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Firm Heterogeneity and Regional Business Cycles Differentials

Roberto Basile
Second University of Naples

Sergio de Nardis
Nomisma

Carmine Pappalardo
National Institute of Statistics

Background

- Previous studies on regional business cycles (RBC): regional differences in the industrial mix are major responsible for RBC divergence

  (Domazlicky, 1980; Carlino and DeFina, 1998)

- But after controlling for industrial composition effects, these studies still find significant RBC heterogeneity

  See also recent studies in Italy (Mastromarco and Woitek, 2007; Brasili and Brasili, 2009)

- 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 offer exhaustive explanations for RBC differences

Aim of the paper

- In this paper we use **microeconomic information** and build 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 ***sector*- and *firm*-specific factors** that alter the transmission mechanism of exogenous shocks

Firm level business survey data

- Monthly firm data on business cycle behaviour (ISTAT):
  - Period: from April 2003 to December 2010
  - The number of firms varies each period
  - Total number of observations: 308,042

- Dependent variable (y_{it}):
  - ordered indicator of firm production level:
    - **y= 1** if the firm considers the current production level as **low**
    - **y= 2** if the firm considers the current production level as **normal**
    - **y= 3** if the firm considers the current production level as **high**

Modelling firms' business cycle behaviour

- Random effects ordered probit model (RE-OPM)

$$y_{it}^{*} = \beta' x_{it} + \gamma' z_i + u_{it} = \beta' x_{it} + \gamma' z_i + \nu_i + \varepsilon_{it}$$

$$y_{it} = j \;\; iff \;\; \mu_{j-1} \le y_{it}^{*} \le \mu_j$$

$$\Pr(y_{it} = j \mid x_{it}, z_i) = \Pr\left(\mu_{j-1} \le y_{it}^{*} \le \mu_j\right)$$

$$= \Pr\left(\frac{\mu_{j-1} - \beta' x_{it} - \gamma' z_i}{\sqrt{1-\sigma_v^2}} \le \frac{\nu_i + \varepsilon_{it}}{\sqrt{1-\sigma_v^2}} \le \frac{\mu_j - \beta' x_{it} - \gamma' z_i}{\sqrt{1-\sigma_v^2}} \right)$$

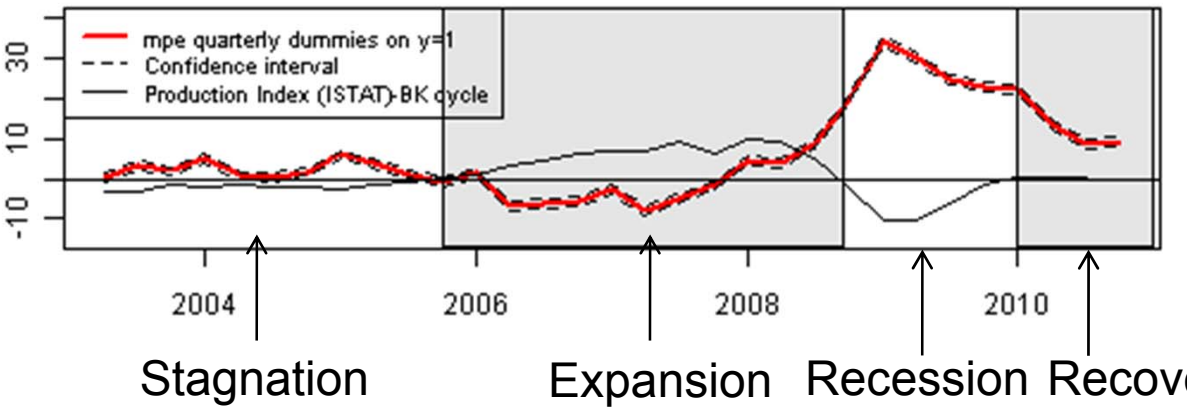
- Error components are normally distributed and orthogonal to the set of predictors

