BANCA D'ITALIA

EUROSISTEMA

Questioni di Economia e Finanza

(Occasional Papers)

Productivity and reallocation: evidence from the universe of Italian firms

by Andrea Linarello and Andrea Petrella

September 2016

Number 353

BANCA D'ITALIA
EUROSISTEMA

Questioni di Economia e Finanza

(Occasional papers)

Productivity and reallocation: evidence from the universe of Italian firms

by Andrea Linarello and Andrea Petrella

Number 353 – September 2016

The series Occasional Papers *presents studies and documents on issues pertaining to the institutional tasks of the Bank of Italy and the Eurosystem. The* Occasional Papers *appear alongside the* Working Papers *series which are specifically aimed at providing original contributions to economic research.*

The Occasional Papers *include studies conducted within the Bank of Italy, sometimes in cooperation with the Eurosystem or other institutions. The views expressed in the studies are those of the authors and do not involve the responsibility of the institutions to which they belong.*

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

PRODUCTIVITY AND REALLOCATION: EVIDENCE FROM THE UNIVERSE OF ITALIAN FIRMS

by Andrea Linarello* and Andrea Petrella*

Abstract

This paper investigates the contribution of allocative efficiency to aggregate labor productivity growth in Italy between 2005 and 2013. Exploiting a unique dataset that covers the universe of active firms, we find that allocative efficiency accounted for 35 per cent of aggregate productivity in 2005 and its weight increased by almost 7 percentage points during the period of observation. We show that the dynamics of aggregate labor productivity benefited from the reallocation of resources among continuing firms and from the net effect of business demography. Among industries, we find that reallocation has been stronger in industries that are more exposed to import competition from developing countries. Moreover, we document that the observed adjustments have not evenly affected all firms across the productivity distribution: selection has become tougher for firms belonging to the lower tail, forcing the exit of the least productive firms and favoring the reallocation of the workforce to the best performing firms.

JEL Classification: L25, O47.
Keywords: aggregate labor productivity, allocative efficiency.

Contents

1. Introduction 5
2. Data 8
3. Productivity decompositions: level and dynamics 9
4. Results 12
   4.1 Baseline results 12
   4.2 Netting from sectoral composition 14
   4.3 Cyclical fluctuations 15
   4.4 Industry characteristics 16
   4.5 Effects along the productivity distribution 17
   4.6 The importance of observing the universe of firms: a comparison with other popularly used data cuts 18
5. Conclusions 18
References 21
Tables 23
Figures 28
Appendix A: Additional checks 33
Appendix B: Additional tables 35
Appendix C: Additional figures 38

* Bank of Italy, Directorate General for Economics, Statistics and Research.

1 Introduction[1]

Thanks to the increasing availability of firm-level data, a growing theoretical and empirical literature documented large and persistent productivity differences across countries and firms within narrowly defined sectors (Bartelsman et al., 2005). This research agenda largely improved our understanding of aggregate productivity dynamics by highlighting two distinct mechanisms of adjustment. On the one hand, aggregate productivity is the result of technological and managerial decisions made by entrepreneurs (Aghion et al., 2009; Bloom and Van Reenen, 2010); on the other hand, it reflects the ability of an economy to allocate resources towards its most productive units (Hsieh and Klenow, 2009).

Several studies have documented that the share of aggregate productivity explained by the latter, i.e. allocative efficiency, is substantial: up to almost 50 per cent in the U.S. and around 30 per cent in other developed countries (Bartelsman et al., 2009); moreover, it allows to explain the productivity differentials among countries (Andrews and Cingano, 2014). Intuitively, aggregate productivity increases whenever production factors are reallocated from least to most productive units; one interesting conclusion of this line of research is that heterogeneity in firm-level productivity may reflect misallocation of resources across firms due to frictions in factor and output markets.

Despite the increasing interest from both academic researchers and policy makers on misallocation, it is still debated what is the most instructive measure of firm-level heterogeneity to detect possible distortions in the allocation of resources. Following the pioneering contribution of Hsieh and Klenow (2009), several studies used the dispersion in revenue productivity to proxy for misallocation. Recently, however, Bartelsman et al. (2013) argue, both theoretically and empirically, that within industry covariance between size and productivity, also known as Olley-Pakes covariance (Olley and Pakes, 1996), is a robust measure to assess misallocation.

In this paper we aim at documenting the contribution of allocative efficiency to aggregate labor productivity dynamics in Italy. We take advantage of a unique dataset covering the universe of Italian firms operating in the private business non-agriculture and non-financial sector over the period 2005–2013. Data on the universe of active firms, while largely available for other countries (among others, U.S., France and Belgium), is new for Italy and it is the outcome of a collaboration between the Bank of Italy (BoI) and the Italian National Statistical Agency (ISTAT). The dataset combines several information from statistical, administrative and fiscal sources. It contains information on firms' loca-

[1]We are grateful to Matteo Bugamelli, Francesca Lotti, Paolo Sestito and Corrado Abbate for helpful comments. We thank Maria Gabriela Ladu for excellent research assistance. The views expressed herein are those of the authors and do not involve the responsibility of the Bank of Italy.

tion, legal form, date of incorporation, industry classification, number of person employed, turnover and value added (see Ladu and Linarello (2016) for a detailed description of the dataset).

As a first step in our analysis, in order to quantify the weight of allocative efficiency in Italy, we follow Olley and Pakes (1996) and we decompose the *level* of aggregate labor productivity into the *unweigthed* firm-level average productivity and the *OP covariance* term between labor productivity and size. We find that the OP covariance term accounted for about 35 percent of aggregate productivity in 2005; moreover, its contribution to aggregate labor productivity increased by almost 7 percentage points between 2005 and 2013. As a second step in our analysis, we apply the dynamic decomposition proposed by Melitz and Polanec (2015) to aggregate labor productivity growth. This methodology allows us to distinguish between two mechanisms affecting the allocative efficiency: first, the reallocation of resources among existing firms; second, the selection, i.e. entry and exit, of firms in the market. Our results show that, among incumbents, the positive contribution of the reallocation component is larger (in absolute value) than the decline in average productivity, with the exception of some years during the crisis, and therefore positively contributed to aggregate productivity growth. The net contribution of firm demography is always positive in our data: the exit of least productive firms more than compensates the entry of newborn firms, whose productivity level is on average lower than that of incumbent firms.

We then look at the correlation between our measures of reallocation and selection, and some industry structural characteristics. Not surprisingly, when we focus on the effect of business cycle, we find that average productivity and reallocation among existing firms increased more in the industries experiencing a boom. This is consistent with the evidence that firms invest in productivity enhancing technology and machinery when they experience an increase in market size (Syverson, 2011). We also document that the contribution of entry and exit to aggregate productivity growth is countercyclical, i.e. it is lower in industries that experience a boom. This result is consistent with the cleansing hypothesis, i.e. that recessions are period of tougher selection for business initiatives (Caballero and Hammour, 1994; Foster et al., 2014). Moreover, we show that reallocation is stronger in sectors that were more exposed to competition from developing countries; a fiercer competitive environment —especially in low value-added sectors— might have favored an improvement of allocative efficiency through the exit of the least productive firms and the reallocation of resources towards the most productive ones. A similar mechanism has been highlighted for U.S. manufacturing firms by Bernard et al. (2006), as a consequence of the exposure to low-wage country imports.

We conclude our analysis by providing some suggestive evidence of the underlying

forces behind the observed increase in allocative efficiency. We explore the role of firms entry, exit and employment growth along the productivity distribution. Between 2005 and 2013, we find that entry rate declined and exit rate increased for firms in the low tail of the productivity distribution. Moreover, average firm employment growth declined for all firms: in particular it became negative for the least productive firms, while it remained positive for the most productive ones. These results suggests that the Italian economy undertook some structural adjustments, eventually reinforced during the crisis, that led to the exit of unproductive firms and that favored the reallocation of workforce towards the best performing ones.

Recently, several studies explored the misallocation hypothesis as one of the possible causes behind the productivity slowdown experienced by many advanced economies (Cette et al., 2016). Gopinath et al. (2015) show that the decline in real interest rates, observed in Southern Europe, was associated with capital inflows increasingly misallocated towards firms with high net worth, though not necessarily being the most productive. García-Santana et al. (2016) document, for the case of Spain, that the increase in misallocation has been more severe in those industries in which the influence of the public sector is larger (e.g. through licensing or regulations).

Several contributions have also analyzed the role of allocative efficiency in Italy. Gamberoni et al. (2016) —using data on incorporated firms with more than 20 employees— show an increase in allocative efficiency after the global financial crisis in Italy, as well as in other European countries. Calligaris et al. (2016), using data on incorporated firms, documented for the Italian manufacturing sector an increase in the allocative efficiency starting in 2008.

The evidence provided in this paper is broadly in line with the analysis conducted so far on the Italian case, highlighting a relevant role of allocative efficiency in shaping productivity dynamics. However, while existing studies struggle to find a positive effect of reallocation on aggregate productivity growth before 2008, our results show that the OP covariance was increasing even before the crisis (between 2005 and 2007, in our data). Part of this discrepancy can be attributed to the different data sources used: as a matter of fact, while the existing evidence on allocative efficiency in Italy is limited to the subsample of incorporated firms, one of our main contribution to the current debate is that of using data for the universe of active firms. Moreover, we propose a simple, though effective, method to exploit the detailed sectoral disaggregation of our dataset, in order to net out our results from sectoral composition effects and cyclical conditions at the sector level.

2 Data

Our firm-level dataset covers all firms active for at least 6 months in a given business year from 2005 to 2013. The construction of the dataset is the result of a joint collaboration between the Bank of Italy (BoI) and the Italian National Statistical Agency (ISTAT); the dataset combines several information from the business registry and statistical, administrative and fiscal sources. It contains information on firms' location, legal form, incorporation date, industry classification (Nace rev. 2), number of people employed, turnover and value added[2]. The construction rely heavily on works done at ISTAT over the past few years for the construction of the FRAME-SBS dataset, an integrated firm-level census dataset that covers all active firms. While the census FRAME-SBS represents the source of information in our dataset starting from 2012, the joint effort of BoI and ISTAT contributed to filling the gaps backwards and building a longer time series of data, suitable for studying the evolution of the Italian economy starting from the mid 2000s.

