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The series is available online at www.bancaditalia.it .

ISSN 1972-6627 (print)
ISSN 1972-6643 (online)

Printed by the Printing and Publishing Division of the Bank of Italy

HETEROGENEOUS FALL IN PRODUCTIVE CAPACITY IN ITALIAN INDUSTRY DURING THE 2008-13 DOUBLE-DIP RECESSION

by Andrea Locatelli[§], Libero Monteforte* and Giordano Zevi*

Abstract

Between 2008 and 2013 productive capacity was considerably downsized in the Italian manufacturing sector. This paper analyses the micro-data collected for the Bank of Italy surveys to identify the main drivers of the reduction in the whole 2008-13 period and in four sub-periods (pre-crisis 2001-07, first phase of the crisis 2008-09, recovery 2010-11, and second crisis 2012-13). Our main findings are that i) losses of productive capacity varied widely across manufacturing sub-sectors with differences in pre-crisis trends tending to persist in a few sub-sectors during the double-dip recession; ii) large firms were more successful in avoiding major capacity losses, especially in the first phase of the crisis; iii) the share of sales on foreign markets was negatively correlated with performance in 2008-09, but the correlation turned positive in 2012-13; iv) among the Italian macro-regions, the Centre weathered the long recession better; v) subsidiaries underperformed firms not belonging to any group; and vi) the negative effects on productive capacity of credit constraints, which discouraged investments, were felt by Italian firms particularly in 2012-13.

JEL Classification: E32, L16, L60
Keywords: productive capacity, manufacturing.

Contents

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1. Introduction and motivation[1]

In this work we analyse the productive potential of Italian manufacturing firms during the period 2008-13 using individual data from the Bank of Italy Survey of Industrial and Service Firms ('Invind' according to its Italian acronym). We compute a measure of the capacity change at the firm level and explore which characteristics of firms (size, share of export turnover, sector of activity and macro-region) were associated with that change. We further investigate the role played by credit constraints and whether or not being part of a group mattered.

In recent years several studies have assessed the impact of the prolonged economic crisis on the potential of the Italian economy as a whole. Aprigliano and Conti (2014), using a quarterly Bayesian VAR model, find a cumulative loss of about 2.0% of Italian potential GDP in 2013 with respect to 2007, mainly concentrated between 2007 Q3 and 2009 Q3; Gerali et al. (2015) estimate, by means of a dynamic general equilibrium model, that potential GDP declined in Italy by about 2 percentage points in 2011-13; Ball (2014) finds a cumulative decline of potential output of more than 10% in 2015 with respect to the real time forecasts of late 2007.

Focusing on the manufacturing sector, Monteforte and Zevi (2015) estimate a loss of productive potential between 11% and 17% in 2008-13, depending on the methodology employed (a production function approach, a survey based method, and statistical filtering of the industrial production series); the contraction reaches almost 20% compared with

[1] We thank Antonio Accetturo, Chiara Bentivogli, Luigi Federico Signorini, Stefano Siviero, Francesco Zollino and participants at the XXVII Villa Mondragone International Economic Seminar for helpful suggestions and comments, as well as Leandro D'Aurizio for sharing his unique insight on the dataset of the Bank of Italy's Survey of Industrial and Service Firms. All remaining errors are ours.

the counterfactual 'no crisis' scenario. A similar production function approach is employed in Banca d'Italia (2014) to compute the fall in manufacturing capacity in the Italian macro-regions, pointing to a decline of about 15% in the South and 9% in the rest of the country. Nomisma (2015) estimates a loss of almost 18% between 2007 and 2014.

All the above studies employ macro or aggregated data; the key novelty of this paper is that it is, to our knowledge, the first one to use firm-level data to address this issue for Italy.

In line with the existing literature we draw a distinction between (1) the global financial crisis that followed the bankruptcy of Lehman Brothers and hit the Italian economy – as well as most countries in the world – mainly through the sharp decline in foreign demand between 2008 and 2009 ('first phase of the crisis'), and (2) the second recession, triggered by the sovereign debt crisis, which resulted in a deep slump in domestic demand in 2012 and 2013 ('second phase of the crisis'). Between these two contractions the Italian economy experienced a short-lived recovery ('recovery').

Our main findings are the following: i) productive capacity losses were extremely heterogeneous across sectors of manufacturing activity, and differences in pre-crisis trends persisted in a few sectors; ii) large firms were more successful in limiting capacity losses, especially in the first phase of the crisis; iii) the share of sales in foreign markets was negatively correlated with performance in 2008-09, but the correlation turned positive in 2012-13; iv) among the Italian macro-regions, the Centre weathered the long recession relatively better, especially in 2008-09; v) in 2012-13 subsidiaries underperformed firms not belonging to any group, while the performance of parent companies was broadly in line with the average; and vi) the negative effects of credit constraints on productive capacity, which discouraged investments, were felt by Italian firms particularly in 2012-13.

In Section 2 we describe our dataset and explain the statistical treatments and in Section 3 we show the heterogeneous loss of productive capacity across a number of firm dimensions (foreign trade exposure, size, sector of activity, location, credit constraints). In Section 4 we conduct an econometric analysis to estimate to what extent those firm-level characteristics are associated with the decline in productive capacity, controlling for other observables.

2. Data definitions and statistical treatments

As productive capacity (PC) is by nature unobservable, following Malgarini and Paradiso (2010) we define it as:

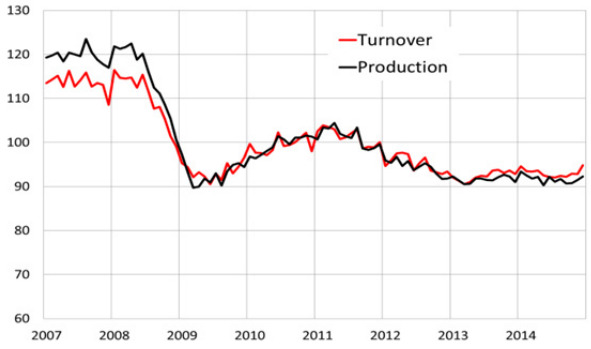
$$c_{i,t} = \frac{y_{i,t}}{u_{i,t}} \qquad (1)$$

where $y_{i,t}$ is the production level of firm i at time t and $u_{i,t}$ stands for its contemporaneous rate of capacity utilization (CU). We are interested in the percentage change of $c_{i,t}$ from time $t-1$ to time t. In order to carry out micro level analyses, the estimation of PC requires firm-level data on production and CU. As Istat provides only aggregate measures of industrial production, we resort to the Bank of Italy Invind dataset, which contains firm-level data on CU and useful information to build a proxy for production at annual frequency.

We use the Invind sub-sample of manufacturing firms with 50 or more employees, which are asked to report their CU in each wave. This leaves us with about 1,700 observations per year as shown in Table a1 of the Appendix. We restrict the time horizon to years after 2001.

Figure 1

Industrial production and real turnover in Istat data



Source: Istat.
Note: Series are seasonally adjusted. 2010=100

We approximate a firm's production by deflating the nominal turnover by the average change in prices recorded in the sample stratum to which the firm belongs (identified according to the macro-region where it is located and its main sector of activity). This approach is supported by the evidence that the proxy is fairly well correlated with the index of industrial production, especially in the period of major interest for our analysis, after 2008 (Figure 1).[2]

[2] A potentially misleading factor is a firm's sales of third party products, which could be relevant for firm analysis even if not necessarily in the aggregate. We are able to control for this as in the 2007 and 2012 Invind waves firms were asked how far their turnover was influenced by sales of third party products. Similar shares were reported by the same firms in the two waves: in 2012, 41% of firms sold third-party products, explaining 20.7% of their total turnover, or about 8% of total industry turnover. We kept note of these firms in the estimations conducted in Section 4. A more detailed analysis of sales of third-party products as described in the Invind survey can be found in Di Nino (2015).