FIRST STEP:
Capturing national business cycle

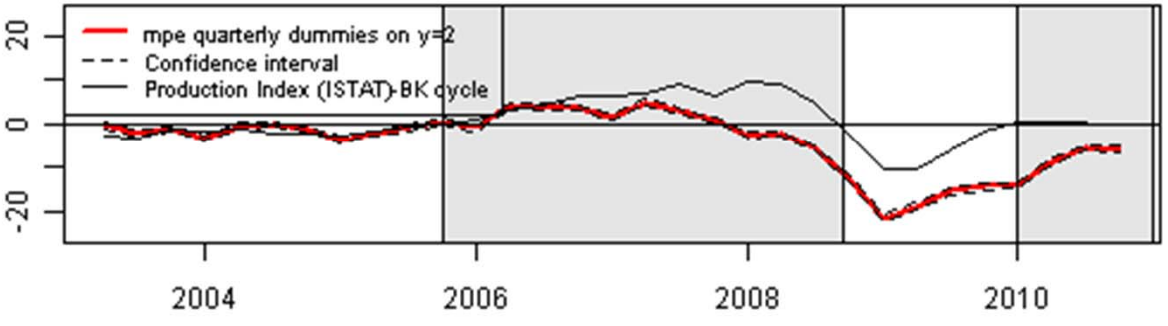
- We start by estimating a RE-OPM introducing only **quarterly dummies** (*qt*) as explanatory variables

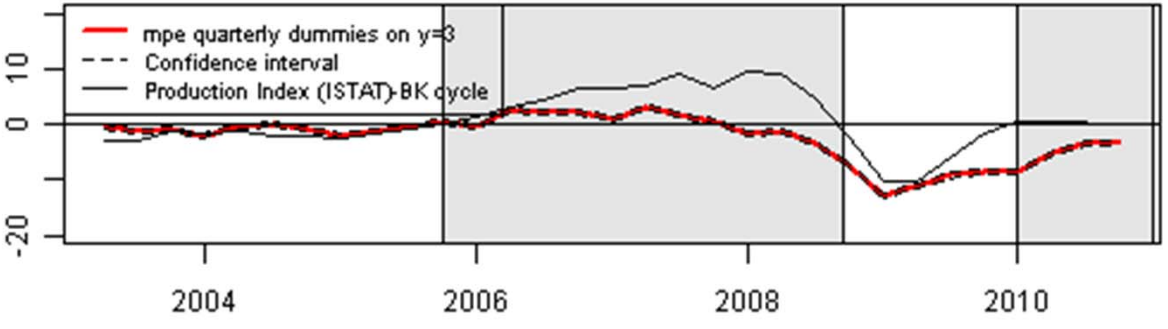
- The marginal effect of *qt* highly correlated with the **cyclical component of the quarterly index of Italian industrial production** **=>** the production level is a good proxy of the deviance business cycle

Cyclical component of the industrial production index and marginal probability effects of quarterly dummies



Stagnation Expansion Recession Recover





2003:2-2005:3: stagnati

2005:4-2008:3: boom;

2008:4-2009:4: recessio

2010:1-2010:4: recover

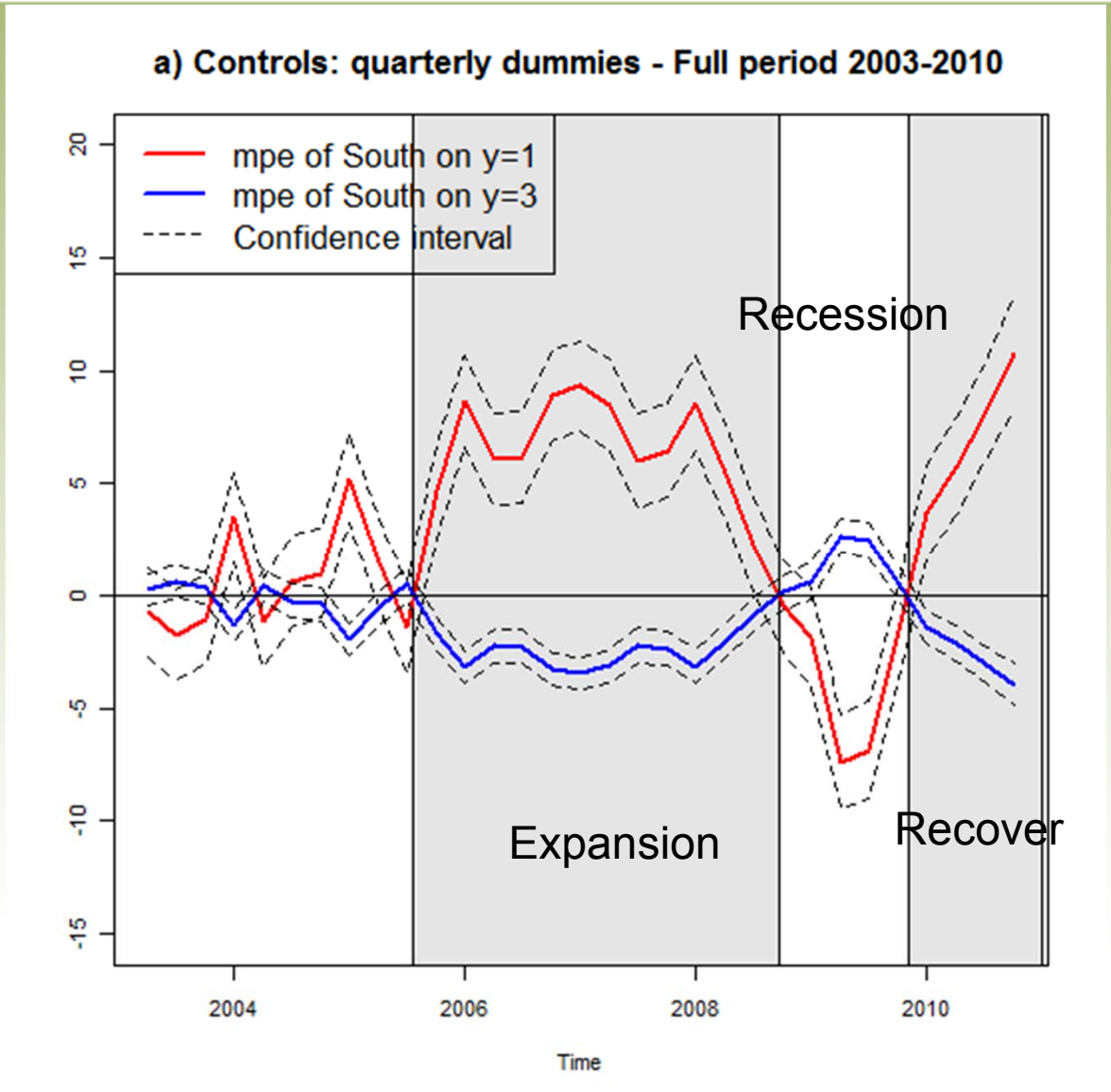
SECOND STEP:
Measuring the Southern effect

