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Productivity and resource allocation of Portuguese firms

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Abstract

Portuguese productivity growth has been weak since early 2000s. Gains in productivity are therefore essential to guarantee sustained economic growth, and convergence to euro area values of labour productivity. Looking at evidence from Portuguese firms, this article gives a picture on how resources are distributed across firms, sectors and firm dimensions, measures the importance of resource allocation to productivity growth, and works as a starting point to a deeper analysis on the determinants of misallocation in Portugal. The main results indicate improvements in productivity can be accomplished through a more efficient allocation, especially across sectors. They also suggest improvements in allocative efficiency within sectors was important to explain recent productivity dynamics.

Key words: productivity; misallocation; allocative efficiency.

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1. Introduction

Portuguese potential growth has been weak since early 2000s, similarly to other European countries. This trend is explained by decreasing contributions from productivity and lower levels of investment. To guarantee sustained economic growth in the future, gains in productivity and competiveness are essential. These improvements are especially important for Portugal, as they would promote a convergence of the country's labour productivity levels to those of euro zone[1].

Raising productivity is frequently associated with policies that promote increases to productivity at the firm level, i.e. they have an impact on how efficiently resources, such as labour and capital, are used in the production process by the firm. However, productivity can also rise when the most productive firms are able to grow, and concentrate larger shares of resources than less productive units. This means that, at the aggregate level, productivity not only depends on how efficient firms are, it also depends on how efficiently resources are allocated across firms.

Evidence in the literature shows there are several policies that can influence how resources are allocated across firms, with potential impact on aggregate productivity levels. These results are particularly important for Portugal, not only due to the potential large impact on firm's productivity and allocative efficiency resulting from the very comprehensive set of structural reforms implemented in the last decade, but also due the need to converge to euro area levels of labour productivity. Therefore, studying how resources are allocated across firms in more detail, and measure how important is resource allocation to productivity growth is paramount and will be the focus of this analysis. It can serve to inform policy makers on which areas misallocation is more severe, and works as a starting point to a deeper analysis on its determinants and policy effects.

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[1] In 2018, the levels of labour productivity for Portugal represented 55% of the average value for the euro zone. Additional information on productivity differentials is available in Annex 3 – figure A.3.1.

The analysis is structured as follows, chapter 2 reviews some of the literature on some of the frictions and policies that have been linked to resource misallocation; chapter 3 analyses how labour and capital are allocated across firms, sectors and firm dimensions, depending on their productivity; chapter 4 decomposes productivity growth, measuring the contribution of resource allocation; chapter 5 concludes.

2. Determinants of resource misallocation

Resources are often misallocated due to presence of frictions in the market, with less productive firms attracting a large amount of resources, lowering the growth potential of the most productive ones. This inefficiency in the distribution of resources has a detrimental impact on aggregate level of productivity. In fact, research have found a link between aggregate productivity differentials across countries, within-sector misallocation of resources and productivity dispersion (Hsieh and Klenow, 2009; Bartelsman et al., 2013). Understanding which frictions have an impact on misallocation is paramount for an efficient policy design. In the recent years, researchers studying misallocation found that regulation in the labour and product market; exposure to trade; insolvency regimes and restructuring procedures; as well as, policies related to financial frictions; size-dependent policies and policies associated with informal sector can influence how resources are distributed across firms[2].

Concerning employment protection legislation (EPL), some authors found evidence that firing costs and similar policies imposing barriers to reallocation of workers, have a negative impact on productivity, by not allowing firms to adjust their labour force to changes in demand of workers (Hopenhayn and Rogerson, 1993; Andrews and Cingano, 2014), and skills (Adalet McGowan and Andrews, 2015a and 2017). On the other hand, other authors have found that a more stringent EPL may promote the participation of workers in training activities, and better screening of employees when hiring, leading to productivity improvements (Wasmer, 2006; Belot et al., 2007; Cingano et al., 2015[3]). As such, policy decisions should consider both the positive and negative effects on productivity, and take into account that the net impact on productivity of changes in EPL is not straightforward, with some empirical evidence indicating non-positive impacts (Acharya et al, 2013; Correia and Gouveia, 2017), as well as, important costs in the short-run, such as increases in the unemployment rate (Cacciatore et al., 2012).

Increases to competition, through lower levels of regulation in the Product Market or exposure to trade, have also been linked to improvements in allocative efficiency (AE), by promoting the exit of the least productive firms, and promoting the entry of more innovative and productive firms. For instance, Andrews and Cingano (2014) found that barriers to entry and exit of firms have a detrimental impact on AE, with stronger effects in sectors characterized by creative destruction patterns of innovation. Additionally, while looking at policies targeting specific sectors, Monteiro et al. (2017) found evidence that decreases in regulation of upstream sector[4] leads to a higher probability of exit of the least productive firms, improving the allocation of resources. However, and similarly to changes to EPL, policies promoting deregulation of product markets may be associated with short-run costs, including increases to the unemployment rate (Cacciatore et al., 2012).

In the same vein, Melitz (2003) shows that improvements in the allocation of resources can be linked to the exposure to export markets. As access to these markets requires firms to incur in some costs, only the most productive are able to profit and gain market share under these conditions. The remaining less productive firms have to downsize or exit the market, creating a more efficient allocation of resources.

In the last few years, research has also focused on zombie firms[5], and their relation to allocative efficiency, revealing a large prevalence and share of resources sunk on these firms for some countries, with negative impact on aggregate productivity.

[2] For a comprehensive revision of the literature, please see Restuccia and Rogerson, 2013; Restuccia, 2013; and Hopenhayn, 2014.

[3] The author provides several references on the impact of EPL on productivity through multiple channels.

[4] Upstream sectors refer to network services such energy, transportation, telecommunications and postal services.

[5] There are several definitions of zombie firms in the literature. Adalet McGowan et al. (2017a) defines zombie firms as old firms that have insufficient funds to cover their interest, and that remain in activity due to for example inefficient insolvency regimes, bank forbearance, inefficient banking system, or even SME benefits.

Adalet McGowan et al. (2017a) shows zombie firms to be less productive than their counterparts, and to lower growth the opportunities of viable firms with negative effects on allocative efficiency. Adalet McGowan et al. (2017b) found that improvements in the allocation of capital could be achieved through changes to insolvency regimes, by decreasing the barriers to restructuring and personal costs to entrepreneurs. However, measures to address the negative impact of changes to insolvency regimes should be implemented as well, especially those targeting displaced workers (Andrews et al., 2017; Carneiro et al., 2015).

Some authors have looked specifically at the impact of frictions on a specific set of firms the frontier firms, i.e. the most productive firms in the economy. Andrews, Criscuolo and Gal (2016) found that these firms display important differences in productivity dynamics relative to their peers (laggard firms), with the first presenting a large increase in their productivity level during the past years, in contrast the residual growth of laggard firms. Therefore, Andrews, Criscuolo and Gal (2015) argue that productivity improvement could be achieved if the most productive firms in each country – the national frontier firms - were able to grow to their optimal size. In their view, this could be accomplished through a set of structural reforms focused on lowering barriers to the growth of these firms, such as, higher flexibility on product and labour markets, lower obstacles to exit or easier access to financial markets.

Most of these studies have focused on the allocation of workers and capital across firms. However, workers are not homogenous, and how their characteristics match the demand of skills of firms influences aggregate productivity. In this sense, skill mismatch occurs when this match is not perfect, or when the most skilled workers are not allocated to the most productive firms. In the recent years, some authors started to study the impact of policy intervention on this issue. Adalet McGowan and Andrews (2015a, 2017) found evidence that more flexible product and labour markets, particularly less rigid permanent contracts, by giving firms more flexibility to adjust their labour force to new demand of skills, reduces skill mismatch, and its negative impact on aggregate productivity (Adalet McGowan and Andrews, 2015b). They also found that additional improvements could be achieved through increases in managerial quality and lifelong learning.

Other determinants also seem relevant to explain misallocation. For instance, as most firms use external resources to finance their investment decisions, misallocation of credit (and capital) across sectors and firms, can occur when financial frictions prevent the most productive firms from getting the sufficient funds to growth at their optimal size. These financial restrictions can be associated with asymmetries in information, collateral requirements, ever greening or the use of non-economic criteria for credit supply (Buera et al., 2011; Midrigan and Xu, 2014; Gopinath et al, 2017; Azevedo et al., 2018).

On the other hand, allocation of resources may also be distorted when the rules and regulations are applied differently to firms of different dimensions. These size-dependent regulations include, for example, taxes on capital and labour applicable to larger firms, lighter legislation or subsidies to smaller firms. In general, such policies incentivize firms to enter the market despite their low productivity, to remain small, or to have lower than optimal size due to regulation costs, with negative consequences to aggregate productivity (Guner et al., 2008; Garicano et al., 2016; Gourio and Roys, 2014).

Lastly, misallocation of resources can also arise from the informal sector. These firms, more prevalent in developing countries, are often smaller, less productive and operated by managers with low education levels when compared with firms from the formal sector. Regulation may be one of the reasons these firms operate informally, but improving the quality of management may be the key to create firms that are more productive and can bear the costs of regulation (La Porta and Shleifer, 2014).

Misallocation of resources in Portugal

As policies and dynamics differ considerable across countries, it is also important to look at the evidence for the Portuguese economy. According to Banco de Portugal (2016), evidence suggests there is a misallocation of resources, which are, on average, allocated to the least productive sectors. Additionally, Dias et al. (2014) found that misallocation is stronger in the services sector, with capital distortions explaining most of the results. Dias et al. (2016) also found evidence of increasing misallocation of resources until the crisis, with misallocation being concentrated in smaller firms, which may be related to size-dependent policies, such as subsidized credit or tax benefits, or with tax evasion. However, the studies for the post-crisis period indicate an improvement in the allocation, with evidence of a cleansing effect during the crisis (Banco de Portugal, 2015 e 2016; Dias and Marques, 2018).

These improvements may be associated to the structural reforms that took place in the past decade, including changes in the product and labour market, insolvency regimes, education and financial system (Fernandes et al., 2019). For instance, Monteiro et al. (2017) found evidence that product market reforms increased the probability of exit of the least productive firms, promoting a more efficient resource distribution. Azevedo et al. (2018) found that prior to the crisis, a large share of credit was granted to low productive firms, with a negative effect on reallocation of credit to the most productive units. However, their research also suggests misallocation of credit has been improving since 2013. Gouveia and Osterhold (2018) studied the impact of changes to the insolvency regime, and found they were associated with the restructure of the most productive firms and exit of the non-viable and least productive ones. On the other hand, looking at the impact of labour market deregulation during the crisis, Correia and Gouveia (2017) found no positive impact on productivity of these reforms, i.e. the overall impact was not positive, which does not exclude a positive impact on allocation of resources. To conclude, Pimenta and Pereira (2019)[6], study the adequacy of education level to the position occupied by the workers, concluding that under-qualification improved over the past years, while over-qualifications remained small.

3. Data and descriptive statistics

Portuguese productivity growth has been weak since early 2000s. Gains in productivity are therefore essential to guarantee sustained economic growth, and convergence to euro area values of labour productivity. Evidence has shown that improvements in productivity can be accomplished by a more efficient allocation of resources. Hence, having a picture of how resources are distributed across firms and how this distribution has changed in the recent years is important, as it can serve to inform policy makers on which areas misallocation is more severe, and work as a starting point for a deeper analysis.

The indicators included in this study use information from IES dataset (*Informação Empresarial Simplificada*), which contains balance sheet data of Portuguese firms from 2006 to 2016, annually reported by firms to meet their legal obligations. The analysis focuses on the dynamics of non-financial corporations from manufacturing (except tobacco and oil products), utilities, construction and services activities (except non-market services, real estate, financial sector)[7]. Firms with non-positive values of Gross Value Added (GVA), assets, and turnover were excluded.

In this analysis, *productivity* is defined as labour productivity, given by the logarithm of the ratio of GVA over the number of workers. To accomplish an aggregate measure of productivity, the weighted average is computed using the logarithm of labour as weights[8]. As for resources, *labour* is defined as the number of individuals working on a firm, and *capital* includes both tangible and intangible assets in euros. The indicators are expressed in nominal terms.

[6] These results do not look at productivity directly.
[7] See annex 1 for further information on the firms included in the analysis.
[8] See annex 1 for information on the methodology used to compute the indicator.

Figure 1. Evolution of labour productivity

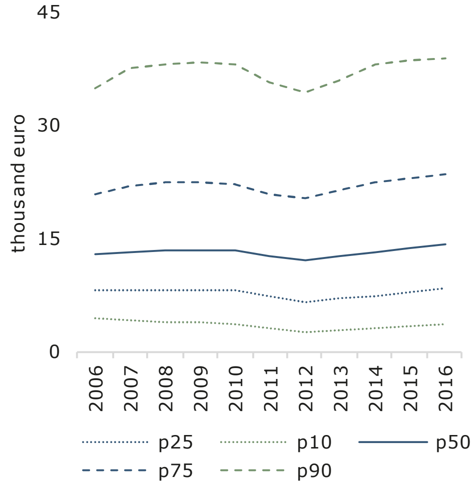
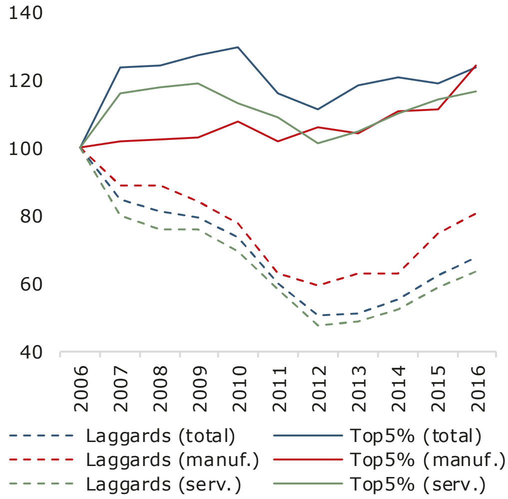


Figure 2. Average labour productivity for top performers (top 5%) and laggards (bottom 95%)
2006=100



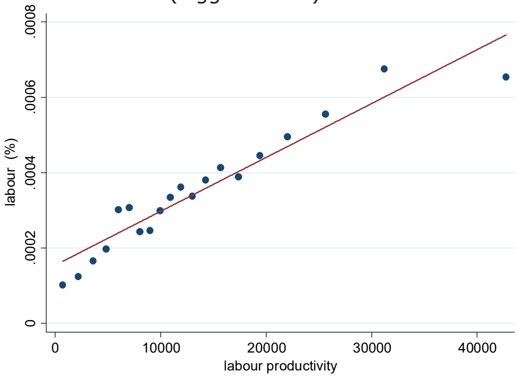
Source: authors calculations using IES
Note: p10: 10th percentile; p25: 25th percentile; p50: median; p75: 75th percentile; p90: 90th percentile.
For this analysis, laggard firms are firms with a productivity level below the 95th percentile.