At the aggregate level[3] our firm-level dataset replicates National Accounts data very well[4]. Panel (a) of figure 1 compares the growth rates of value added between the two data sources, separately for manufacturing and business services; panel (b) shows the comparison for the growth rates of labor productivity. In the manufacturing sector, the goodness of fit for both value added and labor productivity dynamic is excellent. Some differences emerge in the business services sector, largely due to the fact that National Account data include estimates of underground economy and illegal workforce, that weigh more in business services than in manufacturing. According to the latest official figures, illegal economy accounts for 7 percent of people employed and 6 percent of value added in manufacturing, against 16 percent and more than 20 percent in business services.

Table 1 and 2 report some descriptive statistics from our firm-level dataset: the number of firms in the manufacturing sector declines almost every year; in 2013 there were about 36,000 firms less than 2005. In business services, the number of firms do not exhibit a clear pattern, and in 2013 there were more firms than at the beginning of the period. Between 2005 and 2013, average firm size —measured by the number of people employed— increased in both sectors: in 2013 the average firm employed 9.3 people in manufacturing sector and 3.4 in the business service sector.

Aggregate labor productivity in the non-agriculture and non-financial business sectors,

[2]See Ladu and Linarello (2016) for a detailed description of the dataset.

[3]We exclude from the analysis sectors 19 (Manufacture of coke and refined petroleum products), 53 (Postal and courier activities) , 61 (Telecommunication) and 68 (Real estate activities).

[4]The comparison with National Accounts data is done at current prices in order to assure high comparability of data sources and prevent deviation due to use of aggregate price deflator for firm-level data.

measured as real value added per worker, increased between 2005 and 2007, and declined during the global financial (2007–09) and the sovereign debt (2011) crisis; overall, it was lower in 2013 than in 2005. The aggregate dynamics reflects heterogeneous patterns between manufacturing and services: in the former, aggregate labor productivity increased between 2005 and 2013, while in the latter it declined. Before the crisis, the increase of labor productivity in the manufacturing sector was due to a rise of value added greater than the one of employment; during the crisis period, instead, the adjustment of the labor force has been strongest. In business services, the negative dynamics of aggregate labor productivity is largely due to the constant increase in the number of people employed, despite the decline in value added since 2007.

3 Productivity decompositions: level and dynamics

Aggregate labor productivity (Φ) in year t corresponds to the weighted average of the individual firm's productivity (φ_i), with the weights (ω_i) being the firms' share on total employees. More formally:

$$\Phi_t = \sum_{i=1}^{n} \varphi_{it}\omega_{it} \tag{1}$$

Aggregate productivity can be further decomposed in the sum of the unweighted average firm productivity ($\bar{\varphi}$) and the covariance between firm productivity and the share of employees:

$$\Phi_t = \bar{\varphi}_t + \mathrm{Cov}(\varphi_{it}, \omega_{it}) = \bar{\varphi}_t + \sum_{i=1}^{n}(\varphi_{it} - \bar{\varphi}_t)(\omega_{it} - \bar{\omega}_t) \tag{2}$$

The covariance term is often referred to as "Olley and Pakes (OP) covariance". In Olley and Pakes (1996), this decomposition —applied to the US telecommunications industry— allowed the authors to distinguish between the efficiency gains deriving from a reallocation of resources towards the most productive firms (measured by the OP covariance), and those arising from the productivity growth of individual firms (captured by the average productivity term); the former component has been found to explain the most relevant share of the observed productivity gain.

The most recent developments of the economic literature devote an increasing attention to allocative efficiency, since it reflects most of the institutional and regulatory features that distort the functioning of the markets. As an example, Olley and Pakes (1996) document that, in the Eighties, the aggregate productivity of the US telecommunications industry grew considerably after an episode of market liberalization, and that this increase was

largely due to an improvement of allocative efficiency. In another study, Bartelsman et al. (2013) quantify the contribution of allocative efficiency, by showing that US aggregate labor productivity is roughly 50% higher with respect to a hypothetical scenario where workers are randomly allocated across firms.

On top of studying the contribution of allocative efficiency to the level of aggregate productivity, it is possible to analyze the dynamics of aggregate productivity through a decomposition that assesses —for each couple of years— the relative contribution of three groups of firms: the ones that survive (also called incumbents), entrants and exiting. The demographic processes play a role in determining the productivity dynamics, since entrants and exiting are different (also with respect to the incumbents) in terms of productivity levels. For incumbents, it is possible to further distinguish into the contribution of two more components: (i) the variation in the efficiency of individual firms (so-called *within* margin); and (ii) the reallocation of resources to firms characterized by different productivity levels (so-called *between* margin). This latter component is closely linked to the previously-described OP contribution, being its dynamic counterpart.

In order to rewrite equation (2) in dynamic terms, firms are divided in three groups g, as mentioned above[5]:

entrants (E) firms that were not active at time $t-1$ and enter the market at time t;

exiting (X) firms that were active at time $t-1$ and exit from the market at time t;

incumbents (S) firms that are active on the market in both periods.

With these definitions in hand, equation (2) can be rewritten as:

$$\Phi_t = \sum_{i=1}^{n} \varphi_{it}\omega_{it} = \sum_{g \in G} \Phi_{gt}\omega_{gt} \tag{3}$$

where the weights ω_{gt} correspond to the share of employees in group g, Φ_{gt} represents the aggregate productivity of group g, and $G = \{E, X, S\}$.

A dynamic version of equation (2) can be derived following the methodology —known as *dynamic OP decomposition*— recently proposed by Melitz and Polanec (2015). Considering two consecutive time periods, it is possible to express the aggregate productivity of the first period (Φ_1) as the weighted average of the productivity of the firms that will survive and the one of the firms that will exit the market; analogously, the aggregate productivity

[5]In all the analyses presented below, firm demography has been purged of false entrants and false exits, in the spirit of Geurts and Van Biesebroeck (2014).

of the second period (Φ_2) can be expressed as the weighted average of the productivity of the firms that have survived and the one of the firms that have entered the market:

$$\Phi_1 = \Phi_{S1}\omega_{S1} + \Phi_{X1}\omega_{X1} \tag{4}$$

$$\Phi_2 = \Phi_{S2}\omega_{S2} + \Phi_{E2}\omega_{E2} \tag{5}$$

The difference between Φ_2 and Φ_1 returns the variation in aggregate productivity:

$$\Phi_2 - \Phi_1 = (\Phi_{S2} - \Phi_{S1}) + \omega_{E2}(\Phi_{E2} - \Phi_{S2}) + \omega_{X1}(\Phi_{S1} - \Phi_{X1}) \tag{6}$$

where the first term $(\Phi_{S2} - \Phi_{S1})$ represents the productivity variation for the firms that are active on the market in both periods (the incumbents); the second $(\Phi_{E2} - \Phi_{S2})$ is the contribution of entrants, which is positive (negative) if their productivity is higher (lower) than the one of the incumbent firms; the third $(\Phi_{S1} - \Phi_{X1})$ is the contribution of firms that exit the market, which is positive (negative) if their productivity is lower (higher) than the one of the incumbents. The term $(\Phi_{S2} - \Phi_{S1})$ can be further decomposed in the variation of the incumbents' average productivity $(\Delta\bar{\varphi}_S)$ and the one of the covariance between incumbents' productivity and the share of employees (ΔCov_S), capturing the intensity of the reallocation process. To sum up, the variation of aggregate productivity can be expressed as the sum of the following four components:

$$\Phi_2 - \Phi_1 = \underbrace{\Delta\bar{\varphi}_S}_{\text{Average productivity}} + \underbrace{\Delta\text{Cov}_S}_{\text{Reallocation}} + \underbrace{\omega_{E2}(\Phi_{E2} - \Phi_{S2})}_{\text{Entry}} + \underbrace{\omega_{X1}(\Phi_{S1} - \Phi_{X1})}_{\text{Exit}} \tag{7}$$

where the sum of average productivity and reallocation add up to the contribution of the incumbents, and the sum of entry and exit add up to the contribution of net firm demography.

When applied to data expressed in logs, equation (7) directly returns the contributions to the growth rate of aggregate productivity. However, such decomposition may return imprecise results, since the covariance term would not be invariant to proportional changes in measured productivity. This drawback is easily fixed by using labor productivity in levels (instead of logs) and by rescaling it as suggested in Melitz and Polanec (2015, p. 374). All the results presented below are obtained under the latter methodology.

4 Results

4.1 Baseline results

We first have applied the decomposition in equation (2) to the level of Italian aggregate productivity. Figure 2 shows the contribution of the OP covariance, $\frac{\text{Cov}(\varphi_{it},\omega_{it})}{\Phi_t}$, for total economy, and for manufacturing and services separately. On average, allocative efficiency accounts for slightly less than 40% of aggregate productivity; the contribution is higher in manufacturing than in services.[6] In the 2005–13 period, the weight of allocative efficiency has risen by nearly 7 percentage points, more strongly and steadily in manufacturing than in services. In table B.1 we report the OP contribution for each 2-digit sector between 2005 and 2013.

The increasing incidence of allocative efficiency on the level of aggregate productivity is suggestive of the fact that reallocation may have played a major role in shaping the dynamics of Italian labor productivity in the period of observation. The decomposition outlined in equation (7) allows us to shift our focus to the growth rate of aggregate productivity —a more relevant variable both for policy and welfare considerations— and to have a more complete picture of the reallocation process, including firm demography as well.

Table 3 shows the results obtained applying the above-mentioned decomposition to our firm-level data. The first column contains the contribution of incumbent firms' average productivity to the dynamics of aggregate productivity; this contribution reflects both variations in technical efficiency at the firm level and fluctuations in the demand faced by firms, that may influence —especially in the short run— the pricing strategies of firms.[7] The second column shows the contribution of the reallocation among the surviving firms; in other words, it tells how much of the observed productivity dynamics depends on reallocation of employment shares to the most efficient firms. The contribution of entry (third column) is typically negative, as it reflects the lower productivity of these firms with respect to the incumbents; such productivity divide may derive on one side from the smaller size f entrants, on the other from the fact that newborn firms tend to compress their markups, setting up more aggressive price strategies upon entry, in order to rapidly acquire market shares (Foster et al., 2016). The positive contribution of exit, instead, reflects the selection

[6] Bartelsman et al. (2013) document the contribution of the OP covariance term to the aggregate productivity of the manufacturing sector in eight different countries; their results range from 51% for the US to -3% for Romania.