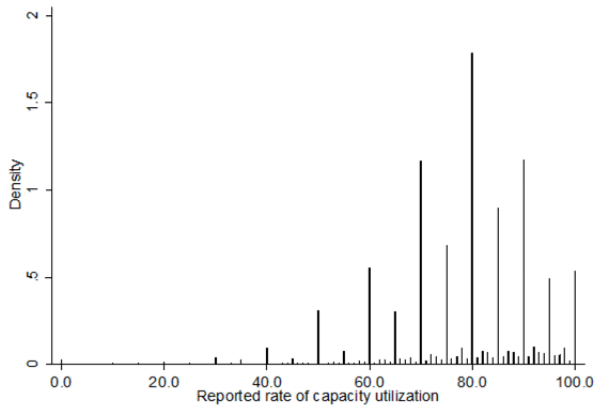
The second component needed to estimate potential output is a measure of CU. In the Invind firms are asked regularly to report their CU and in most cases the average records are in line with Istat aggregate data for the respective sector of activity and size of firm. However, a share of firms do not report their CU. In the case of missing values we adopt an imputation procedure that uses the firm's history and the sample stratum. Table a2 details the number of imputed values by year, geographical area, firm size and sector of activity. Between 2000 and 2013, about 17% of the values were imputed, with the share increasing until 2010-11 and declining in the last two years.[3]

A statistical issue arises in connection with the evidence that firms in the sample tend to report rounded values for CU. The distribution of actual answers (excluding imputed values) shows a clear preference for figures that end in 5 or 0: in fact, 82.5% of the answers are heaped around multiples of 5 (Figure 2).

This may result in an attenuation bias, to the extent that firms do not revise their reported estimates of CU when the changes in the latter from one period to the next are small. We pay special attention to this problem, as CU is a key driver of our estimate for PC. In order to correct heaped reported values first, we estimate the distribution of CU as a function of firm-level observables.[4] We then use the predicted values to smooth the distribution of CU rates around the answer provided.[5] We notice that all the main descriptive statistics are similar whether the original Invind data are used or those with our correction.

Figure 2

Distribution of reported CU rates



Source: Invind data.

Both production and CU in our dataset, constructed as explained above, closely track the corresponding aggregate Istat

[3] The highest share of imputed values was recorded in the North West of the country (24.2%) and among large firms.

[4] The model includes the following firm-level observables: the natural logarithm of the number of employees at time t and t-1; the natural logarithm of the inflation-adjusted income and investments at time t and t-1; and a set of fixed effects for its sector of economic activity, geographical macro-region, export share, legal form and years.

[5] We subtract (add) 2 percentage points when the predicted value lies in the bottom (top) quintile of the distribution, 1 point when it lies in the second quintile, and we leave the provided values unchanged when they are not multiples of 5. The use of an independent variable predicted on a set of controls in a regression that includes the same controls does not bias coefficient estimates but may induce downward bias in the estimated standard errors.

series.

Our analysis is based on the unbalanced panel of firms that participated in the survey between 2001 and 2013.[6] Table a1 reports the number of observations per firm. The change in PC can only be computed when firm i is observed for two consecutive waves. This leaves us with 16,939 observations between 2002 and 2013 for which we can compute the outcome of interest (about 75% out of a total of 23,138 observations).

We are agnostic about the reasons for firms' entry in and exit from our sample. In principle, a firm can exit for a variety of reasons, e.g. a firm might drop out of the market; it may reduce its labour force to fewer than 50 employees, in which case it is no longer asked to report its CU; a firm in financial distress may chose not to participate or not to answer to all the questions, as participation in this survey is not compulsory; further reasons are also possible. Although, at this stage, there is no strong evidence that sample selection drives our results, the issue is certainly worth further investigation.

We approximate the percentage change of PC from time t-1 to time t by its log-difference:

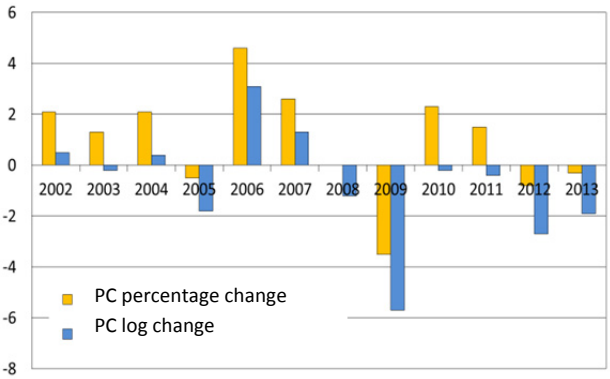
$$\delta_{it} = \frac{c_{i,t} - c_{i,t-1}}{c_{i,t}} \approx \ln(c_{i,t}) - \ln(c_{i,t-1}) \equiv \delta'_{it} \qquad (2)$$

The distributions of δ_{it} and δ'_{it} are similar; however, the former has a longer upper tail while the latter has a longer lower tail.

For both measures δ_{it} and δ'_{it} we computed average yearly PC variation in the economy. Figure 3 shows that the average percentage variation is lower for the log-differences, pointing to the presence of a significant number of large yearly negative changes at the firm level (the larger the change, the greater is the downward bias induced by the log-difference). The logarithmic measure yields more realistic results in reducing the

Figure 3

Yearly change in PC: alternative measures



Source: Our computations based on Invind data.
Note: All distributions are weighted with the number of firms.

[6] The balanced panel would include only 324 observations out of a total of about 1,800 firms per year.

upward bias displayed by the aggregate firm-level data with respect to the macro series, the presence of which has been already pointed out in Monteforte and Zevi in relation to the Invind dataset.[7] In fact, cumulating the firms' percentage variations does not result in a large PC loss over the whole crisis period, whereas using the measure in log-differences, with a 1-99% trimming, results in a cumulative decline of 11.6%, in line with aggregate evidence (Table 2).

As a robustness check, we also compute changes in PC by trimming the top and bottom decile and quintile, and the resulting estimates are roughly similar; from this we conclude that the dynamics of the log-difference measure are not overly affected by what goes on in the tails of the distribution. The cumulative decline in PC in 2007-13 amounts to 7.5% and 6.4% respectively if the extreme deciles and extreme quintiles are trimmed. Based on these findings, in the following we adopt the measure of PC variation in log-differences with the 1-99% trimming.

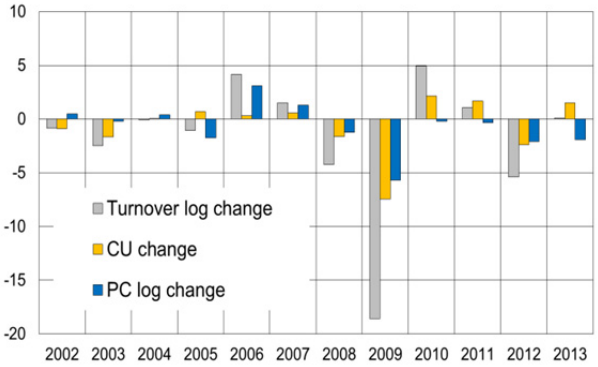
Before proceeding, some remarks are in order. First, for several reasons we expected to find a smaller decline in PC than in Monteforte and Zevi (2015) and Nomisma (2015). On the one hand, the sample we analyse consists of firms with at least 50 employees: these firms, according to the latest available data (Istat, 2014), accounted on average for 52% of employees in manufacturing, 60% of fixed capital investments, 61% of value added and 66% of total turnover in 2008-12. As mentioned, larger firms consistently over-performed smaller firms along all those dimensions. If we assume that the PC adjustment was concentrated on the *intensive* margin (i.e. the changes in PC, keeping the total number of firms fixed), an 11.6% decrease in PC for the firms in our sample would imply a strong (more than 20%) decrease in PC for firms with fewer than 50 employees, given the decline for the total manufacturing sector estimated by previous studies using macro data (around 15%). On the other hand, a substantial share of the fall in PC came from adjustments in the *extensive* margin (i.e. the number of active firms): preliminary results from Mistretta and Monteforte (2015) find that losses on this margin could amount to a few percentage points of the total PC. In light of this estimate, consistency with the aggregate figure requires a PC loss of about 15% for firms with fewer than 50 employees.

[7] Monteforte and Zevi (2015) find a generalized upward bias in firms' assessments of their own PC change, of a magnitude that is broadly stable in time and across sectors.

A final note of caution on the interpretation of our quantitative results: by construction, our PC measure is very sensitive to shocks to turnover in real terms, which in turn immediately reacts to demand shocks (Figure 4).[8] Therefore, annual changes in PC may over-emphasize high frequency volatility, so that a more reliable interpretation of our estimates should probably focus on a longer time horizon.

Figure 4

Turnover, CU and PC
(annual changes)



Source: Our computations based on Invind data.
Note: Distributions are weighted with the number of firms.

