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A quantitative explanation of the low productivity in South-Eastern European economies: the role of misallocations[1]

Dr. Petre Caraiani[2]

It is well known that southeast Europe is the least developed area in Europe. Using a methodology based on the idea of heterogeneous firms, this paper studies the degree to which firm heterogeneity and resource misallocation can explain the lower TFP in southeast Europe. The results show a significant degree of heterogeneity and resource misallocation, although the results are sensitive to the calibration used. There are evidences that firm-level productivity depends on firm size, while taxation negatively influences it. There is also some evidence that foreign-owned firms are more competitive, as are exporting firms. Results are generally robust across the various specifications used, but less so relative to the measure of productivity used. Additional evidences suggest that infrastructure-related obstacles as well as institutional instability drive the output distortion, while no factor is underlined as a significant driver of capital distortions, suggesting the need for better data sources for the latter.

Keywords: total factor productivity; firm heterogeneity; South East Europe.
JEL Classification: D24; O47; L25.

1. Introduction

One of the most important issues in macroeconomics and economics is the question of the determinant of differences in income per capita. The literature has converged to pointing to TFP as the main cause of differences in per capita income, see Howitt (2000) or Klenow and Rodriguez-Clair (2005) for key references.

The older literature has considered the differences of TFP as coming from the different productivity levels associated with the representative firm. Two explanatory

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reasons were proposed in the literature, see Restuccia and Rogerson (2013), namely the hypothesis of delayed adoption of technologies in lower-income countries, and the hypothesis that firms in lower-income economies operate less efficiently.

However, in the last decade, understanding of why TFP differs across countries has increased. Instead of focusing on a single representative firm, the recent literature has considered the more realistic case of heterogeneous firms. Introducing heterogeneous firms leads to the fact that the aggregate TFP depends not only on the TFP of each firm, but also on how efficiently inputs are allocated, see Restuccia and Rogerson (2013).

The issue of low TFP can be linked to issues specific to development and industrial policies which were discussed in much earlier literature. The early literature emphasized the role of policy mistakes, Krugman (1987), and inadequate liberalization in transitional contexts, see Murphy et al. (1992). Furthermore, the early literature like Murphy et al. (1989) also underscored the importance of big investment pushes in fixed costs.

These issues are in line with recent research that emphasizes the distortionary role of inadequate policies leading to misallocations and lower productivity, see Restuccia and Rogerson (2008). It can also be linked to the recent evidences pointing to the crucial role of fixed costs, Buera et al. (2011). At the same time, though poorly-designed industrial policies can lead to temporary positive effects, in the longer run they will have effects of only low significance, see Buera et al. (2013), or Gerschenkron (1962) for an early reference.

In this paper we propose an analysis of the impact of misallocations on the low productivity and underdevelopment of the economies in South and Eastern Europe (SEE, hereafter). The main research question answered by this research is to what degree misallocations can explain the low TFP and income in these countries and what the main drivers of these misallocations are. In order to reveal the main drivers of TFP misallocation, the research will focus on the firms and discuss several key issues that might explain the TFP misallocation and low productivity in SEE economies: the role of institutions and policy distortions in shaping firm-level productivity and distortions as well as the role of various factors that drive the firm-level productivity.

There are widespread evidences of the role of institutions and policies in emerging economies in shaping the productivity of firms operating in such economies, see for example the reference review by Tybout (2000). In the context of heterogenous establishments, empirical studies support this view, see Hsieh and Klenow (2009) or Busso et al. (2013).

The literature mentions two main approaches in dealing with the measurement of misallocations, one direct and the other indirect, see Restuccia and Rogerson (2013).

Essentially, in the direct approach, one selects a number of relevant factors for misallocations, measure them and compute the general level of misallocation in an economy with heterogeneous agents. An early study using this approach is Hopenhayn, and Rogerson (1993) who build on the earlier work by Hopenhayn (1992). A key factor of misallocation and (indirectly) of underdevelopment has been found in credit market imperfections, see Banerjee and Duflo (2005) for a comprehensive study on the microeconomic evidences. While the direct approach has the merit of illuminating the various reasons behind emerging economies' lower TFP and income per capita, its main drawback is the difficulty in either selecting the specific explanatory factors or in aggregating their impact.

In the indirect approach, one computes the level of TFP in an economy affected by various distortions compared to the level of an efficient economy unaffected by any distortions. By comparing these two economies, one can derive the aggregate net effects of the various distortions affecting an economy and its aggregate TFP. Obviously, this approach lacks the focus on specific factors provided by the direct approach. Reference papers about this indirect approach can be found in Restuccia and Rogerson (2008) or Hsieh and Klenow (2009), to cite the most important ones.

This paper follows the indirect approach in measuring the impact of various distortions affecting the aggregate TFP, but, at the same time, it aims at uncovering the various factors that lead to the distortions measured. To do so, it attempts to use the extensive firm data in the World Bank Enterprise Survey to underline what specific institutional and economic factors drive firm level distortions and TFP.

An alternative though equally valuable approach has been taken by Alfaro (2009). Based on the development accounting proposed by Caselli (2005), they take a

heterogeneous production model calibrated such that its output taxes and subsidies have values making the model's plant size distribution match that of a specific country. They find that resulting misallocations are a powerful factor that can explain the cross-country differences in income.

This paper contributes to several strands of literature. As already underlined, it is strongly related to the rapidly-growing literature on the role of misallocations in driving aggregate TFP. The main contributions to this literature are twofold: on the one hand it extends the existing studies to a set of countries where, following the transition from socialism, misallocations are expected to be larger; on the other hand, it enriches the literature by focusing on the drivers of the two key distortions, output and capital distortions.

This paper is also related to the rather large literature on manufacturing firms in emerging economies, see the review by Tybout (2000). Not only does this paper study the distribution of firm level productivity as well as firm level distortion, it also relates these variables to known factors like business environment or institutions. Thus the paper provides new evidences on significant questions such as the role of size on firms' level efficiency, or how institutions affect the performance of firms in emerging economies.

The main findings of the paper are as follows. There is a significant degree of heterogeneity in resource allocation across firms in SEE economies. Reallocating the resources to the more competitive firms would increase aggregate TFP by 30 to 50% and reduce the productivity gap relative to the US. However, the gains are sensitive to the calibration used. Furthermore, the productivity at firm level is significantly influenced by size, with smaller firms being less productive than large ones. There are evidences that exporting and foreign-owned firms are more productive. At the same time, infrastructure-related obstacles, institutional instability as well as unfair taxation negatively influence firm level productivity. The findings are generally robust across different econometric specification, but not across the measure of productivity used.

2. The Model

We start from the baseline decomposition framework outlined in Hsieh and Klenow (2009), The presentation follows Hsieh and Klenow (2009) as well as Busso et al. (2013).

It is assumed that there is a single final good produced by a representative firm. The firm operates on a competitive final goods market. The technology used by the firm is a Cobb Douglas one. The final output Y_t is given by:

$$Y = \prod_{s=1}^{S} Y_s^{\theta} \tag{1}$$

The production function has constant returns to scale.

For each sector, it is assumed that the output Y_s is produced by an individual firm with a CES technology which combines M differentiated goods denoted by Y_{si} as follows:

$$Y_s = \left[\sum_{i=1}^{M} Y_{si}^{\frac{(\sigma-1)}{\sigma}} \right]^{\frac{\sigma}{\sigma-1}} \tag{2}$$

The differentiated goods Y_{si} are produced with a Cobb Douglas technology given by:

$$Y_{si} = A_{si} K_{si}^{\alpha_s} L_{si}^{1-\alpha_s} \tag{3}$$

where A_{si} is the level of productivity, α_s is the capital share, Y_{si} is the level of production, L_{si} is the labor and K_{si} is the capital stock.