[7] It has to be stressed that we are not able to perfectly control for price variations, since the deflators at our disposal are disaggregated at the 2-digits level. Hence, price variations may still show up in our data, as long as they depart from the average price dynamics within each 2-digit sector.

mechanisms that force the exit from the market of the least productive firms.

In the period under analysis (2005–13), aggregate productivity in manufacturing has risen by 8.9%, despite the fall experienced in correspondence to the two episodes of economic crisis. The generalized decline of average productivity has been counterbalanced by a positive contribution of reallocation in every year of our sample. Despite being positive in the vast majority of the cases, in services the reallocation has not been strong enough to counterbalance the steady decline experienced in terms of average productivity; this had a detrimental impact on the overall dynamics of aggregate productivity, which fell by 9,4% over the 2005–13 period.

Aggregate productivity has also been influenced by firm demography. As expected, the entry component is always negative (since entrants are, on average, less productive than incumbents), and the exit one is always positive (since exiting firms are less productive than incumbents, as well). Overall, the net contribution of firm entry and exit has sustained the dynamics of aggregate productivity in almost all years, despite being relatively small in magnitude; the contribution of firm demography has been substantially higher in the years of deepest financial crisis (2008–09), as a result of an increase in the exit component induced by a more pronounced selectivity on the market.

Ultimately the contribution of firm demography depends on two factors: on one side, the rates of entry/exit from the market; on the other, the relative productivity of entering and exiting firms with respect to the incumbents. The dynamics of these two factors is reported in Table 4. Services are characterized by substantially higher entry and exit rates with respect to manufacturing. Moreover, while in manufacturing the exit rate is always higher than the entry rate,[8] in services it is usually the opposite,[9] if we exclude, the sudden tightening up of the selection process in the most acute phase of the sovereign debt crisis (2012 and 2013). Entry rates in both manufacturing and services have shrunk over time, while the pattern followed by exit rates is less clear-cut; it is apparent, though, that exit rates suddenly increase in the years of crisis, suggesting that recessions influence firm demography by mainly pushing firms out of the market, rather than by preventing the entrance of new firms. Looking at the characteristics of entrants and exiting, firms entering in manufacturing are —relative to the incumbent firms— smaller but more productive with respect to the new entrants in services. Relative productivity has been declining for both entering and exiting firms throughout all the period of observations, more intensely in manufacturing, where —as shown in Table 3— the process of reallocation has sustained

[8]This is coherent with other data sources —such as the Infocamere database— that provide information on firm demography in manufacturing.

[9]This pattern has been also documented in Lotti (2007).

the aggregate productivity of incumbents.

4.2 Netting from sectoral composition

The results of the aggregate labor productivity decomposition presented in table 3 may crucially depend on composition effects: the relative weight of the four components could be heterogeneous across more narrowly-defined sectors, as it is likely to be influenced by structural sectoral characteristics —such as the degree of competitiveness or the exposure to international trade, for example. In order to check whether are results are significantly affected by these composition effects, we have replicated the dynamic OP decomposition on each narrowly-defined sector (according to the 5-digit Ateco 2007 classification), pooled together all the sectors, and estimated for each component the following OLS model:

$$\Delta y_{st} = \delta_s + \delta_t + \varepsilon_{st} \tag{8}$$

where Δy is one of the four components of aggregate labor productivity growth between year t and $t-1$ (as defined in equation (7)), s indexes 5-digit sectors, t indexes years, δ_s are sector fixed effects, δ_t are fixed effects for year t, and ε_{st} is an error term. The idea behind this specification is to control for invariant sectoral characteristics by means of the sectoral fixed effects δ_s. The year fixed effects δ_t estimated under this framework can thus be interpreted as the contribution of each component to the dynamics of aggregate productivity, net of the composition effects discussed above.

For each component, Figure 3 plots the estimated year fixed effects for the total economy. The results presented in table 3 are broadly confirmed; moreover, the evolution over time of the various components emerges now more clearly, highlighting in particular the steadily-increasingly positive role of reallocation in counterbalancing the fluctuations in average firm productivity.

Net of sectoral composition, aggregate labor productivity —which was moderately increasing until 2007— experienced a conspicuous swing in the years of the financial crisis and then settled on a pattern of sluggish growth, interrupted by a new trough at the onset of the sovereign debt crisis. This dynamics is largely dominated by the contribution of incumbent firms, which summarizes the often diverging contribution of the average productivity and of the reallocation terms: on one side, the firms' average productivity —sluggishly growing at the beginning of our sample— suffered sharp declines in correspondence to the two crisis episodes, and negatively weighed on aggregate productivity in all post-crisis years, except 2010; on the other side, the contribution of reallocation —initially less sizable— experienced a considerable jump at the onset of the financial crisis, maintain-

ing its contribution at the same high levels in the following years. Adding to the positive effect of the reallocation process, the contribution of firm demography reinforced over the period of observation, thanks to the relevant increase of the exit component, favored by a more selective market environment after the two crisis episodes. These broad tendencies are largely confirmed when the exercise is repeated for manufacturing and services separately.[10] The most notable difference relates to the contribution of reallocation, which —despite being similar in size at the beginning of the sample— experienced a stronger increase for the firms in services than for those in manufacturing; though, the former were penalized by a worst dynamics of the average productivity term.

4.3 Cyclical fluctuations

The results presented in sections 4.1 and 4.2 do not disentangle the effect that different cyclical conditions at the sectoral level may have on the four components in the aggregate productivity decomposition. In order to explore the role of business cycle, we enrich equation 8 with an additional term, exploiting the information on real sales at the industry level. More specifically, we estimate the following regression by OLS:

$$\Delta y_{st} = \delta_s + \delta_t + \beta \Delta I_{st} + \varepsilon_{st} \tag{9}$$

where ΔI_{st} is the growth rate of a real sales index for each 5-digit sector s between years t and $t-1$. In this case, our coefficient of interest is β, representing the elasticity of each component of the aggregate labor productivity to business cycle at the industry level.

Table 5 collects the estimated β coefficients for each component, and for manufacturing and services separately. The first two columns confirm that both average productivity and reallocation among existing firms are procyclical. The elasticity on average productivity is stronger in manufacturing, while the one on the reallocation component is not statistically different between the two sectors. As regards the extensive margins (i.e. entry and exit), columns 3 and 4 show that both elasticities are negative. A negative elasticity of entry means that —during booms— the negative contribution of entry to aggregate productivity growth is stronger. It is interesting to notice that the aggregate effect is driven by the estimates in the manufacturing industries, for which the coefficient is statistically significant. This elasticity is in line with the evidence relative to the years of the global financial crisis (2008–09), but are at odds with the results for the aggregate productivity decomposition during the sovereign debt crisis (2012–13). However, while the first crisis triggered a credit crunch that reduced the availability of finance to unproductive new initiatives; the second

[10] These results are shown in figures C.1 and C.2 in the appendix.

crisis was characterized by a fall in aggregate demand and an increase in uncertainty that reduced the average productivity of new projects. A negative elasticity of exit has a different interpretation because it implies that during recessions the positive contribution of exit to aggregate productivity growth is stronger. The correlation is coherent with a large body of literature, that claims that during recessions selection processes are tougher.[11]

4.4 Industry characteristics

Finally, we explore to what extent the four components of equation (7) are influenced by structural characteristics at the industry level. In order to do so, we perform an OLS estimation on the following regression:

$$\Delta y_s^{LR} = \beta x_{s,t0} + \varepsilon_s \tag{10}$$

where Δy_s^{LR} is the long-run sectoral contribution (between 2005 and 2013) of each of the four components defined in equation (7), $x_{s,t0}$ is the structural sectoral characteristic of interest in sector s, measured at the beginning of the period, and ε_s is an error term.

Market structure In the panel (a) of table 6, we look at the effect of the degree of concentration within each industry, measured by means of the Herfindahl index on sales (measured in logs): $x_{s,t0} = \ln(H_{s,2005})$. The last column indicates that more concentrated industries experience higher aggregate productivity growth. By looking at the different components, it is apparent that the overall effect is likely to be driven by reallocation: in concentrated industries the positive effect of reallocation is stronger. This might reflect the "winner takes all" dynamics, i.e. the fact that technological leaders increase their advantage with respect to laggard firms. Significant effects also emerge in terms of firm demographics: our results show that in more concentrated sectors the negative contribution of entry and the positive contribution of exit are attenuated in size. In the case of exit, this result is mostly driven by the fact that exit rates tend to be lower in more concentrated sectors. As regards entry, instead, the attenuation is mainly due to the fact that in concentrated sectors the entrants are more similar to incumbents in terms of relative productivity, probably as a consequence of higher barriers to entry.

Import penetration In the last two decades, Italy has been exposed to a substantial increase in competition from abroad (especially from developing countries), as a conse-

[11] In this sense, our results are coherent with the theoretical and empirical literature that investigated the cleansing effect of recessions (Caballero and Hammour, 1994; Foster et al., 2014).

quence of the gradual reduction in trade costs and of the process of globalization; this induced a deep restructuring of Italian productive system, that is likely to have influenced the dynamics of aggregate productivity. We therefore focus on the manufacturing sector and we look at the correlation between import penetration from developing countries and the different components of the aggregate productivity decomposition. Import penetration is measured as the share of imports from developing countries in domestic consumption; it has been computed for each 4-digit industry, and refers to year 2005. The results are displayed in panel (b) of table 6. Despite being non-significant for aggregate productivity as a whole, import penetration from developing countries has an impact on some of its components. In particular, import penetration has a strong and positive effect on reallocation and exit; this might be consistent with the fact that a greater exposure to competition from developing countries favors the exit of least productive firms and the reallocation of resources towards most productive incumbents.