As it is usually described in the literature (Syverson, 2011), the results confirm significant heterogeneity in productivity levels across firms. For instance, the productivity of firms in the 90th percentile is, on average, 11 times higher than the productivity of firms in the 10th percentile (figure 1). On the other hand, while top performing firms have increased, on average, their productivity by 23% in the period 2006-2016, the laggard firms' productivity decreased more than 30% in the same period (figure 2).

These differences are relevant, as gains in productivity can be accomplished through a different allocation of resources across firms. As such, understanding where resources are currently allocated is relevant for policy design. A picture on resource distribution across laggard firms is given by figures 3 and 4, where the relationship between labour productivity and share of resources is represented. The results indicate the relationship is positive, i.e. firms with higher (lower) levels of productivity have on average higher (lower) shares of labour and capital. However, when frontier firms[9] are included, the relationship between labour productivity and labour share is not clear[10].

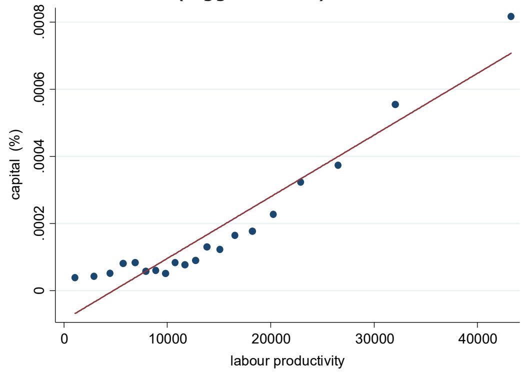
[9] Frontier firms are firms with productivity levels above the 95th percentile.
[10] Results for all firms, i.e. both laggard and frontier firms, are available in annex 3, figures A.3.2. and A.3.3. Results for frontier firms (the 5% most productive firms) are available in annex 3, figures A.3.4. and A.3.5, which show there is no clear relationship between labour productivity and labour share.

Figure 3. Binscatter[11] of labour share and labour productivity (laggard firms)



Source: authors calculations using IES

Figure 4. Binscatter of capital share and labour productivity (laggard firms)



Source: authors calculations using IES

It is also important to analyse if there is a positive relationship between growth rates of capital and labour and the productivity of firms, which would suggest improvements in the allocation of resources. Figures 5 and 6 show a positive connection between the indicators for laggard firms. Again, the relationship is not clear when frontier firms are included[12]. This relationship is influenced by changes in how efficiently resources are allocated across sectors, and across firms within each sector, as well as firm dynamics.

Figure 5. Binscatter of labour growth and productivity (laggard firms)

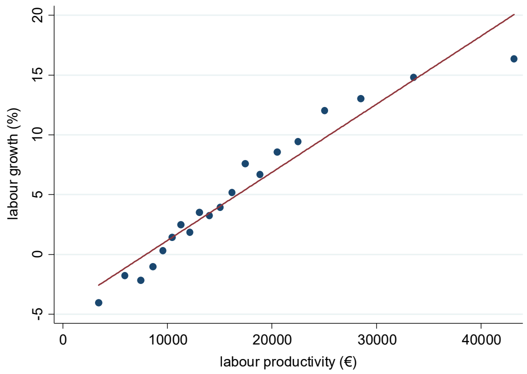
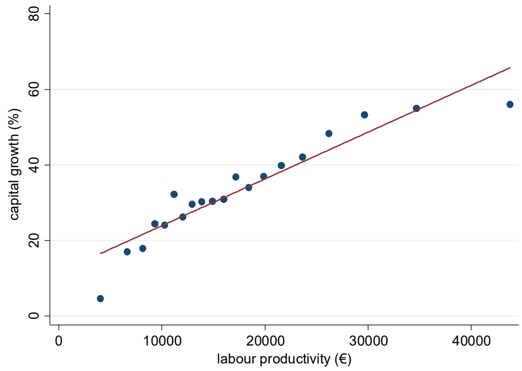


Figure 6. Binscatter of capital growth and productivity (laggard firms)



Source: authors calculations using IES

Source: authors calculations using IES

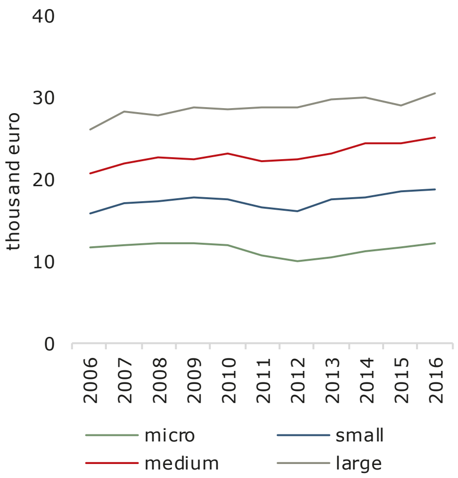
Note: top and bottom 5% values of labour growth were considered outliers and removed from this analysis.

To further understand how resources are distributed across firms, it is important to look at the differences across sizes and sectors. With respect to size (figure 7), results show that productivity increases with the size of the firm, with large firms being 2.5 times more productive than micro firms. This effect can be partially explained by the presence of economies of scale. The evidence indicates that a significant share of resources is allocated to micro and small firms (50% of labour and 25% of capital), which are on average less productive than larger firms (figure 8).

[11] Binscatter is a program in Stata that allows for a better visualization of the relation between two variables, when firm-level data are used. In this case, it divides labour productivity of the firms into equally sized bins; computes the mean for labour productivity and of the resource share/growth within each bin; creates a scatterplot of each data point and draws the population regression line. The results from the regressions from figures 3 to 6 are available in Annex 3, tables A.3.1 to A.3.4.

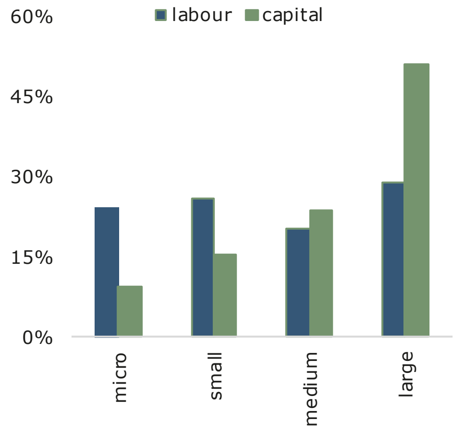
[12] Results for all firms, i.e. both laggard and frontier firms, are available in annex 3, figures A.3.6. and A.3.7. Results for frontier firms are available in annex 3, figures A.3.8. and A.3.9, which show there is no positive relationship between the indicators.

Figure 7. Evolution of average labour productivity for the different sizes



Source: authors calculations using IES

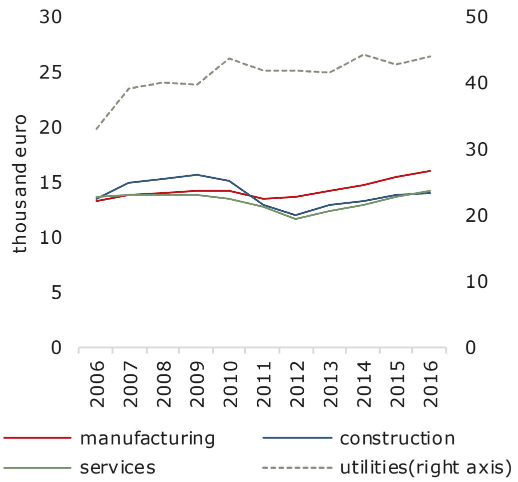
Figure 8. Allocation of labour and capital across firm sizes



Source: authors calculations using IES

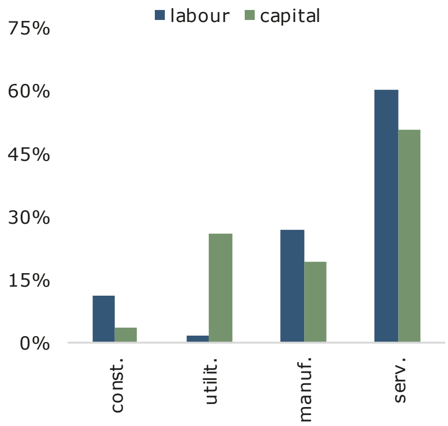
There is also heterogeneity in productivity levels across economic sectors (figure 9). For instance, the productivity of the utilities sector is 2.9 times higher than the productivity of the manufacturing sector[13]. Differences in productivity dynamics are also evident and important. For instance, while the manufacturing and utility sectors, observed a positive trend over the period 2006-2016, with relative small declines during 2010-2012, construction and services suffered significant reductions between 2008 and 2012. A closer look into resource allocation reveals an uneven allocation of both capital and labour across sectors (figure 10). A large share of labour and capital is concentrated in services (60% and 51% respectively), which is the sector that displays the lowest levels of productivity.

Figure 9. Evolution of average labour productivity for sectors



Source: authors calculations using IES

Figure 10. Allocation of labour and capital across sectors

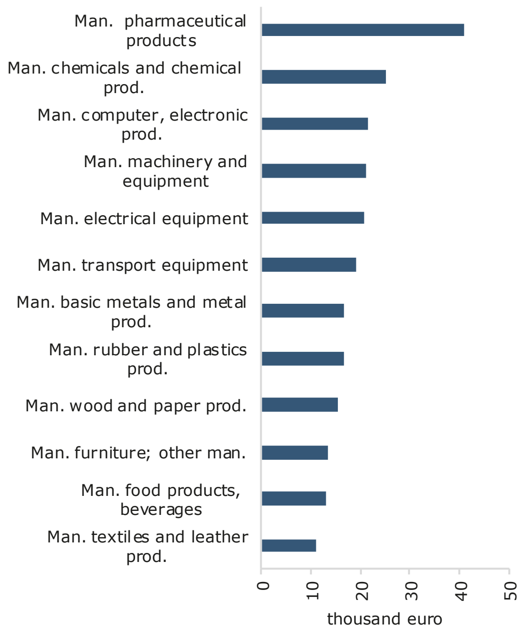


Source: authors calculations using IES

As shown in figures 11 and 13, differences in productivity across industries are large, warranting a deeper look at the allocation of resources at more disaggregated level. In manufacturing, industries with the lowest productivity levels - manufacture of textile, leather, food, furniture products, and beverages - attract more than half of all workers in the sector.

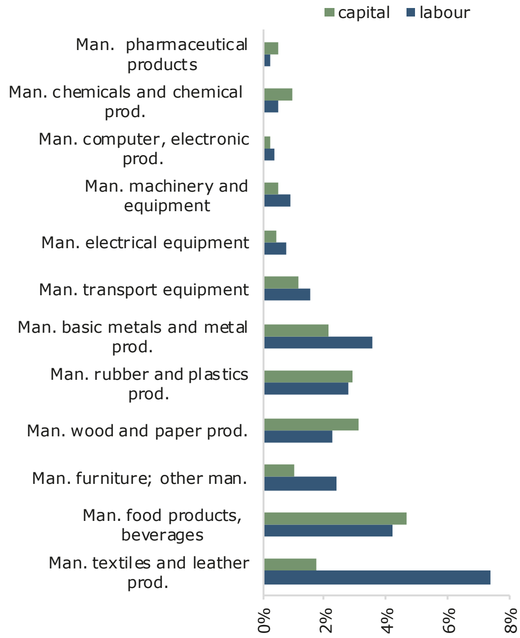
[13] A possible explanation for its large productivity is the very high capital intensity of the utilities sector.

Figure 11. Average labour productivity in manufacturing sectors (2006-2016)



Source: authors calculations using IES

Figure 12. Allocation of resources across sectors – Manufacturing (2010-2016)

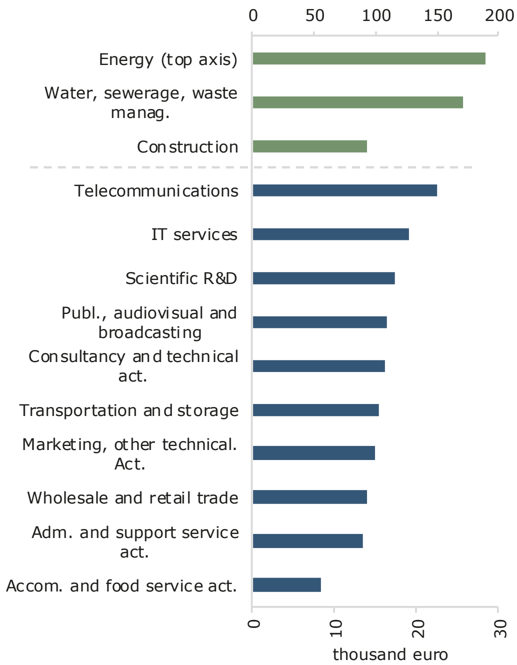


Source: authors calculations using IES

Note: industries are sorted by descending order of productivity both in figure 15 and figure 16.