The profits of an individual firm can be written as:

$$\pi_{si} = \left(1 - \tau_{Y_{si}}\right) P_{si} Y_{si} - w L_{si} - \left(1 + \tau_{K_{si}}\right) R K_{si} \tag{4}$$

Here w stands for the wage rate and R for the rental rate of capital.

We can directly compute the marginal revenue of capital:

$$MRPK_{si} = \frac{R\left(1 + \tau_{K_{si}}\right)}{1 - \tau_{Y_{si}}} \tag{5}$$

and of labor:

$$MRPL_{si} = \frac{w}{(1 - \tau_{Y_{si}})} \tag{6}$$

Based on the marginal revenue products, we are able to derive the distortions which affect the allocation of inputs by a firm. These are given by τ_{Ysi} and τ_{Ksi}. Each of these two distortions can be given an economic interpretation. While τ_{Ksi} affects the ratio between the marginal product of capital and labor, τ_{Ysi} affects the output prices. Each of these has different potential causes. The literature has shown that τ_{Ysi} can come from various barriers like transportation costs or economic corruption, while τ_{Ksi} can come from either credit constraints or labor market regulations.

One can estimate the physical total factor productivity which is given by A_{si} using the following expression which can be approximated by data:

$$A_{si} = \frac{Y_{si}}{K_{si}^{\alpha_s} L_{si}^{1-\alpha_s}} = \frac{\left(P_{si} Y_{si}\right)^{\frac{\sigma}{\sigma-1}}}{K_{si}^{\alpha_s} L_{si}^{1-\alpha_s}} \tag{7}$$

Here, $P_{si}Y_{si}$ is obtained from the data on value added. For the case of the capital share, one assumes it is equal for all firms in an industry *s*. Finally, the labor services are determined using the plant wage bill, while capital services are from data on manufacturing firms.

Furthermore, we can compute the so-called dispersion of productivity in a given sector *s* by the following formula:

$$\log\left(\frac{A_{si}}{\overline{A_s}}\right) \tag{8}$$

As shown in Hsieh and Klenow (2009), the revenue productivity TFPR can be computed as a ratio between the distortions faced by a firm:

$$TFPR_{si} \propto \frac{\left(1+\tau_{K_{si}}\right)^{\alpha_s}}{\left(1+\tau_{Y_{si}}\right)} \tag{9}$$

Finally, we compute a general measure of dispersion in a sector of the economy using the formula:

$$\log\left(\frac{TFPR_{si}}{\overline{TFPR_s}}\right) \tag{10}$$

which depends on the distortions in a specific sector of the economy. Essentially, it shows by how much a certain economy departs from a theoretical economy with no

distortions (where more inputs would be allocated to more productive firms until the revenue productivity was equal across all firms).

The loss of TFP at aggregate level would be given by the ratio between actual TFP and the TFP in an efficient economy, denoted by TFP^*, namely by:

$$\frac{TFP}{TFP^*} = \prod_{s=1}^{S} \left[\sum_{i=1}^{M_s} \left\{ \frac{A_{si}}{\overline{A_s}} \frac{\overline{TFPR_s}}{TFPR_{si}} \right\}^{\sigma-1} \right]^{\frac{\theta_s}{\sigma-1}} \quad (11)$$

3. Data and Methodology

3.1. Data

The focus of this paper is on South-East Europe (SEE), and we therefore selected a sample of economies from this geographical area of Europe, namely using data for Albania, Bosnia-Herzegovina, Bulgaria, Croatia, Czech Republic, Hungary, Kosovo, Macedonia, Moldavia, Montenegro, Poland, Romania, Serbia, Slovenia, Slovakia and Turkey.

Obviously, Central and Eastern European countries are not really part of the SEE group. Two basic reasons explain their presence: firstly, a larger number of firms in the samples helps the estimations, and secondly, these economies provide a comparison group for certain statistics. Moreover, having also passed through a transition period, they are similar to most of the other SEE economies. Nevertheless, when commenting the results, we focus mostly on the SEE group since it forms the focus of the paper.

Given the sectoral decomposition of the TFP, appropriately measuring the losses in aggregate TFP requires good data at firm level. Ideally, such data should be taken from national surveys on firms or manufacturers. Given the lack of such data for most (if not all) countries in this sample, we used the World Bank Enterprise Survey to collect data on firms for different industries and countries.

In order to have homogenous data, we used the 2009 version of the World Bank Enterprise Survey (available at www.enterprisesurveys.org). The number of firms by country is available in Appendix A.

The questionnaire classifies the industries according to United Nations ISIC Rev.3.1, available in 4 digits using the main product that the firm sells. Given that the number of firms is not too large, we transform the classification of industries using 2 digits. The number of firms by industries in the samples can be seen in Appendix B.

Given the lack of data on prices, in order to measures $P_{si}Y_{si}$ we use data on value added (computed as sales less costs of production, with the latter including the costs of raw materials, electricity, fuel and other costs). The labor input is measured through the plant wage bill. We further assume that α_s is uniform across all firms and it is measured as one minus the corresponding labor share for a given industry in the US (as Buera et al. (2010) argue, this is the easiest way to control for any distortion that could affect the capital share), with the US considered as the undistorted economy. We also assume a constant elasticity of substitution σ for all sectors, namely we set σ at 3.

The capital services are measured as the sum of netbook value of land and the net book value of equipment (the alternative is to use the market value of land and equipment).

3.2. Methodology

Given the nature of the data (cross-country observations across firms in various industries), we use an econometric approach based on the literature on this topic. More particularly, we follow Busso et al. (2013), and use the following specification as the baseline one:

Appendix J studies the robustness of the results when the baseline model in equation (1) is extended to account for country fixed effects, namely:

$$z_{ij} = \alpha D_{ij} + \varepsilon_{ij} \qquad (1)$$

Here z_{ij} represents the revenue (quantity) *TFP* for firm *i* in industry *j* in country *c*, D_{ij} stands for the obstacle faced by this firm while ε_{ij} are the robust standard errors.

The econometric analysis in section 4 is based on this specification. However, since it is customary for this sort of data to be analyzed by considering either fixed effects or clustered-robust standard errors, we further enhance this specification in Section 5, where we discuss robustness tests.

4. Results

4.1. Firm Heterogeneity

We start by discussing the degree of firm heterogeneity in South Eastern European countries. We focus on several variables to measure heterogeneity: the dispersion of productivity (measured as either physical productivity or total factor revenue productivity), output distortions as well as capital distortions. We use three statistical measures: the standard deviation, the 90^{th} less the 10^{th} percentile and the 75^{th} less the 25^{th} percentile.

The reported results, see Appendix D.1 for the baseline calibration and Appendix D.2 for the alternative calibration (when σ is set to 5), show quite high values of dispersion, especially for Croatia and Turkey. This is true for both physical productivity and total factor revenue productivity. In general, the values found here indicate a much higher dispersion of productivity than in the case of the US (as found in e.g. Hsieh and Klenow (2009)).

We also analyze the dispersion of output and capital dispersions. Theoretically, the efficient allocation of resources would imply that there are no distortions. The larger are the dispersions of distortions, the larger is the inefficient allocation of resources. We also find a relatively high level of dispersion of distortions, although the results among the countries in the sample are more compact for distortions than for TFP. This time, the highest levels of distortions were found for Montenegro and Romania.

Overall, we find both relatively high levels of distortions for TFP and for the two distortions considered here. Moreover, the findings are quite robust to an alternative parametrization which sets sigma to 5.

