Comparing misallocation between sectors in Portugal

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Abstract
Recent empirical studies documented that the level of resource misallocation in the service sector is significantly higher than in the manufacturing sector. In this article, we try to understand to what extent the documented differences are due to methodological reasons or reflect structural differences between the two sectors. Our results suggest that about 50 percent of the original estimated differences can be attributed to methodological choices, while the other 50 percent can be attributed to differences in the characteristics of the two sectors. We also conclude that higher output-price rigidity and labour adjustment costs, together with higher informality in the service sector, account for the remaining differences of allocative efficiency between the two sectors. (JEL: D24, O11, O41, O47)

Introduction

The empirical literature has recently documented that the level of resource misallocation in the service sector is significantly higher than in the manufacturing sector (see, for instance, the evidence in Dias et al. (2015a), Garcia-Santana et al. (2015) and Benkovskis (2015) for Portugal, Spain and Latvia, respectively). This is an important finding. The service sector accounts for about 80 percent of total GDP both in the U.S. and the euro area, while the contribution of the manufacturing sector is below 20 percent. Thus, being by far the most important sector, significantly higher levels of resource misallocation in the service sector have dramatic consequences for aggregate productivity. In particular, the impact of misallocation on aggregate productivity estimated in the literature, using data from the manufacturing...
sector alone for several countries, is likely to strongly underestimate the real importance of misallocation in those countries.

This finding also has important consequences for developing countries and economies undergoing structural transformation. Hsieh and Klenow (2009) show that differences in misallocation in the manufacturing sector are important for understanding the differences of total factor productivity between developed and developing countries. Using data for the manufacturing sector in China and India, the authors conclude that eliminating distortions in these economies would increase productivity by 30-50 percent in China and 40-60 percent in India relative to the U.S. levels. However, if a significant difference of allocative efficiency between manufacturing and the service sector, similar to that documented for Portugal, Spain or Latvia are present in other countries, the importance of resource misallocation to explaining productivity differences between developed and developing countries may even be higher than currently documented in the literature. Duarte and Restuccia (2010) demonstrate that differences in productivity in the service and agriculture sectors across countries are one of the main factors behind productivity differences between countries and that, in particular, low productivity in the service sector and lack of catch-up will explain the experiences of slowdown, stagnation, and decline observed across economies. In turn, the evidence for some southern European economies suggests that low productivity in the service sector and lack of catch-up across countries may be reflecting higher and increasing levels of misallocation in this sector (see, Dias et al. (2015a) for Portugal, Garcia-Santana et al. (2015) and Gopinath et al. (2015) for Spain, Calligaris (2015) for Italy).

In this article we try to understand to what extent the documented differences of allocative efficiency between manufacturing and services stem from methodological reasons or, more importantly, reflect structural differences between the two sectors of economic activity. We resort to the theoretical framework developed in Hsieh and Klenow (2009), but extend their model to consider a production function with intermediate inputs as a third factor of production, as in Dias et al. (2015a).

Using data for the Portuguese economy for 2008 and 2010, we document that the significantly higher levels of allocative inefficiency in the service sector are not the result of a small number of industries with abnormal levels of resource misallocation, but rather the result of a strong regularity: among the 50 percent of the industries with the highest allocative efficiency only 7.1 percent belong to the service sector. By investigating the consequences of using alternative assumptions for our model, we conclude that about 50 percent of the original estimated differences of misallocation between the service and the manufacturing sectors can be attributed to methodological choices and the other 50 percent to differences in the characteristics of the two sectors.
Productivity shocks, which capture the impact of (capital and/or labour) adjustment costs and/or output-price rigidity on misallocation, is the most important factor contributing to the differences of misallocation between the two sectors. However, the contribution of productivity shocks stems more from the difference of the impacts, than from differences of the shocks between the two sectors. In particular, the impact of productivity shocks in the service sector is significantly higher than the impact in the manufacturing sector. Overall, it appears that the bulk of the difference in misallocation due to productivity shocks is consistent with the hypothesis of higher output-price rigidity and higher labour adjustment costs in the service sector.

The sectoral structure, which captures the impact on misallocation of size-dependent distortions, and is proxied by the skewness of the productivity distribution, emerges as the second most important factor to explaining the difference of misallocation between the two sectors. Again, the bulk of the contribution of this regressor comes from its higher impact in the service sector, which we see as a result of the higher informality that makes the enforcement activity of tax collection much more difficult than in the manufacturing sector.

Finally, our empirical model suggests that the proportion of young firms also has a bearing on the difference of misallocation between the two sectors. We link this impact to the presence of credit constraints imposed by financial institutions on young firms, because they have no credit history or because they have insufficient guaranties. This regressor contributes with two opposite effects to the difference between misallocation in the manufacturing and the service sectors. On the one hand, the impact of the difference between the mean of this regressor in the manufacturing and the service sectors contributes to increase the difference in misallocation between the two sectors, but, on the other hand, the difference in the impact between the two sectors has the opposite effect, so that the total contribution of this regressor is negative.

