Business-Environment Distortions and Firm-level Productivity: Global Evidence*

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Abstract

This paper quantifies the effect of business-environment distortions on revenue total factor productivity (TFPR) and TFPR dispersion using a unique global database that collects information on policy variables related to the business environment at the firm-level for 68 countries. Using a methodology that addresses endogeneity of inputs choices and allows for an endogenous productivity process that depends on the business environment, the paper estimates the marginal effects of removing distortions and simulate the effect of a common policy shock on aggregate TFPR. Thus, the paper identifies the business environment policy variables that can have the largest effects on aggregate TFPR and thus provides inputs for prioritizing the productivity policy reform agenda. In addition, the paper shows that contrary to what the Hsie and Klenow (2009) framework would predict, there is not a unidirectional relationship between TFPR dispersion and business-related distortions. This is partly because the marginal effects of several policy variables vary along the TFPR distribution. For example, economies may exhibit higher TFPR dispersion when they are less distorted if, for example, TFPR dispersion reflects lower frictions in the market for credit, as access to external sources of funding, which disproportionately benefits high-productivity firms, allows more experimentation, finances investments in tangible and intangible assets, and increases the gap between top and bottom firms. Last, the paper simulates the productivity gains countries will obtain from removing economic distortions. Results show that productivity gains from removing distortions are high. In the MENA region, these gains range from 14 percent for Egypt to 34. 58 percent for Yemen. Gains in SA are large for Pakistan (20.25 percent) and Afghanistan (30.37 percent), while they are high for Botswana (26.58 percent) and Democratic Republic of Congo (29.92 percent) in the SSA region. In LAC, Colombia and Peru are the countries with the largest productivity gains from removing distortions, 30.83 and 28.95 percent, respectively. The largest benefits in ECA are registered for Albania (37.49 percent) and Kyrgyzstan (39.78 percent).

JEL: D22, D24, L25, O47

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1 Introduction

Since the seminal work developed by Hsieh and Klenow (2009, hereafter HK), Economists have often employed their theoretical framework to quantify the productivity gains a country can obtain

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by removing economic distortions and identify the type of distortions that impede the efficient allocation of resources towards the most productive firms, a phenomenon coined as misallocation.

Two strands of research have emerged in the literature. The first one, known as the indirect approach (see Restuccia and Rogerson, 2008), attempts to quantify the extent of (mis)allocation without identifying its sources. It is also called the wedge approach and relies on the use of the HK theoretical framework in which dispersion in the marginal product of labor (MPL), capital (MPK), or revenue-based total factor productivity (TFPR) reflects the presence of economic distortions or heterogeneous policy treatment at the firm level to quantify the efficiency gains from removing economic distortions. The second strand of research, known as the direct approach, attempts to identify specific sources of misallocation and understand the mechanisms through which they operate. This literature focuses on adjustment costs in labor and capital (Hopenhayn and Rogerson 1993), taxes (Guner, Ventura, and Xu 2008), informality (Busso, Madrigal, and Pags 2012), government regulations (Brandt, Trevor, and Zhu 2013; Fajgelbaum et al. 2015; Hsieh and Moretti 2015), property rights (Banerjee 1999; Besley and Ghatak 2010; Deininger and Feder 2001), trade protection (Pavcnik 2002; Trefler 2004), and financial frictions (Buera, Kaboski, and Shin 2015) to mention a few.

One of the main implications of the HK framework is that dispersion in revenue-based total factor productivity reflects the presence of economic distortions and, under specific conditions, higher TFPR dispersion implies lower productivity at the aggregate level. One of the advantages of the HK framework is its tractability and easy replicability, which helped Economists and policymakers to better understand how economic distortions affect the efficiency with which resources are allocated across firms and the productivity margins (e.g., within, between, entry-exit) through which they operate.

The disadvantage is that the framework relies on restrictive assumptions, including constant markups, homogeneous technology, and elasticity of prices to technological improvements equal to -1 (e.g., constant returns to scale and perfect pass-through). Indeed, recent evidence by Haltiwanger et al. (2018) shows that the assumptions are not validated by the data when looking into the U.S. Evidence on imperfect pass-through has also been found in several developing countries, including Argentina (Chen and Juvenal, 2016), India (De Loecker et al. 2016), Malaysia (Zaourak, 2018), and Mexico (Cusolito, Iacovone and Sanchez, 2018).