It would be interesting to see how both firm level productivity and distortions are distributed. We present histograms with the distributions in Appendix E. We focus first on a measure of dispersion of productive relative to the mean of the sector, namely on $\log\left(\frac{A_{si}}{\overline{A_s}}\right)$, as well as on the relative distortions given by $\log\left(\frac{1+\tau_{Ksi}}{1+\overline{\tau_{Ks}}}\right)$, the capital

distortion, and $\log\left(\frac{1-\tau_{Ysi}}{1-\overline{\tau_{Ys}}}\right)$, the output distortion, see Appendix E.1. The focus is on the full sample of firms, across all sectors and countries.

The results are rather interesting, as they are not uniform across the measure of productivity of distortions. Although the highest density is found for positive TFPs at firm level, overall, most of the firms are rather more productive than the sector average; however, their productivity is only marginally positive. This suggests something not unknown for former transition economies: firms are marginally efficient, while many perform relatively poorly.

In terms of distortions, the findings for output and capital distortions respectively are rather different. The histogram for output distortions indicates positive values for most firms, suggesting that there are a small number of firms with high output distortions relative to the sectoral means. The reverse is true for capital distortions, which suggest that most firms underperform relative to the sectoral average performance. This is somewhat expected as most firms are affected by credit constraints or labor market regulations. At the same time, not many firms (in a relative sense) seem to be heavily affected by output distortions like bribery or high transportation costs.

In Appendix E.2, we show the distribution of firm-level TFP for different sectors across the various countries in the sample. We select some of the most representative sectors in terms of number of firms in the sample. Quite interestingly, there is high variation in the distribution of productivity at firm level across the various industries.

In general, the distribution for many industries tends to respect the distribution over the whole sample, with most of the firms on the positive side of the distribution (again, measured as the relative measure of productivity at firm level to the sector mean). There are however also industries for which most firms are on the negative side in terms of production relative to the sector mean, especially from the manufacturing industries – for instance, Plastics, Chemical, and Machinery. This result is somewhat expected, given the fact that few firms in the manufacturing sector in these countries are very efficient, owing to the massive deindustrialization that took place during the transition period.

Mirroring the left fat tail in the distribution of firm-level productivity in the aggregate sample, a few industries present similar left fat tails in the distribution of firm-

level productivity, such as Garments, Metal Fabricated or Machinery. Again, the manufacturing sector is emphasized.

4.2. Misallocations and TFP Gains

In this section, based on the approach of Hsieh and Klenow (2009), we quantify the level of TFP gain under the hypothesis that these resources would be allocated to the most productive firms. The results are shown in Appendix C. We consider both the baseline and the alternative parametrization.

Appendix C.1 shows the results of the basic calibration. In general, allocating the resources optimally would result in a TFP increase of 30 to 50%. This is however in line both with previous results in the literature, for example in Hsieh and Klenow (2009) for China and India or in Busso et al. (2013) with Latin American economies, and with what statistics have shown in terms of productivity dispersion. At the same time, the results with respect to productivity gains relative to the US show much more modest results, which can be explained by the fact that the US themselves have a certain degree of productivity heterogeneity.

We can also notice that the countries liable to gain the most from the elimination of resource misallocation are Croatia and Turkey. On the one hand, the results should not seem surprising since other authors, like Busso et al. (2013), also find similar degrees of TFP gains for some Latin American countries. On the other hand, these two countries are also the countries which display a very high degree of production heterogeneity across sectors.

We check the robustness of the results by considering an alternative calibration, namely by setting σ to 5, see Appendix C.2. The results in terms of absolute TFP gains generally show lower gains, except for Croatia and Turkey for which the TFP gains would be even higher. In relative terms, the gains relative to the allocation of resources in the United States are very low, and in many cases we can see some TFP losses.

4.3. Drivers of Productivity

In this section, we analyze what drives productivity at firm level. We consider two measures of productivity – the level of productivity in the revenue sense, and the physical TFP (see section 2 for its modeling).

We use several types of explanatory variables. We start with the size of the firm, since it is known from the literature that size and productivity are generally related. We consider three different measure of size, namely small firms (with fewer than 10 workers), medium firms (between 10 and 50 workers) and large firms (more than 50 workers).

We also loosely follow the methodology in Busso et al. (2013) in order to construct measures for the policies that most affect productivity level and dispersion. Various pieces of information about the policy constraints affecting the firms can be found in the WBES questionnaire. Busso et al. (2013) construct measures of policy constraint related to restrictive access to capital, restrictive labor regulations, bad functioning of courts, detrimental regulations and unstable institutions as well as unfair taxation. These measures are constructed using a principal component analysis, by retaining the factors with eigenvalues higher than one. For each of policy constraint, three types of information were used: information from subjective questions about the opinion of the managers regarding the difficult of various regulations (referring to access to finance, labor regulations, functioning of the courts, etc.), by rankings from each firm of the obstacles faced, and finally using information on variables related to policy constraints.

These variables measure various obstacles that are related to a firm's operations, which we succinctly present below (for a complete definition and coverage, one might consult the WBES database). More explicitly, restricted access to capital comprises information such as the difficulty of receiving financing, whether financing is one of the top obstacles or whether financial statements are audited. The variable labor regulations contain information regarding how labor regulation interferes with the operations of the firm, percentage of unionized workforce, whether labor regulations are among the top obstacles, and whether the labor force is inadequately educated. Functioning of the courts

basically refers to whether the courts influence the operations of the firms negatively, whether the justice system is affordable, quick and fair, or whether the functioning of the courts is among the top obstacles. The variable institution instability contains information on whether licensing and permits are an obstacle for firm activity, whether regulations and institutions are among the top obstacles, whether political instability is an obstacle for firm operation, or whether corruption is negatively affecting firm operation. Finally, unfair taxation is a term covering information regarding how much of an obstacle taxes are for a firm's current operations, whether tax administration is an obstacle, whether taxes are among the top obstacles for the activity of a firm, and whether the firm has been visited inspected by tax officials.

Unfortunately, due to unavailable information, we were unable to derive policy constraints referring to infrastructure, institutions and taxes, since for labor regulations and financial constraints we did not have enough variables to perform a principal component analysis. However, we supplement the analysis using information on the subjective obstacles reported by managers with respect to both access to financing and labor regulations.

4.3.1. Firm Size and Productivity

A well-known assertion in the literature is that size and productivity are strongly related, see Tybout (2000) for a review. In order to test this hypothesis, we run regressions between the productivity at firm level (either taken as revenue productivity, tfpr, or quantity productivity, tfpq) and the three types of size (small, medium and large) as defined in the previous section. The results are presented in Appendix F, F.1 and F.2.

Based on the quantity productivity (see section 2), the results indicate that being small- or medium-sized has a negative impact on productivity, while the fact that a firm is large has a positive impact on the productivity at firm-level. These findings are quite expected and confirm the benefits of large firms due to the economies of scale, as argued in the literature. At the same time, as Appendix F.1 shows, most firms in these economies are small or medium ones, and thus there might potentially be some negative effects on aggregate productivity due to the lower proportion of large firms.

At the same time, we can notice that the findings are not robust to the type of productivity used. When revenue productivity is used, the coefficients are no longer statistically significant.

Although it is generally believed that increasing the size of firms leads to higher productivity, surveys cited by Tybout (2000) indicate that gains from increases in plant size might not be that large. The results here, however, do indicate a positive connection between size and productivity, a rather expected result. Tybout (2000) reviews the results in the literature on the issue of whether small-size firms are less productive in developed economies. Somewhat unexpectedly, the results are not as clear as the theory suggests. Very small firms are indeed less efficient, but it is less clear whether small firms are less efficient than larger firms. Surprisingly, given the general consensus suggested by the literature, he concludes that small firms in developing economies do not tend to locate their activity in sectors where they would suffer efficiency costs relative to large firms from the same sectors.