The rest of the article is structured as follows. Section 2 provides a brief description of the theoretical framework. Section 3 describes the dataset used in the empirical analysis. Section 4 computes misallocation under alternative assumptions as a way of evaluating the part of the difference between the two sectors that is due to methodological choices. Section 5 presents the empirical results and discusses their interpretation and section 6 summarizes the main findings.

Theoretical framework

This section summarizes the methodology used to identify the linkage between aggregate productivity and resource misallocation that results from the existence of distortions and frictions affecting the optimal allocation of resources at the firm-level. We adopt the framework developed in Hsieh and
Klenow (2009, 2011), but extend their model to consider a production function with intermediate inputs, as a third factor of production. The model with three factors of production, as well as the derivation of the full set of results was presented elsewhere, so that here we just briefly review the model and summarize the main results needed for the purposes of the present article.¹

A first assumption of the model is that within each industry there is monopolistic competition and the production function is the same for all firms. In particular, the gross output of a generic firm $i$ in industry $s$ is given by the following Cobb-Douglas production function with constant returns to scale:

$$Y_{si} = A_{si} K_{si}^{\alpha_s} H_{si}^{\beta_s} Q_{si}^{1-\alpha_s-\beta_s}$$  

where $Y_{si}, A_{si}, K_{si}, H_{si}$ and $Q_{si}$ stand for the firm’s gross output, total factor productivity (TFP), capital stock, labour and intermediate inputs, respectively. Parameters $\alpha_s$ and $\beta_s$ stand for the output elasticities of capital and labour, respectively.

A second assumption is the existence of distortions or wedges in the economy, the importance of which may vary from firm to firm, and can impact the prices of the inputs or directly affect the output of the firm. In particular, it is assumed that there are three distortions that we designate by the output distortion, the capital distortion and the labour distortion. Such distortions take the form of a tax or a subsidy on revenues, on capital services and on labour costs, respectively.

From the profit maximization conditions, given the model assumptions, it is possible to obtain the expression of the so-called total factor revenue productivity for firm $i$ in industry $s$ ($TFPR_{si}$):

$$TFPR_{si} = \frac{\sigma}{\sigma - 1} \Psi_s \frac{(1 + \tau_{k_{si}})^{\alpha_s} (1 + \tau_{h_{si}})^{\beta_s}}{(1 - \tau_{y_{si}})}$$  

where $\tau_{y_{si}}, \tau_{k_{si}}$ and $\tau_{h_{si}}$ stand for the output, capital and labour distortions, respectively; $\sigma$ measures the elasticity of substitution between varieties of differentiated goods and $\Psi_s$ is a constant, which is common to all firms of industry $s$ (and is a function of the prices of inputs, as well as of other parameters of the model).

The output, capital and labour distortions are identified in the model by comparing the ratio of factor costs in the firm with the average ratio of these costs in the corresponding industry. For example, we infer the presence of a capital distortion in a firm when the ratio of intermediate consumption to the capital costs is high relative to what one would expect from the output elasticities with respect to capital and intermediate inputs.

¹ The interested reader if referred to Dias et al. (2015a) and Dias et al. (2016) for further details on the theoretical model and derivation of the full set of results.
Equation (2) is very important because it shows that in the context of the model, TFPR, which by definition corresponds to the product of the price of output and TFP, i.e., $\text{TFPR}_{si} = P_{si}A_{si}$, does not vary across firms within the same industry, unless they face some kind of distortion. Intuitively, this equation tells us that, in the absence of distortions, more capital, labour and intermediate inputs will be allocated to the most productive firms (with higher TFP) to the point where their higher output results in a lower price, implying the same TFPR for all firms. In contrast, in the presence of distortions, a high (low) TFPR is a sign that the firm confronts barriers (benefits from subsidies) that make it produce below (above) the optimal level.

Let us now assume a hypothetical exercise in which the distortions in a given industry are eliminated so that TFPR is equalized across firms. According to equation (2), however, there are several alternative solutions for this TFPR, which vary according to the assumptions we make to the distortions $\tau_{y_{si}}$, $\tau_{k_{si}}$ and $\tau_{h_{si}}$. One possibility would be to use the TFPR that would result if all distortions or wedges were equal to zero ($\tau_{y_{si}}=\tau_{k_{si}}=\tau_{h_{si}}=0$). However, this definition does not guarantee that in equilibrium the demand for factors of production at the industry level will be the same before and after the reallocation of resources. This would have general equilibrium effects which would lead to changes in the prices of the factors of production. An alternative solution, that we will adopt here, is the one that is obtained when all firms face the same average wedges $(1 + \tau_{k_{s}})$, $(1 + \tau_{h_{s}})$ and $(1 - \tau_{y_{s}})$, and these are such that the demand for factors of production at the industry level is the same before and after the reallocation of resources. Thus, our hypothetical exercise will involve a reallocation of the available resources away from firms that were benefitting from subsidies towards firms that were being taxed. The new TFPR, common to all firms in the industry, which is obtained under these conditions, is the so-called efficient TFPR of industry $s$, and will be represented by $\text{TFPR}_{s}^\ast$. It can be shown that $\text{TFPR}_{s}^\ast$ may be written as:

$$\text{TFPR}_{s}^\ast = \frac{\sigma}{\sigma - 1} \Psi_s \frac{(1 + \tau_{k_{s}})^{\alpha_s} (1 + \tau_{h_{s}})^{\beta_s}}{(1 - \tau_{y_{s}})}$$