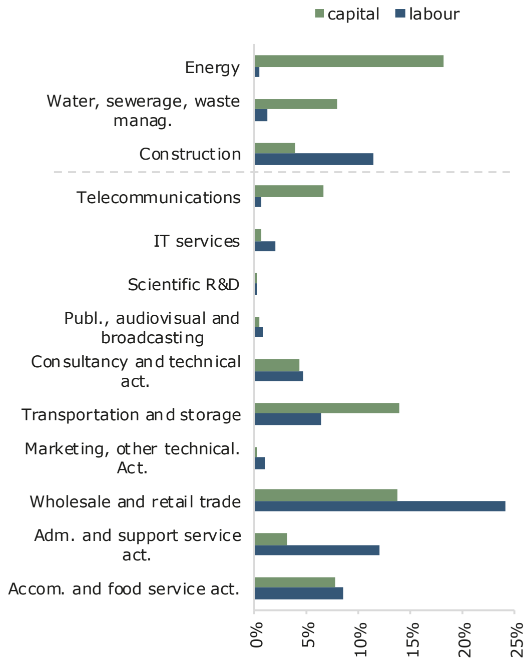
The evidence for capital is less clear; nonetheless, more than half of the sector's capital stock is allocated to the four least productive industries (figure 12). Although there is some evidence that resources could be allocated more efficiently, any policy recommendation should take into consideration their tradable character and export potential.

Figure 13. Average labour productivity services, utilities and construction (2006-2016)



Source: authors calculations using IES

Figure 14. Allocation of resources across sectors - services, utilities and construction (2010-2016)



Source: authors calculations using IES

A similar exercise was performed for the industries in the services sector (figure 14), arriving at similar results, with 74% of the workers and 48% of the capital allocated to the three industries with the lowest average productivity - Accommodation and food services, Administrative and Support activities, Wholesale and retail trade.

Figure 15. Capital and labour growth rates - manufacturing (2011-2016)

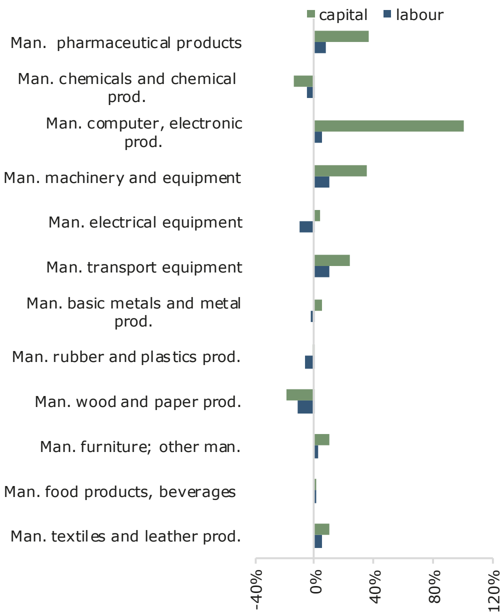
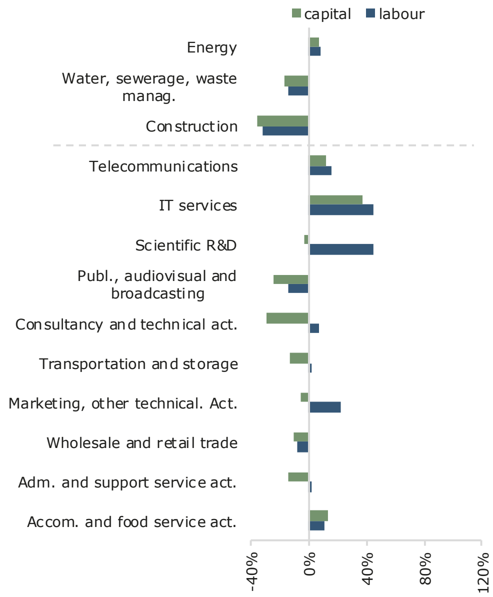


Figure 16. Capital and labour growth rates - services, utilities and construction (2011-2016)



Source: authors calculations using IES

Source: authors calculations using IES

Note: industries are sorted by descending order of productivity both in figure 15 and figure 16.

It is also important to understand if this pattern of allocation has been stable, or if it has changed through the years. Figure 15 shows that for manufacturing, capital increased more in the industries with a strong technological component, while the increases in employment were small.

Whereas in the services sectors (figure 16), high levels of capital and labour growth were observed in Telecommunications, IT services, and Accommodation and food services industries, and negative growth rates were observed for the non-tradable sectors – Construction, Retail and Wholesale trade and Water and Sewerage.

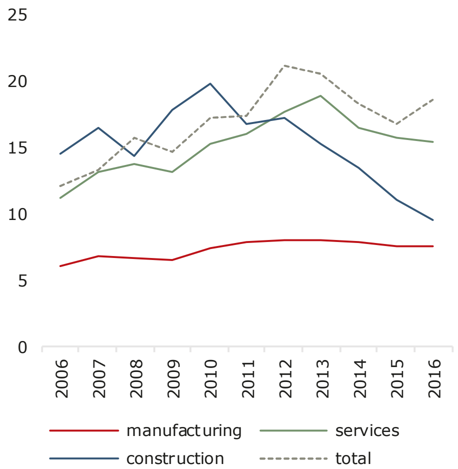
However, the analysis of capital and employment flows should be done with caution, due to the small period under consideration (2010-2016)[14], not allowing for a distinction between cyclical and structural developments, and due to strong financial restrictions present in the period.

This picture of resource distribution across manufacturing and services' industries suggests there are potential improvements on aggregate productivity that can take place through an increase in resources allocated to the more productive sectors or reduction to those allocated to the less productive. However, to have a more complete picture on resource allocation, it is important to look at how capital and labour are distributed across firms inside each sector.

[14] The methodology used to compute fixed assets change in 2010. For this reason the sample used in this analysis corresponds to the period 2010-2016.

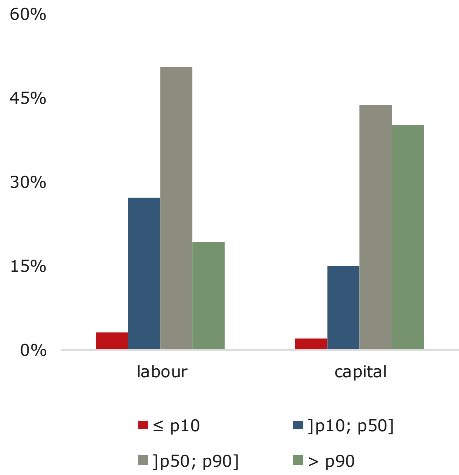
In fact, as common in the literature, the results (figure 17) show high heterogeneity in terms of productivity levels across firms within a sector. Therefore, improvements to aggregate productivity can be accomplished by increasing the resources allocated to the best performing firms in each sector, and through a reduction of those allocated to worst performers.

Figure 17. 90/10 productivity ratio for selected sectors (2006-2016)[15]



Source: authors calculations using IES

Figure 18. Within-industry allocation of resources across firms by performance[16] (2010-2016)[17]

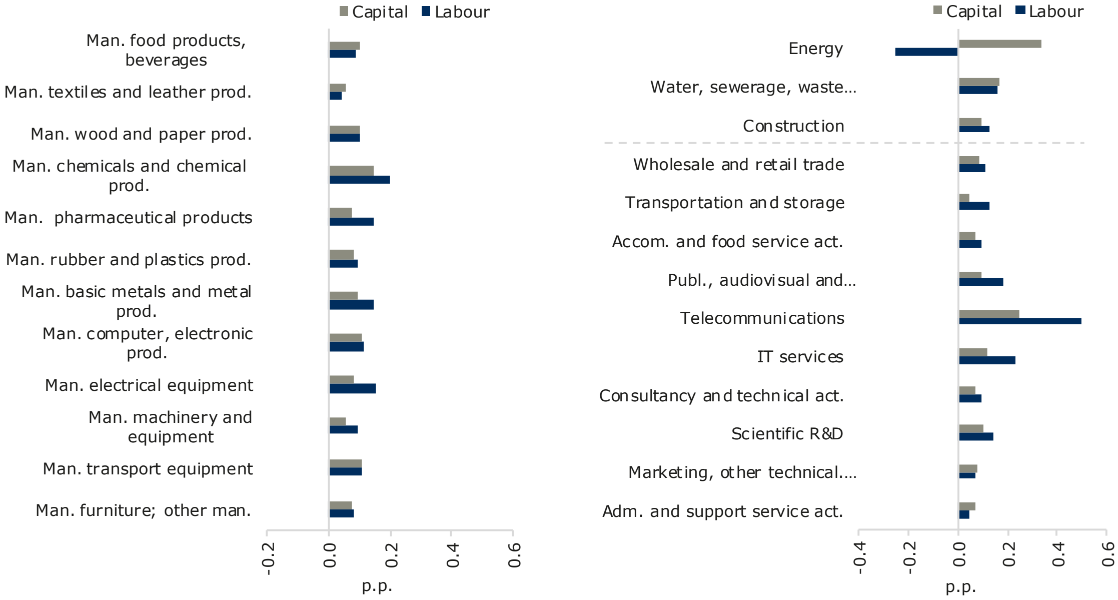


Source: authors calculations using IES

Nonetheless, figure 18 shows that a large share of resources is being allocated to the most productive firms inside each sector[18]. For instance, firms above the median (i.e. the top 50% more productive firms in each sector) are able to attract 69% of workers and 83% of capital, while the top 10% concentrates 19% of the workforce and 40% of the capital stock[19]. In the period from 2010 to 2016, there were some changes to the distribution of resources, with top performing firms increasing their share of labour and capital by 2 p.p. and 5 p.p., respectively.

[15] Ratio 90/10 is computed as the ratio between the 90th percentile and the 10th percentile of productivity.
[16] <p10: includes firms with labour productivity (LP) below 10th percentile (worst performers); >90: includes firms with LP above 90th percentile (best performers); [p10;p50] includes firms with LP below median excluding worst perf.; and [p50;p90] includes firms with LP above median excl. best perf. The results correspond to an average of the values obtained for the 59 industries (2-digit disaggregation).
[17] The results correspond to an average of the values obtained for the 59 industries (2-digit disaggregation).
[18] Information for the manufacturing and services sector can be found in annex 3 – figures A.3.10 and A.3.11.
[19] Nonetheless, there is some heterogeneity in the allocation of resources in terms of industries (Annex 3, table A.3.5). Capital allocated to the 10% most productive firms ranges from 1.8% in the Remediation activities, to almost 100% in Telecommunications. As for labour, the share allocated to the most productive firms ranges from 0.5% in Air transport services to 64% in Telecommunications.

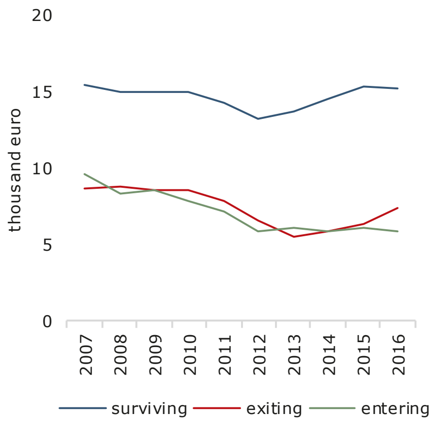
Figure 19. Covariance between labour/capital and labour productivity (2016)



Source: authors calculations using IES   Source: authors calculations using IES

These results were confirmed using a more disaggregated approach, where the distribution of resources in 2016 was compared with a hypothetical scenario where resources are equally distributed across all firms in a given sector, using the covariance between the two indicators (figure 19). The results indicate a positive relationship between the productivity of firms and their share of resources, and that the distribution of resources is more efficient than the equal distribution across firms. The only exception is the energy sector, which displays a negative relationship between labour allocation and productivity.

Figure 20. Productivity of entering and exiting firms



Source: authors calculations using IES

Figure 21. Number of exiting and entering firms

Source: authors calculations using IES

To finish, aggregate productivity can also be influenced by firm dynamics, i.e. the decision of firms to enter or exit the market. Figure 16 shows that, as expected, entering and exiting firms have lower productivity when compared to surviving firms. The differential on productivity among groups, as well as, the large number of firms making the decision to enter or exit the market (figures 20 and 21) suggest that these dynamics should not be disregarded when studying the evolution and drivers of productivity.

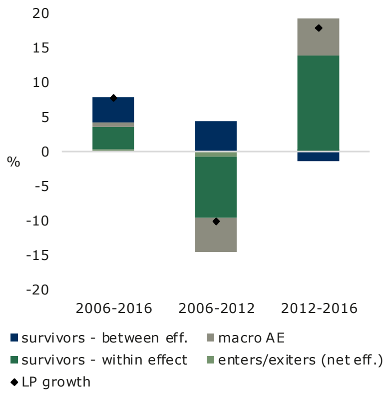
In general, the results confirm the high heterogeneity of productivity levels of Portuguese firms. They indicate that a large share of resources, such as labour and capital, are allocated to the industries with the lowest levels of productivity, suggesting that productivity improvements can be accomplished. The results also show a different picture for the distribution of resources across firms in the same industry, where a large share of resources is allocated to the 50%, and even to the 10% most productive firms. Indeed, top performers have been able to capture a larger share of resources during the 2010-2016 period. Lastly, the large number of firms entering and exiting the market, and the large differential of productivity between these firms and surviving firms indicate that firm dynamics can have a significant impact on productivity growth. Therefore, it is important to understand the role of these effects in productivity dynamics and identify the effects that had a significant impact on growth.

4. Decomposition

In order to understand the role of resource allocation in explaining productivity dynamics, productivity growth was decomposed into four effects[20], i) the effect of changes to the efficiency in the allocation of resources across industries (macro AE), the effect of changes to the productivity of the individual industries, which includes ii) the effect of firm dynamics[21] (enters and exiters net effect), iii) the effect of changes to average productivity of incumbent firms[22] (survivors - within effect); and iv) the effect of changes to the efficiency of resource allocation across incumbent firms (survivors – between effect)[23]. The analysis was performed for the period 2006-2016, and sub-periods 2006-2012 and 2012-2016.

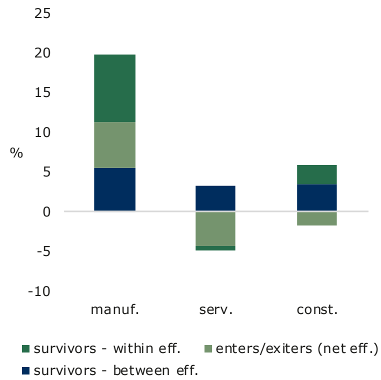
These results indicate that improvements to efficiency on resource allocation between incumbent firms (between-effect), and improvements to the average productivity of individual firms (within-effect) were the main drivers of growth during the period 2006-2016, representing 3.3 p.p. and 3.6 p.p. of productivity growth, respectively (figure 22). The results also show, that efficiency in allocation of resources between industries (macro allocative efficiency or macro AE), and firm dynamics, had positive small effects on growth (figure 22). The decomposition of growth shows important differences between sectors that should be considered (figure 23).