4.3.2. Obstacles, Policy Distortions and Productivity

In this section, we discuss the effects of various obstacles and policy distortions, as detailed in the section above. We focus on a few key types of distortions and obstacles: infrastructure, unstable institutions, unfair taxation, obstacles to financing (that is, credit constraints) and, finally, restrictive labor regulations. Again, we consider two types of productivity, both in the revenue and quantity sense. Results are shown in Appendix G.

Quite interestingly, we found that only unfair taxation has a statistically significant coefficient. The sign is as we would expect, i.e. a negative one. While this finding was expected, less expected is the fact the factors like infrastructure or credit constraints matter less. In the case of infrastructure, this might be explained through the fact that some of the countries in this sample have a pretty well-developed infrastructures (for example, Turkey, with the largest number of firms in the sample). Furthermore, credit constraints might not be really an issue, especially since the financial services sector, though not very developed in some of the countries in the sample (but more

developed in countries like Turkey), is still able to provide the financial capital for the development of the firms.

4.3.3. Other drivers of productivity

In this section, we investigate a few other potential drivers of productivity at firm level. We consider the maturity of the firm (a firm is mature if it is older than 5 years), the level of active market competition, whether is foreign-owned and whether it is an exporter. The results are shown in Appendix H.

The only factor found to influence the level of productivity (in the quantity sense) is whether or not firms are foreign-owned. The finding should not be surprising, as foreign-owned firms are generally more efficient in former transition economies. However, at this time, the findings are not robust to the measure of productivity used.

5. What drives output and capital distortions?

An interesting question refers to the potential factors that determine the distortions, namely the output distortions and the capital distortions, not clearly answered in the literature up to this moment. We focus on the relative distortions, following Busso et al. (2013), namely: capital distortion, $\log\left(\frac{1+\tau_{Ksi}}{1+\bar{\tau}_{Ksi}}\right)$ and output distortion, $\log\left(\frac{1-\tau_{Ysi}}{1-\bar{\tau}_{Ysi}}\right)$.

Theoretically, we would expect output distortions to be driven by various factors that move the output price from its efficient level (e.g. bribes, transportation costs or taxation), while the capital distortions are driven mainly by capital market imperfections (in the form of credit constraints) or labor market regulations.

Appendix I shows the analysis results, which parallels the analysis of the impact of various obstacles and policy distortions on productivity. Only one factor is found to be significant, unfair taxation, which has a statistically positive effect on output distortion: namely, the higher the level of unfairness of the taxes, the higher the relative level of output distortion for an individual firm. We did not find any significant factor influencing capital distortion. This finding might suggest that there are other factors driving the

capital distortions in these economies which are neither properly measured through the data available in WBES or have a different source.

6. Robustness of results

In this section, we further check the robustness of the results found so far by checking, on the one hand, for the effects of using country-level dummies, and on the other by considering cluster-robust standard errors.

Appendix J studies the robustness of the results when the baseline model in equation (1) is extended to account for country fixed effects, namely:

$$z_{ij} = \alpha D_{ij} + \eta_c + \varepsilon_{ij} \qquad (2)$$

where z_{ij} stands for the revenue of quantity *TFP* for firm *i* in industry *j* in country *c*, D_{ij} is the obstacle faced by this firm while η_c is the country fixed effect.

The results are basically the same. Again, we find that a small size results in lower productivity at firm level, while exporting and foreign-owned firms negatively influence the level of firm-level productivity. The only difference relative to the baseline case was that the evidence regarding medium-sized firms is mixed: in a univariate regression, the impact is rather negative, while in a multivariate specification including both small and medium-size firms, the impact is negative, as with the baseline specification.

Furthermore, it is also customary to implement specifications considering clustered-robust standard errors. In order to check if the use of clustered standard errors leads to significant changes, we use again the baseline specification in (1):

$$z_{ij} = \alpha D_{ij} + \varepsilon_{ij} \qquad (3)$$

where ε_{ij} are now clustered-robust standard errors. Appendix K shows the results for this specification.

Given the fact that we would expect some variation relative to the baseline case, as the standard errors are now clustered for the different countries, the findings are rather surprising. The estimated coefficients do differ with respect to magnitude and/or significance; however, the differences are rather small.

We find again that the small and medium firm sizes lead to lower productivity, while larger firm size has a positive impact on firm-level productivity. Furthermore, taxes

again have a negative impact on productivity, while being foreign-owned leads a firm to higher productivity.

There are however some differences relative to the baseline specification. For example, the status of exporter now has a negative impact on firm-level productivity. At the same time, quite interestingly, we also find that the obstacles or policy distortions in terms of infrastructure and institutions (i.e. the instability of institutions) also lead to negative effects on the firm-level productivity. Although this is a rather expected result, it was not uncovered using the other two specifications.

7. Conclusion

One of the biggest questions in economics is why so many countries are less developed. Recently, a potential explanation was proposed, based on the idea of heterogeneous firms, namely that resources are misallocated across available firms. While the paper finds some degree of misallocation, it also identifies that although some gains would be made relative to the United States through proper reallocation, the size of the gains relative to the US is dependent on the calibration used.

We also investigate what drives the level of productivity at firm level. We find that there is evidence that the larger the size, the higher the productivity, while taxation negatively influences productivity levels. There is also some evidence that foreign-owned firms are more productive, though the evidence depends on the measure of productivity used. The findings are generally robust to the various specifications used, but less so to the measure of productivity. For some specifications, we also find a negative impact from obstacles related to infrastructure as well as institutional instability on firm-level productivity.

In addition to previous studies on this topic, we also document and analyze the drivers of the two distortions, output and capital distortion. We find a negative impact from taxation on output distortion, but no factor from the available data seems to drive the capital distortion. The latter finding, though apparently surprising, might stem from the fact that the factors driving the capital distortions are not well measured in this dataset.

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Appendix A. Firms in Sample by Country

Industry	Frequency	Percentage	Cumulative
Bulgaria	293	4.63	4.63
Albania	360	5.68	10.31
Croatia	360	5.68	16.00
Turkey	1,344	21.22	37.22
Poland	542	8.56	45.78
Romania	540	8.53	54.30
Serbia	360	5.68	59.99
Moldova	360	5.68	65.67
Bosnia-Herzegovina	360	5.68	71.36
Macedonia	360	5.68	77.04
Kosovo	202	3.19	80.23
Czech Rep.	254	4.01	84.24
Hungary	310	4.89	89.14
Slovakia	268	4.23	93.37
Slovenia	270	4.26	97.63
Montenegro	150	2.37	100.00
Total	6,333	100.00	