(3)

so that from equations (2) and (3) we get:

$$\ln \left( \frac{\text{TFPR}_{si}}{\text{TFPR}_{s}^\ast} \right) = \alpha_s \log \left( \frac{1 + \tau_{k_{si}}}{1 + \tau_{k_{s}}} \right) + \beta_s \log \left( \frac{1 + \tau_{h_{si}}}{1 + \tau_{h_{s}}} \right) - \log \left( \frac{1 - \tau_{y_{si}}}{1 - \tau_{y_{s}}} \right)$$

(4)

Equation (4) allows us to decompose the (log) scaled TFPR ($\text{TFPR}_{si}/\text{TFPR}_{s}^\ast$) for each firm as a weighted sum of the (log) scaled capital, labour and output wedges. If scaled TFPR is above one, the firm is being "taxed" so that it will increase production if distortions are eliminated from the economy. By looking at the right-hand side of this equation we are able to tell where the increase in production comes from. If, for instance, the scaled capital wedge, $(1 + \tau_{k_{si}})/(1 + \tau_{k_{s}})$, is larger than one, the firm is facing a capital distortion, so that it will increase the capital stock if the distortion is eliminated. Similarly for
the scaled labour wedge. In contrast, firms for which the scaled output wedge, \((1 - \tau y_{si})/(1 - \tau y_{s})\), is above one are benefiting from output subsidies, so that they would decrease production if those subsidies were eliminated.

Given the expression for \(TFPR^*_s\), it is possible to compute the output of the industry \(s\) that would be obtained in the absence of distortions, i.e., the level of efficient output. Comparing the efficient output with the actual output, we can compute the industry reallocation gains. It can be shown that the real gross-output gains in industry \(s\) are given by:

\[
Y^*_s \frac{Y_s}{Y^*_s} = \left[ \frac{1}{\sum_{i=1}^{M_s} \omega_{si} \left( \frac{1}{TFPR^*_s} \right)^{\sigma-1}} \right]^\sigma
\]  

where \(Y^*_s\) and \(Y_s\) stand for the efficient and actual gross output in industry \(s\), \(M_s\) is the number of firms, \(TFPR^*_s\) is scaled TFPR \(=\frac{TFPR_{si}}{TFPR^*_s}\) and \(\sum_{i=1}^{M_s} \omega_{si} = 1\). Equation (5) shows that efficiency gains in industry \(s\) are a weighted sum of the inverse scaled TFPR \(1/TFPR^*_s\) across firms, where the weights, \(\omega_{si}\), are the contribution of each firm to the efficient industry TFP. The smaller is this weighted sum, the larger are the efficiency gains obtained if distortions are eliminated from the industry. In particular, this sum will be small and, thus, efficiency gains will be large if there is a strong positive correlation between the weights \(\omega_{si}\) and \(TFPR^*_s\). In other words, efficiency gains will be higher if, on average, more productive firms face higher distortions. From (5), we can also intuitively see that, everything else constant, efficiency gains will be higher the larger the dispersion of \(TFPR^*_s\).

Equation (5) will be used to compute industry gross output reallocation gains. As the exercise fixes the total amount of inputs and calculates how much gross output could be increased by reallocating resources between firms within each industry, it follows that potential gross-output gains coincide with potential TFP gains, so that (5) gives us the potential efficiency gains both in terms of gross output and TFP. In the empirical section we compute gross-output gains for the agriculture, manufacturing and services, by aggregating the (weighted) efficiency gains of the industries belonging to each sector.

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2. Note that efficiency gains are zero if \(TFPR^*_s = 1\) for all firms, i.e., if there are no distortions in the industry, which means that dispersion of \(TFPR^*_s\) is zero. Introducing distortions implies, in practice, making the dispersion of \(TFPR^*_s\) differ from zero.

3. The exercise assumes that eliminating all the distortions identified in the context of the model is a good thing to do. It may, however, be argued that there are distortions that cannot or should not be completely eliminated. For example, we can think of an optimum situation in which the cost of capital (interest rate) differs across firms according to some risk criteria.
The data

In this article we use firm-level balance-sheet data and industry-level factor shares. The firm-level data draws on annual information for Portuguese firms reported under the Informação Empresarial Simplificada (IES). IES data exist from 2006 onwards and covers virtually the universe of Portuguese non-financial firms. The almost universal coverage of IES emerges from the fact that it is the system through which firms report mandatory information to the tax administration and the statistical authorities like the Instituto Nacional de Estatística (INE), the Portuguese Statistics Institute, and the Banco de Portugal, the Portuguese central bank. The data provide very detailed information on the firms’ balance sheets and income statements. From this dataset we get information on firms’s gross output, value added, consumption of intermediate inputs, labour costs (wages and benefits including social security contributions), employment (average number of employees), gross investment (or gross fixed capital formation), annual and accumulated depreciations, and the book values of gross and net capital stock.