4.5 Effects along the productivity distribution

In this section we provide some suggestive evidence at the firm and industry level on the underlying mechanisms of the documented increase in allocative efficiency in Italy between 2005 and 2013.

We start by exploiting our firm level data. First, we divide firms into within-industry percentiles of the labor productivity distribution; second, for each percentile we compute the entry rate, the exit rate and the average employment growth of surviving firms. The left panel of figure 4 shows the entry rates in 2006 and in 2013. As already documented in table 4, entry rate have fallen in Italy. As the figure shows, however, the decline has not been homogeneous along the productivity distribution. Entry rates fall up to the 70^{th} percentile of the productivity distribution, while they remain almost unchanged for top percentiles. The right panel shows the exit rates in 2005 and 2012. Exit rates increased for almost all percentiles of the productivity distribution; nonetheless, they more than doubled for the lowest percentiles, while the increase has been very small among the most productive firms.

Figure 5 reports the average employment growth of surviving firms in 2005–06 and in 2012–13. In 2005–06 employment growth was higher for the more productive firms, ranging from almost 1 percent among firms in the lowest percentiles to about 3 percent for firms in the top percentiles of the productivity distribution. This corroborates the evidence presented in the previous sections, showing that the contribution of reallocation to aggregate productivity growth in Italy was positive even before the crisis. In 2012–

13 employment growth declined for all firms; it became negative for firms up the the 80^{th} percentile of the productivity distribution, and it remained positive for the most productive firms. Overall, this pattern positively contributed to the strengthening of the allocative efficiency of the Italian economy.

4.6 The importance of observing the universe of firms: a comparison with other popularly used data cuts

Among the features of this work, the completeness and the quality of the data used are two of the most relevant aspects; this is especially true for the Italian case, since this paper is the first one —to our knowledge— that exploits data on the universe of Italian firms to analyze productivity dynamics. In order to stress the importance of having access to data on the universe of firms, we have fictitiously reduced our sample, and then compared our results with those obtained from different sample cuts that are commonly used in the literature.

Figure 6 summarizes the discrepancies across different sample cuts, by showing the contribution of the OP covariance to the level of aggregate productivity; each line depicts the contribution resulting from a different sample cut. The most prominent difference is in terms of levels: the weight of the OP covariance is higher when using the full sample, and it progressively reduces when more restrictive sample cuts are applied. The weight of OP covariance slightly reduces when we keep only the firms with positive value added; it suffers a further drop if we only consider incorporated firms, and it drops even more if we restrict our analysis to incorporated firms with balance-sheet data. The incidence of the OP covariance is minimum if we only consider firms with 20 employees or more: in this case, the discrepancy with respect to the full sample ranges, roughly, from 20 to 30 percentage points, depending on the year.

The results also differ in terms of dynamics. As a matter of fact, most of the sample cuts fail to single out the increased weight of the OP covariance term in the years 2005–07 and its reduction at the onset of the global financial crisis (2008–09). The subsequent recovery is captured by the samples that only include incorporated firms, but not by the samples with 20 or more employees, that display divergent dynamics.

5 Conclusion

In this paper we exploit a unique dataset covering the universe of Italian firms operating in the non-agricultural and non-financial sector over the period 2005–2013, in order

to document the contribution of allocative efficiency to the dynamics of aggregate labor productivity.

Following the Olley and Pakes methodology, we have expressed the level of aggregate labor productivity as the sum of firm average productivity and a term capturing the strength of allocative efficiency. We find that allocative efficiency accounted for about 35 percent of aggregate productivity in 2005, and that its incidence increased by almost 7 percentage points between 2005 and 2013.

We then analyzed the the dynamics of aggregate labor productivity, distinguishing between the contribution of different factors: on one side, the contribution of incumbent firms, depending on both the dynamics of average firm productivity and the reallocation of resources across firms; on the other, the contribution of firm demographics (entry and exit of firms in the market), mainly driven by selection mechanisms. The reallocation component —net of sectoral composition effects— positively contributed to the dynamics of aggregate productivity in all years, even before the burst of the global financial crisis (years 2005–07 in our sample). Over the whole period 2005–13, it steadily increased its relevance. The net contribution of firm demography is always positive in our sample: the positive contribution linked to the exit of least productive firms more than compensated the negative contribution arising from the entry of small low-productivity newborn firms.

The contribution of the different components to the dynamics of aggregate productivity varies according to the business cycle that the firms are facing. Average productivity and reallocation are both procyclical, consistently with the evidence that firms tend to invest more when they receive a positive demand shock. The contribution of entry and exit is, instead, countercyclical, pointing at a more stringent selection process during recessions. Reallocation is also stronger in sectors that were more exposed to the competition from developing countries; this might have favored an improvement of allocative efficiency through the exit of least productive firms and the subsequent reallocation of resources towards the most productive incumbents.

Over the period of observation, the heterogeneous response of entry rates, exit rates and employment growth along the productivity distribution also provides some suggestive evidence on the mechanisms behind the observed increase in allocative efficiency. Over the period of observation, exit rates increased and entry rates dropped for firms in the low tail of the productivity distribution, suggesting that the prolonged phase of recession gave rise to a more selective environment. Moreover, average firm employment growth declined across the whole distribution, becoming negative for the sole firms in the lower tail. Overall, these results suggest that the structural adjustment of Italian productive system —already in action before the burst of the global financial crisis— reinforced during the prolonged

period of recession; such adjustment predominantly unraveled through the exit of the least productive firms and the reallocation of workforce to the best performing ones.

To our knowledge, this paper is the first one that analyzes productivity dynamics using detailed data on the universe of Italian firms. The advantage of using complete and high-quality data is non-negligible: we show that different sample cuts, often used in the literature, underestimate the weight of allocative efficiency on aggregate productivity and fail to capture its dynamics.

References

Aghion, P., R. Blundell, R. Griffith, P. Howitt, and S. Prantl (2009). "The effects of entry on incumbent innovation and productivity". *The Review of Economics and Statistics* 91 (1), pp. 20–32.

Andrews, D. and F. Cingano (2014). "Public policy and resource allocation: evidence from firms in OECD countries". *Economic Policy* 29 (78), pp. 253–296.

Bartelsman, E., S. Scarpetta, and F. Schivardi (2005). "Comparative analysis of firm demographics and survival: evidence from micro-level sources in OECD countries". *Industrial and Corporate Change* 14 (3), pp. 365–391.

Bartelsman, E., J. Haltiwanger, and S. Scarpetta (2009). "Measuring and analyzing cross-country differences in firm dynamics". *Producer dynamics: New evidence from micro data*. University of Chicago Press, pp. 15–76.

— (2013). "Cross-country differences in productivity: The role of allocation and selection". *The American Economic Review* 103 (1), pp. 305–334.

Bernard, A. B., J. B. Jensen, and P. K. Schott (2006). "Survival of the best fit: Exposure to low-wage countries and the (uneven) growth of US manufacturing plants". *Journal of International Economics* 68 (1), pp. 219–237.

Bloom, N. and J. Van Reenen (2010). "Why do management practices differ across firms and countries?" *The Journal of Economic Perspectives* 24 (1), pp. 203–224.

Caballero, R. J. and M. L. Hammour (1994). "The Cleansing Effect of Recessions". *The American Economic Review* 84 (5), pp. 1350–1368.

Calligaris, S., M. Del Gatto, F. Hassan, G. I. P. Ottaviano, and F. Schivardi (2016). "Italy's Productivity Conundrum. A Study on Resource Misallocation". European Economy Discussion Paper 030, European Commission.

Cette, G., J. Fernald, and B. Mojon (2016). "The pre-Great Recession slowdown in productivity". *European Economic Review*.

Foster, L., C. Grim, and J. Haltiwanger (2014). *Reallocation in the Great Recession: Cleansing or Not?* Working Paper 20427. National Bureau of Economic Research.

Foster, L., J. Haltiwanger, and C. Syverson (2016). "The slow growth of new plants: Learning about demand?" *Economica* 83 (329), pp. 91–129.

Gamberoni, E., C. Giordano, and P. Lopez-Garcia (2016). "Capital and labour (mis)allocation in the euro area: some stylized facts and determinants". Forthcoming on Questioni di economia e finanza, Banca d'Italia.

García-Santana, M., E. Moral-Benito, J. Pijoan-Mas, and R. Ramos (2016). "Growing like Spain: 1995-2007".

Geurts, K. and J. Van Biesebroeck (2014). "Job creation, firm creation, and *de novo* entry". CEPR Discussion Paper No. DP10118.

Gopinath, G., S. Kalemli-Ozcan, L. Karabarbounis, and C. Villegas-Sanchez (2015). *Capital Allocation and Productivity in South Europe*. Working Paper 21453. National Bureau of Economic Research.

Hsieh, C.-T. and P. J. Klenow (2009). "Misallocation and Manufacturing TFP in China and India". *The Quarterly Journal of Economics* 124 (4), pp. 1403–1448.

Ladu, M. G. and A. Linarello (2016). "The construction of a new dataset for the universe of Italian firms from administrative and fiscal data 2005–2013".

Lotti, F. (2007). "Firm dynamics in manufacturing and services: a broken mirror?" *Industrial and Corporate Change* 16 (3), pp. 347–369.

Melitz, M. J. and S. Polanec (2015). "Dynamic Olley-Pakes productivity decomposition with entry and exit". *The RAND Journal of Economics* 46 (2), pp. 362–375.

Olley, G. S. and A. Pakes (1996). "The dynamics of productivity in the telecommunications equipment industry". *Econometrica* 64 (6), pp. 1263–1297.

Syverson, C. (2011). "What Determines Productivity?" *Journal of Economic Literature* 49 (2), pp. 326–365.

