6.3. How important is resource reallocation for productivity growth?

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1. Introduction

Aggregate productivity dynamics depends not only on technical progress at the firm-level, but also on the efficient use of inputs. For this reason, the contribution of input reallocation for productivity growth has been recognised as an important issue in the literature. Some recent papers even suggest that the decline in the reallocation of inputs is important for explaining the slowdown in global productivity since the start of this century (Decker et al., 2017; Decker et al., 2018).

This Section uses firm-level data to assess the importance of resource reallocation for total factor productivity (TFP) growth in Portugal, over the decade 2006-2015. To quantify this reallocation effect, productivity is decomposed into the contributions made by the various groups of firms operating in the economy. In each year, these firms may be classified into three types: firms that began activity in that year (entrants or entering firms), firms that ceased activity in that year (exiters or exiting firms) and firms which are active and survive to the next year (incumbents, survivors or surviving firms). Productivity growth in a given sector may be seen as the result of efficiency gains within the surviving firms (within-firm effect), efficiency gains from the reallocation of resources between these firms (between-firm effect) and efficiency gains from the reallocation of resources through the exit and entry of firms.

Overall, we find that total reallocation of resources, involving the between effect of surviving firms and the contribution of entering and exiting firms, had a clearly positive impact on productivity growth in the tradable sector (manufacturing and tradable services), but a negative impact in the nontradable sector (nontradable services). The negative performance of total reallocation in the nontradable sector alone fully accounts for the negative productivity growth in this sector, as well as the negative contribution of total input reallocation for the economy as a whole.

This finding, which highlights the contrast between the tradable and nontradable sectors, suggest that the implementation of competition-enhancing policies in the nontradable sector could bring about larger productivity gains, stemming from a larger contribution of resource reallocation.

2. The dataset

The data source for the analysis is *Informação Empresarial Simplificada* (IES). IES data exist from 2006 onwards and covers virtually the universe of Portuguese non-financial firms. The data provide very detailed information on firm´s balance sheets and income statements. After cleaning the original dataset by dropping firms that do not report strictly positive figures for the relevant variables, and excluding industries with fewer than 10 firms (to avoid estimation problems), we are left with 202 industries (defined at 3-digit NACE code). In order to obtain variables at constant prices (real gross output, real intermediate consumption), we use industry-level price deflators, as firm-level prices are not available.

It is important bo bear in mind that the use of industry-level price deflators may have important implications for the interpretation of our productivity measure, below. If firms operate in an environment of differentiated products, there should be an inverse relationship between productivity and the price set by the firm. This means that our productivity measure, because it is computed using an industry-level price, tends to underestimate productivity for high productivity firms and to overestimate productivity for low productivity firms. A similar phenomenon may occur in the case of new firms. The evidence in the literature (Foster et al., 2008) suggests that these firms tend to set lower prices than older firms. In this situation, the use of industry-level price deflators understates new firms' real output relative to that of incumbent firms and thereby may affect the measured contribution of these firms to total productivity growth.

3. Firm-level and aggregate total factor productivity

In this exercise, we look at total factor productivity (TFP) defined on gross output. In line with most literature, we assume that the output of firm i in year t is given by a three-input Cobb-Douglas production function. From the estimated production function, we compute firm-level TFP_{it} as:

$$lnTFP_{it} = lnQ_{it} - \alpha lnK_{it} - \beta lnL_{it} - \gamma lnM_{it} \tag{17}$$

where Q_{it}, K_{it}, L_{it} and M_{it} stand for real gross output, real capital stock, employment and real intermediate consumption, respectively. Sectoral or economy-wide aggregate productivity is computed as a weighted average of firm-level productivities:

$$P_t = \sum_i \theta_{it} p_{it} \tag{18}$$

where $p_{it} = \ln(TFP_{it})$ and the weights θ_{it} sum to 1. As p_{it} is defined in logs, $\Delta P_t = P_t - P_{t-1}$, our variable of interest, represents a rate of change.

One important point here refers to the choice of weights θ_{it} to be used in equation (18). To compute aggregate TFP measures, the literature has used essentially two types of weights: gross output (or gross value added) and the composite input from the production function (Foster et al., 2001; Bartelsman and Dhrymes, 1998). For this exercise, we define the weights θ_{it} using the log of the composite input, $K_{it}^{\alpha} L_{it}^{\beta} M_{it}^{\gamma}$. Logs are used to account for outliers in the data and prevent a small number of very big firms from dominating the results. The log transformation compresses the distribution of the weights around the mean, decreasing the relative weight of the larger firms and increasing the relative weight of the smaller firms. Thus, our aggregate productivity measure, which is robust to the presence of outliers, can be seen as representing the productivity of a "typical" firm.