For the purpose of this article, even though we report results only for 2008 and 2010, we also use data for 2007 and 2009, because we need sequential years for the construction of some ancillary variables such as productivity shocks. In the IES there are 375,783 observations (different firms) in 2008 and 370,326 observations in 2010. Before using the data, we clean the dataset by dropping firms that do not report strictly positive figures for gross output (production), labour costs, employment, capital stock, intermediate consumption and value added. After cleaning the data, we are left with 236,022 and 230,157 observations for 2008 and 2010, respectively.

Table 1 records the relative importance of agriculture, manufacturing and services in our dataset in terms of employment, gross output and value added. Note the small contribution of agriculture for total employment and value added (around 2 percent), while the service sector contributes around 75 percent. Manufacturing, that has been the focus of most empirical studies, contributes only 22-24 percent to total value added.

<table>
<thead>
<tr>
<th></th>
<th>2008</th>
<th>2010</th>
</tr>
</thead>
<tbody>
<tr>
<td>Employment</td>
<td>1.97</td>
<td>25.34</td>
</tr>
<tr>
<td>Gross output</td>
<td>2.42</td>
<td>34.46</td>
</tr>
<tr>
<td>Value added</td>
<td>2.35</td>
<td>25.57</td>
</tr>
<tr>
<td>Number of firms</td>
<td>6,069</td>
<td>34,237</td>
</tr>
</tbody>
</table>

Table 1. Relative importance of each sector in the dataset (percentage)

Agriculture also includes forestry, fishing, mining and quarrying; services also include construction and energy.
The exercises in this article are conducted with industries defined at the 3-digit NACE code (Rev. 2.1). Overall, this classification implies 213 different industries for 2008 (16 for agriculture (including forestry, fishing, mining and quarrying), 101 for manufacturing and 96 for services (including energy and construction)) and 215 industries for 2010 (16 for agriculture, 101 for manufacturing and 98 for services).

For the industry-level factor shares, we use the average factor shares that are observed in the U.S. during the period 1998 to 2010, which are published by the BEA (Bureau of Economic Analysis).\textsuperscript{4}

**Misallocation under alternative assumptions**

In order to take the model to the data, a set of assumptions are needed, which may have important implications for the final quantitative results. In particular, implementation requires assumptions for the elasticity of substitution parameter ($\sigma$), but the final outcome also depends on some practical issues related to the sample, such as the way outliers are dealt with or the type of firms that are analysed. In our case we are especially interested in investigating if changes in these assumptions impact on manufacturing and service sectors differently, thus significantly affecting the difference between the two sectors in terms of efficiency gains.

In line with other studies (see, for instance, Hsieh and Klenow (2009), Ziebarth (2013) and Dias \textit{et al.} (2015a)), we define a baseline by making the following set of assumptions: i) the elasticity of substitution, $\sigma$, equal to 3; ii) trimming the top and bottom 1.0 percent tails of the TFP and TFPR distributions across industries; iii) inclusion of all firms in the retained industries.\textsuperscript{5}

The efficiency gains for 2008 and 2010, obtained under the baseline assumptions, are recorded in Table 2. We can see from the first row that, if distortions in the economy were eliminated, the gross-output efficiency gains (or TFP gains) for the whole economy would be around 43 percent in 2008 and 49 percent in 2010 (this figure also includes firms from agriculture). Efficiency gains are also clearly higher in the service sector (around 59 percent in 2008 and 66 percent in 2010) than in the manufacturing sector (around 16 and 17 percent in 2008 and 2010, respectively). Thus, the service sector emerges as far

\textsuperscript{4} This means that the U.S. are taken as a benchmark of a relatively undistorted economy.

\textsuperscript{5} In order to avoid computing misallocation with a very small number of firms, we drop industries that are left with less than 10 firms after the trimming. This condition is imposed in all the variants considered in Table 2 below, to ensure comparability. After excluding industries with less than 10 firms, we are left with 162 different industries for 2008 (7 for agriculture, 80 for manufacturing and 75 for services) and 163 industries for 2010 (8 for agriculture, 79 for manufacturing and 76 for services).
more inefficient than the manufacturing sector in line with the results in Dias et al. (2015a).