Appendix B. Firms in Sample by Industry

Industry	Frequency	Percentage	Cumulative
Other Mining	1	0.02	0.02
Food	468	7.39	7.41
Tobacco	2	0.03	7.44
Textiles	229	3.62	11.05
Garments	299	4.72	15.77
Leather	38	0.60	16.37
Wood	126	1.99	18.36
Paper	46	0.73	19.09
Publishing	96	1.52	20.61
Petroleum etc.	3	0.05	20.65
Chemicals	173	2.73	23.39
Plastics	151	2.38	25.77
Minerals	253	3.99	29.76
Metals-basic	39	0.62	30.38
Metals-fabricated	354	5.59	35.97
Machinery	186	2.94	38.91
Office	6	0.09	39.00
Electrical	60	0.95	39.95
Communication Equipment	20	0.32	40.27
Precision Instruments	34	0.54	40.80
Motor Vehicles	25	0.39	41.20
Other Transportation Equipment	21	0.33	41.53
Furniture	142	2.24	43.77
Recycling	12	0.19	43.96
Construction/Transport	467	7.37	51.33
Sales, Repair Autos	265	4.18	55.52
Wholesale Trade	582	9.19	64.71
Retail	1,596	25.20	89.91
Hotels, Restaurants	272	4.29	94.20
Land Transport	166	2.62	96.83
Water Transport	4	0.06	96.89
Air Transport	3	0.05	96.94
Auxiliary Transport	58	0.92	97.85
Telecommunication	23	0.36	98.22
Insurance	1	0.02	98.23
Real Estate	33	0.52	98.75
IT	72	1.14	99.89
Other Business	5	0.08	99.97
Disposal	1	0.02	99.98
Other Services	1	0.02	100.00
Total	6,333	100.00	

Appendix C. Gains from Reducing Misallocations

C.1. Baseline Parametrization

Country	Mean TFP gain	Mean TFP gain Relative to US
Bulgaria	54.88226	8.385064
Albania	52.96708	7.044844
Croatia	196.0757	107.1908
Turkey	165.0785	85.49933
Poland	58.83521	11.1513
Romania	49.30487	4.482062
Serbia	50.2679	5.155981
Moldova	49.02954	4.289392
Bosnia-Herzegovina	47.29404	3.074909
Macedonia	60.06587	12.01251
Kosovo	53.36935	7.326346
Czech Rep.	54.22087	7.922234
Hungary	89.54844	32.64412
Slovakia	51.88823	6.289877
Slovenia	50.57152	5.368455
Montenegro	49.04677	4.301448

C.2. Alternative Parametrization - sigma=5

Country	Mean TFP gain	Mean TFP gain Relative to US
Bulgaria	45.68823	1.951177
Albania	35.04965	-5.493596
Croatia	266.6006	156.5435
Turkey	295.5569	176.8068
Poland	45.51039	1.826722
Romania	26.05701	-11.78655
Serbia	52.54266	6.747838
Moldova	27.69156	-10.64271
Bosnia-Herzegovina	29.4749	-9.394749
Macedonia	63.23491	14.23016
Kosovo	39.72039	-2.225058
Czech Rep.	42.3794	-0.3643103
Hungary	113.1398	49.15309
Slovakia	33.79378	-6.372443
Slovenia	34.87139	-5.618344
Montenegro	25.37262	-12.26549

Appendix D. Heterogeneity of Firms

D.1. Basic Parametrization

D.1.1. Physical and Revenue Total Factor Productivity

country	logAsi			logTFPRi		
	SD	90th-10th	75th-25th	SD	90th-10th	75th-25th
Bulgaria	1.61	3.59	2.06	1.15	1.31	1.13
Albania	2.67	4.16	3.61	2.31	3.60	3.19
Croatia	3.95	10.75	3.15	2.94	6.81	2.18
Turkey	4.51	13.04	5.93	3.76	10.01	5.59
Poland	1.56	3.13	1.26	1.15	1.54	0.91
Romania	2.47	4.10	2.30	1.80	1.90	1.27
Serbia	2.04	5.35	3.14	1.47	2.78	1.78
Moldova	1.70	4.31	3.14	1.00	1.44	1.07
Bosnia-Herzegovina	1.64	3.89	2.49	1.15	2.31	1.54
Macedonia	1.57	4.32	2.38	1.12	2.04	1.62
Kosovo	1.78	4.47	2.75	1.31	2.24	1.99
Czech Rep.	2.20	5.19	3.15	1.57	2.58	1.79
Hungary	1.06	2.63	1.59	1.03	1.12	1.66
Slovakia	1.13	3.04	1.56	0.73	0.69	0.80
Slovenia	1.20	3.20	1.53	0.66	1.09	0.74
Montenegro	2.12	5.36	3.68	1.46	2.94	2.19

D.1.2. Capital and Output Distortions

country	Logtau_k			Logtau_y		
	SD	90th-10th	75th-25th	SD	90th-10th	75th-25th
Bulgaria	1.55	3.79	1.82	0.93	1.89	0.90
Albania	4.45	4.86	1.13	1.39	3.70	0.72
Croatia	1.75	4.12	1.85	1.39	2.05	0.79
Turkey	2.29	4.03	1.91	2.07	4.31	1.99
Poland	0.62	1.57	0.48	1.06	2.12	0.74
Romania	2.38	5.44	2.11	2.12	3.86	1.06
Serbia	2.36	2.86	1.29	1.06	2.06	0.82
Moldova	1.69	4.47	1.49	0.91	2.17	1.09
Bosnia-Herzegovina	1.56	3.80	1.03	1.16	3.04	1.10
Macedonia	1.72	4.22	1.96	0.84	2.14	1.01
Kosovo	1.62	3.26	1.22	1.23	2.89	1.90
Czech Rep.	1.71	3.30	1.39	1.57	3.52	1.29
Hungary	1.23	2.11	0.77	1.00	2.22	1.11
Slovakia	1.11	3.16	0.99	0.66	2.00	0.65
Slovenia	1.28	3.11	1.73	0.67	1.42	0.79
Montenegro	1.75	5.40	1.46	1.57	4.18	1.40

D.2. Alternative Parametrization – sigma=5

D.2.1. Physical and Revenue Total Factor Productivity

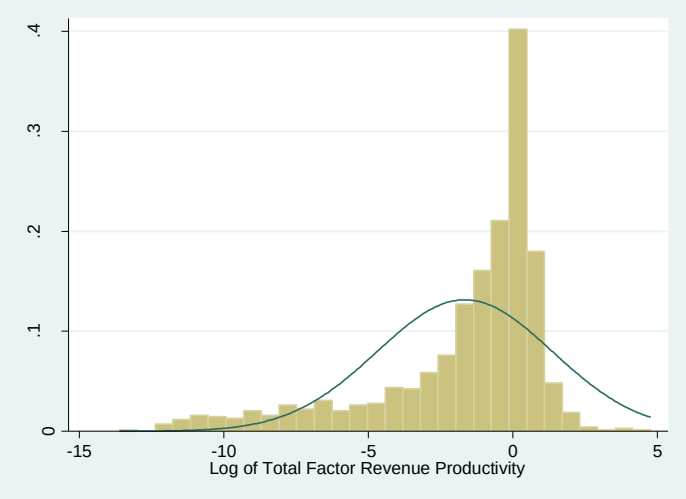
Country	logAsi			logTFPRi		
	SD	90th-10th	75th-25th	SD	90th-10th	75th-25th
Bulgaria	1.38	3.02	1.90	1.15	1.49	1.13
Albania	2.45	4.15	3.58	2.31	3.78	3.19
Croatia	3.78	10.19	2.98	2.94	6.99	2.18
Turkey	4.42	12.79	5.84	3.77	10.18	5.59
Poland	1.40	2.81	1.29	1.15	1.73	0.91
Romania	2.09	3.77	2.02	1.80	2.08	1.27
Serbia	1.89	5.18	2.81	1.47	2.96	1.78
Moldova	1.29	2.98	1.98	1.00	1.62	1.07
Bosnia-Herzegovina	1.38	3.11	2.10	1.15	2.49	1.54
Macedonia	1.32	3.53	2.14	1.12	2.23	1.62
Kosovo	1.55	3.76	2.34	1.31	2.42	1.99
Czech Rep.	1.83	4.24	2.18	1.57	2.76	1.79
Hungary	1.03	2.64	1.69	1.03	1.31	1.66
Slovakia	0.93	2.14	1.37	0.73	0.87	0.80
Slovenia	0.90	2.49	1.25	0.66	1.28	0.74
Montenegro	1.78	4.39	2.95	1.46	3.12	2.19