2.1 Computed versus self-declared capacity changes

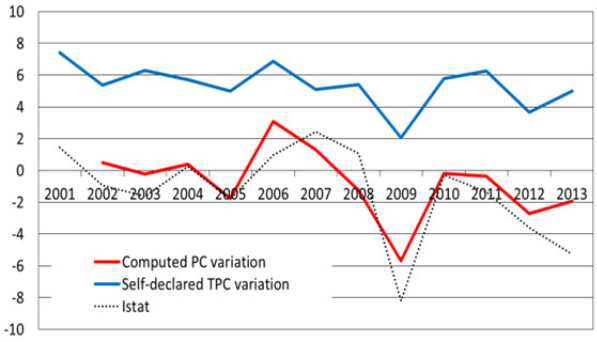
In the Invind survey firms are asked to report the change in their technical productivity capacity (TPC), defined as the 'maximum possible production attainable with full plant capacity utilization with no changes in labour shifts'.[9] Aggregating the individual records we find that the resulting change in TPC is consistently higher than both the change in PC computed in the previous section and the one derived from the aggregate Istat series.[10] Figure 5A shows that the three series have remarkably similar dynamics (with the notable exception of 2013); the similarity is particularly pronounced for the two measures based on Invind data, suggesting that our computed series both reflects the dynamics declared by firms and helps to reduce the upward bias that is apparent with respect to Istat data.

The pattern of the firms' responses to the question about the change in their TPC is reported in Figure 5.B; relatively few firms report a decline (less than 10% in all years, except for 13.5% in 2009) whereas the share of firms reporting an increase in their TPC is consistently higher than 50%, and about one in three respondents report an unchanged TPC. Interestingly, a similar ad hoc survey conducted in November 2014 by Istat (2015) found that the self-declared increase in productive capital in 2014 was close to zero for 63% of the firms and positive for 27%, leaving just 10% of firms reporting a reduction.

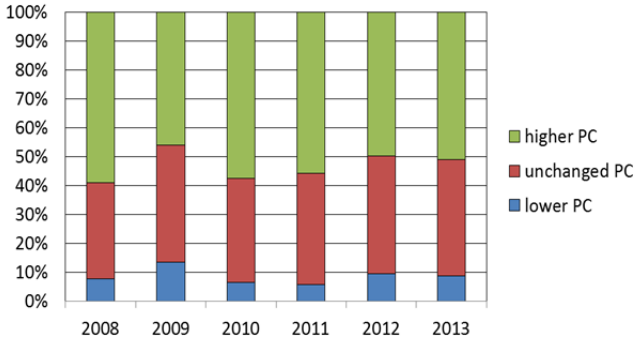
[8] The correlation, in changes, of PC with turnover is 0.85, whereas with CU it is 0.73.
[9] The wording of the question is: 'Percentage change in technical productive capacity between year T and T-1'.
[10] The series derived from Istat data are described in Monteforte and Zevi (2015).

Figure 5

A-Alternative measures of capacity change



B-Self-reported change in TPC



Source: Panel A: our computations based on Invind data and Istat; Panel B: Invind 2008-13
Note: The variables based on Invind data are weighted with the number of firms.

In order to better understand how firms interpret the question about TPC we estimate the following equation:

$$\Pr(answer_{it}) = \Phi\left(\delta n_{it} + \log\left(\frac{inv_{it}}{n_{i,t}}\right) + controls\right) \qquad (3)$$

where $answer \in$ ('higher PC', 'lower PC', 'unchanged PC'), $\delta n_{it} = n_{it} - n_{it-1}$ is the change in the number of employees of firm i from t-1 to t, inv_{it} are contemporaneous investments, and $controls$ include a set of year, sector, macro-region and size dummies. As expected, the probability of reporting a positive change in TPC increases when new employees are hired and investment expenses per employee increase (Table a4); the same variables are negatively correlated to the probability of the firm reporting zero or negative TPC growth. However, the distribution of declared TPC clearly shows a dense mass around 0, with relatively few negative observations, whereas our computed change in PC is more normally distributed around zero.

3. Heterogeneous impact of the crisis

Our measure of productive capacity shows that in the pre-crisis period (between 2001 and 2007) PC increased on average by 0.5% per year, a cumulative 3.3% (Table 1); PC started falling in 2008 and began to decline dramatically in 2009 (phase 1 of the crisis); in the subsequent two years it declined only slightly (recovery); with the inception of the sovereign debt crisis, PC was further reduced in 2012-13 (phase 2 of the crisis) to a cumulative -8.7% with respect to 2001.

Table 1

Sub-periods and cumulative capacity changes from 2001

Periods	Years	Cumulative changes in PC (%)
Pre-crisis	2001-07	3.3%
Phase 1 of the crisis	2008-09	-3.8%
Recovery	2010-11	-4.4%
Phase 2 of the crisis	2012-13	-8.7%

Table 2 further reports the computed yearly change in PC across different dimensions, i.e. sectors of activity, share of export turnover, geographical macro-regions and firm size; the relevance of each of these factors is discussed in turn in the following sub-sections.

Table 2

Changes in PC

Total	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	Avg PC change before 2007	Cum PC change from 2007
Yearly average	0.5	-0.2	0.4	-1.8	3.1	1.3	-1.2	-5.7	-0.2	-0.4	-2.7	-1.9	**0.5**	**-11.6**
Sectors (1)														
Food	-0.6	1.3	-0.1	0.5	0.7	-1.3	-0.3	3.1	2.1	-0.1	-0.2	-2.3	**0.1**	**2.2**
Textiles and leather	-0.9	-1.9	-0.6	-3.8	-1.8	-0.4	-3.1	-10.9	2.5	-0.9	-2.1	-5.5	**-1.5**	**-18.9**
Wood and paper	3.4	2.1	5.6	-0.9	1.8	2.1	-4.2	-0.7	-4.7	-1.9	-1.9	-4.8	**2.5**	**-16.9**
Coke, chemicals, rubber and plastics	1.7	-0.1	1.7	-6.6	3.5	2.0	-2.0	0.1	0.9	-3.3	-3.4	-1.9	**0.3**	**-9.3**
Non-metallic minerals	0.2	2.8	-1.4	-3.7	4.5	0.7	-1.6	-9.2	-3.7	-4.2	-0.4	-3.5	**0.5**	**-20.8**
Metals	0.2	1.1	-4.3	-4.3	2.1	1.3	-1.7	-2.8	-3.6	-0.3	-3.2	4.8	**-0.7**	**-6.8**
Machinery and mechanical appliances	2.4	-1.7	0.4	0.6	7.8	4.0	-0.2	-13.0	0.7	1.8	-0.5	-0.9	**2.3**	**-12.2**
Electrical machinery and appliances	0.3	-0.8	5.0	1.4	7.3	2.8	2.1	-10.2	4.9	1.7	-8.6	-1.6	**2.8**	**-12.0**
Transport vehicles	1.2	3.3	0.5	5.9	2.0	1.5	1.9	-1.6	-2.1	1.4	-2.9	-15.3	**2.5**	**-18.1**
Other	*-5.5*	*-3.3*	*3.7*	*1.4*	*0.6*	*-2.8*	*-0.4*	*-8.3*	*-0.1*	*0.9*	*-6.2*	*-5.4*	***-1.0***	***-18.3***
Share of export turnover														
Nil	0.4	0.3	-1.5	-0.7	4.4	-2.0	-0.4	-2.8	0.8	-4.0	-4.4	-9.0	**0.1**	**-18.5**
Between 0-1/3	0.4	-1.0	0.2	-3.1	1.8	-0.1	-1.1	-1.9	-0.9	-0.2	-4.0	-1.8	**-0.3**	**-9.5**
Between 1/3-2/3	0.8	-0.1	0.9	-2.2	2.9	2.9	-2.1	-6.3	-0.9	-0.2	-2.6	-2.0	**0.9**	**-13.4**
Over 2/3	0.4	0.9	0.9	0.6	4.7	2.4	-0.6	-11.9	1.5	0.4	-0.8	-0.4	**1.7**	**-11.8**
Macro-region (2)														
North West	0.4	-0.5	-0.3	-3.4	1.8	1.6	-1.7	-7.0	0.7	-0.4	-2.5	-2.1	**-0.1**	**-12.5**
North East	1.1	0.8	0.1	-0.5	3.8	1.4	-0.9	-6.2	-0.8	-0.1	-3.2	-2.1	**1.1**	**-12.7**
Centre	-0.2	-3.2	0.5	0.1	3.4	2.0	0.1	-4.1	0.3	0.0	-2.2	-1.3	**0.4**	**-7.1**
South and Islands	0.3	1.9	4.0	-1.4	5.3	-0.9	-2.3	-1.0	-2.7	-1.3	-2.8	-1.5	**1.6**	**-11.1**
Number of employees														
50-99	0.2	-0.6	0.0	-1.6	3.0	0.2	-1.3	-7.2	-0.5	-0.8	-4.4	-2.0	**0.2**	**-15.3**
100-199	0.6	-0.7	0.5	-3.1	3.8	2.3	-1.1	-4.5	1.5	0.4	-1.4	-1.4	**0.6**	**-6.4**
200-499	1.4	1.5	1.1	0.1	1.9	4.0	-1.1	-3.8	-1.4	-0.5	0.9	-2.2	**1.7**	**-7.9**
500+	1.5	2.0	1.4	-1.1	3.0	1.3	-1.2	-0.2	-2.6	1.7	0.5	-3.1	**1.4**	**-4.9**

Source: our computations on Invind data.