Figure 22. Decomposition of productivity growth using a dynamic approach[24]



Source: authors calculations using IES

Figure 23. Decomposition of sectoral productivity growth using a dynamic approach [25] (2006-2016)

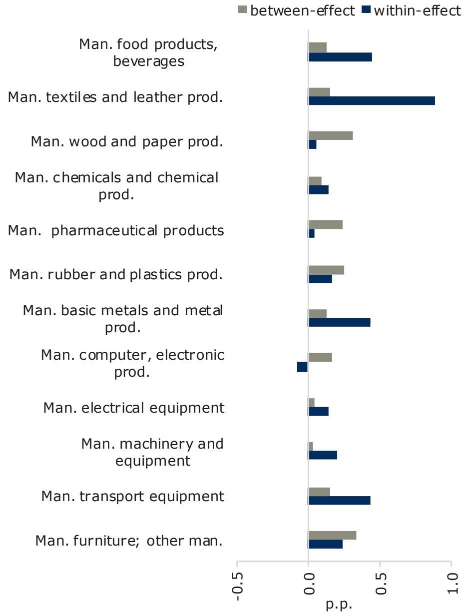


Source: authors calculations using IES

As mentioned previously, the most important effect to explain productivity growth for the period 2006-2016 was the improvement to the efficiency in resource allocation across incumbent firms (between-effect). Figures 24 and 25 give additional details on this effect. They show that these improvements were broad-based across industries when the entire period, or first period are considered, and smaller or even negative when looking at the second period, especially in the services sector[26].

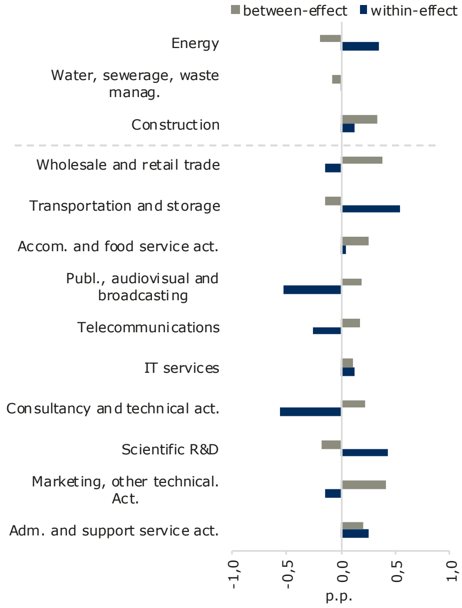
[20] The details on methodology used for the decomposition are available in Annex 2.
[21] The effect from the exiting and entering firms. For example, productivity growth can be achieved if the least productive firms decide to exit the market.
[22] Incumbent firms are those firms that remain in the market in the period under analysis.
[23] Due to the methodology that was used, the decomposition can only evaluate the allocative efficiency of labour across sectors and across firms. It does not consider the allocative efficiency of capital. This can constitute a limitation of the analysis.
[24] The effects were computed using information for 2 digit NACE codes, corresponding to a total of 59 industries. The figure shows the average results for the economy.
[25] The effects were computed using information for 2 digit NACE codes, corresponding 22 industries in manufacturing, 29 in services and the remaining in construction and utilities. The figure shows the average results per sector.
[26] Additional information for the sub-periods is available in Annex 3, figures A.3.12. and A.3.13.

Figure 24. Decomposition of productivity growth by industry – between and within effects of surviving firms[27] in manufacturing (2006-2016)



Source: authors calculations using IES

Figure 25. Decomposition of productivity growth by industry - between and within effects of surviving firms[10] in construction, services and utilities (2006-2016)



Source: authors calculations using IES

The second most important effect to explain productivity growth was average productivity improvements (within-effect). The results for the sub-periods indicate a broad-based increase in the period 2006-2012, followed by a broad-based decrease in the period 2012-2016[28]. Considering the effect for the entire period, evidence suggests it was positive for more than 60% of the industries[29], reflecting the dominant influence of manufacturing industries (figures 24 and 25). However, these results should be carefully interpreted, as they may be influenced by, among others, the economic cycle and price effects, or they can be related to the numerous structural reforms implemented in the last two decades.

Productivity growth is also influenced, to a lesser extent, by changes to macro allocative efficiency. Macro allocative efficiency corresponds to the covariance between share of labour allocated to a sector and its labour productivity. If positive, the allocation of labour across sectors is more efficient than a baseline scenario, where workers across sectors are evenly distributed. If negative, the allocation is worse than the baseline scenario. The evidence indicates that both in 2006 and 2016, the allocative efficiency was negative, but that an improvement was observed in 2016 relative to the first year (figure 26), with a positive contribution of half of the industries[30]. Telecommunications, Remediation activities and Manufacture of wearing apparel were the industries that contributed the most for the improvement in allocative efficiency.

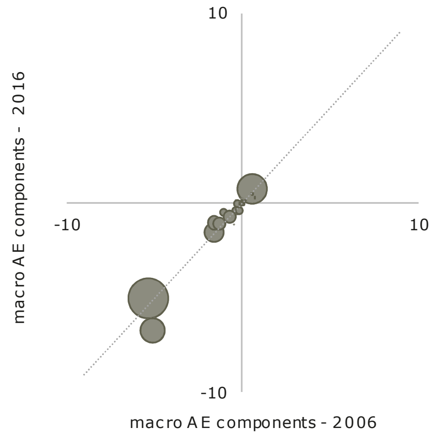
[27] The effect was computed using information for 2 digit NACE codes, corresponding to a total of 59 industries, with 22 industries in manufacturing, 29 in services and the remaining in construction and utilities. Figures 24 and 25 show the results aggregated in 25 sectors to allow for a better visualization.

[28] Additional information for the sub-periods is available in Annex 3, figures A.3.14. and A.3.15.

[29] See table A.3.6. in annex 3

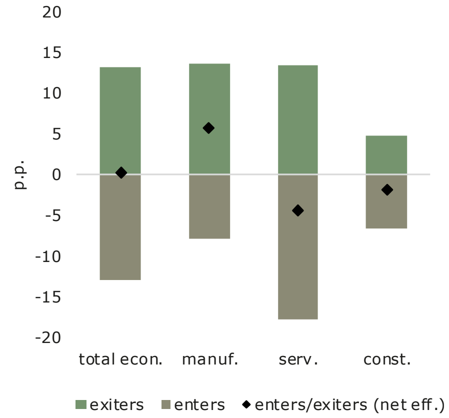
[30] Additional information for the sub-periods is available in Annex 3, figures A.3.16. and A.3.17.

Figure 26. Decomposition of productivity growth - AE components[31] (2006-2016)



Source: authors calculations using IES

Figure 27. Contribution of exiting and entering firms to productivity growth[32] (2006-2016)

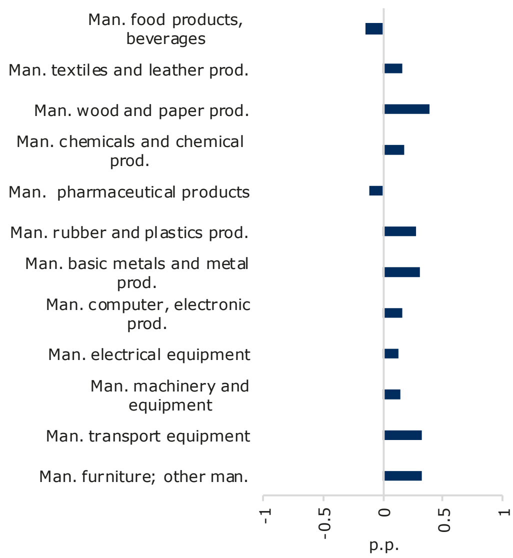


Source: authors calculations using IES

Firm dynamics, i.e. firm entry and exit, had a marginal effect on productivity growth at the aggregate level (figure 27). Looking at the firm dynamics effects separately, it is possible to observe that firms that exit the market were, on average, less productive than those that remained in activity. As such, their effect to productivity growth was positive.

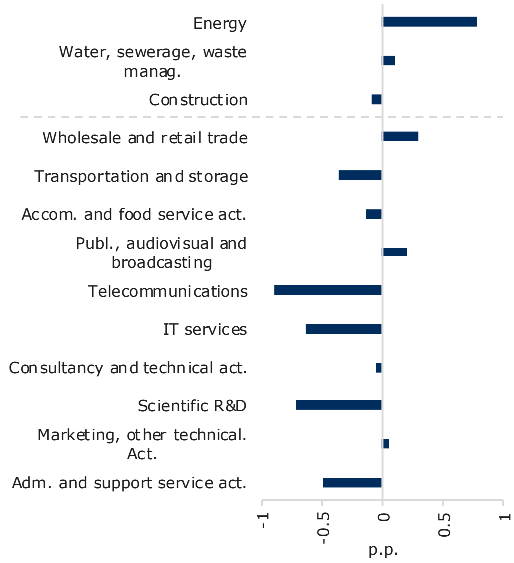
However, new firms were also less productive than incumbents during their first year in activity. For this reason, these firms had a negative effect on productivity growth in the first year. Therefore, the analysis does not consider future effects that can become positive as these firms reach their optimal size.

Figure 28. Decomposition of productivity growth by industry - net effect of enters and exiters in manufacturing (2006-2016)



Source: authors calculations using IES

Figure 29. Decomposition of productivity growth by industry - net effect of enters and exiters in services, construction and utilities (2006-2016)



Source: authors calculations using IES

[31] The figure compares the components of macro allocative by industry from two years. The 45 degree line was introduced to facilitate the interpretation: industries located above the 45º line have improved their contribution to the macro allocative efficiency indicator; whereas industries bellow that line have worsen their contribution. The calculations use 2 digit NACE codes. Industry's dimension is measure by its labour share.

[32] The figure shows the effect of enters and exiters on the growth of total aggregate LP decomposed by comparing the labour productivity of enters or exiters with the productivity of surviving firms. The effect was computed using information for 2 digit NACE codes, corresponding to a total of 59 industries, with 22 industries in manufacturing, 29 in services and the remaining in construction and utilities.

Despite the insignificant role of firm dynamics to explain aggregate growth, evidence shows the effect was relevant at a more disaggregated level. For instance, figure 28 shows it was positive and significant for the manufacturing industries, with the exception of Manufacture of food products and beverages and Manufacture of pharmaceutical products. As for services, figure 29 shows that the effect was negative for most industries, and large for Telecommunications, Scientific R&D, IT services and Administration and Support services activities. The largest positive effect was obtained by the Energy sector.

Overall, the results show how the different effects influence productivity growth. Moreover, they also show they may differ across industries, calling for a policy design that takes into account the specificities of each sector.

Conclusion

In this analysis, the results show large differences in productivity levels across firms, sectors and sizes. This heterogeneity implies that potential improvements in aggregate productivity are possible through a more efficient allocation of resources across firms. Research has shown that resources are often misallocated, due to frictions in the market, such as, financial frictions, regulatory framework in the labour and product markets, insolvency regimes specifications, size-dependent regulations, among others.

This is quite relevant for the case of Portugal. As the country implemented a very comprehensive set of structural reforms in these areas, changes to the allocation of resource are expected. Moreover, due to persistent differences in labour productivity relative to its euro area peers, additional reforms may be needed to ensure convergence. Therefore, a deeper understanding on resource allocation is important. This paper contributes to the literature by giving a picture of the current pattern of resource allocation and by identifying possible drivers of productivity growth, which can help policy design and serve as a starting point for further research.

The results indicate that, for laggard firms, the relationship between the productivity of a firm and its share of capital and labour, as well as their growth, is positive, i.e. the higher the productivity of a firm, the higher is the share of resources allocated to it, and the higher its labour and capital growth. However, evidence for frontier firms is not conclusive, which can be an interesting topic for future research.

An efficient allocation of resources is influenced by the distribution of resources across sectors in the economy. Due to the high heterogeneity in productivity levels of the different sectors, if resources become more concentrated in those sectors with higher productivity, aggregate productivity is expected to increase. Allocative efficiency is also influenced by how resources are distributed across firms inside each sector. Firms operating in the same sector show very different levels of productivity. Therefore, if resources become more concentrated in those firms that exhibit higher levels of productivity, aggregated productivity is expected to rise as well.

The results show that, in Portugal, both capital and labour are, on average, more concentrated in the most productive firms inside each sector. Moreover, the results for the allocation of resources inside each industry indicate the current distribution of resources is more efficient than an equal distribution, i.e. firms that have above average productivity concentrate more resources than the least productive units do.

Evidence for the allocation of resources across sectors shows a different picture, where labour is actually more concentrated in the industries with the lowest levels of productivity, both in manufacturing and services. Additionally, the results suggests that the current distribution of labour is less efficient than an equal distribution across sectors, i.e. higher shares of labour are allocated to industries with below average productivity, than they are to the most productive ones. Evidence for capital is not as straightforward.

One possible interpretation of these findings is that the current distribution of resources across industries is not efficient, with a potential negative impact on productivity. In theory, improvements would be possible by increasing the concentration of resources to the most productive industries, and reducing their share in the least productive. However, reallocating existing resources across sectors may not be possible, as skills and capital requirement are likely to be different across sectors, and may be associated with large losses, which can undo the potential gains from a better allocation. Further research on this area would be useful. Moreover, there is also evidence that a more efficient allocation of resources across firms inside each sector is possible, with a potential positive impact on productivity.

In order to understand the role of resource allocation in explaining productivity dynamics, productivity growth was decomposed into four effects – the effect of changes to the efficiency of resource allocation across incumbent firms, the effect of changes to average productivity of incumbent firms, the effect of changes to the efficiency in the allocation of resources across industries, and the effect of firm dynamics. The results suggest that most of the increase in productivity for the period 2006-2016 is explained by improvements to the first two effects, while the last two were found to have a residual role. A more disaggregated approach reveals some important differences in the drivers of growth across sectors, suggesting that a policy design should take into account these differences.