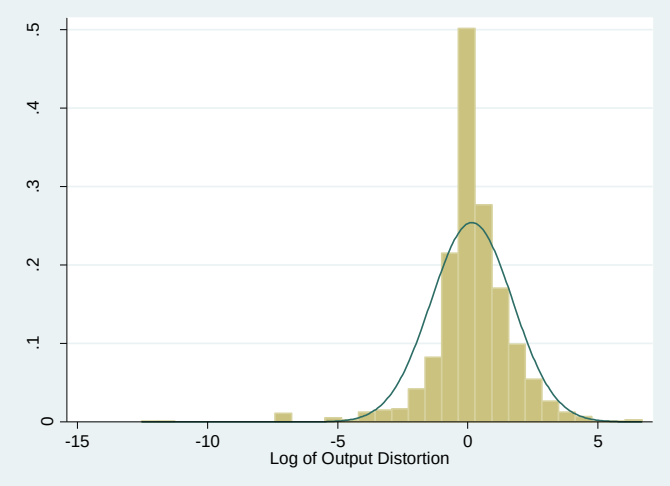
D.2.2. Capital and Output Distortions

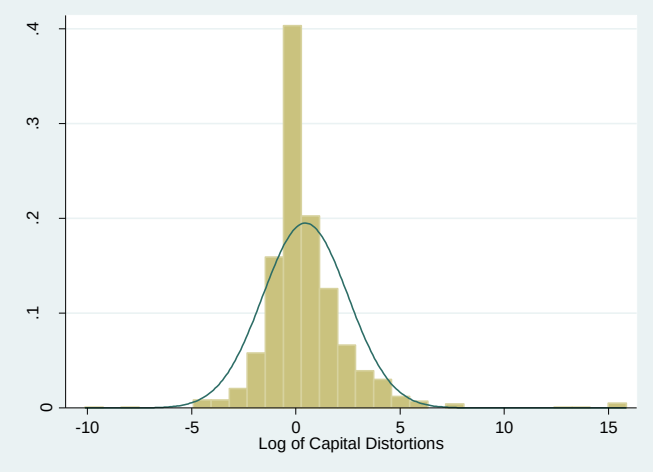
country	logtauk			logtauy		
	SD	90th-10th	75th-25th	SD	90th-10th	75th-25th
Bulgaria	1.55	3.79	1.82	0.93	1.89	0.90
Albania	4.45	4.86	1.13	1.39	3.70	0.72
Croatia	1.75	4.12	1.85	1.39	2.05	0.79
Turkey	2.29	4.03	1.91	2.07	4.31	1.99
Poland	0.62	1.57	0.48	1.06	2.12	0.74
Romania	2.38	5.44	2.11	2.12	3.86	1.06
Serbia	2.36	2.86	1.29	1.06	2.06	0.82
Moldova	1.69	4.47	1.49	0.91	2.17	1.09
Bosnia-Herzegovina	1.56	3.80	1.03	1.16	3.04	1.10
Macedonia	1.72	4.22	1.96	0.84	2.14	1.01
Kosovo	1.62	3.26	1.22	1.23	2.89	1.90
Czech Rep.	1.71	3.30	1.39	1.57	3.52	1.29
Hungary	1.23	2.11	0.77	1.00	2.22	1.11
Slovakia	1.11	3.16	0.99	0.66	2.00	0.65
Slovenia	1.28	3.11	1.73	0.67	1.42	0.79
Montenegro	1.75	5.40	1.46	1.57	4.18	1.40

E. Distribution of Firm Level Productivity and Distortions

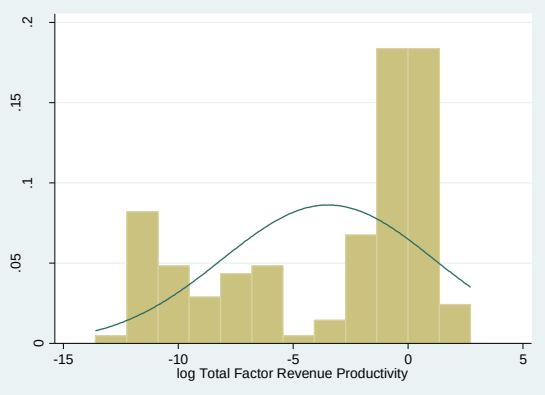
E.1. Dispersion of Productivity and Distortions over the Full Sample



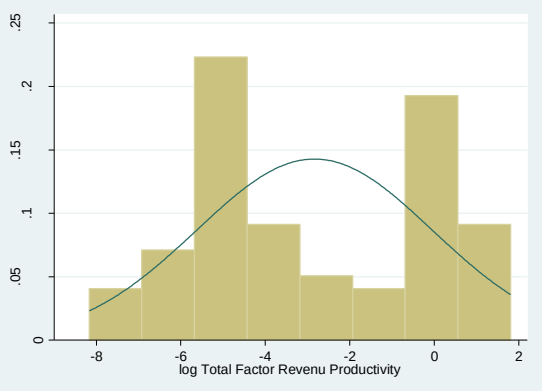




E.2. Dispersion of Productivity over Various Industries



Food Industry



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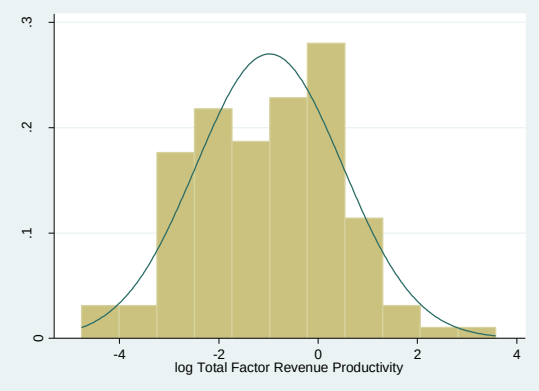

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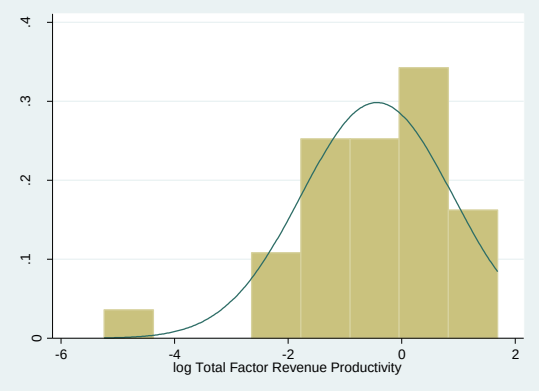
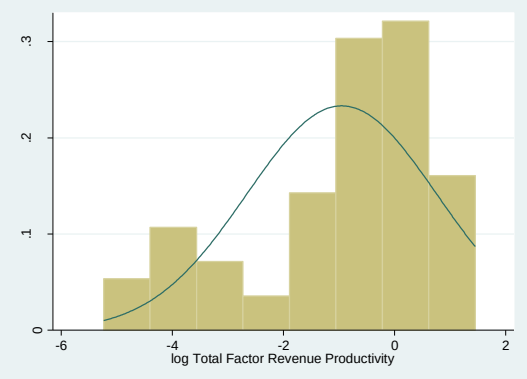