<table>
<thead>
<tr>
<th>Assumptions</th>
<th>2008</th>
<th></th>
<th></th>
<th>2010</th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Total</td>
<td>M</td>
<td>S</td>
<td>S-M</td>
<td>Total</td>
<td>M</td>
</tr>
<tr>
<td>1) Baseline</td>
<td>43.36</td>
<td>16.02</td>
<td>59.19</td>
<td>43.18</td>
<td>49.33</td>
<td>16.81</td>
</tr>
<tr>
<td>2) $\sigma = 4.5$</td>
<td>63.48</td>
<td>19.93</td>
<td>90.65</td>
<td>70.72</td>
<td>71.55</td>
<td>20.33</td>
</tr>
<tr>
<td>3) Trimming=2.5%</td>
<td>36.35</td>
<td>16.36</td>
<td>47.43</td>
<td>31.07</td>
<td>40.00</td>
<td>17.12</td>
</tr>
<tr>
<td>4) Employment&gt;10</td>
<td>28.31</td>
<td>12.92</td>
<td>38.33</td>
<td>25.41</td>
<td>31.37</td>
<td>13.43</td>
</tr>
<tr>
<td>5)= 2)+3)+4)</td>
<td>28.46</td>
<td>14.15</td>
<td>37.66</td>
<td>23.51</td>
<td>31.28</td>
<td>14.43</td>
</tr>
</tbody>
</table>

**Table 2. Efficiency gains under alternative assumptions**

Efficiency gains in the baseline are computed taking all firms in the dataset, assuming $\sigma = 3.0$ and trimming 1 percent tails of the TFP and TFPR distributions. M stands for manufacturing and S for services. S-M is the difference between the service and the manufacturing sectors. The total also includes firms from agriculture.

Figure 1 depicts industries ordered by the level of efficiency gains for 2008. The striking message from this figure is that the significantly higher levels of efficiency gains in the service sector are not the result of a small number of industries with abnormal levels of efficiency gains, but rather the result of a strong regularity: the bulk of the industries pertaining to the manufacturing sector ranks first, while the bulk of the industries of the service sector appears on the right-hand side of the chart. More specifically, among the 50 percent of the industries with the lowest TFP gains (77 industries) only 11 industries (7.1 percent of the total) belong to the service sector. This strongly suggests that the presence of higher levels of inefficiency is a widespread phenomenon in the service sector.

One question that may arise here is whether the documented difference in misallocation between the two sectors can be explained by one or more of the assumptions that underlie the baseline results. We thus now consider the implications of alternative assumptions to the baseline.

**Elasticity of substitution**

In the absence of country specific estimates, the empirical literature usually assumes $\sigma=3$ as a way of computing a conservative estimate for the importance of misallocation. However, the estimates available for Portugal (see Amador and Soares (2013)) imply an (non-weighted) average of $\sigma=4.5$ for the Portuguese economy. Thus, in what follows, we use $\sigma=4.5$, as a more realistic number for Portugal. From Table 2 (second row), we see that the estimated efficiency gains increase vis-à-vis the baseline in the two sectors. Moreover, the increase in the service sector is significantly higher implying that the difference between the two sectors increases from around
43 percentage points (pp) to around 71 pp in 2008, and from around 50 pp to around 81 pp in 2010.

**Treatment of outliers**

The presence of outliers also has strong implications for the empirical estimates of efficiency gains. For example, if a firm mistakenly reports very low input factors it will generate very large numbers for TFP and TFPR, giving rise to spurious misallocation. One way to deal with this problem is to trim the TFP and the TFPR distributions. Of course, the choice of the trimming is largely ad-hoc, but it has implications for the results, especially in cases of possible large measurement errors. The way changes in the trimming affects the difference of efficiency gains between the service and the manufacturing sectors will depend on how outliers are distributed across the two sectors.

Table 2 (third row) reports the estimates for TFP gains when we trim 2.5 percent on each tail of the TFP and TFPR distributions. Interestingly, we see that estimated efficiency gains decrease in the service sector, but remain basically unchanged in the manufacturing sector, so that the difference between the two sectors is reduced from 43 to 31 percent, thanks only to changes in the service sector. This result shows that a significant part of
the baseline difference between the two sectors is due to outliers that are concentrated in the service sector.

**Minimum firm size**

Another important issue is that of the minimum firm size to consider in the exercise. Technically, it is possible to compute the efficiency gains stemming from labour distortions for firms with one or more employees. However, it is unclear whether one should base the estimates of the industry efficiency gains on micro or very small firms. In fact, the reallocation gains in some of these firms may be somewhat overestimated, either because the model does not allow for indivisibilities in the input factors (labour force or capital stock), which mainly affect micro and small firms, or because some of these units (young firms) might be growing at a faster pace, as they are in the process of converging to their optimal size.

When we compute efficiency gains for different groups of firms defined by their size according the numbers of employees we conclude that heterogeneity (efficiency gains) within small firms is higher than heterogeneity between small and large firms. We believe that misreporting of some relevant items, like sales or gross output might be an explanation for such an outcome. Thus, for purpose of the present exercise, we restrict the analysis to firms with more than 10 employees. The chosen cut-off is somewhat ad-hoc but we believe that given the importance of small and medium-sized firms in the Portuguese economy this solution strikes a balance between the need to reduce the importance of spurious misallocation and the representativeness of the final sample. By dropping firms with 10 or less employees, the number of firms in the dataset is reduced from 236,022 to 41,123 in 2008 and from 230,157 to 38,675 in 2010. Despite representing around 83 percent of the total number of firms, firms with 10 or less employees account only for 16.8 percent of total gross output and 25.4 percent of total employment in 2008 (the figures for 2010 are similar). From Table 2, we see that if we drop firms with 10 or less employees from the dataset, the efficiency gains for the whole economy are reduced from around 43 to about 28 percent (row 4), and the difference between the two sectors is reduced from about 43 pp to about 24 pp in 2008 and from about 50 pp to about 26 pp in 2010.