Therefore, resource allocation not only had a relevant role in recent productivity dynamics at the aggregate level, explaining more than half of the growth between 2006 and 2016, evidence shows this effect was positive for 52 out of the 59 industries considered, suggesting a broad-based improvement in this type of allocative efficiency.

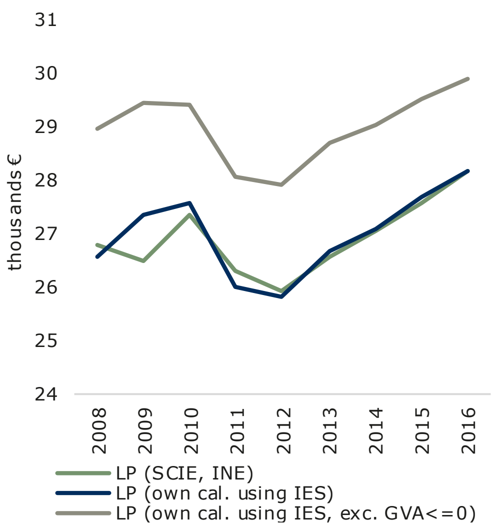
This paper gives important information on the distribution of resources across firms and sectors, identifying the areas in which misallocation is more severe, and evaluates the contribution to productivity growth of a more efficient allocation of resources, while working as a starting point to a deeper analysis. The paper also identifies the most important frictions to an efficient allocation of resources described in the literature. However, further research on this area using data for Portuguese firms would be important. Namely, studying the impact of the very comprehensive set of structural reforms implemented in Portugal in the last decades, and identifying the most important frictions behind the current misallocation of resources would be important to design or adjust public policies, aimed at promoting a better allocation of resources, especially across sectors, and achieving convergence to euro zone productivity levels.

Annex 1 – Methodology

This study uses information from the IES dataset (*Informação Empresarial Simplificada*), which contains balance sheet data from Portuguese firms from 2006 to 2016. The analysis focuses on the dynamics of non-financial corporations (S11). To performe it, standard data cleaning processes were required, such as, the exclusion of negative/null/missing values of total assets, turnover, number of employees, ESS (external supplies and services), and GVA. It was assumed that firms reporting zero employees had one person working in the firm (the owner).

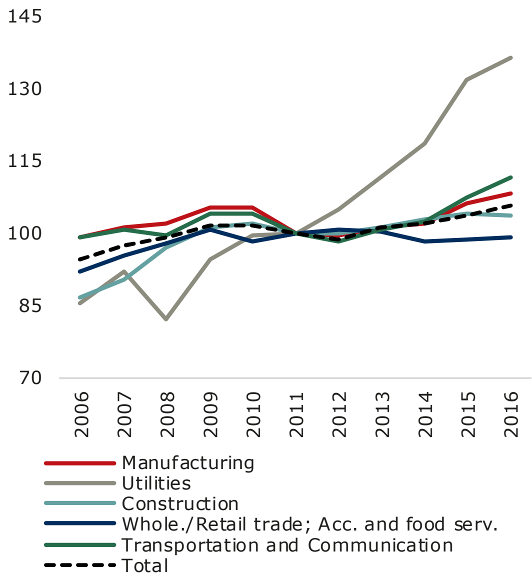
Using these restrictions, two simple measures of labour productivity were computed, where labour productivity is defined as the ratio of total GVA over total employment. The first measure does not exclude firms with non-positive values of GVA, whilst the second only includes firms with positive values for GVA. To understand the impact of the imposed restrictions, a comparison between these simple productivity measures with the ones published by INE regarding SCIE (database that incorporates information from IES) was performed. Figure A.1.1 shows the evolution of the three series, indicating some differences in the level of productivity of the second measure of productivity relative to the other two. Moreover, removing observations with negative or null values of GVA does not affect the dynamics of labour productivity.

Figure A.1.1. Evolution of aggregate Labour productivity



Source: INE, authors calculations using IES

Figure A.1.2. GVA deflator by industry (2011=100)



Source: INE

The dataset only includes information on non-financial corporations. Therefore, a representativeness issue can occur for those economic sectors where other institutional units (such as financial corporations, households and government) play a relevant role in the production process. Using information on the number of workers and GVA per industry, the aggregated results from the database were compared to the values recorded in National Accounts. Some industries showed significant differences on one or both indicators and were excluded from the analysis.

The following industries were removed from the analysis: Agriculture (A), Financial and insurance activities (K), Real estate activities (L), Public Administration and defence, Compulsory social security (O), Education (P), Human health and social work activities (Q), Arts, entertainment and recreation (R), Other services (S), Activities of households as employers, undifferentiated goods and services-producing activities of households for own use (T), and Activities of extraterritorial organizations and bodies (U). Moreover, the following industries were also excluded due to the presence of outliers: Mining and quarrying, Manufacture of tobacco and Manufacture of coke and refined petroleum products.

One of the limitations of the IES database is the absence of the required information to compute real measures of GVA. For this reason, nominal GVA was used instead. This limitation is common to other analyses that use firm-level data, and it should be taken into account when interpreting the results. Figure A.1.2. shows that, for most of the industries (excluding the utilities sector), the growth in prices was small for the period under analysis (2006-2016).

For this study, a more complex measure of aggregate productivity was computed using firm-level data which is more in line with standard literature on reallocation (see for instance Melitz and Polanec, 2012, European Commission, 2018, Banco de Portugal, 2016 and European Commission, 2013). Aggregate productivity was computed using a geometric weighted average of firm-level labour productivity, i.e. the ratio of nominal GVA over employment of a firm. Moreover, following the methodology used by Dias and Marques (2018), shares of log employment were used as weights to attenuate the impact of outliers. This implies that the results are not directly comparable to those published by INE.

Firm-level labour productivity (LP^i) is defined as the ratio of nominal GVA (GVA^i) over employment ($employment^i$) of a firm.

$$LP^i = \frac{GVA^i}{employment^i}$$

At the sectoral level, labour productivity of firms is aggregated (LP^s), using as weights the logarithm of the share of employment (θ^i).

$$\theta^i = \frac{employment^i}{employment\ in\ sector\ s};\ \ LP^s = \sum_{i=1}^{N} \theta^i\ LP^i$$

At the macro level, aggregated productivity (LP) is computed in a similar way, using LP (LP^s) and log employment share (θ^s) at the sector level.

$$\theta^s = \frac{employment\ in\ sector\ s}{total\ employment};\ LP \quad = \sum_{s=1}^{N} \theta^s\ LP^s$$

Annex 2 – Decomposition

Understanding the effects that are driving productivity growth is important to policy design. In this analysis productivity growth was decomposed into four effects: i) The effect of changes to the efficiency in the allocation of resources across industries - macro Allocative Efficiency; and the effect of changes to the productivity of individual industries, that can be further divided into: ii) the effect of firm dynamics (enters and exiters net effect), iii) the effect of changes to average productivity of incumbent firms (survivors - within effect); iv) the effect of changes to the efficiency of resource allocation across incumbent firms (survivors – between effect).

The descomposition involves three stages. In the first stage, aggregate productivity growth at the industry level is decomposed into three effects: enters and exiters net effect, within effect of survivors and between effect of survivors. In the second stage, aggregate productivity growth at macro level is decomposed using industry level information, into macro allocative effect and average aggregate productivity growth at the industry level. In stage three the results from the two first stages are merged.

1. Decomposition of productivity growth at the industry level using a dynamic approach

The decomposition of productivity growth at the industry level uses the approach developed by Melitz and Polanec (2012), a "dynamic Olley-Pakes decomposition" with three groups of firms considered: exiters, enters and survivors[33]. The dynamic decomposition is different from the simple Olley-Pakes decomposition (Olley and Pakes, 1996), in the sense, that allows the effect of exiters and enters in the decomposition of sectoral productivity. To accomplish this extention only changes to labour productivity (i.e. productivity growth) are considered.

In this analysis, labour productivity growth is computed as the difference of the logarithms of aggregate produductivity. Moreover, the logarithm of aggregate labour productivity at the industry level (Φ_{st}) is estimated as a weighted average of firm-level productivity (φ_{it}) using labour share (θ_t) as weights.

$$\log \text{Labour productivity} = \sum_{i=1}^{N} \theta_{it}\varphi_{it}$$

For the first period (equation a), log labour productivity is decomposed into the effect of surviving firms (Φ_{It}) and the effect of firms that exited the market between t and t+1 ($\theta_{Xt1}[\Phi_{Xt1} - \Phi_{Ct}\ ]$). The last term measures the effect of exiters by computing the difference between exiters' productivity with the one from surviviors, weighted by exiters' labour share.

$$\Phi_t = \Phi_{It} + \theta_{Xt1}[\Phi_{Xt1} - \Phi_{Ct1}] \qquad (a)$$

Furthermore, labour productivity of survivors can be decomposed as in the standard Olley-Pakes decomposition in two terms, the unweighted average of firm's productivity term, $\overline{\Phi_t}$, and the sectoral allocative efficiency term (corresponding to covariace between firm's productivity and its labour share).

$$\Phi_{It} = \bar{\Phi}_I + cov_{IC}$$

In the second period (equation b), log labour productivity is decomposed into the effect of surviving firms (Φ_{It+1}) and the effect of firms that entered the market between t and t+1. The last term measures the effect of enters by computing the difference between survivors' productivity with the productivity from enters, weighted by enters' labour share. Labour productivity of survivors can also be decomposed as in the standard Olley-Pakes decomposition in two terms as in the first period.

$$\Phi_{t+1} = \Phi_{It+1} + \theta_{Et2}[\Phi_{Et2} - \Phi_{Ct2}] \qquad (b)$$

To summarize, in this analysis, changes in productivity for sector S are measured as a sum:

- Changes to the unweighted average productivity of survivors. This terms measures the effect of changes to average productivity of incumbent firms (survivors - within effect)
- Changes to the covariance term of surviving firms. This terms measures the effect of changes to the efficiency of resource allocation across incumbent firms (survivors – between effect).
- Two terms that measure the effect of the firms that entered or exited the market in the period under analysis. These terms measure the effect of firm dynamics (enters and exiters net effect)

[33] In this note, exiters (X) are firms in the market in the first year of the period under consideration and were not in the last year of such period. On the other hand, enters (E) are firms which were in the market in the last year of the period under analysis but not in the first year of the period. Survivors (I) are firms in the market in both years.

$$\Delta\Phi_S = (\Phi_{It+1} - \Phi_{It}) + \theta_{Et+1}[\Phi_{Et+1} - \Phi_{It+}\ ] + \theta_{Xt}[\Phi_{It} - \Phi_{Xt}]$$

$$\Delta\Phi_S = \Delta\bar{\Phi}_I + \Delta cov_I + \theta_{Et+1}[\Phi_{Et+1} - \Phi_{It+1}] + \theta_{Xt}[\Phi_{It} - \Phi_{Xt}] \quad (c)$$

2. Decomposition of aggregate productivity at the macro level

In the second stage, aggregate productivity growth at macro level is decomposed using industry level information. These computations are based on the work of Olley and Pakes (1996), European Commission (2018), Banco de Portugal (2016) and European Commission (2013). The last two papers apply a sector-level variant of the productivity decomposition.

In this analysis, log labour productivity at the macro level is decomposed in two terms. The first term measures improvements in industry labour productivity ($\overline{\Phi_{st}}$), and the second term measures the covariance between industry efficiency and the allocation of labour (AE), i.e. measures how efficient resources are allocated across industries, and if they are going to the most productive sectors in the economy (macro allocative efficiency).

$$\varphi_t = \sum_{S=1}^{N} \theta_{st}\Phi_{st} = \frac{1}{S}\sum_{S=1}^{N} \Phi_{st} + \sum_{S=1}^{N} (\theta_{st} - \bar{\theta}_t)(\Phi_{st} - \bar{\Phi}_t) = \overline{\Phi_{st}} + AE_t \qquad (e)$$

3. Decomposition of aggregated productivity growth (dynamic approach)

In the third step, aggregate labour productivity growth at the macro level is decomposed in more detail using the information from the previous steps. This more complex decomposition, can be accomplished by departing from the decomposition at the macro level described in point 2.

$$\Delta\varphi_t = \sum_{S=1}^{N} \theta_{st2}\Phi_{st2} - \sum_{S=1}^{N} \theta_{st}\ \Phi_{st1}$$

$$= \frac{1}{S}\sum_{S=1}^{N} \Phi_{st}\ - \frac{1}{S}\sum_{S=1}^{N} \Phi_{st1} + \sum_{S=1}^{N} (\theta_{st2} - \bar{\theta}_{t2})(\Phi_{st2} - \bar{\Phi}_{t2}) - \sum_{S=1}^{N} (\theta_{st}\ - \bar{\theta}_{t1})(\Phi_{st1} - \bar{\Phi}_{t1})$$

$$\Delta\varphi_t = \Delta\bar{\Phi}_S + \Delta AE \qquad (f^{34})$$

The decomposition of productivity growth at the macro level is represented in equation f. It includes a first term which refers to the unweighted average of labour productivity growth at the industry level, and a second term which includes changes to allocative efficiency across sectors. As seen in point 1, the productivity growth at the sector level can be computed using firm-level information. If productivity growth is computed for all the industries in the economy (as in point 1), the results could be incorporated in the first term of equation f. Moreover, point 1 also shows it is possible to decompose productivity growth at the sector level in three components or effects.

By incorporating this information in equation f, it is possible to decompose aggregate productivity growth at the macro level in four effects. The first term measures the effect of changes to the sectoral unweighted productivity of surviving firms (measure if firms are increasing their own LP); the second term measures changes to sectoral allocative efficiency (measures how efficient resources are being allocated in a given economic sector); the third term measures the effect of enters; the third effect measures the effect of exiters and the last term measures changes to macro allocative efficiency (i.e. measures how efficiently resources are allocated across industries).