Chemicals



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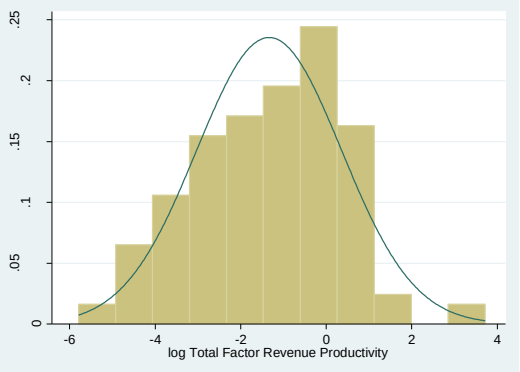

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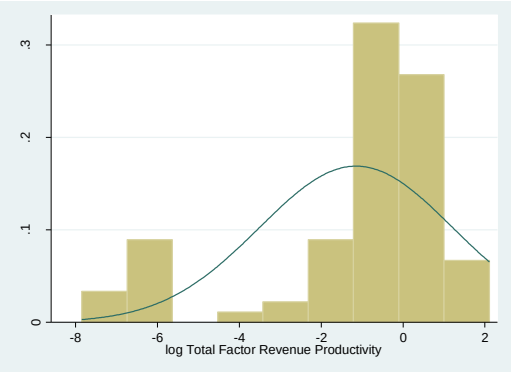

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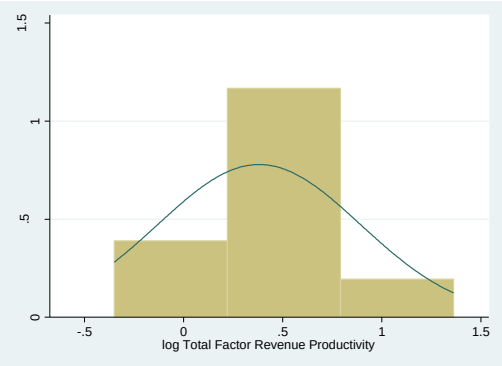
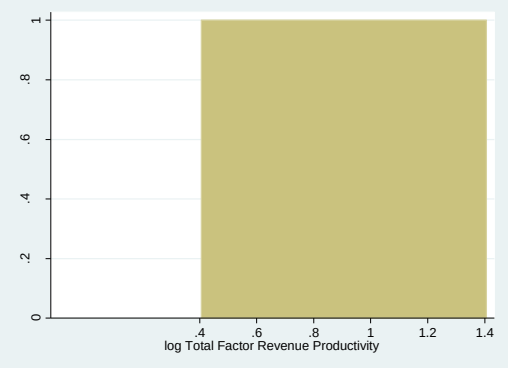
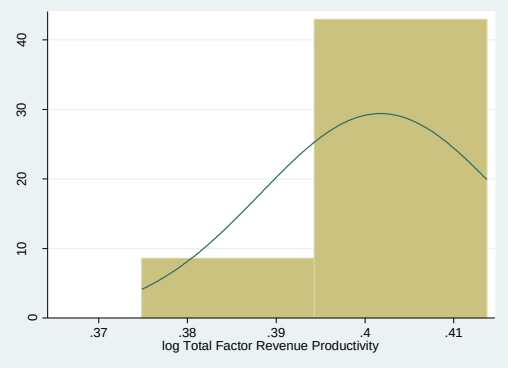


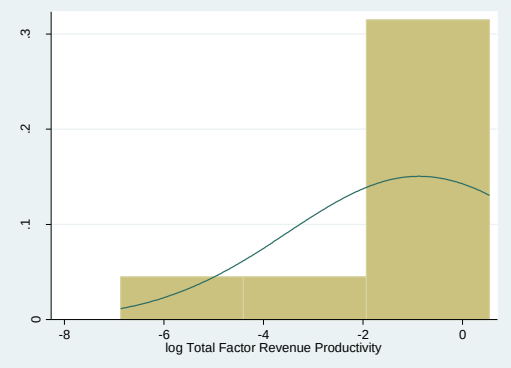
Construction/Transport



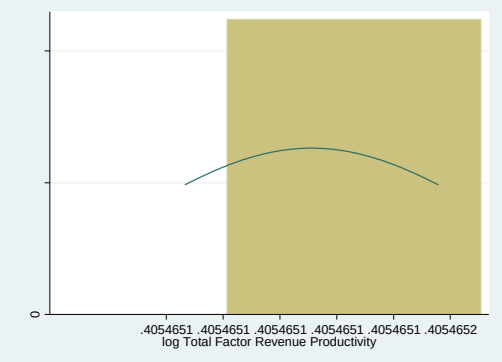
Sales/Repairs Autos



Trade



Retails



Land Transport

Appendix F. Size and Productivity

F.1. Distribution of Firms According to Size

Type	Size	Percent	Cumulative
Small	Size [1,<10)	19.80	19.80
Medium	Size [10,50)	48.92	68.72
Large	Size [50,-)	31.28	100.00
	Total	100.00	

F.2. Size and Quantity TFP by Firms

Dependent variable: tpfq for firm i	1	2	3	4	5
Small	-0.10* [0.05]			-0.20*** [0.06]	-0.03 [0.05]
Medium		0.08* [0.04]		-0.16*** [0.05]	
Large			0.17* [0.05]		0.16*** [0.05]
Observations(firms)	1106	1106	1106	1106	1106

Note: Robust standard errors in brackets. *** p<0.1; ** p<0.5; * p<0.1.

F.3. Size and Revenue TFP by Firms

Dependent variable: tpfr for firm i	1	2	3	4	5
Small	0.09 [0.20]			-0.06 [0.39]	0.19 [0.16]
Medium		-0.23 [0.24]		-0.25 [0.37]	
Large			0.20 [0.37]		.25 [0.37]
Observations(firms)	1106	1106	1106	1106	1106

Note: Robust standard errors in brackets. *** p<0.1; ** p<0.5; * p<0.1.

Appendix G. Distortions, Obstacles and Productivity

G.1. Distortions and Quantity TFP by Firms

Dependent variable: tpfr for firm i	1	2	3	4	5
Infrastructure	-0.005 [0.003]				
Institutions instability		-0.0005 [0.0004]			
Taxes			-0.003** [0.001]		
Credit constraints				-0.033 [0.02]	
Labor regulations					-.0005 [0.003]
Observations(firms)	1106	1106	1106	1106	1106

Note: Robust standard errors in brackets. *** p<0.1; ** p<0.5; * p<0.1.

G.2. Distortions and Revenue TFP by Firms

Dependent variable: tpfr for firm i	1	2	3	4	5
Infrastructure	-0.011 [0.008]				
Institutions instability		-0.0005 [0.0006]			
Taxes			-0.008** [0.004]		
Credit constraints				0.051 [0.12]	
Labor regulations					-.021 [0.022]
Observations(firms)	1106	1106	1106	1106	1106

Note: Robust standard errors in brackets. *** p<0.1; ** p<0.5; * p<0.1.

Appendix H. Other Potential Drivers of Productivity

H.1. Drivers of Quantity TFP by Firms

Dependent variable: tpfr for firm i	1	2	3	4	5
Exporter	0.046 [0.049]				0.007 [0.07]
Foreign owned		0.27*** [0.0.83]			0.35*** [0.13]
Mature (age >5 years)			0.13 [0.09]		0.04 [0.15]
High competition				-0.09 [0.07]	0.53 [0.14]
Observations(firms)	1106	1106	1106	1106	1106

Note: Robust standard errors in brackets. *** p<0.1; ** p<0.5; * p<0.1.