The lack of empirical evidence on the HK assumptions has led Economists to the debate about what exactly TFPR dispersion captures. For example, De Loecker et al. (2014) shows that TFPR dispersion can be explained by adjustments costs in capital coupled with volatility in sales, which are very common features of developing countries. Two recent papers by David and Venkateswaran (2017) and David et al. (2018) show that half of dispersion in the average product of capital is related to markup and technological differences, while the rest is unexplained and potentially driven by economic distortions.

If TFPR dispersion captures more than distortions, what are the implications of this finding for the unidirectional relationship between TFPR dispersion and distortions implied by the HK framework? In other words, is it possible to find policy drivers related to the business environment that will generate higher TFPR dispersion when markets are less distorted? or, alternatively, is it possible to find policy drivers that will generate less TFPR dispersion when markets are more distorted?

Answering those questions require to go beyond the standard exercises of quantifying the effects of removing distortions and identifying the main policy drivers behind TFPR. Efforts done by the direct approach to identify the main policy drivers behind TFPR and TFPR dispersion have found important limitations as most of the studies focus only on one economic distortion due to the lack of firm-level data. This prohibits the identification of the most important binding constraint and the establishment of policy priorities to boost firm-level productivity. The purpose of this paper is to fill this gap using a unique firm-level global database that contains information on policy variables related to the business environment at the firm-level, the paper explores the effect of business-related economic distortions on TFPR and TFPR dispersion.

To quantify the effect of policy variables on TFPR, we followed the method developed by De Loecker (2013), which based on the control function approach and identification assumptions proposed by Ackerberg, Caves, and Frazer (2015), allows the productivity process to be endogenous and therefore a function of policy variables that affect the business environment in which firms operate.

The use of the De Loecker methodology coupled with Enterprise Survey data has four advantages compared to previous approaches. First, it eliminates the bias due to a mis-specified productivity process characteristic of the frequently used two-step approach, which assumes that productivity evolves exogenously. Second, it helps identify which policy variables related to the business environment affect TFPR without imposing restrictive demand- and supply-side assumptions as in the HK framework. Third, the functional form used to estimate TFPR is flexible enough to take into consideration the potential heterogeneity impact of policy distortions on different types of firms, as the effects vary along the productivity distribution. Four, coupled with the availability of global data on policy variables at the firm-level, the paper allows to make cross- and within-country comparisons and identify binding constrains to productivity growth at the global level. Our analysis thus provides a new global database with the productivity gains 68 developing countries can obtain by removing economic distortions and their effect on productivity dispersion.

Leaving aside the effect of product market competition, which is more controversial as an increase in product market competition dissipates rents and decreases TFPR, the paper shows that for all the regions except East Asia Pacific (EAP), a reduction in tax-related bribes is the most effective way to increase TFPR, followed by fostering access to credit (except in the Middle-East and North Africa). In Middle-East and North Africa (MENA), reducing competition from informal firms and informal payments appear as the second most important priority to boost TFPR. Further, increasing access to credit and reducing the number of competitors have the largest positive effect on TFPR dispersion for all the regions. Reducing competition from informal firms and informal payments reduces TFPR dispersion, especially for the MENA region.

In addition, our paper shows that there is not a unidirectional relationship between TFPR dispersion and business-related distortions. In other words, it is possible to find higher TFPR dispersion when economies are less distorted and lower TFPR dispersion when economies are more distorted. For example, improving access to credit increases TFPR dispersion probably because less financial constrains allow firms to do more experimentation and innovation; while higher red tape, which affects negatively and disproportionately high-productivity firms, trim the right tail of the TFPR distribution and reduces TFPR dispersion.

The structure of the paper is as follows. Section 2 presents information about the Enterprise Survey and database used for the analysis. Section 3 presents the methodology. Section 4 explores the correlation between the measures of distortions calculated using the HK framework and the policy variables related to the business environment and displays the results of the simulations. The final section concludes.

2 Data

To conduct the analysis, we used the World Bank Enterprise Survey Database that provides firm-level information for a representative sample of a country?s formal private sector. The survey covers a broad range of business environment topics, including access to finance, corruption, formal and informal product market competition and firm-performance (e.g., sales, labor, capital, materials). The sampling methodology is stratified random sampling with strata based on firm size, industry, and regional categories.