Tables

Table 1 Descriptive statistics - levels

	# of firms	# of employees	Value added	Value added per worker	Employees per firm
			Manufacturing		
2005	443,623	4,092,856	196,077	47,907	9.23
2006	437,926	4,088,521	209,095	51,142	9.34
2007	432,761	4,132,101	215,387	52,125	9.55
2008	426,798	4,138,323	208,775	50,449	9.70
2009	412,571	3,961,776	173,791	43,867	9.60
2010	402,670	3,842,702	193,345	50,315	9.54
2011	404,919	3,847,575	201,370	52,337	9.50
2012	414,524	3,858,736	197,725	51,241	9.31
2013	407,047	3,769,859	196,599	52,150	9.26
			Services		
2005	2,467,007	7,702,550	287,347	37,305	3.12
2006	2,486,227	7,943,321	301,964	38,015	3.19
2007	2,529,322	8,219,761	313,316	38,117	3.25
2008	2,543,113	8,443,327	311,815	36,930	3.32
2009	2,515,252	8,357,716	284,289	34,015	3.32
2010	2,518,288	8,405,556	303,168	36,068	3.34
2011	2,513,429	8,490,370	302,135	35,586	3.38
2012	2,543,379	8,626,073	291,132	33,750	3.39
2013	2,517,042	8,526,864	288,292	33,810	3.39
			Total		
2005	2,910,630	11,795,406	483,424	40,984	4.05
2006	2,924,153	12,031,842	511,059	42,476	4.11
2007	2,962,083	12,351,862	528,703	42,804	4.17
2008	2,969,911	12,581,650	520,590	41,377	4.24
2009	2,927,823	12,319,492	458,079	37,183	4.21
2010	2,920,958	12,248,258	496,513	40,537	4.19
2011	2,918,348	12,337,945	503,505	40,809	4.23
2012	2,957,903	12,484,809	488,857	39,156	4.22
2013	2,924,089	12,296,723	484,891	39,433	4.21

Data on value added are expressed in million of Euros; data on value added per employee are expressed in Euros.

Table 2 Descriptive statistics - growth rates

	# of firms	# of employees	Value added	Value added per worker	Employees per firm
			Manufacturing		
2005–06	-1.28	-0.11	6.64	6.75	1.19
2006–07	-1.18	1.07	3.01	1.92	2.27
2007–08	-1.38	0.15	-3.07	-3.22	1.55
2008–09	-3.33	-4.27	-16.76	-13.05	-0.96
2009–10	-2.40	-3.01	11.25	14.70	-0.62
2010–11	0.56	0.13	4.15	4.02	-0.43
2011–12	2.37	0.29	-1.81	-2.09	-2.03
2012–13	-1.80	-2.30	-0.57	1.77	-0.51
			Services		
2005–06	0.78	3.13	5.09	1.90	2.33
2006–07	1.73	3.48	3.76	0.27	1.72
2007–08	0.55	2.72	-0.48	-3.11	2.16
2008–09	-1.10	-1.01	-8.83	-7.89	0.08
2009–10	0.12	0.57	6.64	6.03	0.45
2010–11	-0.19	1.01	-0.34	-1.34	1.20
2011–12	1.19	1.60	-3.64	-5.16	0.40
2012–13	-1.04	-1.15	-0.98	0.18	-0.12
			Total		
2005–06	0.46	2.00	5.72	3.64	1.53
2006–07	1.30	2.66	3.45	0.77	1.35
2007–08	0.26	1.86	-1.53	-3.33	1.59
2008–09	-1.42	-2.08	-12.01	-10.14	-0.68
2009–10	-0.23	-0.58	8.39	9.02	-0.34
2010–11	-0.09	0.73	1.41	0.67	0.82
2011–12	1.36	1.19	-2.91	-4.05	-0.16
2012–13	-1.14	-1.51	-0.81	0.71	-0.37

Table 3 The decomposition of aggregate productivity's dynamics

	Surviving firms		Firm demography			
	Average productivity	Reallocation	Entry	Exit	Net	Aggregate productivity
			Manufacturing			
2005–06	3.43	3.04	-0.87	1.15	0.28	6.75
2006–07	-0.07	1.73	-0.98	1.24	0.26	1.92
2007–08	-4.31	0.91	-0.96	1.14	0.18	-3.22
2008–09	-17.66	3.72	-0.73	1.62	0.89	-13.05
2009–10	7.30	6.89	-1.10	1.61	0.52	14.70
2010–11	-1.63	5.67	-1.19	1.17	-0.02	4.02
2011–12	-4.93	2.69	-1.03	1.18	0.15	-2.09
2012–13	-4.56	5.89	-1.07	1.51	0.45	1.77
			Services			
2005–06	-2.04	3.44	-2.09	2.59	0.50	1.90
2006–07	-0.92	1.16	-2.41	2.45	0.04	0.27
2007–08	-2.93	-0.48	-2.16	2.45	0.29	-3.11
2008–09	-9.55	0.49	-1.76	2.93	1.17	-7.89
2009–10	-0.02	5.79	-2.38	2.65	0.27	6.03
2010–11	-5.49	3.95	-2.80	3.01	0.21	-1.34
2011–12	-5.66	0.20	-2.46	2.77	0.31	-5.16
2012–13	-4.91	4.55	-2.76	3.29	0.53	0.18
			Total			
2005–06	-1.20	4.50	-1.79	2.13	0.34	3.64
2006–07	-0.79	1.52	-2.06	2.10	0.05	0.77
2007–08	-3.14	-0.39	-1.87	2.06	0.20	-3.33
2008–09	-10.66	-0.57	-1.49	2.58	1.09	-10.14
2009–10	0.99	7.80	-2.14	2.37	0.23	9.02
2010–11	-4.95	5.57	-2.48	2.52	0.04	0.67
2011–12	-5.54	1.32	-2.18	2.35	0.17	-4.05
2012–13	-4.85	5.10	-2.39	2.85	0.46	0.71

Net demography is defined as the sum of entry and exit.

Table 4 Firm demography

	2006	2007	2008	2009	2010	2011	2012	2013
				Manufacturing				
Entry rate	5.55	5.35	5.36	4.39	4.42	4.83	4.47	4.58
Entrant share of VA	1.78	1.75	2.07	1.62	1.62	1.93	1.88	1.91
Entrant relative size[1,2]	30.50	34.07	36.61	35.97	37.31	37.33	40.24	41.02
Entrant relative productivity[2]	82.77	80.31	84.40	81.75	82.65	80.90	73.13	74.71
Exit rate	5.60	5.72	5.98	7.13	5.84	5.65	6.68	6.84
Exiting share of VA	1.23	1.08	1.23	1.61	1.16	0.93	1.09	1.34
Exiting relative size[1,3]	19.43	16.63	19.11	20.19	18.63	15.04	13.76	16.65
Exiting relative productivity[3]	81.79	64.01	63.65	64.14	60.14	57.31	53.95	50.22
				Services				
Entry rate	9.67	11.02	9.29	7.96	8.02	8.92	7.82	7.95
Entrant share of VA	3.81	4.41	4.17	3.56	3.80	4.13	3.57	3.55
Entrant relative size[1,2]	40.87	40.19	45.19	45.59	48.34	41.74	46.71	42.90
Entrant relative productivity[2]	74.86	75.05	78.14	75.62	74.45	70.92	62.88	69.72
Exit rate	6.31	6.27	7.69	8.09	7.26	8.47	9.09	10.15
Exiting share of VA	2.28	1.98	2.39	2.83	2.27	2.40	2.52	2.80
Exiting relative size[1,3]	33.92	30.74	43.61	32.78	32.61	29.20	24.82	23.44
Exiting relative productivity[3]	71.79	67.56	72.03	62.17	74.76	52.51	53.60	46.15
				Total				
Entry rate	7.70	8.31	7.41	6.25	6.30	6.96	6.22	6.34
Entrant share of VA	2.84	3.14	3.17	2.63	2.75	3.08	2.76	2.77
Entrant relative size[1,2]	35.98	37.35	41.20	41.09	43.17	39.71	43.70	42.03
Entrant relative productivity[2]	78.52	77.44	80.95	78.44	78.16	75.49	67.63	72.04
Exit rate	5.97	6.01	6.87	7.63	6.58	7.12	7.94	8.57
Exiting share of VA	1.78	1.55	1.83	2.24	1.74	1.69	1.84	2.10
Exiting relative size[1,3]	26.69	23.66	32.04	26.81	25.97	22.54	19.60	20.25
Exiting relative productivity[3]	76.59	65.85	68.19	63.07	68.11	54.67	53.76	48.05

Average values across the 315 5-digit industries belonging to manufacturing.
[1] In terms of value added.
[2] With respect to surviving firms.
[3] With respect to active firms at t.

Table 5 Elasticity of the aggregate productivity components to the sectoral business cycle

	Average productivity	Reallocation	Entry	Exit	Aggregate productivity
Manufacturing	0.1345***	0.0644**	-0.0039***	-0.0006	0.1683***
	[0.036]	[0.026]	[0.001]	[0.001]	[0.050]
Services	0.0742***	0.0423***	-0.0018	-0.0033***	0.0956***
	[0.026]	[0.015]	[0.002]	[0.001]	[0.025]
Total economy	0.1087***	0.0522***	-0.0024**	-0.0027***	0.1295***
	[0.022]	[0.014]	[0.001]	[0.001]	[0.026]

The reported coefficients are the elasticities of each component to the sectoral business cycle, captured by an aggregate sales index computed for each sector at the 5 digit level of disaggregation. Standard errors clustered at the sectoral level (5 digit). All the regressions have been weighted by the number of employees in each sector.

Table 6 The aggregate productivity components in the long run vs. sectoral characteristics

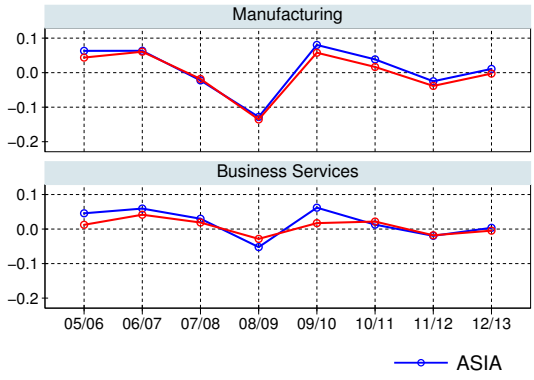
	Average productivity	Reallocation	Entry	Exit	Aggregate productivity
			Panel (a):		
log Herfindahl	-0.8766	1.6105**	0.3955*	-0.6597***	1.4351**
	[0.884]	[0.732]	[0.214]	[0.197]	[0.706]
N	580	580	577	576	580
R^2	0.007	0.032	0.016	0.052	0.026
			Panel (b):		
ImpPen developing	-8.9043	25.7745*	-5.1873	22.7467***	18.7375
	[15.348]	[13.732]	[5.632]	[4.613]	[16.677]
N	184	189	191	190	190
R^2	0.003	0.037	0.020	0.224	0.016

Robust standard errors. All the regressions have been weighted by the number of employees in each sector. The regressions in panel (a) have been performed on data disaggregated at the 5-digit level. Those in panel (b), instead, refer to manufacturing sector only, and have been performed at the 4-digit level, since data on import penetration were not available at a more disaggregated level.