We then include in the RE-OPM the **interactions term *South* x *qt*** in order to capture the average deviation of Southern firms' business cycle from the Northern profile

Results document **sizable asymmetries in Northern and Southern firms business cycles** positively related to the intensity of the national cycle:

- Southern firms are more likely to reduce production levels in periods of business cycle expansion and *viceversa*

Marginal effects of South: period 2003-2010



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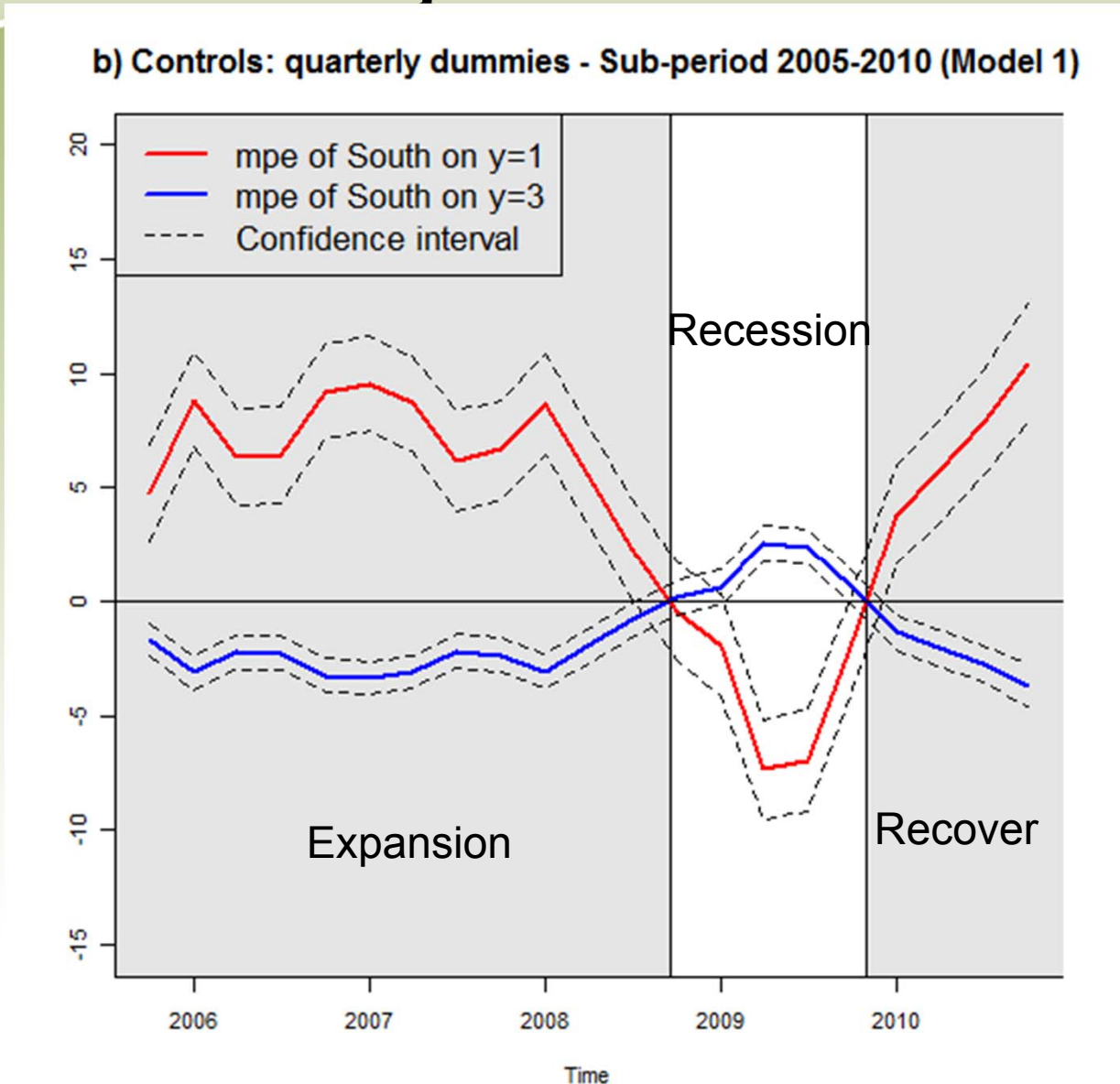
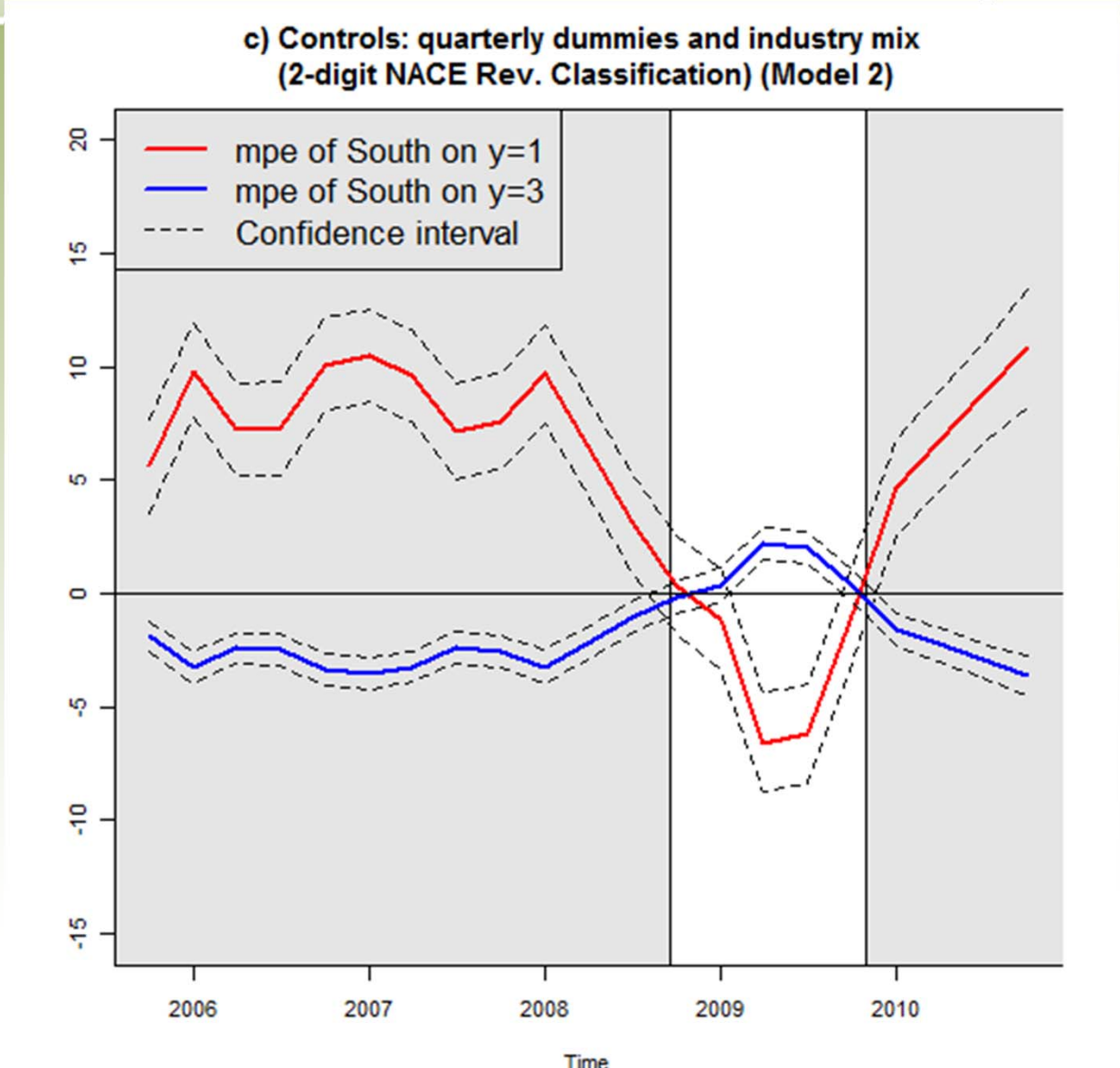


