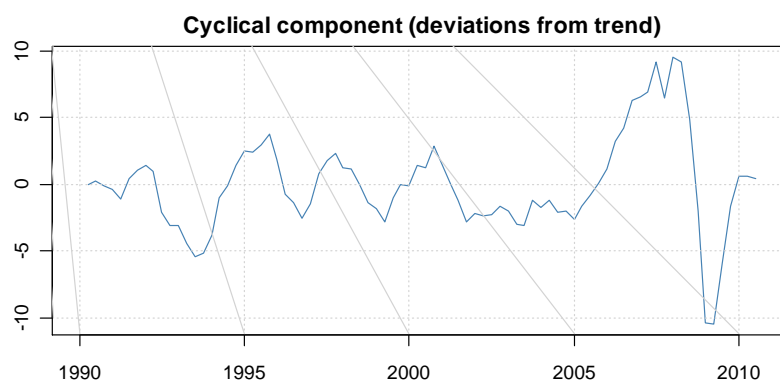
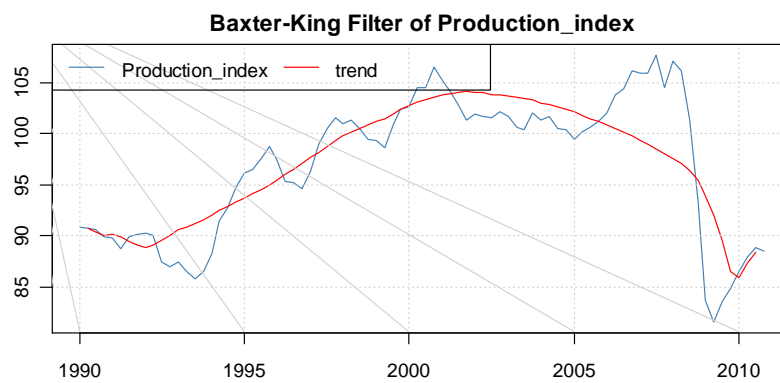
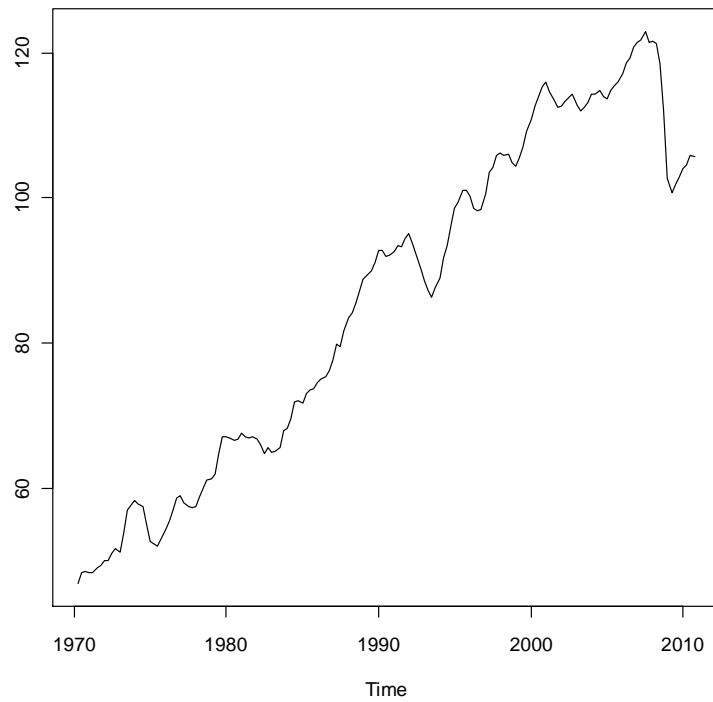
**Table A2**

*Cross correlations between the relative frequencies of assessment on production levels in the North-Center and South*