4. Productivity decomposition

To assess the importance of resource reallocation for productivity growth, we resort to the well-known dynamic Olley-Pakes Decomposition (Melitz and Polanec, 2015). Let S_t, E_t and X_t represent the three groups of firms operating in the economy in period t: survivors, entrants and exiters, respectively. If we use θ_{Rt} and P_{Rt} to denote the aggregate weight and average productivity of firms in group R (R=S_t, E_t, X_t), the dynamic Olley-Pakes decomposition of productivity growth may be written as follows:

$$\Delta P_t = \Delta \overline{P}_S + \Delta Cov_S + \theta_{E,t}(P_{E,t} - P_{S,t}) + \theta_{X,t-1}(P_{S,t-1} - P_{X,t-1}) \tag{19}$$

where $Cov_S = \sum_{i \in S}(\theta_{it} - \overline{\theta}_S)(p_{it} - \overline{P}_S)$ with $\overline{P}_S = (\sum_{i \in S} p_{it})/N_s$, $\overline{\theta}_S = 1/N_S$ with N_S denoting the number of surviving firms. $\overline{P}_S$ represents the unweighted mean productivity of surviving firms and $\overline{\theta}_S$ the mean weight of these same firms.

In this decomposition, the first two terms represent the contribution of surviving firms to productivity growth. The changes in pro-

ductivity over time of this group of firms are decomposed into the sum of two components: one that captures shifts in the productivity distribution (changes in the unweighted mean, $\overline{P}_S$), usually called the within-firm effect, and another that captures the reallocation of inputs between surviving firms (changes in the "covariance" term, Cov_S), usually labelled the between-firm effect. The within-firm effect may be seen as originating in innovation or creation of better and more efficient technologies, as well as in the adoption of new management practices by firms. The between-firm effect in turn reflects the result of the reallocation of resources, namely capital and labour, from less to more productive firms in the industry.

The third and fourth terms of the decomposition represent the contributions to productivity growth made by entering and exiting firms, respectively. Note that the new firms make a positive contribution to productivity growth if and only if they have higher average productivity than that of the surviving firms, in period t. In turn, exiting firms make a positive contribution to productivity growth if and only if they have lower average productivity than that of the surviving firms in period t-1.

5. Empirical results

5.1. *Contributions of the different types of firms*

The cumulative values for 2006-2015 of the contributions to TFP growth made by the three groups of firms identified by the dynamic Olley-Pakes decomposition are in Table 13 (columns (2) to (6)). An important finding relates to the contribution of entering and exiting firms (entry and exit in Table 13). Productivity for the total economy over the 2006-2015 period was very negatively affected by the contribution of entrants and very positively affected by the contribution of exiters. The fact that entering firms make a negative contribution and exiting firms a positive contribution to productivity growth means that entering and exiting firms are, on average, less productive than surviving firms.

The finding for exiting firms is in line with expectations: firms that leave the market are, on average, less productive than those that survive. However, there are situations in which the opposite may occur. Due to the existence of credit restrictions, many high productivity firms may have to close, especially in situations of financial crisis (Hallward-Driemeier and Rijkers, 2013; Eslava et al., 2015). The finding that new firms are, on average, less productive than the incumbent firms, while seemingly unexpected, is relatively

Sectors	Survivors			Entry	Exit	Net entry	Total reallocation	Total change
	Within	Between	Total					
(1)	(2)	(3)	(4)=(2)+(3)	(5)	(6)	(7)=(5)+(6)	(8)=(3)+(7)	(9)=(4)+(7)
Manufacturing	1.0	3.8	4.7	8.9	-6.6	2.4	6.2	7.2
Tradable services	-8.1	-1.7	-9.7	14.3	4.3	18.7	17.0	8.9
Nontradable services	3.8	-0.8	3.0	-26.8	18.6	-8.3	-9.1	-5.3
Total economy	0.5	-1.0	-0.5	-11.4	7.6	-3.8	-4.8	-4.3

Table 13: Productivity decomposition (accumulated contributions 2006-2015)

Note: Total economy also includes agriculture and construction, but excludes electricity, gas and water services. The distinction between tradable and nontradable services was made according to the criterion established in Amador and Soares (2012). Aside from manufacturing, the authors classified as tradable the industries for which the export-to-sales ratio was above 15%.

common in the empirical literature (Foster et al., 2016). However, the analysis by sector of activity shows significant differences in regard to the contribution of entrants and exiters. In manufacturing and tradable services, entering firms are found to be more productive than incumbent firms, contributing positively to sectoral TFP growth. In contrast, new firms are found to be less productive than surviving firms in nontradable services, contributing negatively to productivity growth in this sector.

Overall, the similarity of the role played by entrants in manufacturing and tradable services must be stressed. These firms are found to be more productive than incumbents in these two sectors (which together represent almost all of the economy's tradable sector), but less productive than the incumbents in the nontradable sector (nontradable services). Also, the contribution to TFP growth of exiting firms is clearly lower in the tradable sector (positive, but clearly lower in tradable services than in nontradable services and even negative in manufacturing). The larger contribution of entering firms together with the lower contribution of exiting firms in the tradable sector may be associated with the greater international competition faced by this sector, thus requiring relatively higher levels of TFP to enter and survive in the sector (note that in the tradable sector survival depends on the productivity of firms that compete in international markets, and not so much on productivity of domestic firms operating in the same sector).