THIRD STEP:
Assessing the role of industry mix

- We then include **sectoral dummies** (2-digit NACE Rev. 1 classification) in our model …

- … but sectoral mix does not capture regional differences
  - Some evidence in favor of the hypothesis that industry composition has partially protected the South against the negative shocks of the world crisis (but no statistical significance)

Marginal effects of South: the role of industry mix



LAST STEP:
Assessing the role of firm heterogeneity

- **Working hypothesis**: various strand of literature suggest a strong firm heterogeneity along the business cycle, due to firm specific factors which alter the transmission mechanisms of exogenous shocks

  - ***Borrowing constraints (Firm size)****:* Bernanke and Gertler (1995); Carlino and DeFina (1998); Dedola and Lippi (2000)

  - ***Liquidity constraints****:* Kiyotaki and Moore (2008)

  - ***Export propensity***

  - ***Idiosyncratic demand shocks****:* Foster *et al*. (2008)

  - ***Capacity utilization****:* Fagnart et al. (1997); Fagnart et al. (1999)

LAST STEP:
Assessing the role of firm heterogeneity

- If there is firm heterogeneity in business cycle behavior due to the factors mentioned above …
- … regional differences in entrepreneurial composition (in terms of firm size and export propensity) and in firm behavior (in terms of demand conditions, liquidity conditions, capacity utilization and expectations) may help explain RBC differentials

LAST STEP:
Assessing the role of firm heterogeneity

- Finally, we test the role of ***local externalities***:
  - ***The individual decision to raise or to reduce the production level is influenced by the production decision of nearby firms***

Microeconomic information from business cycle survey in Italy

- Variables capturing firms' heterogeneity in industrial business cycle behaviour
  - Log of **firm size** (number of employees) and its **square term**
  - Firm **export propensity**: export/total revenue
  - Firm **specific demand conditions** and **expectations**
  - Firm's **liquidity conditions** and **expectations**
  - Firm's **capacity utilization**
  - **Local externalities**: Employment density in the province where firm *i* is located X balance of production levels in the same province

Econometric issues

- To deal with possible correlation between unobserved specific effects and covariates (Wooldridge, 2002) we include in the model
  - Time averages of the time-varying variables (*level* effects)
  - Deviations from the averages per individual (*shock* effects)