Figures

Figure 1 Comparison between ASIA database and Italian national accounts

a) VA growth rate



b) VA per worker growth rate

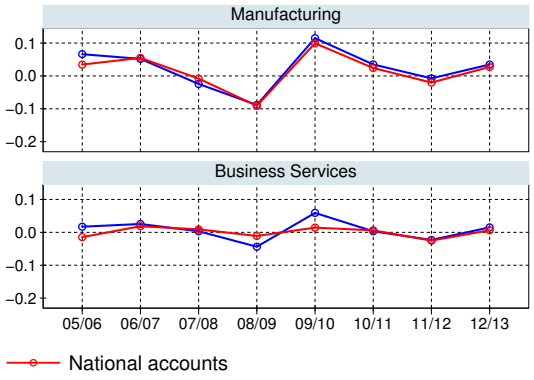


Figure 2 The contribution of reallocation to the level of aggregate productivity

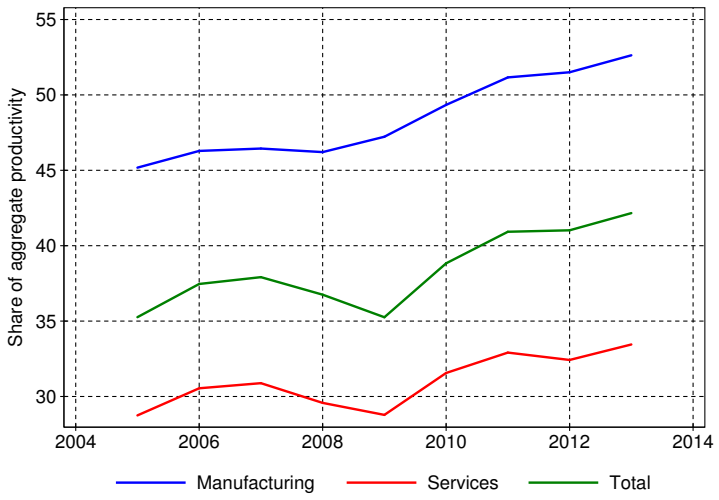
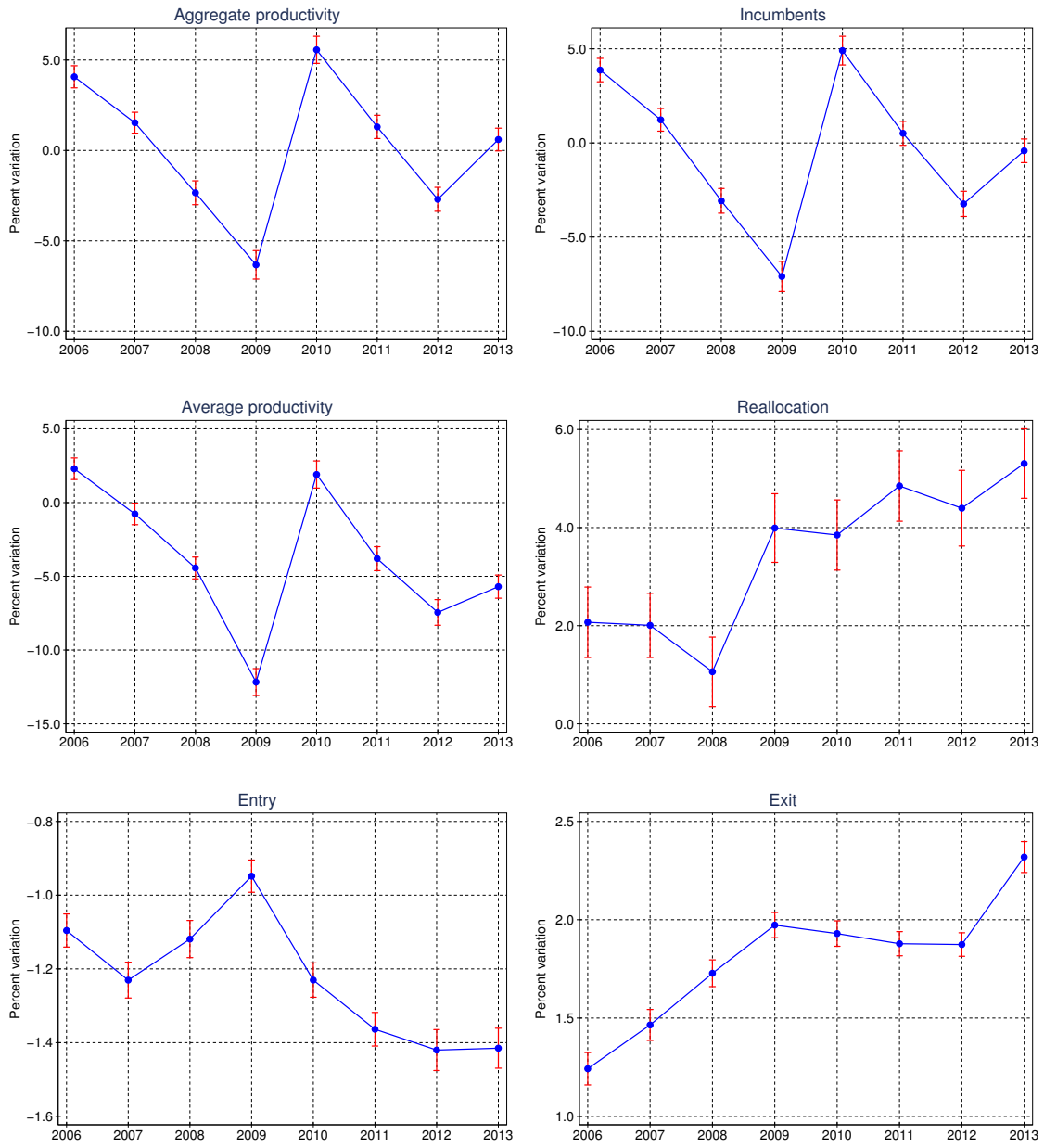


Figure 3 The decomposition of productivity dynamics, net of sectoral fixed effects



Data winsorized at the 5^{th} and 95^{th} percentile.

Figure 4 Entry and exit probability, by percentile of the productivity distribution

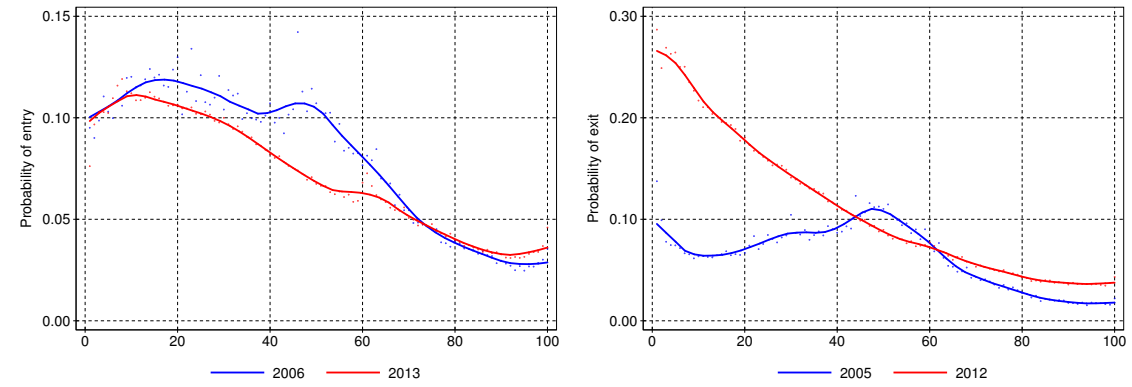


Figure 5 Employment growth, by percentile of the productivity distribution

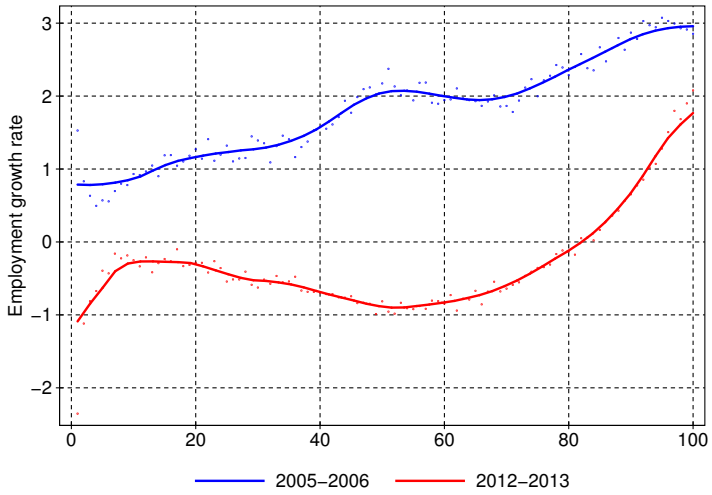
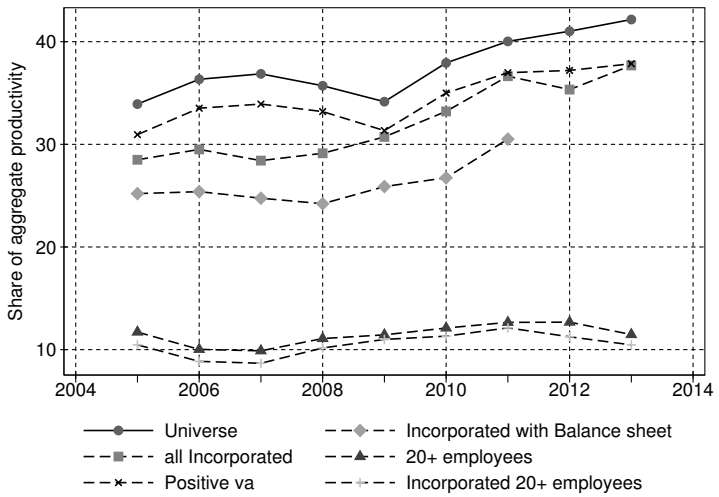


Figure 6 The contribution of the OP covariance to the level of aggregate productivity across samples



A Additional checks

A.1 Dealing with missing values

The validity of our empirical exercise crucially rests on the quality of the data used. One of the main concerns is therefore related to the non-negligible share of firms —especially in the years between 2005 and 2010— for which we are not able to measure value added. As documented in Ladu and Linarello (2016), the missing information has been filled by imputing the median value added per worker within cells defined by industry classification, size class, location and legal form.