5.2. *Resource reallocation*

The total contribution to productivity growth resulting from the reallocation of inputs is generally understood as the sum of the contributions arising from the reallocation of inputs between

surviving firms (between effect) and the contributions arising from the entering and exiting firms. Thus, in terms of the dynamic Olley-Pakes decomposition, we define total reallocation as:

$$\text{Total reallocation} = \text{between effect} + \text{entry} + \text{exit}$$

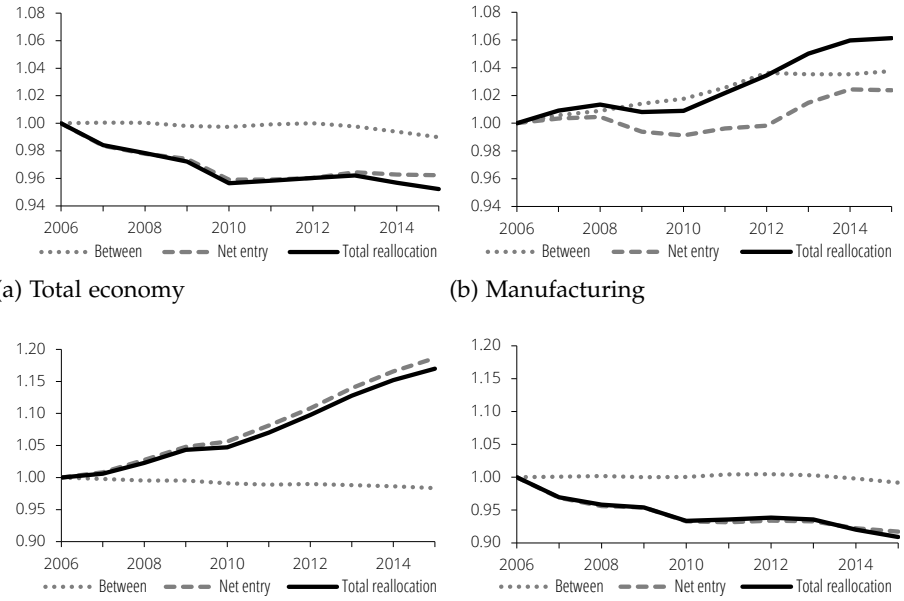
$$= \text{between effect} + \text{net entry effect}$$

An important point to note in Table 13 (column 3) is that the cumulative contribution resulting from the reallocation of inputs between surviving firms (between effect) is positive in manufacturing, but negative in the (tradable and nontradable) service sector, with the result that its cumulative effect over the period is slightly negative for the total economy (-1.0%). In other words, this suggests that in manufacturing the most productive firms increased their market share (measured in terms of inputs), with a corresponding increase in aggregate TFP, but that this did not happen in services. Regarding the net-entry contribution to TFP growth – sum of the contributions of entering and exiting firms – it is positive in the tradable sector (2.4 p.p. in manufacturing and 18.7 p.p. in tradable services), but negative in the nontradable sector (-8.3 p.p.), in the latter case due to the strong negative contribution of entering firms.

Figure 49 shows the evolution over time of the between effect, the net-entry contribution and their sum (total reallocation). Table 13 (column 8) and Figure 49 show that the total reallocation of resources had a clearly positive impact on productivity growth in the tradable sector (manufacturing and tradable services), but negative in nontradable services. The negative evolution of total reallocation in nontradable services was responsible not only for the negative performance of productivity recorded in the sector itself (column (9) of Table 13), but also for the negative developments in total reallocation recorded for the economy as a whole (column (8) of Table 13).

6. Final remarks

The exercise conducted in this Section uses total factor productivity defined on gross output. Other measures of productivity, used in the literature, involve labour productivity and TFP defined on gross value added. It is well known that labour productivity may significantly differ from TFP, depending on the evolution of the capital stock, and that TPF defined on gross output may also differ from



(a) Total economy

(b) Manufacturing

(c) Tradable services

(d) Nontradable services

Figure 49: Cumulated aggregate productivity - resource reallocation

Note: Total economy also includes agriculture and construction, but excludes electricity, gas and water services.

TFP defined on gross value added, depending on the evolution of intermediate inputs.

Furthermore, the analysis of productivity growth was conducted using the dynamic Olley-Pakes decomposition. This decomposition has an attractive feature relative to other decompositions: it can be more directly connected to theoretical models, that have been developed to analyse the pattern of market share reallocations across firms and its consequences for aggregate productivity (Bartelsman et al., 2013). However, there are other decompositions in the literature that differ from the dynamic Olley-Pakes decomposition in the way they quantify the contributions of entry, exit, within or between effects (Foster et al., 2001). Thus, it is important to bear in mind that the conclusions in this Section, regarding the contribution of resource reallocation for productivity growth, may be sensitive to the use of alternative productivity measures or alternative productivity-growth decompositions.

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