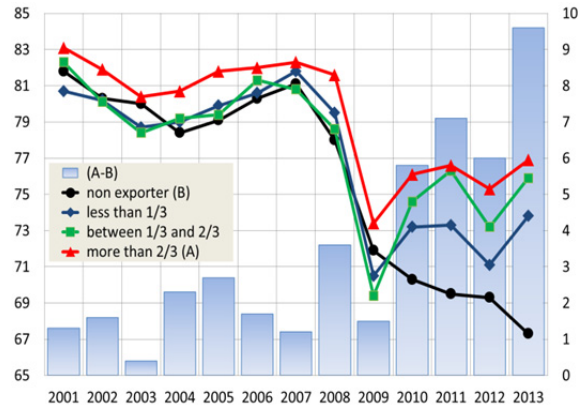
Note: The table gives the average variation in productive capacity computed with equation 2. The extreme percentiles of the yearly distributions of the computed capacity were trimmed. Observations are weighted with the number of firms. – (1) The sectoral classification is based on Ateco 2002.– (2) Macro-region is where the head office of the firm is located.

3.1 Heterogeneity by degree of foreign exposure

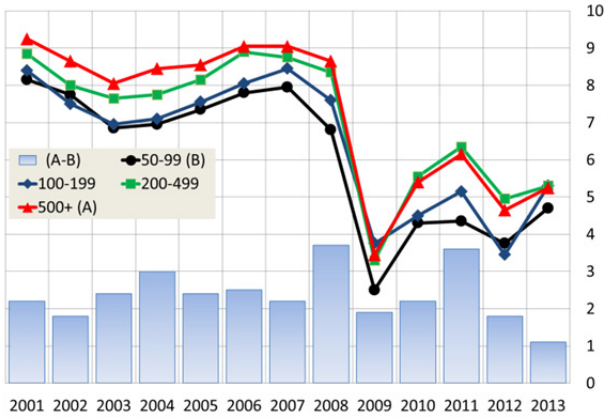
The international financial crisis of 2008-09 hit the Italian economy through the sharp decline of world trade and therefore the firms most exposed to external markets were the worst affected. The cumulative computed PC loss for phase 1 of the crisis ranges from 3.2 among domestic market oriented firms to 12.5% for export oriented ones (Table 2). Between 2010 and 2011 the latter managed to recover some of their lost capacity, while non-exporting firms witnessed a further decline.

Figure 6

A - Capacity utilization rates by ratio of export turnover to total turnover



B - Capacity utilization rates by number of employees



Source: Our computations based on Invind data.
Note: Observations are weighted with the number of firms. Firms are grouped according to the following categories: 1) firms that do not export at all; 2) exporting firms whose export turnover is up to 1/3 of total turnover; 3) exporting firms whose export turnover is between 1/3 and 2/3 of total turnover; 4) exporting firms whose export turnover is above 2/3 of total turnover. Histograms represent the difference in CU between categories 4 and 1.

The more recent sovereign debt crisis led to a decline in domestic demand, both public and private: the PC of non-exporting firms fell by more than 13%, while the decline was almost nil among export-oriented firms. Interestingly, over the whole sample period the large fall in PC for non-exporting firms was the result of a huge contraction in sales (exceeding 30%), partially compensated by a sharp fall in CU (Figure 6.A).

3.2 Heterogeneity by firm size

When the international financial crisis overtook the economy, its impact was initially spread evenly among firms of all sizes.[11] In 2009 the impact became more heterogeneous:

[11]Our sample contains only firms with at least 50 employees, as smaller firms were not asked about their CU until 2013. We aggregate firms depending on the number of employees in the observation year; therefore, the same firm may belong to different groups in different years.

while the PC of smaller firms (50-99 employees) declined by 7.2%, the reduction was about 0.5% among firms with 200-499 employees and virtually nil among the largest ones (the CU did not play a major role in producing those differentials; Figure 6.B). Firms with 50-99 employees were also the ones that suffered the most during the sovereign debt crisis: their PC declined by over 6% compared with less than 3% among the remaining firms. As a result, in 2008-13 firms with between 50 and 99 employees witnessed an overall reduction in PC of 15.3%, while the decrease was significantly smaller for the largest firms (4.9%).

3.3 Heterogeneity by sector of activity

Looking at the post-2007 period, the largest decline in PC took place in manufacturing of non-metallic minerals, which was probably affected by the deep crisis in the construction sector. The textiles and leather goods industry suffered a similar decline during the first phase of the crisis, continuing the negative trend of previous years; moderate recovery occurred between 2010 and 2011 before the further decline during the sovereign debt crisis.

The sector producing transport vehicles performed relatively well through 2012, but was severely affected by the sovereign debt crisis. The overall decrease in PC was moderate among firms producing machinery and appliances, which were hit by the fall in foreign demand in 2008-09 but subsequently managed to broadly stabilize their PC during the recovery phase and in 2012-13. Finally, the PC of manufacturers of food products increased by 2.2% from 2008 to 2013; this was the combined result of an increase before 2010 and a fall thereafter. Figure a5 compares the sectoral changes in PC with those found in Monteforte and Zevi (2015); differences are notable only for sectors with a small number of observations in the Invind.

It should be noted that, focusing on the dynamics before the crisis, between 2001 and 2007 the PC of manufacturers of textiles and leather goods was already declining by 1.5% per year; a less marked but qualitatively similar pattern is found for firms manufacturing metal products. By contrast, the top performing sectors were the manufacture of mechanical machinery, electrical appliances, transport vehicles and wood and paper products.

3.4 Heterogeneity by macro-region

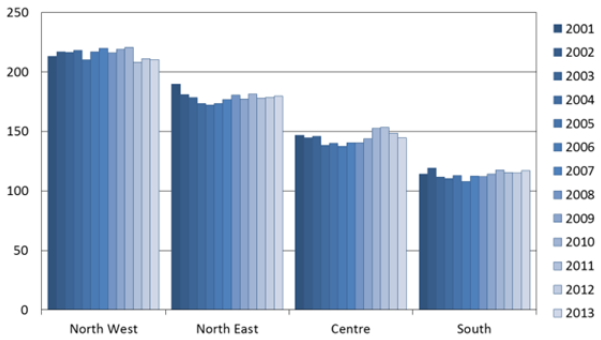
The decline in PC was not evenly distributed across the Italian macro-regions. The macro-regions more exposed to foreign demand were severely hit by the global financial crisis, with PC declining by 8.6% in the North West and 7.0% in the North East.[12]

During the temporary recovery, the South under-performed the rest of the country, losing 4.0% of its PC, while PC stagnated in the other macro-regions. The sovereign debt crisis affected the entire country more evenly. As a result, between 2010 and 2013 the loss of PC in the South (-8.0%) was roughly twice as large as that recorded in the rest of the country (-4.7%), in line with the findings presented in Banca d'Italia (2014), although on a smaller scale, possibly owing to the interaction between the intensive and the extensive margins.

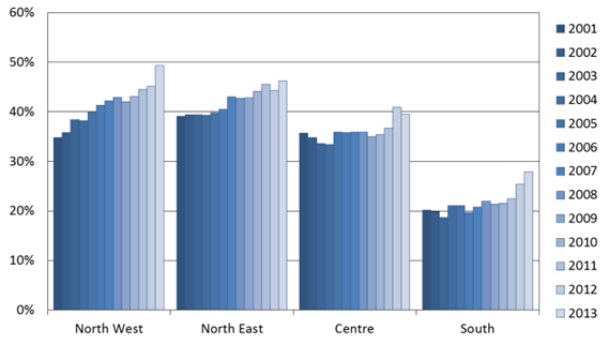
The gap reflects the within-country heterogeneity in firms' characteristics described in Figure 7. Panel A shows that South Italy has mainly small firms, with an average of 100 employees (roughly constant during the double-dip crisis). Average firm size is larger in the Centre, just below 150, and in the North East, around 180, and even more so in the North West (consistently above 200). Panel B shows that southern regions have smaller export shares (about 20%), which are higher everywhere else (around 35% at the beginning of the sample); the export share shows a positive trend in all macro-regions.