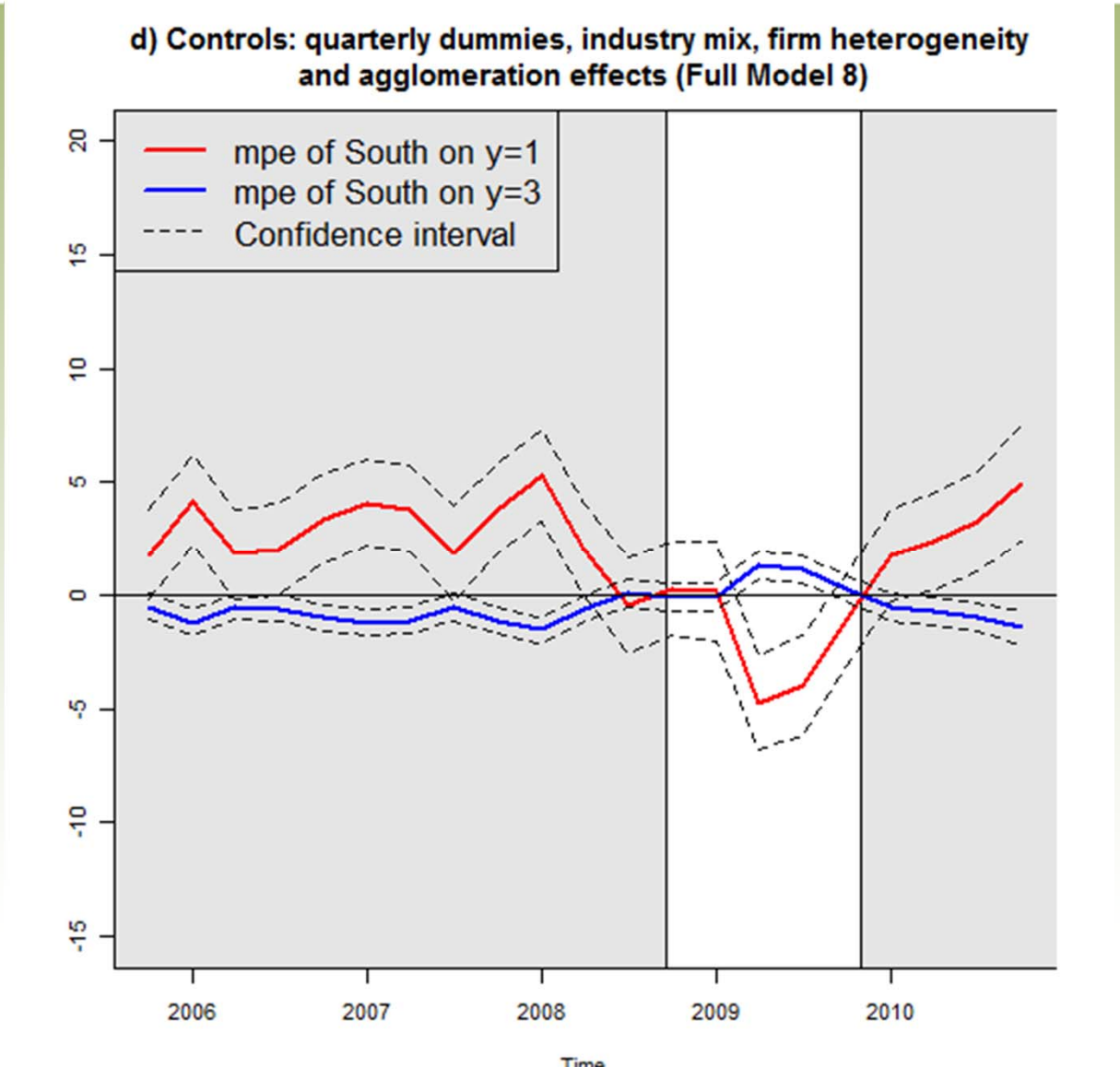
$$y_{it}^{*} = \beta^{'}(x_{it} - \overline{x}_i) + (\psi + \beta)'\overline{x}_i + \gamma' z_i + \xi_i + \varepsilon_{it}$$

- To deal with possible endogeneity problems due to reverse causality and a simultaneity, we lag all right-hand side variables one period