We present an additional exercise that aims at checking the robustness of our estimates against the exclusion of the imputed information on value added. It would be desirable for us that the results of this exercise closely followed those presented in table 3; that would allow us to claim that the imputation performed did not significantly distort our estimates. Table B.2 displays the results obtained excluding from the analysis the records with imputed value added: they are completely in line with those presented above both in terms of average productivity and reallocation; some slight difference emerges in the net contribution of firm demography, which is sometimes negative, especially in services. The results obtained for period 2012–13 exactly replicate those presented in table 3, since in those years data did not present missing values.

Overall, this robustness exercise suggests that the imputation method used to fill in the missing information did not significantly distort the results of our decomposition.

A.2 Alternative productivity measure

We have performed the decomposition exercise using as an alternative measure of productivity, namely sales per worker. Since the information on sales is always present in our database, we would be comforted if the relative importance of the four components was similar to the one resulting from the previous exercise on value added per worker. Of course, the two measures differ in many respects. Though different, however, value added per worker and sales per worker broadly share similar dynamics, as shown in figure C.3: in manufacturing, the dynamics of sales per worker tracks quite closely the one of value added per worker; in services, the two dynamics are still similar, despite showing bigger discrepancies, especially in the last part of the sample. Moreover, it is interesting to look at sales per worker, since it can represent a valid alternative for measuring labor productivity (as in Bartelsman et al. (2013)).

Table B.3 shows the decomposition applied to sales per worker. The results confirm

that the reallocation has sustained aggregate dynamics in both manufacturing and services, though experiencing larger swings than in the previous exercise and turning negative in a few cases; the contribution of average sales per worker is largely negative throughout all the sample, just like the average productivity component in table 3. Entry and exit still offer a negative and positive contribution, respectively, but their net effect —even if small— is not positive in all periods; it is confirmed, however, that the largest contributions from firm demography were registered in the years of the financial crisis (2008–09).

B Additional tables

Table B.1 OP contribution by sector

	Years								
Sectors	2005	2006	2007	2008	2009	2010	2011	2012	2013
10	50.25	52.20	50.37	50.48	53.62	54.12	55.97	55.85	57.47
11	34.19	35.22	34.98	39.78	43.96	49.20	56.02	64.14	61.34
13	37.87	38.66	43.39	39.93	40.40	43.23	44.54	46.93	48.48
14	41.88	44.34	48.34	48.58	50.86	48.44	49.84	48.44	47.77
15	32.16	30.87	34.22	37.40	39.70	43.22	43.24	45.97	46.28
16	35.98	36.18	37.85	35.13	33.64	35.54	37.61	35.98	37.88
17	39.41	38.72	40.40	38.38	45.85	40.77	44.40	46.30	47.74
18	35.49	36.91	37.21	36.78	37.77	39.68	40.91	40.93	42.60
20	43.55	36.35	40.84	32.91	42.09	40.44	43.38	46.93	40.91
21	11.86	-75.00	8.28	11.47	16.50	3.27	0.66	-1.83	3.88
22	30.27	30.71	29.44	29.15	33.15	33.28	36.27	35.58	39.37
23	51.17	51.94	49.65	48.71	48.00	49.78	50.59	52.08	54.18
24	41.50	46.35	49.05	40.88	23.66	34.56	39.19	37.74	37.78
25	31.30	33.21	33.86	34.13	35.35	36.27	37.30	36.88	37.98
26	38.38	38.50	40.21	39.05	37.24	44.72	48.45	46.12	43.07
27	37.46	40.96	39.47	40.08	42.09	43.36	42.57	45.93	42.33
28	27.07	28.67	26.08	27.83	28.86	34.37	35.80	35.79	35.74
29	0.99	23.11	28.80	13.06	18.19	18.86	34.46	41.07	37.00
30	48.69	44.82	37.71	47.33	51.73	61.11	53.15	69.60	67.19
31	33.40	35.95	34.64	33.55	36.25	36.92	38.56	37.49	41.90
32	46.04	49.61	49.37	45.49	40.84	47.86	52.57	48.56	49.82
33	27.04	25.51	26.04	26.29	29.51	29.30	29.91	28.74	33.16
45	44.12	44.64	43.64	40.15	40.28	40.67	43.15	42.08	44.11
46	33.89	34.65	34.18	33.34	33.92	34.49	35.14	36.61	37.26
47	19.35	39.97	40.20	40.24	42.40	45.04	45.70	46.79	48.21
49	37.22	36.88	38.76	41.76	43.45	44.29	44.95	37.33	44.80
50	69.12	68.01	73.69	73.07	72.05	68.29	64.90	49.37	49.09
51	-23.89	18.34	-0.17	-72.31	-29.34	-137.61	12.82	-127.07	-641.82
52	36.25	30.65	23.14	30.85	34.49	38.40	41.45	43.06	47.48
55	21.64	21.54	22.03	20.53	20.97	23.77	27.40	28.87	32.10
56	17.58	18.86	18.51	19.12	19.56	21.93	24.04	26.29	28.36
58	64.24	60.78	60.28	57.45	59.47	65.31	68.56	69.30	69.64
59	27.17	23.71	12.21	12.85	32.98	42.00	43.41	47.47	48.13
60	80.20	84.23	85.19	85.56	83.82	80.53	77.73	80.51	76.02
62	45.03	40.35	41.23	41.45	33.92	45.28	46.89	41.31	41.45
63	32.41	31.57	35.97	33.54	31.67	33.67	35.98	37.27	38.49
69	17.38	17.52	17.41	14.61	12.94	12.53	13.72	13.70	13.30
70	45.82	44.63	52.33	49.99	44.26	47.49	47.78	34.55	34.81
71	23.11	18.43	20.17	17.94	18.71	19.20	19.14	20.83	22.88
72	46.02	39.65	44.45	42.59	41.62	46.76	52.20	41.68	40.89
73	40.45	38.91	33.39	35.49	33.46	37.42	39.86	37.54	28.30
74	16.62	16.29	17.96	12.53	13.99	16.56	18.49	16.92	18.10
75	0.87	1.67	1.13	0.10	-0.39	0.46	0.14	1.08	0.86
77	56.53	59.81	56.75	46.37	46.37	42.61	45.90	52.52	55.32
78	-111.09	-49.43	-69.62	-50.66	-63.64	-5.23	1.71	-11.46	-16.18
79	26.71	33.33	34.73	32.83	35.74	36.88	36.72	32.46	35.66
80	15.56	-26.54	21.75	15.18	22.28	20.09	29.07	37.85	29.44
81	-9.88	-12.11	-15.81	-12.96	-23.25	-13.49	7.70	2.72	4.20
82	28.18	21.67	19.61	16.02	18.76	19.80	19.42	23.47	17.77

Table B.2 The decomposition of aggregate productivity's dynamics, excluding firms with imputed VA

	Surviving firms		Firm demography			Total
	Average productivity	Reallocation	Entry	Exit	Net	
			Manufacturing			
2005–06	2.46	3.80	-1.79	1.66	-0.13	6.1
2006–07	-0.90	2.36	-1.83	1.83	0.00	1.46
2007–08	-6.12	2.27	-1.38	2.24	0.87	-2.99
2008–09	-18.95	4.28	-1.02	2.50	1.48	-13.20
2009–10	6.27	7.50	-1.44	2.30	0.86	14.63
2010–11	-1.12	4.61	-1.79	2.28	0.48	3.97
2011–12	-3.14	2.00	-3.15	0.85	-2.31	-3.45
2012–13	-4.56	5.89	-1.07	1.51	0.45	1.77
			Services			
2005–06	-5.55	6.21	-3.83	3.20	-0.63	0.03
2006–07	-1.18	1.28	-3.75	2.97	-0.79	-0.69
2007–08	-6.01	2.05	-2.76	4.25	1.49	-2.47
2008–09	-10.74	1.25	-2.27	3.60	1.33	-8.16
2009–10	-0.80	6.38	-2.85	3.29	0.44	6.02
2010–11	-3.72	2.52	-4.38	3.62	-0.76	-1.96
2011–12	-6.74	0.87	-3.82	2.32	-1.50	-7.37
2012–13	-4.91	4.55	-2.76	3.29	0.53	0.18
			Total			
2005–06	-4.30	7.16	-3.36	2.66	-0.70	2.16
2006–07	-1.14	1.74	-3.28	2.64	-0.64	-0.03
2007–08	-6.01	1.97	-2.41	3.69	1.28	-2.76
2008–09	-11.91	0.12	-1.90	3.31	1.41	-10.38
2009–10	0.23	8.38	-2.56	3.03	0.47	9.07
2010–11	-3.34	4.01	-3.84	3.28	-0.56	0.11
2011–12	-6.23	2.19	-4.00	1.90	-2.10	-6.13
2012–13	-4.85	5.10	-2.39	2.85	0.46	0.71

Net demography is defined as the sum of entry and exit.