Figure 7

A - Average number of employees



B - Share of foreign sales



Source: Survey of Industrial and Service Firms, 2001-2013.
Note: Observations are weighted with the number of firms.

The degree of foreign exposure helps to explain why the North suffered more during the global financial crisis. Also, the continuing decline of PC in the South since 2007 is

[12] In the Invind firms are grouped according to the location of their head office.

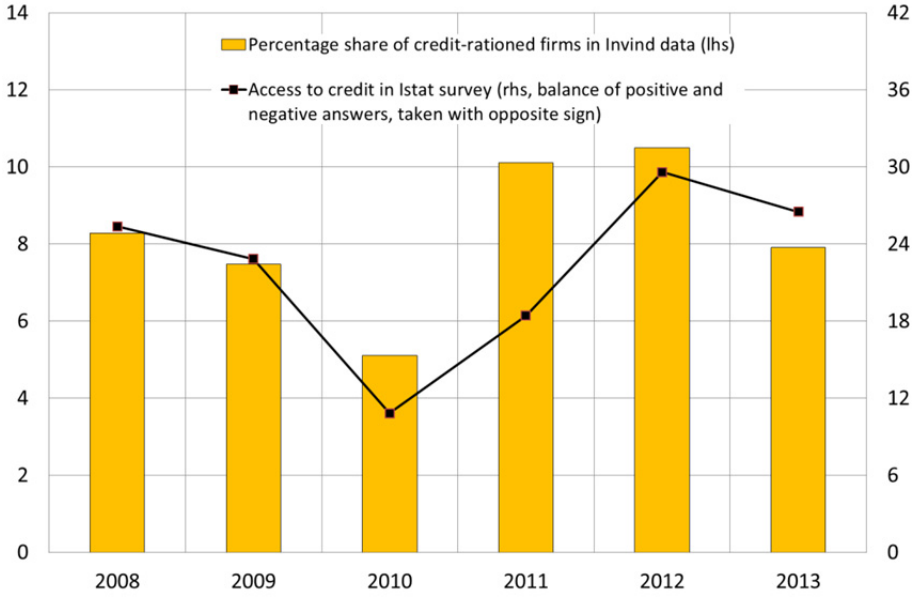
consistent with the smaller firm size in that macro-area (discussed above) and the larger decline of domestic demand there.

3.5 The role of credit constraints

We construct a measure of credit constraints as in Bugamelli, Gaiotti, Viviano (2014): firms are credit constrained if they report that they would like to obtain more credit at current conditions or that they were not granted all or part of the additional credit, despite their willingness to pay more for it.[13] Figure 8 shows that the share of credit constrained firms was particularly large in 2011 and 2012, broadly in line (especially in 2012) with the data recorded by Istat when surveying industrial firms.

Figure 8

Surveys on credit constraints



Source: Istat and our computations based on Invind data.
Note: Invind observations are weighted with the number of firms. In the chart Istat data are shown with opposite sign (an increase shows a deterioration in access to credit).

[13] The definition proposed by Bugamelli, Gaiotti, Viviano (2014) give a homogeneous series spanning the whole sample (in 2010 the questions about firms' financing were modified in the Invind survey: until 2009 respondents were asked whether they would be interested in increasing their debit at the time of the survey, which takes place at the beginning of the second quarter of each year; in the case of a positive answer, an additional question asked whether they would be willing to incur extra cost to receive more credit. Starting from 2010 the section of the questionnaire concerning the financing of the firms was revised and questions were rephrased to make specific reference to the preceding calendar year; our assessment is that this rephrasing did not introduce a break in the series). We explored an alternative definition according to which firms are credit constrained if they would like to receive more credit at current conditions, actually asked banks or other financial intermediaries for more credit, and credit was denied (even in part). The definition proposed by Bugamelli et al. (2014) seems more suited to describe the phenomenon of interest, so we chose to follow their approach. The main results of our analysis are robust to both definitions.

Since 2008 the Istat business survey has collected firms' opinions on access to credit. Figure 8 shows the difference between the share of firms reporting an improvement in credit conditions vis-à-vis those reporting a deterioration in the Istat survey, together with the share of credit-rationed firms estimated on the basis of Invind data: the two series move closely and in the same direction. Further, Figure a6 shows that, as expected, the share of firms that are credit rationed in one year and the contemporaneous average percentage change in PC are negatively correlated (-0.53; -0.64 if we exclude the outlier of year 2009).

Figure 9

Average change in PC
(cumulative percentage points)

Source: Our computations based on Invind data.
Note: Observations are weighted with the number of firms.

Figure 9 shows the change in PC of credit constrained and unconstrained firms in the four sub-periods in our sample. The PC dynamics were rather similar in the two groups before the crisis and in the recovery phase. By contrast, during the two recessions, and especially during the sovereign debt crisis, the decline in PC was much greater for constrained firms. In Section 4 we evaluate the role of credit constraints in determining individual PC dynamics, controlling for the other characteristics of the firm.

4. Relative importance of factors impacting on productive capacity

In this section we exploit the availability of micro-data to assess how the impact of the crisis on individual firms' PC relates to a number of observable firms' characteristics. At this stage we cannot identify causal relationships, but we simply disentangle the relative importance of the factors considered above.

Specifically, we estimate the following equation:

$$\delta'_{it} = \log\left(\frac{c_{i,t}}{c_{i,t-1}}\right) = \alpha + \beta X + \gamma Z + u_{it} \qquad (4)$$

where X is a set of fixed effects for macro-regions (with the North West as the comparison group), share of export turnover (with non-exporters as the comparison group), sector of activity (with metallic and mechanical products as the comparison group) and size, and Z is a vector of additional controls. Estimates for the entire crisis period 2007-13 are reported in Table 3, where our preferred specification is in column (8).[14]

The estimates broadly confirm the evidence of Section 3: we note in particular that the differences relating to sector of activity and to size turn out to be the most significant. The estimated impact of the crisis is statistically different across sectors: *ceteris paribus*, for producers of non-metallic minerals and of textiles and leather goods the change in PC was about 2 percentage points lower than for the comparison group; the change was instead about 1.2 percentage points higher for producers of food and tobacco products.

Our estimates suggest that the performance of the southern regions was not significantly different from that of the northern regions, whereas the annual decline in PC of firms located in the Centre appears to be significantly smaller than in the rest of the country.

Large firms (in terms of the number of employees) performed significantly better than the others: the average annual change in PC for firms with 100 or more employees was at least 1.7 percentage points higher than it was for smaller ones (50-99 employees); the change in PC among the largest firms (1000 or more employees) was 3.0 points higher.

[14] For model 8 as a robustness check we present, in column 9, the estimates using the percentage change in PC (δ_{it}) as the dependent variable instead of the log-differences (δ'_{it}).

Table 3– Estimates of equation (4)