Finally, if we consider the three changes to the baseline altogether ($\sigma=4.5$, trimming=2.5 and employment $>10$), the efficiency gains for the whole economy drop from about 43 in the baseline to about 28 percent in 2008, and from about 49 to about 31 percent in 2010 (see last row in Table 2). In turn, the differences between the service and the manufacturing sectors drop from about 43 pp to about 24 pp in 2008 and from about 50 pp to about 26 pp in 2010. Summing up, the evidence in this section shows that after accounting

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6. For further details, see Dias et al. (2016).
for possible methodological reasons there still remains a significant difference in allocative efficiency between the manufacturing and service sectors, that we will try to explain in the next section.

Explaining differences in misallocation between the service and manufacturing sectors

In this section, we use regression analysis and the Gelbach decomposition to identify which factors are the most relevant to explaining the differences between misallocation in the service and manufacturing sectors.

Let us denote the efficiency gains in industry $s$ by $Z_s = \frac{Y_s^*}{Y_s}$ and let $D$ be a dummy variable which equals 1 if the industry belongs to the service sector and 0 if it belongs to the manufacturing sector. In the simple cross-section regression

$$Z_s = a_0 + a_1 D + \epsilon_s \quad (6)$$

the coefficient $a_1$ measures the difference between the efficiency gains in the service and manufacturing sectors. The $D$ variable in this simple regression may be thought of as proxying for differences of certain factors between the manufacturing and service sectors.

For reasons that will become clear below, we consider as regressors in our model the (industry-level) productivity shocks, the skewness of the productivity distribution and the proportion of young firms, denoted by $X_{1s}$, $X_{2s}$ and $X_{3s}$, respectively. If we account for the possibility of each regressor having a different impact on the service and manufacturing sectors, the general model may be written as:

$$Z_s = a_0 + a_1 D_s + b_1 X_{1s} + c_1 D_s X_{1s} + b_2 X_{2s} + c_2 D_s X_{2s} + b_3 X_{3s} + c_3 D_s X_{3s} + \epsilon_s \quad (7)$$

Using the Gelbach decomposition of omitted variable bias (see Gelbach (2014)), we are able to quantify the contribution of each regressor to explaining the difference of misallocation between the two sectors. In particular, it may be shown that the contribution of each regressor may be divided into the sum of two components: i) one component that stems from the fact that the mean of the regressor differs across the two sectors; ii) a second component that stems from the fact that the impact of the regressor differs across the two sectors.

The results of the Gelbach decomposition are presented in Table 3 for 2008 and 2010, with robust standard errors in parenthesis. The first row records the original difference between efficiency gains in the service and manufacturing sectors.
the manufacturing sectors, that is, the estimate of $a_1$ in equation 6. The second row reports the explained difference, that is the sum of contributions of the 3 regressors. Finally, the second row from bottom records the residual unexplained difference, that is, the estimate of $a_1$ in equation 7. For each regressor the total contribution is divided into the two above mentioned components, which are denoted "mean differences" and "impact differences".

An important result is that the model fully accounts for the difference of efficiency gains between the two sectors. The residual unexplained difference is not significantly different from zero both in 2008 and 2010.

Productivity shocks emerge as the most important factor explaining misallocation differences between the two sectors. Importantly, the contribution of productivity shocks stems mostly from the difference of the impacts between the two sectors. In particular, the impact of productivity shocks in the service sector is significantly higher than in the manufacturing sector. This is an interesting result that warrants some explanations.

According to literature on misallocation, we may expect industry-level efficiency gains to be positively correlated with productivity shocks (see, for instance, Asker et al. (2014) and Bartelsman et al. (2013)). In the presence of adjustment costs, a firm can adjust capital or labour only with some time lags as it takes time to install capital or to hire new employees. A similar process takes place in the presence of output price rigidity. Thus, when hit by an idiosyncratic productivity shock, a firm responds with a lag and adjusts the input level or the output price sluggishly, which leads to variation of TFPR across firms. With this lagged response, greater idiosyncratic shocks lead to greater variation of TFPR across firms and thus, to greater misallocation. However, for the impact of productivity shocks on misallocation to differ across sectors, we need to assume that the importance of input adjustment costs (capital and/or labour) or the degree of price rigidity vary across industries.