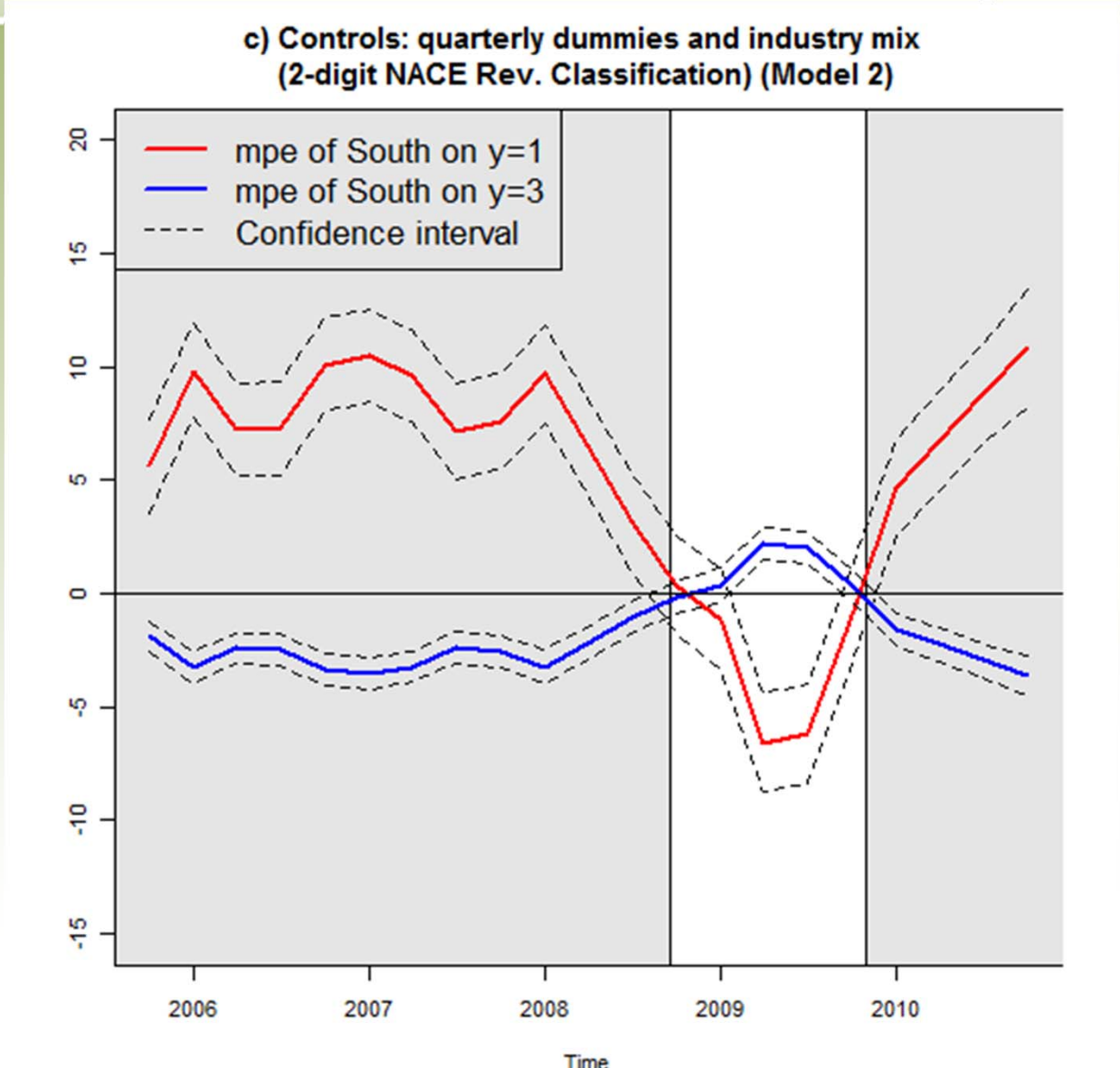
Estimation results

- We have estimated **six nested models** introducing progressively **firm size**, **export intensity**, **liquidity conditions**, **demand conditions**, **capacity utilization** and **local externalities**
- Results show that the **full specification encompasses all the others**
- However, the most consistent improvements in the goodness of fit are observable with
  - ***firm size***
  - ***liquidity conditions***
  - ***demand conditions***

Marginal effects
of South: firm heterogeneity and agglomeration externalities



Marginal effects of South: the role of industry mix



Conclusions

- This study represents a first attempt to analyze the role of firm heterogeneity in RBC behaviour

- Using business survey monthly data for a sample of Italy's manufacturing firms, we show that
  - Southern firms are more likely to reduce production levels than firms located in the North in periods of business cycle expansion and *viceversa*
  - Regional differences in the sectoral composition partly explain the diverging behaviour of Southern firms during the recession period
  - Various firm specific variables (mostly firm size, demand conditions and liquidity conditions) capture large part of RBC differences both during periods of recession and boom

Marginal effects of the interaction between dummy South and quarterly dummies: mean values

Model	Period	Pr(y=1)	Pr(y=2)	Pr(y=3)
1 = Quarterly dummies and *South x qt*	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

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	2010:1-2010:4	7.0	-4.5	-2.4
2 = 1 + Sectoral dummies	2005:4-2008:3	7.9 (2.1)	-5.3 (-2.6)	-2.6 (-1.2)
	2008:4-2009:4	-2.9 (1.1)	1.9 (-1.0)	1.0 (-1.4)
	2010:1-2010:4	7.8 (1.0)	-5.2 (-1.2)	-2.6 (-0.5)

Marginal effects of the interaction between dummy South and quarterly dummies: mean values