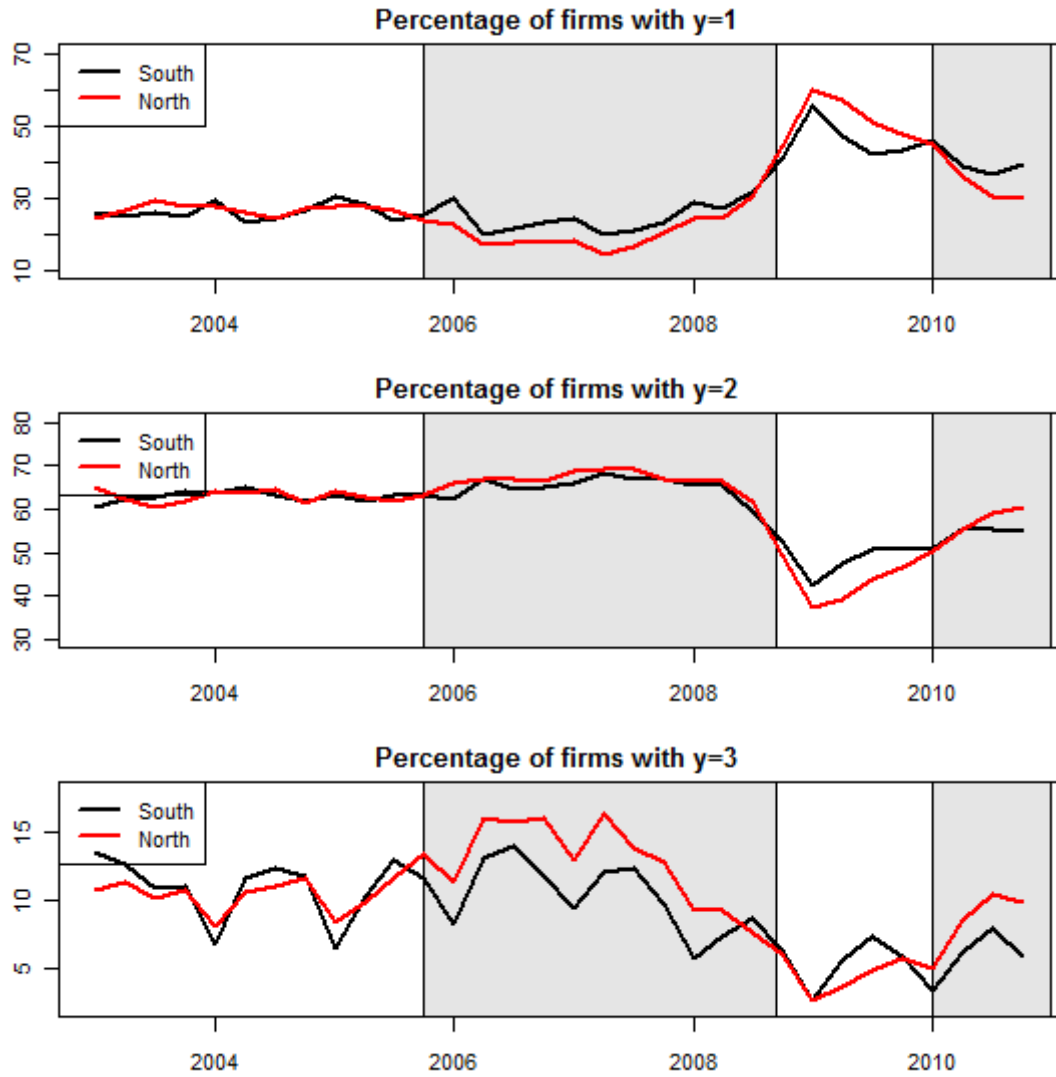
Period		<b>0</b>	<b>1</b>	<b>2</b>	<b>3</b>	<b>4</b>
2003:2 – 2010:4	<i>lead</i>	0.94	0.85	0.69	0.54	0.41
	<i>lag</i>		0.85	0.72	0.60	0.49
2005:4 – 2010:4	<i>lead</i>	0.95	0.86	0.68	0.53	0.36
	<i>lag</i>		0.87	0.73	0.61	0.50



**Figure A1 - Italy's Industrial Production index**



**Figure A2 - Relative frequencies of assessment on production levels in the North-Center and South**



**Figure A3 - Marginal effects of South**