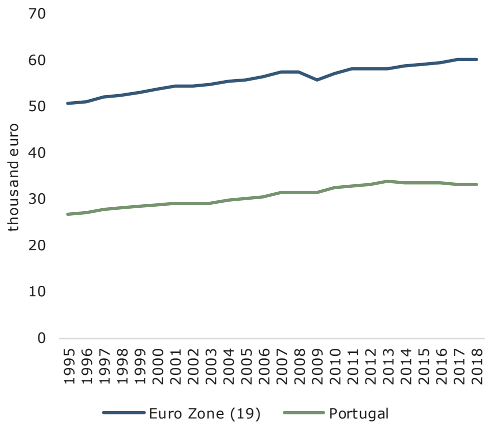
$$\Delta\varphi_t = \frac{1}{S}\sum_{S=1}^{N} (\Delta\bar{\Phi}_C + \Delta cov_C + \theta_{Et2}[\Phi_{Et2} - \Phi_{Ct2}] + \theta_{Xt1}[\Phi_{Ct1} - \Phi_{Xt1}]) + \Delta AE \qquad (g)$$

$$= \frac{1}{S}\sum_{S=1}^{N} \Delta\bar{\Phi}_C + \frac{1}{S}\sum_{S=1}^{N} \Delta cov_C + \frac{1}{S}\sum_{S=1}^{N} \theta_{Et2}[\Phi_{Et2} - \Phi_{Ct}\ ] + \frac{1}{S}\sum_{S=1}^{N} \theta_{Xt}\ [\Phi_{Ct1} - \Phi_{Xt}\ ] + \Delta AE$$

[34] Decomposition of aggregate productivity at the macro level applied to labour productivity growth.

Annex 3 – Additional results

Figure A.3.1. Labour productivity evolution



Source: authors calculations using Eurostat.

Table A.3.1. Regression results from the Binscatter of labour share and labour productivity represented in figure 3 (includes laggard firms)

Source	SS	df	MS			
				Number of obs	=	334,780
				F(1, 334778)	=	512.59
Model	.007235689	1	.007235689	Prob > F	=	0.0000
Residual	4.72568508	334,778	.000014116	R-squared	=	0.0015
				Adj R-squared	=	0.0015
Total	4.73292077	334,779	.000014137	Root MSE	=	.00376

share_L_av~e	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
LP_average	1.43e-08	6.32e-10	22.64	0.000	1.31e-08	1.55e-08
_cons	.0001542	.0000109	14.19	0.000	.0001329	.0001754

Source: authors calculations using IES

Table A.3.2. . Regression results from the Binscatter of capital share and labour productivity represented in figure 4 (includes laggard firms)

Source	SS	df	MS			
				Number of obs	=	291,155
				F(1, 291153)	=	1606.42
Model	.010377154	1	.010377154	Prob > F	=	0.0000
Residual	1.88079037	291,153	6.4598e-06	R-squared	=	0.0055
				Adj R-squared	=	0.0055
Total	1.89116752	291,154	6.4954e-06	Root MSE	=	.00254

share_K_av~e	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
LP_average	1.84e-08	4.59e-10	40.08	0.000	1.75e-08	1.93e-08
_cons	-.0000882	8.18e-06	-10.78	0.000	-.0001042	-.0000721

Source: authors calculations using IES

Table A.3.3. Regression results from the Binscatter of labour growth and labour productivity represented in figure 5 (includes laggard firms)

Source	SS	df	MS			
				Number of obs	=	113,
				F(1, 113985)	=	1944
Model	3475646.79	1	3475646.79	Prob > F	=	0.0
Residual	203784232	113,985	1787.81623	R-squared	=	0.0
				Adj R-squared	=	0.0
Total	207259879	113,986	1818.29241	Root MSE	=	42.

var_L	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interv
LP_average	.0005698	.0000129	44.09	0.000	.0005445	.0005
_cons	-4.526876	.25105	-18.03	0.000	-5.01893	-4.034

Source: authors calculations using IES

Table A.3.4. Regression results from the Binscatter of capital growth and labour productivity represented in figure 6 (includes laggard firms)

Source	SS	df	MS			
				Number of obs	=	96,7
				F(1, 96784)	=	537.
Model	14178486.9	1	14178486.9	Prob > F	=	0.00
Residual	2.5544e+09	96,784	26393.2392	R-squared	=	0.00
				Adj R-squared	=	0.00
Total	2.5686e+09	96,785	26539.4612	Root MSE	=	162.

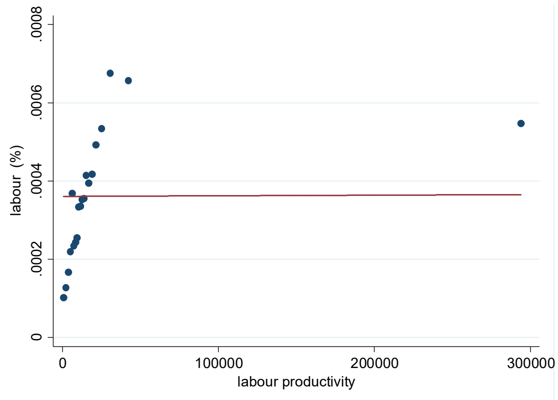
var_K	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interva
LP_average	.0012381	.0000534	23.18	0.000	.0011334	.00134
_cons	11.52915	1.081236	10.66	0.000	9.409942	13.648

Source: authors calculations using IES

Figure A.3.2. Regression results from the Binscatter of labour share and labour productivity (includes laggard and frontier firms)

Source	SS	df	MS			
				Number of obs	=	352,400
				F(1, 352398)	=	0.56
Model	8.0762e-06	1	8.0762e-06	Prob > F	=	0.4553
Residual	5.10532265	352,398	.000014487	R-squared	=	0.0000
				Adj R-squared	=	-0.0000
Total	5.10533072	352,399	.000014487	Root MSE	=	.00381

share_L_av~e	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
LP_average	1.53e-11	2.05e-11	0.75	0.455	-2.49e-11	5.56e-11
_cons	.0003606	6.44e-06	56.02	0.000	.000348	.0003732

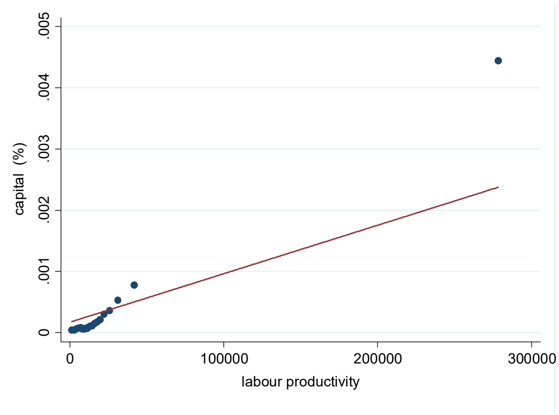


Source: authors calculations using IES

Figure A.3.3. Regression results from the Binscatter of capital share and labour productivity (includes laggard and frontier firms)

Source	SS	df	MS			
				Number of obs	=	305,447
				F(1, 305445)	=	7866.99
Model	2.07940659	1	2.07940659	Prob > F	=	0.0000
Residual	80.7353815	305,445	.000264321	R-squared	=	0.0251
				Adj R-squared	=	0.0251
Total	82.814788	305,446	.000271127	Root MSE	=	.01626

share_K_av~e	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
LP_average	7.92e-09	8.92e-11	88.70	0.000	7.74e-09	8.09e-09
_cons	.0001714	.0000295	5.81	0.000	.0001135	.0002293

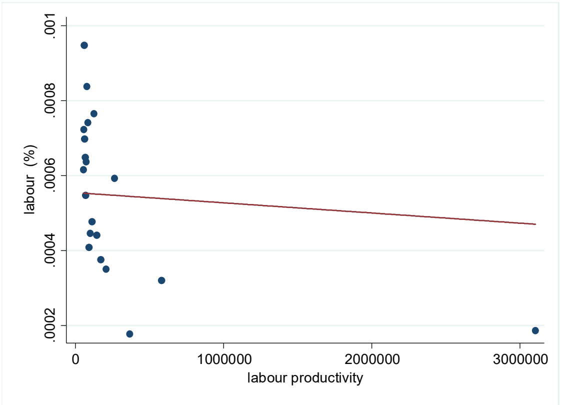


Source: authors calculations using IES

Figure A.3.4. Regression results from the Binscatter of labour share and labour productivity for the top 5% most productive firms

Source	SS	df	MS			
				Number of obs	=	17,620
				F(1, 17618)	=	1.15
Model	.000024326	1	.000024326	Prob > F	=	0.2830
Residual	.371746363	17,618	.0000211	R-squared	=	0.0001
				Adj R-squared	=	0.0000
Total	.371770689	17,619	.000021101	Root MSE	=	.00459

share_L_av~e	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
LP_average	-2.72e-11	2.53e-11	-1.07	0.283	-7.67e-11	2.24e-11
_cons	.0005547	.0000354	15.67	0.000	.0004853	.0006241

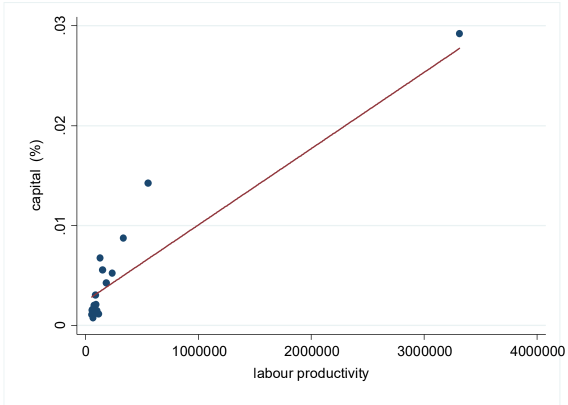


Source: authors calculations using IES

Table A.3.5. Regression results from the Binscatter of capital share and labour productivity for the top 5% most productive firms

Source	SS	df	MS			
				Number of obs	=	14,292
				F(1, 14290)	=	339.36
Model	1.8708451	1	1.8708451	Prob > F	=	0.0000
Residual	78.7777037	14,290	.005512785	R-squared	=	0.0232
				Adj R-squared	=	0.0231
Total	80.6485488	14,291	.00564331	Root MSE	=	.07425

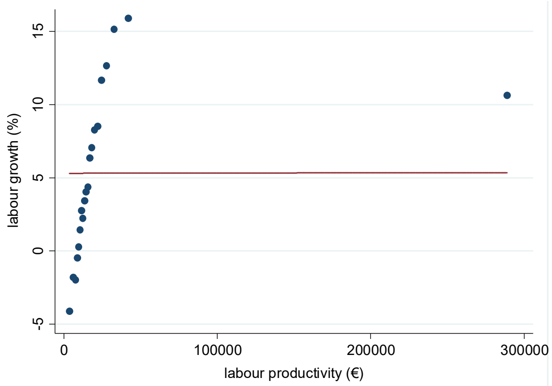
share_K_av~e	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
LP_average	7.63e-09	4.14e-10	18.42	0.000	6.82e-09	8.45e-09
_cons	.0024298	.0006329	3.84	0.000	.0011893	.0036704



Source: authors calculations using IES

Figure A.3.6. Regression results from the Binscatter of labour growth and labour productivity (includes laggard and frontier firms)

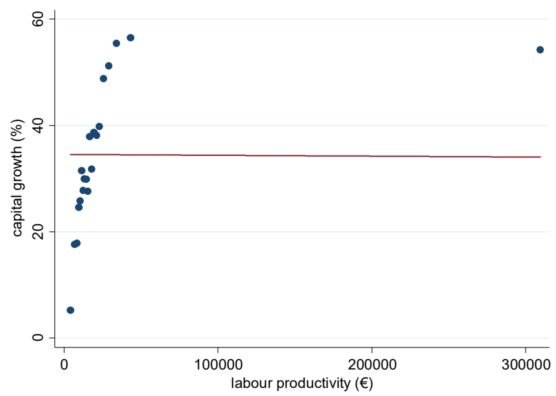
	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
_cons	5.306721	.1239063	42.83	0.000	5.063866	5.549575



Source: authors calculations using IES

Figure A.3.7. Regression results from the Binscatter of capital growth and labour productivity (includes laggard and frontier firms)

	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
_cons	34.54748	.5152265	67.05	0.000	33.53764	35.55732

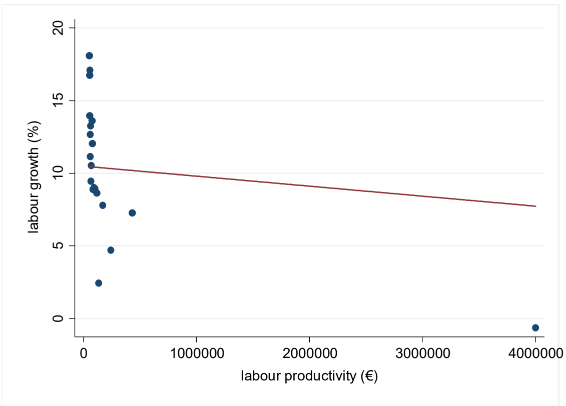


Source: authors calculations using IES

Figure A.3.8. Regression results from the Binscatter of labour growth and labour productivity for the top 5% most productive firms

Source	SS	df	MS			
				Number of obs	=	5,622
				F(1, 5620)	=	4.05
Model	7786.20452	1	7786.20452	Prob > F	=	0.0442
Residual	10806144.9	5,620	1922.80158	R-squared	=	0.0007
				Adj R-squared	=	0.0005
Total	10813931.1	5,621	1923.8447	Root MSE	=	43.85

var_L	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
LP_average	-6.88e-07	3.42e-07	-2.01	0.044	-1.36e-06	-1.77e-08
_cons	10.48974	.5939681	17.66	0.000	9.325333	11.65415

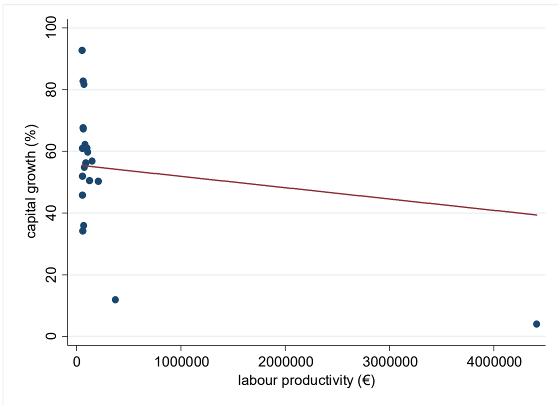


Source: authors calculations using IES

Figure A.3.9. Regression results from the Binscatter of capital growth and labour productivity for the top 5% most productive firms