In order to investigate this issue, we use equation (4). By looking at the correlation between TFP shocks and the dispersion of the individual wedges, we are able to tell whether the impact of TFP shocks on misallocation stems mainly from the presence of capital, labour or output distortions. The correlations suggest that the higher impact of productivity shocks on the service sector is likely to stem from higher price rigidity and higher labour adjustment lags in this sector (see Dias et al. (2016) for further details). It is well known that price rigidity is higher in less competitive markets and that, on average, competition, is lower in the service sector (see Dias et al. (2015b) and ECB (2006)). Thus, higher output price rigidity, stemming from lower product market competition, emerges as a natural explanation for the higher

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8. Note that the difference in efficiency gains between the two sectors in Table 3 is a non-weighted average, which explains the difference vis-à-vis the figures reported in the last row of Table 2.
Impact of productivity shocks on misallocation in the service sector. In turn, higher informational frictions (stemming from higher spatial dispersion of firms due to local markets) might explain why labour adjustment lags appear to be higher in the service sector.

The sectoral structure, as proxied by the skewness of the productivity distribution, emerges in Table 3 as the second most important factor to explaining misallocation differences between the two sectors. We use the skewness of the productivity distribution as a way of summarizing the industry-level characteristics that may affect the impact of size-dependent distortions. The aggregate impact of a size-dependent policy varies across industries according to the characteristics of the size distribution of each industry. In an economy where special lines of credit (with subsidized interest rates) or employment subsidies are available to small and medium sized firms, we would expect the impact on misallocation of such distortions to be higher in industries where the skewness of the size distribution is higher,

<table>
<thead>
<tr>
<th></th>
<th>2008</th>
<th>2010</th>
</tr>
</thead>
<tbody>
<tr>
<td>Difference in efficiency gains</td>
<td>0.202</td>
<td>0.205</td>
</tr>
<tr>
<td></td>
<td>(8.31)</td>
<td>(7.90)</td>
</tr>
<tr>
<td>Explained difference:</td>
<td>0.225</td>
<td>0.207</td>
</tr>
<tr>
<td></td>
<td>(2.36)</td>
<td>(2.45)</td>
</tr>
<tr>
<td>a) Productivity shocks</td>
<td></td>
<td></td>
</tr>
<tr>
<td>$a_1$ Mean differences</td>
<td>0.175</td>
<td>0.123</td>
</tr>
<tr>
<td></td>
<td>(1.82)</td>
<td>(1.64)</td>
</tr>
<tr>
<td>$a_2$ Impact differences</td>
<td>0.027</td>
<td>0.023</td>
</tr>
<tr>
<td></td>
<td>(1.77)</td>
<td>(2.17)</td>
</tr>
<tr>
<td>b) Sectoral structure</td>
<td></td>
<td></td>
</tr>
<tr>
<td>$b_1$ Mean differences</td>
<td>0.016</td>
<td>0.002</td>
</tr>
<tr>
<td></td>
<td>(2.15)</td>
<td>(0.33)</td>
</tr>
<tr>
<td>$b_2$ Impact differences</td>
<td>0.069</td>
<td>0.112</td>
</tr>
<tr>
<td></td>
<td>(2.00)</td>
<td>(2.85)</td>
</tr>
<tr>
<td>c) Importance of young firms</td>
<td>-0.036</td>
<td>-0.029</td>
</tr>
<tr>
<td>$c_1$ Mean differences</td>
<td>0.021</td>
<td>0.014</td>
</tr>
<tr>
<td></td>
<td>(1.83)</td>
<td>(1.70)</td>
</tr>
<tr>
<td>$c_2$ Impact differences</td>
<td>-0.057</td>
<td>-0.042</td>
</tr>
<tr>
<td></td>
<td>(-1.32)</td>
<td>(-1.37)</td>
</tr>
<tr>
<td>Unexplained difference</td>
<td>-0.023</td>
<td>-0.002</td>
</tr>
<tr>
<td></td>
<td>(-0.26)</td>
<td>(-0.02)</td>
</tr>
<tr>
<td>Number of industries</td>
<td>154</td>
<td>154</td>
</tr>
</tbody>
</table>

**Table 3. Difference of efficiency gains between services and manufacturing - Gelbach decomposition**

Efficiency gains are obtained assuming case (5) in Table 2. Difference in efficiency gains is given by the coefficient of the industry-dummy in regression (6), while the unexplained difference is given by the coefficient of the industry-dummy in regression (7). Robust t-statistics in parentheses.
that is, where a reasonable proportion of these (less productive) firms operates together with a few large firms that do not have access to such benefits.9

From Table 3 we see that the bulk of the contribution of the sectoral structure comes from the higher impact of this regressor in the service sector, which means that there must be size-dependent distortions in this sector that are not present or are present to a less extent in the manufacturing sector. The analysis of the correlations between TFP and the individual wedges shows that what distinguishes the two sectors, in qualitative terms, is the output wedge in the sense that a higher proportion of firms appears as benefiting from output subsidies in the service sector (see Dias et al. (2016)). In the model, firms that misreport sales (for tax reasons, for instance) will tend to show up as less productive firms, both in terms of TFP and of TFPR and so, as benefiting from output subsidies (they appear as being producing more than what they should given their TFP levels). The anecdotal evidence suggests that informality is higher in the service sector. Part of this informality stems from characteristics of the sector that make the enforcement activity of tax collection much more difficult than in the manufacturing sector. We believe that this might be part of the story behind the documented difference between the two sectors, but this is certainly an issue deserving further investigation.