Model:	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
Dependent variable:	Log change	Log change	Log change	Log change	Log change	Log change	Log change	Log change	Percent variation	Log change	Log change	Log change
SECTORS OF ACTIVITY												
- Food and tobacco	1.077*	1.051*	1.121*	1.266**	1.143*	1.186**	1.175*	1.187*	0.471	1.435**	1.100*	1.360**
	(0.586)	(0.589)	(0.595)	(0.608)	(0.597)	(0.595)	(0.601)	(0.616)	(0.650)	(0.650)	(0.615)	(0.650)
- Textiles and leather	-1.824***	-1.916***	-1.989***	-2.019***	-1.943***	-2.140***	-2.120***	-2.058***	-2.412***	-2.156***	-2.066***	-2.163***
	(0.680)	(0.676)	(0.673)	(0.669)	(0.665)	(0.664)	(0.662)	(0.668)	(0.652)	(0.688)	(0.667)	(0.687)
- Coke, chemicals, rubber, plastics	0.323	0.330	0.350	0.372	0.299	0.379	0.327	0.281	-0.633	0.641	0.399	0.738
	(0.657)	(0.655)	(0.659)	(0.655)	(0.655)	(0.658)	(0.658)	(0.657)	(0.721)	(0.682)	(0.662)	(0.687)
- Non-metallic minerals	-2.023**	-2.073**	-2.235***	-1.825**	-1.978**	-1.855**	-1.861**	-1.803**	-2.199***	-1.883**	-1.711**	-1.803**
	(0.812)	(0.811)	(0.812)	(0.828)	(0.826)	(0.850)	(0.850)	(0.853)	(0.841)	(0.912)	(0.857)	(0.918)
- Other manufacturing	-1.709**	-1.777**	-1.897**	-1.856**	-1.810**	-1.827**	-1.819**	-1.787**	-2.312***	-1.257*	-1.741**	-1.213*
	(0.774)	(0.780)	(0.776)	(0.762)	(0.762)	(0.753)	(0.752)	(0.756)	(0.700)	(0.648)	(0.756)	(0.647)
MACRO-REGIONS												
- North East			0.104	0.0824	0.0262	-0.0398	-0.0466	-0.0422	-0.104	0.0289	-0.0415	0.0340
			(0.610)	(0.604)	(0.605)	(0.596)	(0.598)	(0.598)	(0.590)	(0.612)	(0.597)	(0.610)
- Center			1.294**	1.450**	1.566***	1.469**	1.326**	1.342**	1.496**	1.084*	1.380**	1.124*
			(0.557)	(0.565)	(0.570)	(0.573)	(0.583)	(0.587)	(0.594)	(0.601)	(0.589)	(0.603)
- South and Islands			-0.117	0.368	0.608	0.423	0.194	0.176	0.736	-0.137	0.162	-0.143
			(0.579)	(0.644)	(0.656)	(0.660)	(0.679)	(0.708)	(0.722)	(0.716)	(0.708)	(0.716)
SHARE OF EXPORTS TURNOVER												
- 0<export share<1/3				1.594	1.439	1.308	1.338	1.403	0.591	0.479	1.407	0.488
				(0.981)	(0.975)	(0.968)	(0.974)	(0.968)	(1.081)	(0.929)	(0.966)	(0.927)
- 1/3≤export share<2/3				1.658	1.426	1.537	1.561	1.612	0.561	0.705	1.634	0.722
				(1.063)	(1.054)	(1.054)	(1.060)	(1.057)	(1.170)	(1.001)	(1.054)	(0.998)
- export share≥2/3				2.028*	1.736	1.810	1.806	1.880*	1.205	0.851	1.927*	0.895
				(1.120)	(1.125)	(1.117)	(1.122)	(1.110)	(1.207)	(1.055)	(1.105)	(1.050)
SIZE												
- 100-199 employees					1.464***	1.620***	1.636***	1.652***	1.788***	1.185**	1.547***	1.095*
					(0.548)	(0.565)	(0.565)	(0.564)	(0.562)	(0.580)	(0.565)	(0.581)
- 200-499 employees					1.600***	2.051***	2.084***	2.110***	1.996***	2.136***	1.959***	2.009***
					(0.556)	(0.635)	(0.639)	(0.644)	(0.626)	(0.666)	(0.642)	(0.663)
- 500-999 employees					0.983	1.642**	1.667**	1.706**	1.554**	2.025**	1.614**	1.945**
					(0.719)	(0.792)	(0.800)	(0.803)	(0.792)	(0.816)	(0.799)	(0.812)
- ≥1,000 employees					2.274***	2.889***	2.939***	2.967***	2.849***	2.916***	2.820***	2.797***
					(0.775)	(0.868)	(0.879)	(0.885)	(0.909)	(0.900)	(0.879)	(0.897)
ADDITIONAL CONTROLS												
Belongs to a group						-1.222**	-1.286**	-1.214**	-0.808	-1.326**	-1.633***	-1.697***
						(0.537)	(0.545)	(0.542)	(0.538)	(0.558)	(0.577)	(0.594)
Is credit rationed										-1.205		-1.253
										(1.333)		(1.332)
Is parent company											1.989**	1.729**
											(0.794)	(0.831)
Year fixed effects	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Age and age squared	No	No	No	No	No	No	Yes	Yes	Yes	Yes	Yes	Yes
Legal form fixed effects	No	No	No	No	No	No	No	Yes	Yes	Yes	Yes	Yes
Constant	-1.001***	1.773***	1.590**	-0.0738	-0.568	-0.0447	0.966	1.155	3.515**	2.321*	1.326	2.465*
	(0.378)	(0.648)	(0.693)	(1.123)	(1.151)	(1.146)	(1.299)	(1.361)	(1.378)	(1.291)	(1.368)	(1.299)
Adj. R-Squared	0.00213	0.0138	0.0141	0.0144	0.0156	0.0164	0.0166	0.0173	0.0169	0.0175	0.0182	0.0182
Observations	9,720	9,720	9,720	9,720	9,720	9,656	9,656	9,656	9,660	9,069	9,656	9,069

Note: OLS estimates of $\underline{\beta}$ and $\underline{\gamma}$ in equation 4. Sample restricted to years 2007-13. In models 1-8 and 10-12 the dependent variable is change in PC measured as the difference between its natural logarithm at time t and at time t-1. In model 9 the dependent variable is the change in PC measured as a percentage change from time t-1 to time t. Extreme percentiles of the dependent variables were trimmed. The omitted sector is 'firms producing metallic and mechanical product'; the omitted macro-region is the North West; the omitted share of exports turnover is "nihil"; the omitted size is'50-99 employee'. Standard errors clustered at firm level in parentheses.

* p<0.1, ** p<0.05, *** p<0.01

Our estimates on the full sample (2008-13) do not indicate systematically significant differences between exporters and non-exporters; this finding presumably stems from the fact that foreign exposure, after impacting negatively in the first phase of the crisis, became markedly favourable in the second. This aspect is discussed again below, when the performances are estimated for different sub-periods.

Running the simple following regression (4a) of the change in PC on a continuous (0-100%) export share variable with time varying coefficients yields that exporters increased their PC significantly more than the others in 2006-07 and reduced it more in 2009, while the variable was not relevant in the remaining years:

$$\delta'_{it} = \alpha + \beta * t_{year} * \frac{x_{it}}{y_{it}} + X + u_{it} \qquad (4a)$$

where t_{year} is a set of year dummies and X is the usual set of control dummies.

Considering conglomerates, on average firms belonging to a group reduced their PC by 1.2 points per year more than firms not belonging to groups. Exploring this evidence further (models 11-12), we find that parent companies fared no differently from firms outside groups while subsidiaries' PC instead fell more. This evidence might suggest that the better performance of the former could have been supported by 'reshoring' some manufacturing activity to the parent company, while leaving the most troubled areas to the subsidiaries.

Finally, we find no evidence that in the overall crisis period 2007-13 the average change in PC of credit rationed firms differed statistically from that of other firms (models 10 and 12). We also find weak evidence that in the period as a whole the capacity decrease was larger among more mature firms; however, this result is at best marginally significant.

4.1 Estimates by sub-period

Estimates for the whole period 2008-13, characterized by two crises and a temporary recovery, could hide heterogeneous patterns: Table 4 reports estimates of our preferred specification (model 8) for each sub-period.

We find that the reasons underlying losses in PC shifted in the course of the years. Regarding the sector of activity, the greatest vulnerability emerges for manufacturers of textiles and leather products, who were already suffering before the onset of the crisis. In 2008-09 the global financial crisis hit all sectors, with the exception of the food sector and

the manufacturing of chemical products. The decline in PC was instead particularly pronounced again in the textiles and leather goods sector; this was also the case in the years 2012-13.

Size differences were statistically significant only in 2008-09, with big firms being much better at weathering the negative foreign demand shock. All other factors being equal, the Centre macro-region was less affected than the rest of country in 2008-09. Compared with non-exporting firms, those with more than two thirds of export turnover suffered a significantly larger (about 4 percentage points per year) loss in PC in 2008-09 but had a better performance in 2012-13 (by 5 percentage points per year).

Finally, focusing on the years 2012-13, a major drag on PC came from the credit tightening: PC was lower by 3.5 percentage points per year in credit constrained firms compared with non-constrained ones. Also, in 2012-13, the PC of subsidiaries fell more than that of firms outside groups.

5. Conclusions

In this paper we use survey micro-data to investigate the drivers of the fall in production capacity in the Italian manufacturing sector during the long, double-dip recession of 2008-13. Looking at the whole sample period, the fall was particularly pronounced among smaller firms, especially those in the textiles and leather sector (whose productive capacity was already declining before 2008) and in the non-metallic minerals sector (which was probably affected by the deep crisis in the construction sector). In 2012-13, productive capacity was significantly affected by both credit constraints and intra-group dynamics (for firms belonging to groups). As expected, the impact of the 2008-09 recession was particularly severe for export-oriented firms, while the opposite occurred in 2012-13. Finally, the fall in productive capacity was broadly evenly distributed across Italian macro-regions, with a somewhat smaller decline in the Centre.