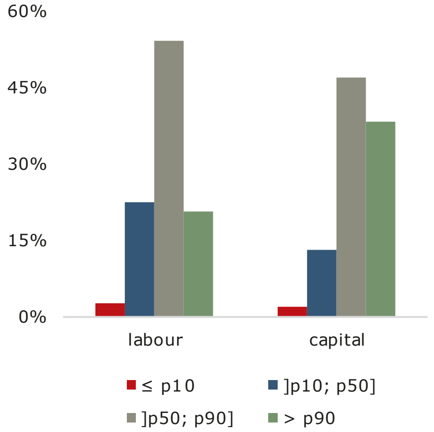
Source	SS	df	MS			
				Number of obs	=	4,961
				F(1, 4959)	=	8.37
Model	275480.572	1	275480.572	Prob > F	=	0.0038
Residual	163250287	4,959	32920.0014	R-squared	=	0.0017
				Adj R-squared	=	0.0015
Total	163525768	4,960	32968.9048	Root MSE	=	181.44

var_K	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
LP_average	-3.68e-06	1.27e-06	-2.89	0.004	-6.17e-06	-1.19e-06
_cons	55.59067	2.607128	21.32	0.000	50.47955	60.7018



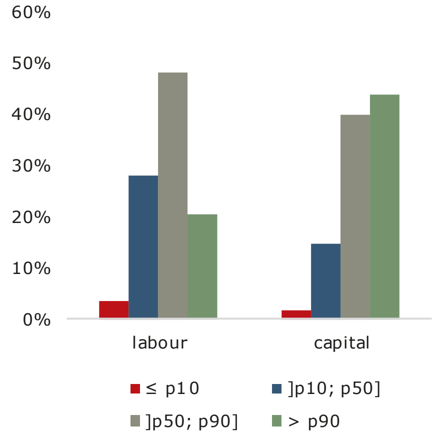
Source: authors calculations using IES

Figure A.3.10. Within-industry allocation of resources across firms by performance[35] (average*, 2010-2016) – manufacturing



Source: authors calculations using IES
*The results correspond to an average of the values obtained for the 59 industries (2-digit disaggregation).

Figure A.3.11. Within-industry allocation of resources across firms by performance[36] (average**, 2010-2016) – services



Source: authors calculations using IES
**The results correspond to an average of the values obtained for the 59 industries (2-digit disaggregation).

[35] <p10: includes firms with labour productivity (LP) below 10th percentile (worst performers); >90: includes firms with LP above 90th percentile (best performers); [p10;p50] includes firms with LP below median excluding worst perf.; and [p50;p90] includes firms with LP above median excl. best perf.

[36] <p10: includes firms with labour productivity (LP) below 10th percentile (worst performers); >90: includes firms with LP above 90th percentile (best performers); [p10;p50] includes firms with LP below median excluding worst perf.; and [p50;p90] includes firms with LP above median excl. best perf.

Table A.3.5. Within-industry allocation of resources across firms by performance (2006-2016)

	labour					capital				
ind.	≤p10	]p10; p50]	]p50; p90]	>p90	>p95	≤p10	]p10;p50]	]p50;p90]	>p90	>p95
man. of food prod.	3%	22%	47%	28%	15%	2%	9%	36%	53%	33%
man. of beverages	2%	18%	54%	26%	7%	2%	14%	57%	28%	9%
man. of textiles	3%	25%	57%	15%	6%	4%	17%	57%	22%	11%
man. of wearing apparel	4%	35%	49%	12%	5%	3%	17%	49%	31%	16%
man. of leather and related prod.	4%	31%	53%	12%	4%	3%	17%	56%	24%	12%
man. of wood, prod. wood and cork, exc. furniture	3%	23%	47%	27%	14%	2%	13%	40%	44%	26%
man. of paper and paper prod.	2%	14%	43%	41%	25%	0%	2%	13%	85%	79%
Printing and reproduction of recorded media	2%	21%	51%	26%	15%	0%	8%	45%	46%	32%
man. of chemicals and chemical prod.	2%	16%	59%	23%	11%	1%	5%	39%	55%	37%
man. of basic pharmaceutical prod.and preparations	1%	28%	63%	8%	2%	1%	18%	53%	28%	7%
man. of rubber and plastic prod.	2%	21%	54%	23%	14%	2%	14%	44%	40%	29%
man. of other non-metallic mineral prod.	2%	21%	51%	26%	14%	1%	11%	38%	50%	37%
man. of basic metals	3%	17%	60%	20%	11%	2%	13%	57%	27%	14%
man. of fabricated metal prod., exc. machin. and equip.	3%	23%	53%	20%	8%	3%	13%	49%	36%	18%
man. of computer, electronic and optical prod.	2%	16%	74%	9%	2%	1%	10%	73%	16%	2%
man. of electrical equipment	1%	13%	56%	30%	17%	1%	8%	50%	42%	24%
man. of machineryand equipment n.e.c.	2%	26%	56%	16%	6%	1%	17%	56%	26%	11%
man. of motor vehicles, trailers and semi-trailers	2%	18%	49%	30%	17%	2%	8%	42%	48%	29%
man. of other transport equipment	4%	31%	59%	6%	1%	5%	36%	49%	10%	1%
man. of furniture	3%	26%	53%	18%	6%	2%	14%	51%	32%	11%
Other manu.	3%	29%	49%	19%	11%	3%	17%	46%	34%	23%
Repair and installation of machinery and equipment	2%	21%	57%	19%	7%	1%	8%	30%	61%	50%
Electricity, gas, steam and air conditioning supply	8%	57%	34%	1%	0%	0%	15%	64%	20%	14%
Water collection, treatment and supply	0%	32%	52%	15%	7%	0%	10%	44%	47%	25%
Sewerage	1%	26%	50%	23%	12%	0%	0%	46%	53%	38%
Waste collection, treatment and disposal act.;	2%	31%	59%	9%	3%	1%	6%	66%	28%	8%
Remediation act. and other waste management serv.	5%	62%	31%	2%	0%	1%	74%	23%	2%	0%
Construction of buildings	6%	38%	53%	4%	1%	4%	13%	44%	40%	27%
Civil engineering	6%	25%	59%	11%	2%	4%	21%	53%	22%	12%
Specialised construction act.	4%	27%	47%	21%	11%	3%	15%	45%	37%	24%
Wholesale/retail trade; repair of motor vehicles	4%	25%	50%	20%	9%	3%	14%	49%	35%	21%
Wholesale trade, except of motor vehicles	4%	29%	51%	17%	9%	2%	16%	46%	36%	26%
Retail trade, except of motor vehicles	5%	35%	47%	13%	6%	3%	22%	44%	31%	16%
Land transport and transport via pipelines	3%	17%	57%	23%	9%	1%	5%	40%	53%	42%
Water transport	2%	14%	63%	21%	9%	1%	4%	44%	52%	28%
Air transport	2%	62%	35%	0.5%	0%	1%	52%	43%	4%	1%
Warehousing and support act. for transportation	2%	21%	56%	21%	14%	1%	3%	7%	89%	82%
Postal and courier act.	0%	3%	23%	74%	14%	0%	1%	17%	82%	14%
Accommodation	2%	21%	61%	16%	4%	2%	10%	52%	36%	15%
Food and beverage service act.	4%	25%	55%	16%	8%	3%	20%	45%	32%	20%
Publishing act.	2%	17%	50%	31%	16%	1%	11%	57%	31%	19%
Motion picture, video, television prod., music act.	4%	28%	57%	11%	6%	2%	19%	47%	32%	24%
Programming and broadcasting act.	3%	15%	41%	41%	23%	1%	4%	16%	79%	70%
Telecommunications	1%	5%	11%	84%	64%	0%	0%	0%	100%	83%
Computer program., consultancy and related act.	2%	17%	61%	20%	9%	1%	11%	36%	52%	38%
Information service act.	2%	16%	58%	25%	3%	1%	6%	49%	44%	16%
Legal and accounting act.	5%	32%	48%	16%	8%	3%	23%	48%	26%	17%
Act. of head offices; management consultancy act.	4%	27%	54%	15%	5%	2%	13%	46%	39%	19%
Architectural and engineering act.;	3%	22%	54%	21%	10%	0%	2%	7%	91%	86%
Scientific research and development	4%	24%	55%	18%	8%	3%	15%	55%	27%	15%
Advertising and market research	5%	27%	48%	20%	10%	2%	15%	47%	35%	20%
Other professional, scientific and technical act.	5%	32%	49%	14%	6%	3%	22%	49%	26%	16%
Veterinary act.	5%	34%	51%	10%	4%	3%	25%	54%	17%	8%
Rental and leasing act.	3%	22%	55%	20%	10%	0%	2%	15%	83%	77%
Employment act.	8%	74%	16%	2%	0%	5%	36%	43%	16%	3%
Travel agency, and related act.	3%	23%	61%	13%	6%	2%	19%	61%	17%	8%
Security and investigation act.	3%	22%	73%	2%	1%	1%	9%	68%	22%	7%
Services to buildings and landscape act.	5%	78%	15%	2%	1%	3%	37%	31%	29%	22%
Office administrative, and business support act.	3%	45%	40%	12%	5%	2%	10%	36%	53%	29%
min.	**0.3%**	**2.7%**	**10.8%**	**0.5%**	**0.0%**	**0.0%**	**0.1%**	**0.4%**	**1.8%**	**0.0%**
p25	**2.0%**	**19.3%**	**48.0%**	**11.7%**	**4.1%**	**0.8%**	**8.0%**	**39.4%**	**26.9%**	**12.1%**
p50	**3.2%**	**24.7%**	**53.1%**	**17.6%**	**7.5%**	**1.7%**	**13.3%**	**46.3%**	**35.4%**	**20.3%**
p75	**4.3%**	**30.8%**	**57.0%**	**22.8%**	**11.1%**	**2.7%**	**17.1%**	**52.1%**	**50.9%**	**29.3%**
máx.	**8.1%**	**77.7%**	**73.6%**	**83.6%**	**64.5%**	**5.2%**	**74.1%**	**72.8%**	**99.6%**	**86.3%**

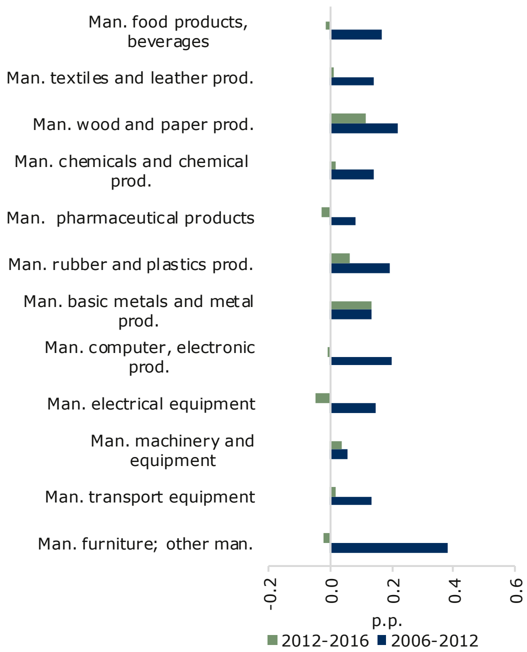
Source: authors calculations using IES

Table A.3.6. Sectoral labour productivity growth decomposition (2006-2016)

	survivors - within eff.	survivors - between eff.	net eff. enters/exiters
man. of food prod.	2%	6%	-2%
man. of beverages	24%	2%	-7%
man. of textiles	15%	5%	9%
man. of wearing apparel	16%	3%	5%
man. of leather and related prod.	22%	2%	-4%
man. of wood, prod. wood and cork, exc. furniture	2%	8%	7%
man. of paper and paper prod.	14%	1%	8%
Printing and reproduction of recorded media	-13%	9%	8%
man. of chemicals and chemical prod.	9%	6%	11%
man. of basic pharmaceutical prod.and preparations	3%	14%	-7%
man. of rubber and plastic prod.	16%	6%	6%
man. of other non-metallic mineral prod.	-6%	9%	11%
man. of basic metals	13%	2%	14%
man. of fabricated metal prod., exc. machin. and equip.	12%	6%	2%
man. of computer, electronic and optical prod.	-5%	10%	10%
man. of electrical equipment	8%	3%	8%
man. of machineryand equipment n.e.c.	12%	2%	8%
man. of motor vehicles, trailers and semi-trailers	8%	1%	9%
man. of other transport equipment	17%	8%	10%
man. of furniture	16%	5%	4%
Other manu.	2%	6%	7%
Repair and installation of machinery and equipment	-3%	9%	7%
Electricity, gas, steam and air conditioning supply	20%	-12%	46%
Water collection, treatment and supply	81%	1%	-34%
Sewerage	31%	-7%	-22%
Waste collection, treatment and disposal act.;	-12%	2%	-5%
Remediation act. and other waste management serv.	-100%	0%	67%
Construction of buildings	-1%	2%	-3%
Civil engineering	-2%	4%	-3%
Specialised construction act.	11%	4%	1%
Wholesale/retail trade; repair of motor vehicles	3%	8%	2%
Wholesale trade, except of motor vehicles	-3%	6%	6%
Retail trade, except of motor vehicles	-9%	8%	10%
Land transport and transport via pipelines	-3%	5%	1%
Water transport	11%	-5%	-27%
Air transport	35%	-18%	20%
Warehousing and support act. for transportation	-4%	6%	-2%
Postal and courier act.	-7%	3%	-13%
Accommodation	21%	5%	-10%
Food and beverage service act.	-17%	10%	2%
Publishing act.	-12%	7%	-7%
Motion picture, video, television prod., music act.	-21%	6%	7%
Programming and broadcasting act.	1%	-2%	12%
Telecommunications	-15%	10%	-53%
Computer program., consultancy and related act.	4%	4%	-8%
Information service act.	3%	2%	-30%
Legal and accounting act.	-2%	2%	-2%
Act. of head offices; management consultancy act.	-15%	3%	0%
Architectural and engineering act.;	-16%	7%	-1%
Scientific research and development	25%	-10%	-42%
Advertising and market research	-7%	5%	-6%
Other professional, scientific and technical act.	-30%	12%	12%
Veterinary act.	28%	7%	-3%
Rental and leasing act.	-10%	8%	3%
Employment act.	11%	1%	-1%
Travel agency, and related act.	3%	3%	-25%
Security and investigation act.	10%	-9%	-11%
Services to buildings and landscape act.	1%	1%	3%
Office administrative, and business support act.	1%	8%	1%