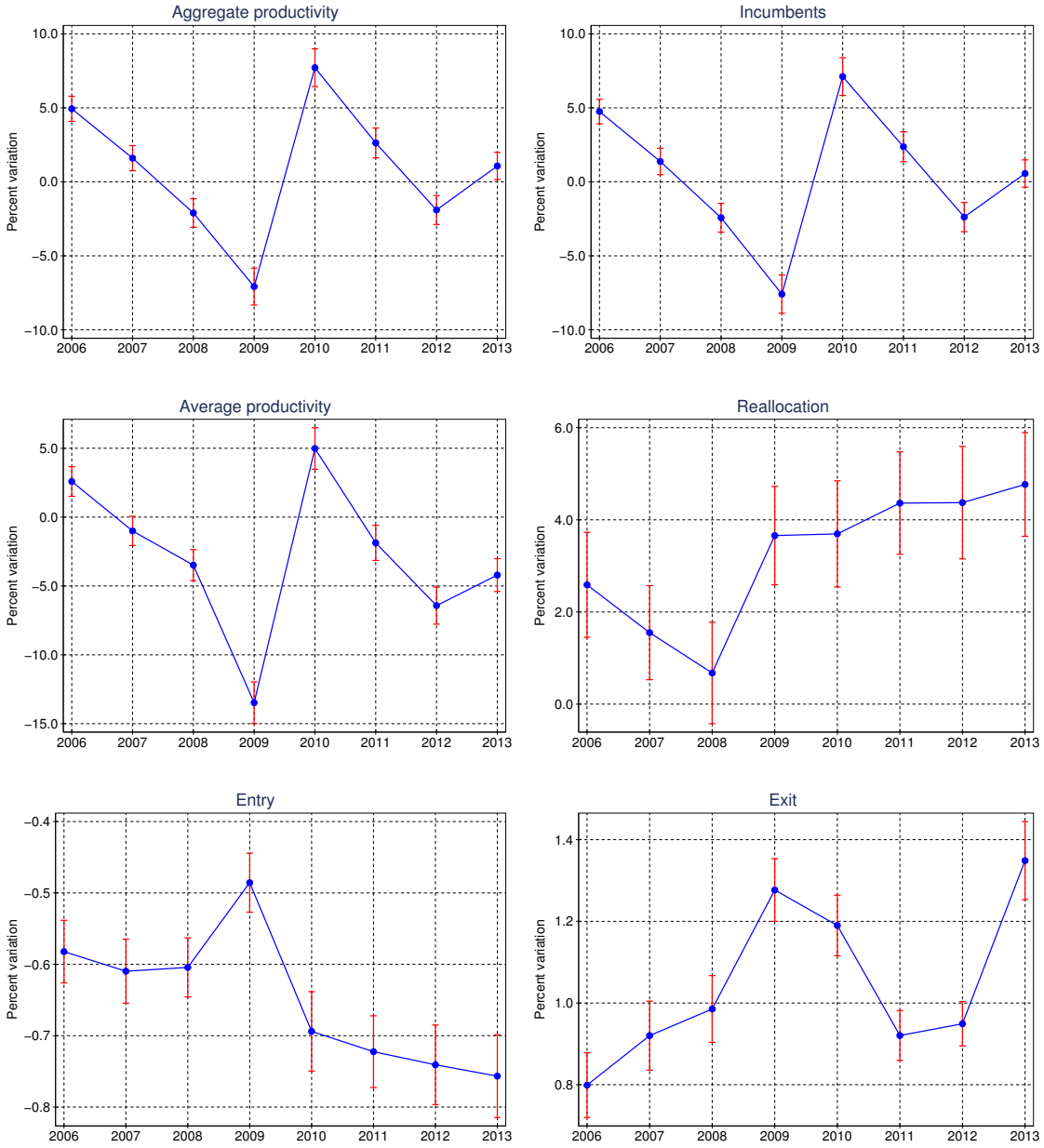
Table B.3 The decomposition of the dynamics of sales per worker

	Surviving firms		Firm demography			Total
	Average sales per worker	Reallocation	Entry	Exit	Net	
			Manufacturing			
2005–06	0.58	5.84	-1.07	0.32	-0.75	5.66
2006–07	-0.52	3.86	-1.24	1.39	0.15	3.50
2007–08	0.90	-3.47	-0.15	1.27	1.12	-1.45
2008–09	-9.06	-4.78	-0.67	1.80	1.13	-12.71
2009–10	-13.44	23.27	-1.25	1.70	0.45	10.28
2010–11	-0.51	5.20	-1.39	1.26	-0.12	4.57
2011–12	-8.99	2.73	-1.06	0.35	-0.71	-6.97
2012–13	-2.98	6.48	-1.16	1.49	0.33	3.83
			Services			
2005–06	-1.58	2.26	-2.31	1.48	-0.83	-0.15
2006–07	0.53	0.71	-2.98	2.25	-0.73	0.51
2007–08	-3.26	1.04	-1.17	2.32	1.16	-1.07
2008–09	-12.26	0.11	-2.11	3.00	0.89	-11.26
2009–10	-4.02	9.30	-2.73	2.72	-0.01	5.27
2010–11	-3.81	4.39	-3.34	3.48	0.14	0.72
2011–12	-7.37	-6.32	-2.41	1.97	-0.45	-14.14
2012–13	-5.55	12.35	-3.10	3.27	0.17	6.97
			Total			
2005–06	-1.27	4.01	-1.95	1.09	-0.86	1.88
2006–07	0.38	1.62	-2.45	1.99	-0.46	1.54
2007–08	-2.63	0.22	-0.89	2.01	1.12	-1.30
2008–09	-11.67	-1.20	-1.66	2.64	0.98	-11.89
2009–10	-5.59	12.39	-2.34	2.42	0.08	6.89
2010–11	-3.28	5.34	-2.81	2.81	0.00	2.06
2011–12	-7.65	-3.45	-2.12	1.50	-0.62	-11.73
2012–13	-5.13	10.71	-2.57	2.79	0.22	5.80

Net demography is defined as the sum of entry and exit.

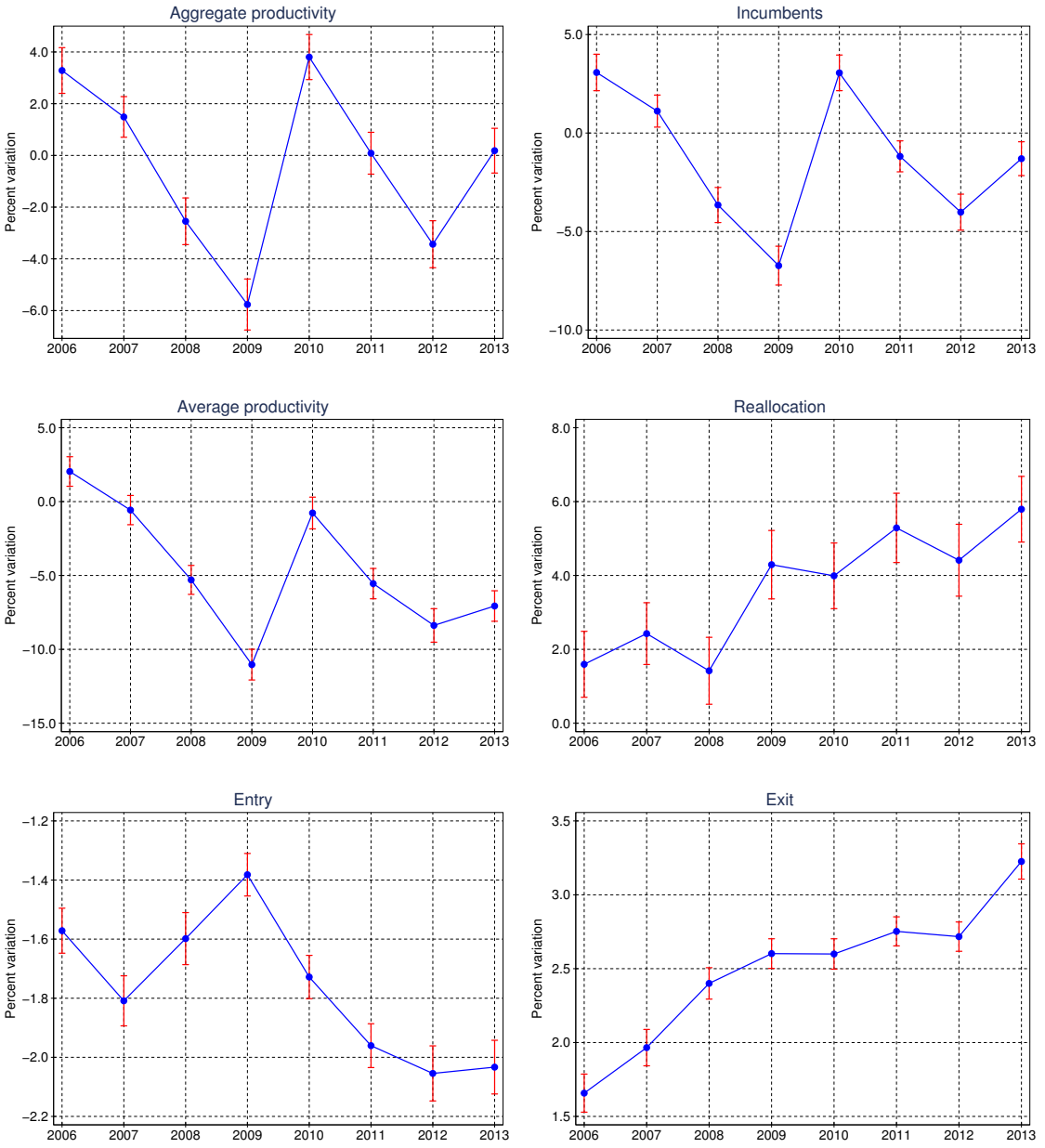
C Additional figures

Figure C.1 The decomposition of productivity dynamics, net of sectoral fixed effects — Manufacturing firms only



Data winsorized at the 5^{th} and 95^{th} percentile.

Figure C.2 The decomposition of productivity dynamics, net of sectoral fixed effects — Service firms only



Data winsorized at the 5^{th} and 95^{th} percentile.

Figure C.3 Comparison between the dynamics of VA per worker and sales per worker