Table 4 – Estimates of equation (4) by sub-period

Sample restricted to years:	2001-07		2008-09		2010-11		2012-13	
Model:	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
SECTORS OF ACTIVITY								
- Food and tobacco	-0.880	-0.778	3.823***	3.736***	1.250	2.370	1.093	0.723
	(0.742)	(0.760)	(1.294)	(1.340)	(1.428)	(1.523)	(1.244)	(1.281)
- Textiles and leather	-2.738***	-2.398***	-3.621**	-3.089**	0.167	-0.389	-2.353**	-3.036**
	(0.909)	(0.899)	(1.535)	(1.555)	(1.719)	(1.881)	(1.162)	(1.240)
- Coke, chemicals, rubber, plastics	-0.599	-0.337	2.319*	2.743**	-1.320	-0.845	0.0961	0.648
	(0.756)	(0.779)	(1.311)	(1.329)	(1.491)	(1.542)	(1.221)	(1.202)
- Non-metallic minerals	-0.386	0.396	-3.620	-3.339	-3.494	-3.299	0.878	1.108
	(0.949)	(1.026)	(2.444)	(2.481)	(2.423)	(2.518)	(1.570)	(1.467)
- Other manufacturing	-0.382	-0.527	-0.502	-0.0349	-1.354	-1.325	-3.010*	-1.022
	(0.767)	(0.774)	(1.355)	(1.373)	(1.612)	(1.691)	(1.702)	(1.192)
MACRO-REGIONS								
- North-East	1.119*	1.037	0.910	0.897	-1.194	-1.430	-0.280	0.227
	(0.672)	(0.675)	(1.172)	(1.199)	(1.494)	(1.631)	(1.070)	(0.998)
- Centre	0.784	0.371	2.939**	2.681*	-0.289	-0.215	0.787	0.490
	(0.721)	(0.736)	(1.341)	(1.370)	(1.437)	(1.507)	(1.198)	(1.191)
- South and Islands	1.697**	1.198	2.015	2.064	-2.606	-2.566	1.365	0.648
	(0.776)	(0.795)	(1.523)	(1.537)	(1.673)	(1.749)	(1.320)	(1.275)
SHARE OF EXPORT TURNOVER								
- 0<export share<1/3	-0.0555	-0.260	0.187	0.0707	0.452	0.0265	3.384	1.450
	(0.852)	(0.868)	(1.785)	(1.796)	(2.752)	(2.876)	(2.141)	(2.007)
- 1/3≤export share<2/3	1.230	1.200	-1.741	-2.187	0.628	0.534	4.881**	2.842
	(0.911)	(0.921)	(1.949)	(1.950)	(2.990)	(3.119)	(2.306)	(2.083)
- export share≥2/3	1.871*	1.734	-3.965**	-4.264**	2.020	1.580	6.729***	5.171**
	(1.050)	(1.063)	(1.993)	(1.989)	(3.073)	(3.173)	(2.327)	(2.121)
SIZE								
- 100-199 employees	0.594	0.354	1.948*	1.652	1.705	1.902	1.311	-0.259
	(0.578)	(0.587)	(1.082)	(1.126)	(1.306)	(1.411)	(1.029)	(1.027)
- 200-499 employees	2.012***	1.645**	3.032**	3.033**	0.288	0.895	2.051*	1.460
	(0.666)	(0.672)	(1.264)	(1.323)	(1.445)	(1.532)	(1.100)	(1.116)
- 500-999 employees	2.031**	1.558*	3.513**	4.189***	0.540	0.851	1.517	1.277
	(0.809)	(0.826)	(1.478)	(1.506)	(1.799)	(1.866)	(1.445)	(1.481)
- ≥1,000 employees	1.312	1.177	6.876***	7.064***	1.229	1.013	0.760	-0.315
	(0.908)	(0.936)	(2.032)	(2.080)	(1.823)	(1.858)	(1.703)	(1.677)
ADDITIONAL CONTROLS								
Belongs to a group	-0.975*	-1.072*	-0.917	-1.204	-1.682	-1.165	-1.344	-3.059***
	(0.571)	(0.601)	(1.034)	(1.068)	(1.277)	(1.355)	(0.937)	(0.981)
Is credit rationed		-0.762		-1.862		0.297		-3.500**
		(1.868)		(1.978)		(3.760)		(1.706)
Is parent company		1.300		1.203		-0.897		3.844***
		(0.902)		(1.837)		(1.814)		(1.202)
Constant	1.015	1.295	0.0747	0.587	1.348	1.250	-4.853	-1.096
	(1.454)	(1.470)	(2.460)	(2.432)	(3.458)	(3.654)	(2.986)	(2.684)
Adj. R-Squared	0.0135	0.0125	0.0372	0.0372	0.00175	-0.00120	0.0141	0.0182
Observations	8,567	8,136	2,773	2,707	2,653	2,472	2,772	2,522

Note: OLS estimates of $\underline{\beta}$ and $\underline{\gamma}$ in equation (4). Sample restricted to years shown above. Models 1, 3, 5 and 7 include the same controls as model 8 of Table 3; models 2, 4, 6 and 8 include the same controls as model (12) of Table 3; all models include: year fixed effects, age, age squared, legal form fixed effects. The dependent variable is the change in PC measured as the difference between its natural logarithm at time t and t-1. Extreme percentiles of the dependent variables were trimmed. The omitted sector is 'firms producing metallic and mechanical products'; the omitted macro-region is the North-West; the omitted share of exported turnover is 'nil'; the omitted size is '50-99 employees'. Standard errors clustered at firm level in parentheses.

* p<0.1, ** p<0.05, *** p<0.01

Appendix

Table a1 – Invind sample size

	Number of observations	Observations for which PC change can be computed
2001	1,713	0
2002	1,797	1,385
2003	1,848	1,393
2004	1,861	1,448
2005	1,890	1,481
2006	1,838	1,509
2007	1,785	1,461
2008	1,752	1,402
2009	1,706	1,379
2010	1,667	1,321
2011	1,749	1,353
2012	1,750	1,389
2013	1,782	1,418
Total	**23,138**	**16,939**

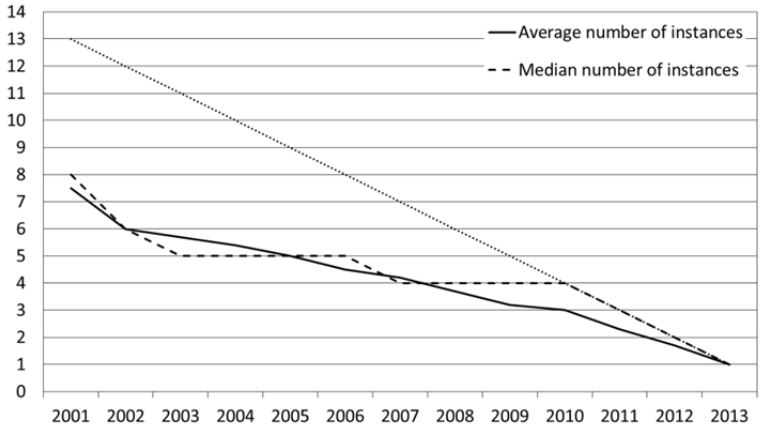
Source: Invind data.

Table a2 - Provided and imputed values on the CU rates in the Invind

	Number of answers provided	Number of imputed values	Total number of observations
Reference year			
2001	1,518	195	1,713
2002	1,531	266	1,797
2003	1,543	305	1,848
2004	1,548	313	1,861
2005	1,573	317	1,890
2006	1,529	309	1,838
2007	1,496	289	1,785
2008	1,412	340	1,752
2009	1,389	317	1,706
2010	1,342	325	1,667
2011	1,409	340	1,749
2012	1,437	313	1,750
2013	1,470	312	1,782
Macro-region			
North West	4,908	1,569	6,477
North East	4,358	902	5,260
Centre	4,481	618	5,099
South and Islands	5,450	852	6,302
Number of employees (1)			
50-99	6,810	1,312	8,122
100-199	5,574	933	6,507
200-499	4,176	877	5,053
500-999	1,503	406	1,909
1000 and over	1,134	413	1,547
Sector of activity			
Food, beverages and tobacco products	2,466	436	2,902
Textiles, wearing apparel and leather	2,498	554	3,052
Wood, paper products and printing	1,242	226	1,468
Coke, chemicals, rubber and plastics	2,229	528	2,757
Non-metallic mineral products	1,422	139	1,561
Metallurgy and metal products	3,054	557	3,611
Machinery and mechanical equipment	2,589	600	3,189
Electrical machinery and equipment	1,482	451	1,933
Transport vehicles	1,153	251	1,404
Other manufacturing	1,062	199	1,261
Total	**19,197**	**3,941**	**23,138**

Source: Invind data. (1) Information not available for firms with 20-49 employees.