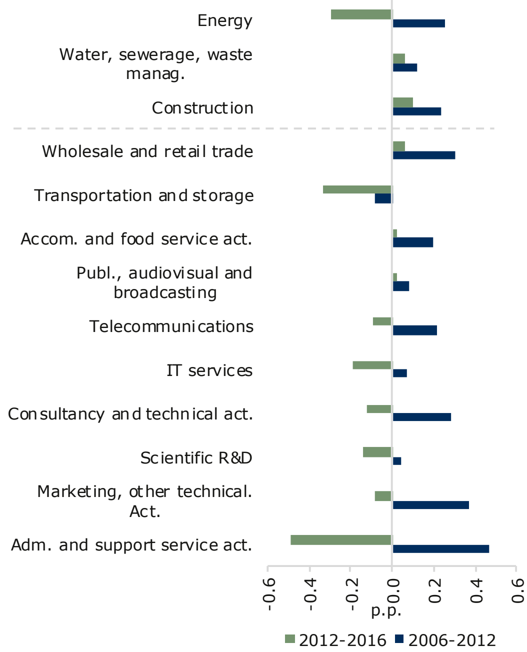
Source: authors calculations using IES

Figure A.3.12. Decomposition of productivity growth by industry - between effect of surviving firms in manufacturing



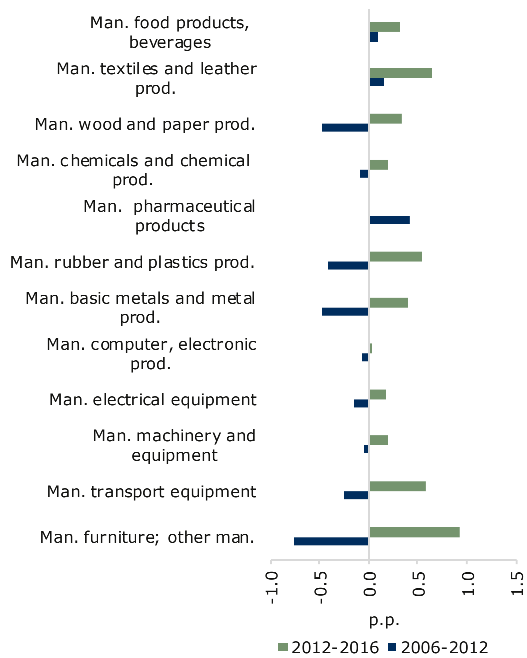
Source: authors calculations using IES

Figure A.3.13. Decomposition of productivity growth by industry - between effect of surviving firms in services, construction and utilities



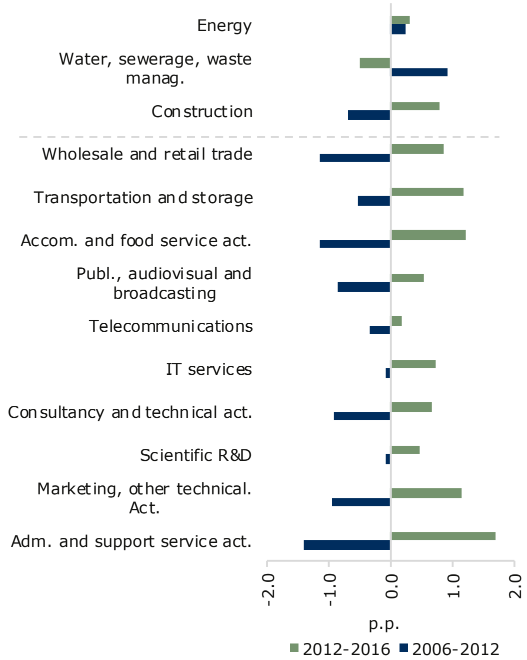
Source: authors calculations using IES

Figure A.3.14. Decomposition of productivity growth by industry - within effect of surviving firms in manufacturing



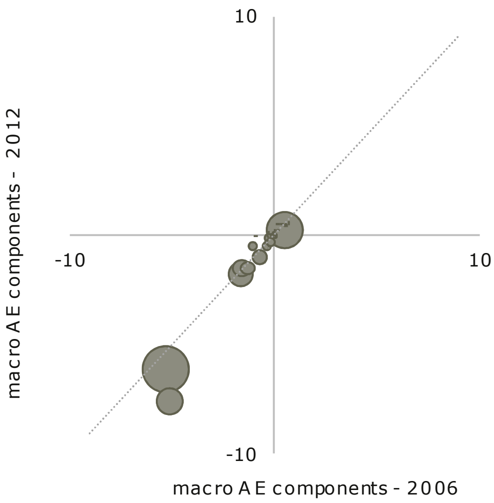
Source: authors calculations using IES

Figure A.3.15. Decomposition of productivity growth by industry - within effect of surviving firms in services, construction and utilities



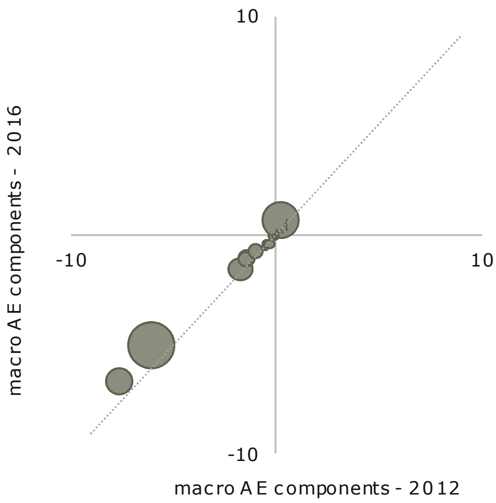
Source: authors calculations using IES

Figure A.3.16. Decomposition of productivity growth - allocative efficiency components (2006-2012)



Source: authors calculations using IES

Figure A.3.17. Decomposition of productivity growth - allocative efficiency components (2012-2016)



Source: authors calculations using IES

Bibliography

Acharya, V., Baghai, P., & Subramanian, K. (2013). "Labor laws and innovation", The Journal of Law and Economics, 56(4), 997-1037.

Adalet McGowan, M. and Andrews, D. (2015a), "Skill Mismatch and Public Policy in OECD Countries", OECD Economics Department Working Papers, No. 1210.

Adalet McGowan, M. and Andrews, D. (2015b), "Labour Market Mismatch and Labour Productivity: Evidence from PIAAC Data", OECD Economics Department Working Papers, No. 1209

Adalet McGowan, M. and Andrews, D. (2017), "Skills mismatch, productivity and policies: Evidence from the second wave of PIAAC", OECD Economics Department Working Papers, No. 1210.

Adalet McGowan, M., Andrews, D. & Millot, V. (2017a), "The Walking Dead?: Zombie Firms and Productivity Performance in OECD Countries", OECD Economics Department Working Papers, No. 1372, OECD Publishing, Paris.

Adalet McGowan, M., Andrews, D. & Millot, V. (2017b), "Insolvency regimes, zombie firms and capital reallocation", *OECD Economics Department Working Papers*, No. 1399, OECD Publishing, Paris.

Andrews, D.& Cingano, F. (2014). "Public Policy and Resource Allocation: Evidence from Firms in OECD Countries". Economic Policy, 29(78), 253-296.

Andrews, D., Criscuolo, C., & Gal, P. (2015). "Frontier firms, technology diffusion and public policy: micro evidence from OECD countries*".* OECD Productivity Working Papers, 2015-02, OECD Publishing, Paris.

Andrews, D., Criscuolo, C. & Gal, P. (2016). "The best versus the rest: the global productivity slowdown, divergence across Firms and the role of public policy", OECD Productivity Working Papers.

Andrews, D., Adalet McGowan, M., & Millot, V. (2017), "Confronting the zombies: Policies for productivity revival", OECD Economic Policy Papers, No. 21.

Azevedo, N., Mateus, M. & Pina, A. (2018). "Bank Credit Allocation and Productivity: Stylised facts for Portugal." Bank of Portugal Working Paper nº 25.

Banco de Portugal (2015). Economic Bulletin, October 2015: 35.

Banco de Portugal (2016). "Productivity and job reallocation in Portugal", Economic Bulletin, October 2016, box 5.3: 63-65.

Bartelsman, E., Haltiwanger, J., & Scarpetta, S. (2013). "Cross-country differences in productivity: The role of allocation and selection". *American Economic Review*, *103*(1): 305-34.

Belot, M., Boone, J., & Van Ours, J. C. (2007). "Welfare effects of employment protection", Economica, 74, pp. 381–396

Buera, F., Kaboski, J. & shin, Y. (2011). "Finance and Development: A Tale of Two Sectors." American Economic Review, 103: 305-334.

Cacciatore, M., Duval, R. & Fiori, G. (2012), "Short-Term Gain or Pain? A DSGE Model-Based Analysis of the Short-Term Effects of Structural Reforms in Labour and Product Markets", *OECD Economics Department Working Papers*, No. 948.

Carneiro, A., Raposo, P., Portugal, P. (2015). "Decomposing the wage losses of displaced workers: the role of the reallocation of workers into firms and job titles", Bank of Portugal Working Paper no. 11.

Cingano, F., Leonardi, M., Messina, J., & Pica, G. (2015). "Employment protection legislation, capital investment and access to credit: evidence from Italy", The Economic Journal, 126(595): 1798-1822.

Correia, H. & Gouveia, A. F. (2017), "Is deregulation of product and labour markets promoting employment and productivity? A difference-in-differences approach", ADEMU working paper 73, October 2017.

Dias, D., Marques, C. & Richmond, C. (2014). "Misallocation and Productivity in the Lead Up to the Eurozone Crisis," Working Paper, Bank of Portugal, 2014.

Dias, D., Marques, C. & Richmond, C. (2016). "A tale of two sectors: why is misallocation higher in services than in manufacturing?", Working Paper, Bank of Portugal.

Dias, A. & Robalo Marques, C. (2018). "Every cloud has a silver lining: micro-level evidence on the cleansing effects of the Portuguese financial crisis". Working Paper 18-2018, Banco de Portugal.

Dias, D., Marques, C. & Richmond, C. (2016) "A tale of two sectors: why is misallocation higher in services than in manufacturing". Working Paper, Bank of Portugal 2016.

Fernandes, A., Simões, M. & Azevedo Pereira, J. (2019). "Alterações estruturais da economia portuguesa, produto potencial e produtividade", Working Paper, GPEARI (MF).

Garicano, L., Lelarge, C. & Van Reenen, J. (2016). "Firm Size Distortions and the Productivity Distribution: Evidence from France". American Economic Review, 106: 3439-3479.

Gopinath, G., Kalemli-Ozcan, S., Karabarbounis, L & Villegas-Sanchez, C. 2017. "Capital Allocation and Productivity in South Europe." Quarterly Journal of Economics 132 (4): 1915-1967.

Gourio, F. & Roys, N. (2014). "Size-dependent regulations, firm size distribution, and reallocation." Quantitative Economics, 5(2): 377-416.

Gouveia, A. F., & Osterhold C. (2018). "Fear the walking dead: zombie firms, spillovers and exit barriers", OECD Productivity Working Papers, 2018-13, OECD Publishing, Paris.

Guner, N., Ventura, G. & Xu, Y. (2008). "Macroeconomic implications of size-dependent policies." Review of Economic Dynamics, 11: 721-744.

Hopenhayn, H. & Rogerson, R. (1993). "Job turnover and policy evaluation: A general equilibrium analysis", Journal of political economy, 101(5): 915-938.

Hopenhayn, H. (2014). "Firms, misallocation, and aggregate productivity: A review", Annu. Rev. Econ., *6*(1): 735-770.

Hsieh, C. T., & Klenow, P. J. (2009). "Misallocation and manufacturing TFP in China and India". *The Quarterly journal of economics*, *124*(4), 1403-1448.

Ichino, A. & Riphahn, R. (2005). "The effect of employment protection on worker effort: Absenteeism during and after probation", Journal of the European Economic Association, 3, pp. 120–143.

La Porta, R. & Shleifer, A. (2014). "Informality and development". Journal of Economic Perspectives, 28(3): 109-26.

Melitz, M. (2003). "The impact of trade on Intra-Industry Reallocations and Aggregate Industry Productivity." Econometrica, 71(6): 1695-1725.

Melitz, M. J., & Polanec, S. (2015). "Dynamic Olley-Pakes productivity decomposition with entry and exit". The Rand journal of economics, *46*(2), 362-375.

Midrigan, V. & Xu, D. (2014). "Finance and Misallocation: Evidence from Plant-level data". American Economic Review, 104: 422-458.

Monteiro, G., Gouveia, A. F. & Santos, S. (2017), "Product markets' deregulation: a more productive, more efficient and more resilient economy?" OECD Productivity Working Papers, No. 9, OECD Publishing, Paris.

Olley, G. & Pakes, A. (1996). "The dynamics of productivity in the Telecommunications Equipment Industry." Econometrica, 64(6): 1263-1297.

Pimenta, A. & Manuel, C. (2019). "Desajustamento entre escolarização e ocupações dos trabalhadores portugueses: uma análise agregada", Working paper, Bank of Portugal.

Restuccia, D. & Rogerson, R. (2013). "Misallocation and Productivity", Review if Economic Dynamics, 16(1): 1-10.

Restuccia, D. (2013). "Factor misallocation and development", The New Palgrave Dictionary of Economics, Online Edition, Eds. Steven N. Durlauf and Lawrence E. Blume, Palgrave Macmillan.

Syverson, C. (2011). "What Determines Productivity?" Journal of Economic Literature, 49(2), 326-65.

Wasmer, E. (2006). "General versus specific skills in labor markets with search frictions and firing costs", American Economic Review, 96(3): 811-831.