Model	Period	$\Pr(y=0)$	$\Pr(y=1)$	$\Pr(y=2)$
1 = Quarterly dummies and South*qt	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 (2.1)	-5.3 (-2.6)	-2.6 (-1.2)
	2008:4-2009:4	-2.9 (1.1)	1.9 (-1.0)	1.0 (-1.4)
	2010:1-2010:4	7.8 (1.0)	-5.2 (-1.2)	-2.6 (-0.5)
8 = 7 + Agglomeration effect (Full model)	2005:4-2008:3	2.6 (-0.8) [-10.1]	-1.8 (0.8) [9.1]	-0.7 (0.8) [12.2]
	2008:4-2009:4	-1.8 (0.3) [2.7]	1.3 (-0.3) [-2.4]	0.5 (-0.3) [-3.5]
	2010:1-2010:4	3.0 (-0.2) [-4.9]	-2.1 (0.2) [4.3]	-0.9 (0.2) [6.0]

Level effects and shock effects in the full model

Firm size

	y	Shock effect	Se
Ln emp (2005:4-2008:3)	0	-12.701***	2.331
	1	9.044***	1.661
	2	3.656***	0.672
Ln emp^2 (2005:4-2008:3)	0	0.001	0.334
	1	-0.001	0.238
	2	0.000	0.096
Ln emp (2008:4-2009:4)	0	-8.821***	2.933
	1	6.282***	2.089
	2	2.540***	0.845
Ln emp^2 (2008:4-2009:4)	0	-0.020	0.420
	1	0.014	0.299
	2	0.006	0.121
Ln emp (2010:1-2010:4)	0	-15.139***	3.150
	1	10.781***	2.245
	2	4.358***	0.908
Ln emp^2 (2010:1-2010:4)	0	1.400***	0.431
	1	-0.997***	0.307
	2	-0.403***	0.124

Effect of firm size higher in expansion periods than in recession

Firm size affects more Pr(y=1), rather Pr(y=3)

Considering that interest rates move in the upside during a boom (and downside in a recession), these results are in line with our theoretical underpinnings

Level effects and shock effects in the full model

Export intensity

	y	Shock effect	Se
exp (2005:4-2008:3)	0	-0.072***	0.012
	1	0.051***	0.009
	2	0.021***	0.003
exp (2008:4-2009:4)	0	-0.088***	0.019
	1	0.063***	0.013
	2	0.025***	0.005
exp (2010:1-2010:4)	0	-0.105***	0.020
	1	0.075***	0.014
	2	0.030***	0.006

The greater is firm's export intensity the better is its resilience during downturns and the higher is its capacity to raise production in the upturn

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

Level effects and shock effects in the full model

Liquidity conditions

		y	Shock effect	Se
Liquidity conditions	Good	0	-6.332***	0.418
		1	4.509***	0.299
		2	1.823***	0.121
	Mediocre	0	-3.645***	0.337
		1	2.595***	0.241
		2	1.049***	0.097
Expectations on liquidity conditions	Better	0	-17.214***	0.413
		1	12.259***	0.309
		2	4.956***	0.127
	Equal	0	-11.517***	0.307
		1	8.201***	0.228
		2	3.315***	0.093

Again the 'low production' modality is the one that mainly discriminates firm-by-firm cyclical behaviour

Expectations on future liquidity conditions seem to play a more relevant role than assessment on current conditions

Level effects and shock effects in the full model

Demand conditions

		y	Shock effect	se
omestic demand onditions	High	0	-35.370***	0.431
		1	25.188***	0.362
		2	10.183***	0.154
	Normal	0	-18.915***	0.267
		1	13.469***	0.216
		2	5.445***	0.092
oreign demand onditions	High	0	-15.978***	0.562
		1	11.378***	0.409
		2	4.600***	0.167
	Normal	0	-5.779***	0.342
		1	4.116***	0.245
		2	1.664***	0.099
xpected demand onditions	Increase	0	-9.597***	0.348
		1	6.834***	0.254
		2	2.763***	0.103
	Stationarity	0	-10.445***	0.308
		1	7.438***	0.226
		2	3.007***	0.092

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=1) are substantially larger than those related to Pr(y=3)

Estimation results also point out that production levels are affected by expectations on future demand

Level effects and shock effects in the full model

Capacity utilization

		y	Shock effect	Se
Capacity utilization	Favourable	0	0.951**	0.461
		1	-0.677**	0.329
		2	-0.274**	0.133
	Stationarity	0	-5.236***	0.438
		1	3.729***	0.313
		2	1.507***	0.127

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=1) and a negative *mpe* on Pr(y=3), with the former effect (also in this case) being larger than the latter

Level effects and shock effects in the full model

Local externalities

	y	Shock effect	Se
Agglomeration effects	0	-0.806***	0.133
	1	0.574***	0.095
	2	0.232***	0.038

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)