Figure a3 – Panel structure: average and median number of instances,[1] by initial year in the data



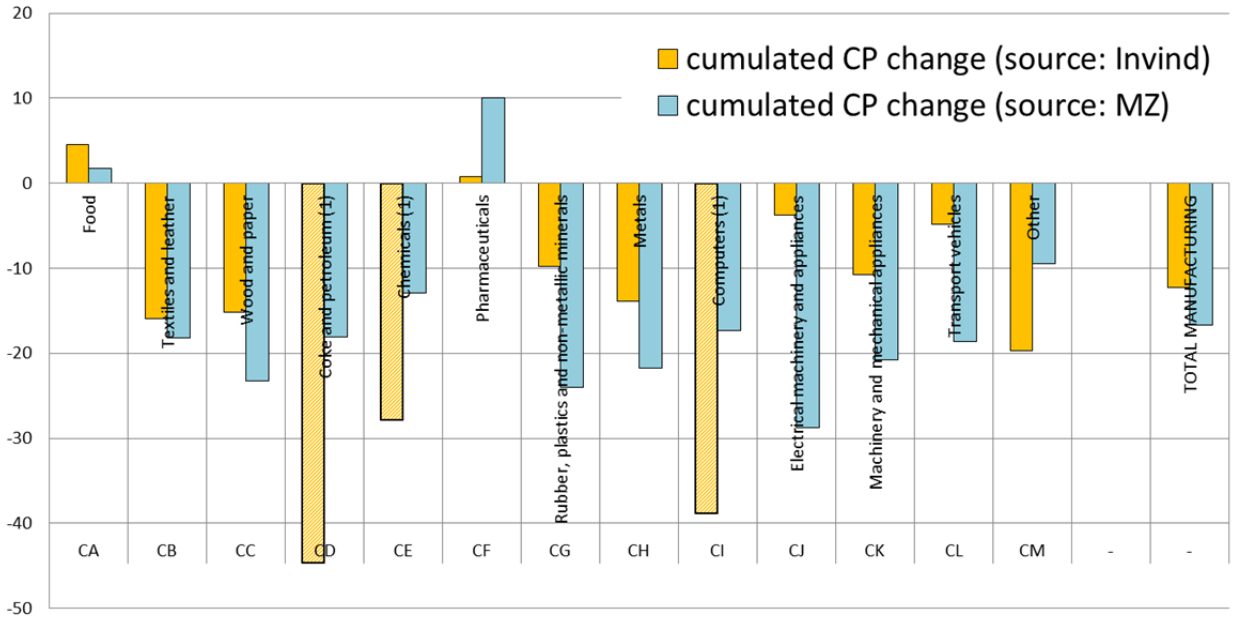
Source: Invind data
Note: (1) instances are the times (possibly non-consecutive) that each firm is interviewed in the survey.

Table a4 – Reported change in TPC in the Invind

	Self-reported increase in PC	Self-reported no change in PC	Self-reported decrease in PC
Δ number of employees	0.0042***	-0.0017***	-0.0072***
	(0.00045)	(0.00044)	(0.00061)
Log(investments/employee)	0.13***	-0.11***	-0.074***
	(0.0089)	(0.0088)	(0.011)
Observations	22,678	22,678	22,678

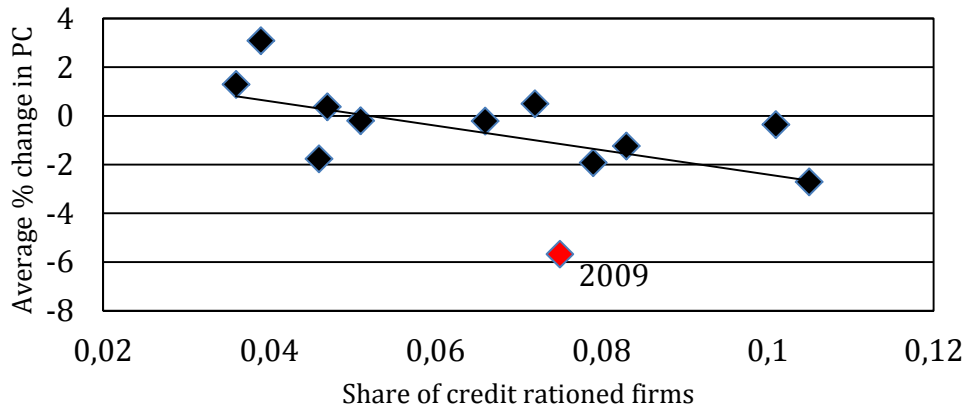
Note: Invind data between 2001-2013. The table reports marginal effects from probit estimates of equation (3); robust standard errors in parentheses, corrected for firm level clustering; controls include year, sector, macro-region and size dummies. * p<.1, **p<.05, *** p<.01.

Figure a5 – PC by sector: micro- vs macro-data series
(percentage changes 2013-08)



Source: Our computations based on Invind data for cumulative variations in PC computed on micro-data; Monteforte and Zevi (2015) for cumulative variations in PC computed on Istat macro series.
Note: (1) Less than 50 observations for some or all years for those sectors.

Figure a6 – Share of credit rationed firms and average changes in PC



Source: Our computations based on Invind data.

References

Aprigliano, V. and Conti, A. M. (2014), 'How Financial and Sovereign Risk Shocks Shape Potential Output in Italy' in *Gli effetti della crisi sul potenziale produttivo e sulla spesa delle famiglie in Italia*, Workshops and Conferences, Banca d'Italia.

Ball, L. M. (2014), 'Long-Term Damage from the Great Recession in OECD Countries', *NBER Working Papers* 20185, National Bureau of Economic Research.

Banca d'Italia (2014), 'L'economia delle regioni italiane. Dinamiche recenti e aspetti strutturali', *Economie regionali* No. 43.

Baker M, (1992), 'Digit Preference in CPS Unemployment Data', *Economics Letters*, 39/ 1, pp. 117–121.

Becker, R. A., Haltiwanger, J., Jarmin, R. S., Klimek, S. D., and Wilson, D. J., (2006), 'Micro and Macro Data Integration: The Case of Capital', in NBER, *A New Architecture for the U.S. National Accounts*, Dale W. Jorgenson, J. Steven Landefeld, and William D. Nordhaus (eds), University of Chicago Press.

Bugamelli, M., Gaiotti, E. and Viviano, E., (2014), 'Domestic and foreign sales: complements or substitutes?', Questioni di Economia e Finanza (Occasional Papers) 248, Banca d'Italia.

Di Nino V. (2015), 'The phenomenal CAT: firms clawing the goods of others', Questioni di Economia e Finanza (Occasional Papers) 281, Banca d'Italia.

Gerali, A., Locarno, A., Notarpietro, A. and Pisani, M. (2015), 'Every cloud has a silver lining. the sovereign crisis and Italian potential output', Temi di Discussione (Working Papers) 1010, Banca d'Italia.

ISTAT, *Struttura e competitività del sistema delle imprese industriali e dei servizi, Anno 2012*, November 2014.

ISTAT, *Rapporto sulla competitività dei settori produttivi, Edizione 2015*, February 2015.

Malgarini, M. and A. Paradiso, (2010), 'Measuring capacity utilization in the Italian manufacturing sector: a comparison between time series and survey models in light of the actual economic crisis,' ISAE WP n. 129.

Mistretta, A. and Monteforte, L. (2015), 'La demografia d'impresa e la capacità produttiva dell'industria italiana durante la crisi', mimeo, Banca d'Italia.

Monteforte, L. and Zevi, G. (2015), 'An inquiry on manufacturing capacity in Italy after the double-dip recession', Questioni di Economia e Finanza (Occasional Papers) forthcoming, Banca d'Italia.

NOMISMA, 'Potenziale Manifatturiero', S. De Nardis (ed.), *Scenario di febbraio 2015*.