H.2. Drivers of Revenue TFP by Firms

Dependent variable: tpfr for firm i	1	2	3	4	5
Exporter	-0.23 [0.22]				-0.24** [0.09]
Foreign owned		0.27 [0.39]			0.08 [-.12]
Mature (age >5 years)			0.03 [0.35]		-0.35 [0.60]
High competition				-0.033 [0.02]	-0.11 [0.12]
Observations(firms)	1106	1106	1106	1106	1106

Note: Robust standard errors in brackets. *** p<0.1; ** p<0.5; * p<0.1.

Appendix I. Drivers of Distortions

I.1. Capital Distortions

Dependent variable: Capital distortion for firm i	1	2	3	4	5
Infrastructure	-0.0009 [0.006]				
Institutions instability		-0.0032 [0.0036]			
Taxes			-0.0002 [0.0043]		
Credit constraints				-0.033 [0.59]	
Labor regulations					-.0064 [0.0075]
Observations(firms)	1071	1117	1095	1038	1111

Note: Robust standard errors in brackets. *** p<0.1; ** p<0.5; * p<0.1.

I.2. Output Distortions

Dependent variable: Output distortion for firm i	1	2	3	4	5
Infrastructure	0.0046 [0.0056]				
Institutions instability		-0.00008 [0.0002]			
Taxes			0.005** [0.0022]		
Credit constraints				0.0242 [0.0514]	
Labor regulations					0.0013 [0.0056]
Observations(firms)	1071	1117	1095	1038	1111

Note: Robust standard errors in brackets. *** p<0.1; ** p<0.5; * p<0.1.

Appendix J. Robustness of Results: Using Country dummies

J.1. Size and Quantity TFP by Firms

Dependent variable: tpfq for firm i	1	2	3	4	5
Small	-0.14* [0.05]			-0.30*** [0.06]	-0.05 [0.05]
Medium		0.12* [0.04]		-0.24*** [0.05]	
Large			0.26* [0.05]		0.24*** [0.05]
Observations(firms)	1106	1106	1106	1106	1106

Note: robust standard errors in brackets. *** p<0.1; ** p<0.5; * p<0.1.

J.2. Size and Revenue TFP by Firms

Dependent variable: tpfr for firm i	1	2	3	4	5
Small	0.08 [0.19]			-0.07 [0.35]	0.18 [0.17]
Medium		-0.23 [0.22]		-0.26 [0.33]	
Large			0.21 [0.33]		.26 [0.33]
Observations(firms)	1106	1106	1106	1106	1106

Note: robust standard errors in brackets. *** p<0.1; ** p<0.5; * p<0.1.

J.3. Distortions and Quantity TFP by Firms

Dependent variable: tpfr for firm i	1	2	3	4	5
Infrastructure	-0.005 [0.003]				
Institutions instability		-0.0005 [0.0004]			
Taxes			-0.003** [0.001]		
Credit constraints				-0.033 [0.02]	
Labor regulations					-.0005 [0.003]
Observations(firms)	1106	1106	1106	1106	1106

Note: robust standard errors in brackets. *** p<0.1; ** p<0.5; * p<0.1.

J.4. Distortions and Revenue TFP by Firms

Dependent variable: tpfr for firm i	1	2	3	4	5
Infrastructure	-0.011 [0.008]				
Institutions instability		-0.0005 [0.0006]			
Taxes			-0.008** [0.004]		
Credit constraints				0.051 [0.12]	
Labor regulations					-.021 [0.022]
Observations(firms)	1106	1106	1106	1106	1106

Note: robust standard errors in brackets. *** p<0.1; ** p<0.5; * p<0.1.

J.5. Drivers of Quantity TFP by Firms

Dependent variable: tpfr for firm i	1	2	3	4	5
Exporter	0.069 [0.050]				0.09 [0.07]
Foreign owned		0.23*** [0.0.81]			0.31** [0.12]
Mature (age >5 years)			0.04 [0.09]		-0.01 [0.15]
High competition				-0.13 [0.08]	-0.13* [0.07]
Observations(firms)	1106	1106	578	578	1106

Note: robust standard errors in brackets. *** p<0.1; ** p<0.5; * p<0.1.

J.6. Drivers of Revenue TFP by Firms

Dependent variable: tpfr for firm i	1	2	3	4	5
Exporter	-0.25 [0.25]				-0.14 [0.10]
Foreign owned		0.26 [0.41]			0.016 [0.12]
Mature (age >5 years)			0.001 [0.39]		-0.54 [0.63]
High competition				-0.15 [0.13]	-0.14 [0.13]
Observations(firms)	1106	1106	578	578	1106

Note: robust standard errors in brackets. *** p<0.1; ** p<0.5; * p<0.1.

Appendix K. Robustness of Results: Using cluster-robust standard errors

J.1. Size and Quantity TFP by Firms

Dependent variable: tpfq for firm i	1	2	3	4	5
Small	-0.10 [0.06]			-0.20* [0.11]	-0.03 [0.05]
Medium		-0.08** [0.04]		-0.16* [0.07]	
Large			0.17* [0.08]		0.16* [0.07]
Observations(firms)	1106	1106	1106	1106	1106

Note: Cluster-robust standard errors in brackets. *** p<0.1; ** p<0.5; * p<0.1.

J.2. Size and Revenue TFP by Firms

Dependent variable: tpfr for firm i	1	2	3	4	5
Small	0.09 [0.08]			-0.06 [0.20]	0.19 [0.11]
Medium		-0.23 [0.20]		-0.25 [0.27]	
Large			0.20 [0.25]		.25 [0.27]
Observations(firms)	1106	1106	1106	1106	1106

Note: Cluster-robust standard errors in brackets. *** p<0.1; ** p<0.5; * p<0.1.

J.3. Distortions and Quantity TFP by Firms

Dependent variable: tpfr for firm i	1	2	3	4	5
Infrastructure	-0.005** [0.001]				
Institutions instability		-0.0005*** [0.0001]			
Taxes			-0.003** [0.001]		
Credit constraints				-0.033 [0.023]	
Labor regulations					-.0005 [0.001]
Observations(firms)	1106	1106	1106	1106	1106

Note: Cluster-robust standard errors in brackets. *** p<0.1; ** p<0.5; * p<0.1.

J.4. Distortions and Revenue TFP by Firms

Dependent variable: tpfr for firm i	1	2	3	4	5
Infrastructure	-0.011 [0.012]				
Institutions instability		-0.0005 [0.0004]			
Taxes			-0.008 [0.005]		
Credit constraints				0.051 [0.075]	
Labor regulations					-.021 [0.014]
Observations(firms)	1106	1106	1106	1106	1106

Note: Cluster-robust standard errors in brackets. *** p<0.1; ** p<0.5; * p<0.1.

J.5. Drivers of Quantity TFP by Firms

Dependent variable: tpfr for firm i	1	2	3	4	5
Exporter	0.046 [0.054]				0.007 [0.05]
Foreign owned		0.27*** [0.065]			0.31*** [0.09]
Mature (age >5 years)			0.13 [0.08]		0.04 [0.08]
High competition				-0.09 [0.11]	-0.10 [0.11]
Observations(firms)	1106	1106	578	578	576

Note: Cluster-robust standard errors in brackets. *** p<0.1; ** p<0.5; * p<0.1.

J.6. Drivers of Revenue TFP by Firms

Dependent variable: tpfr for firm i	1	2	3	4	5
Exporter	-0.23 [0.18]				-0.24** [0.08]
Foreign owned		0.27 [0.24]			0.08 [0.09]
Mature (age >5 years)			0.039 [0.20]		-0.35 [0.36]
High competition				-0.11 [0.15]	-0.11 [0.17]
Observations(firms)	1106	1106	578	578	576

Note: Cluster-robust standard errors in brackets. *** p<0.1; ** p<0.5; * p<0.1.