Finally, according to the model, the importance of young firms, proxied in the model by the proportion of firms with 3 years of age or less, also has a bearing on the difference of misallocation between the two sectors. We link this impact to the presence of financial constraints imposed by financial institutions on young firms, because they have no credit history or because they have insufficient guaranties (see, for instance, Midrigan and Xu (2014), Moll (2014) and Gilchrist et al. (2013)).10

From Table 3, we conclude that this regressor contributes with two opposite effects to the difference in misallocation between the manufacturing and the service sectors. On the one hand, the impact of the difference in the mean of this regressor between the manufacturing and the service sectors contributes to increase the difference in misallocation between the two sectors (2.1 pp in 2008), but the difference in the impact of the regressor between the two sectors has the opposite effect (-5.7 pp), so that the total impact of this regressor is negative (-3.6 pp). This means that the impact on misallocation of the proportion of young firms in the service sector (despite being positive) is lower than the corresponding impact on the manufacturing sector. By looking at the relationship between firms’ age and scaled wedges,

9. Note that distortions in the model are identified in relative terms, so that, in the limit, if special lines of credit were available to all types of firms in the same industry because, say, there are only small or medium sized firms in that industry, the model will not identify any capital distortion.

10. Indivisibilities in the input factors (labour force or capital stock) or faster grow of (small) young firms might also contribute to justify higher misallocation levels within these firms.
we conclude that young firms, on average, face higher distortions (higher TFPR) than older firms, stemming from higher capital costs and the presence of output distortions. Again, as in the case of the skewness regressor, the output wedge emerges as the main responsible for the differences in the impact of this regressor between the two sectors: output distortions for young firms are much less important in the service than in the manufacturing sector, contributing for a smaller contrast between younger and older firms in the former.

Conclusions

The empirical literature on misallocation has recently documented that resource misallocation in the service sector is significantly higher than in the manufacturing sector. Because the service sector is by far the most important sector of activity in developed economies, significantly higher levels of misallocation in this sector may have serious consequences for aggregate productivity. Using data for the Portuguese economy, we document that the significantly higher levels of allocative inefficiency in the service sector are not the result of a small number of industries with abnormal levels of inefficiency, but rather the result of a strong regularity. The great majority of the industries belonging to the manufacturing sector rank among the industries with the lowest misallocation.

By exploring the consequences of using alternative assumptions for our model, we conclude that about 50 percent of the original estimated differences of misallocation between the service and the manufacturing sectors can be attributed to methodological choices. In order to understand which factors explain the remaining gap we resorted to regression analysis, where the regressors were defined so as to capture the impact of the different sources of misallocation suggested in the literature.

Productivity shocks, which capture the impact of (capital and/or labour) adjustment costs and/or output-price rigidity on misallocation, is the most important factor contributing to the differences of misallocation between the two sectors. Such contribution stems from the fact that the impact of productivity shocks in the service sector is significantly higher than in the manufacturing sector. Overall, the bulk of the difference in misallocation due to productivity shocks is likely to originate from the presence of higher output-price rigidity and higher labour adjustment lags in the service sector.

The sectoral structure, which captures the impact on misallocation of size-dependent distortions, and is proxied by the skewness of the productivity distribution, emerges as the second most important factor in explaining the difference of misallocation between the two sectors. Also in this case, the bulk of the contribution comes from its higher impact in the service sector, which
we see as a result of the higher informality that makes the enforcement activity of tax collection much more difficult than in the manufacturing sector.

Finally, the empirical model suggests that the proportion of young firms also has a bearing on the difference of misallocation between the two sectors, but its impact in the service sector is lower. We link the impact of this regressor to the presence of credit constraints imposed by financial institutions on young firms, because they have no credit history or because they have insufficient guaranties.

Our findings have important implications for economic policy. A significant part of the difference of allocative efficiency between the two sectors may be attributed to higher output-price rigidity in the service sector, so that measures aimed at increasing competition in the product market in the service sector will contribute to increase allocative efficiency in this sector and thus, will boost aggregate productivity. Also, less productive firms appear as benefitting from capital and labour subsidies, which suggests that there might be a trade-off between employment creation and aggregate productivity. Thus, size-contingent laws passed by the economic authority and aimed at boosting employment creation in small or medium-sized firms (special lines of credit with subsidized interest rates and/or labour subsidies), to the extent that they contribute to the survival of unproductive firms, especially in the service sector where competition is weaker, will increase misallocation and have a strong negative impact on aggregate productivity.

References


Dias, Daniel, Carlos Robalo Marques, and Christine Richmond (2016). “Why is misallocation higher in the service than in the manufacturing sector?” mimeo.