The final database is a balanced panel that covers 47,858 firms from 68 countries, out of which 9,383 present panel information for 2 years. Firms were clustered in four income groups according to the World Bank country classification i.e., high, middle-high, middle-low, and low. The database covers six regions, including East Asia and Pacific, Latin America and the Caribbean, Europe and Central Asia, Middle East and North Africa, South Asia, and Sub-Saharan Africa. The analysis focuses on the manufacturing sector (2-digit, ISIC Revision 3.1). Since the timeframe for data collection varies across countries, all monetary variables have been expressed in 2009 constant dollars using GDP deflators.

Since several of the variables in our sample present missing values, we used a pseudo-Gibbs sampler to impute missing values and maximize sample size. The sampler simulates the joint multivariate distribution that generates the data (see van Buuren, Boshuizen, and Knook, 1999 and Raghunathan et al., 2001).

Our analysis focuses on six policy variables related to the business environment in which firms operate (access to credit, product market competition, red tape, informality, informal payments, and tax-related bribes) that have been identified by the literature as important determinants of TFPR.[1] Table 1 presents information about these variables, while Table 2 presents summary statistics of them.

3 Methodology

3.1 TFPR estimation

Since the Enterprise Survey does not collect information on product prices at the firm level, we used country deflators to deflate firm-level sales and construct a proxy of output at the firm level. Unfortunately, sectoral deflators are not available for all the countries in the database. Thus, our productivity measure, revenue total factor productivity (TFPR), is a measure of firm performance confounds both demand- and supply-side determinants as in the HK framework. To estimate TFPR, we assume a Cobb-Douglas production function and the same factor of production elasticities at the country income-sector group.

We estimate the production function following the method De Loecker (2013) developed to explore learning by exporting effects but instead of looking into exporting effects only, we focused on the effects of policy variables that shape the business environment in which firms operate. The method endogenizes the productivity process because an exogenous productivity process, as it is often assumed in the control function approach (see Olley and Pakes, 1996; Levinshon and Pretrin, 2003; and Ackerberg, Caves, and Frazer (ACF), 2015) implies that policy variables related to the business environment have no impact on direct technological improvements or sales, while there

[1] See King and Levine, R. (1993), Holmstrom and Tirole, (1997), Aghion et al. (2012) and Duval et al. (2017) for access to credit, Aghion et al. (2009) product market competition, Bloom and Van Reenen (2007 and 2010) for red tape, Maloney (2004) for informality, Mauro (1995) for informal payments and tax-related bribes.

is vast evidence showing the contrary. Further, the usual two-step approach of estimating TFPR in the first step and then analyzing the relationship between TFPR and policy variables in a second step leads to biased estimates of the production function coefficients due to a mis-specified productivity motion equation.

The De Loecker method relies on the control function approach proposed by Ackerberg et al. (2015). The method controls for endogeneity of input choices using, as in the Levinson and Petrin (2003) method, materials to identify the coefficients of the production function. However, as pointed out by Ackerberg et al. (2015), the identification of the labor coefficient, a flexible input, cannot be done in the first step because labor does not vary independently of the non-parametric function used to make productivity observable. To solve the potential collinearity problem in the Levinson and Petrin approach, the authors propose to find an alternative data generation process that will move the labor input independently of the non-parametric function used in the first step. The idea involves assuming that labor (chosen at t - b, with 0 < b < 1) is less variable and is chosen after capital (chosen at t - 1), but before materials (chosen at t). With the new approach, the labor coefficient is estimated in the second stage. While, the ACF approach also allows controlling for potential selection bias coming from entry and exit decisions, which affect the demand of quasi-fixed and fixed inputs, as in Olley and Pakes (1996), we were not able to control for it as the Enterprise Survey database provides only balanced panels at the country level.

3.2 First step: estimation procedure

Estimating TFPR first requires estimation of a production function (PF). For the sake of simplicity, we assume a Cobb-Douglas production function, where the inputs are labor, capital, and materials. After log-linearizing, we get the following expression:

$$y_{it} = \beta_L l_{it} + \beta_M m_{it} + \beta_K k_{it} + \omega_{it} + \varepsilon_{it} \tag{1}$$

where y_{it}, l_{it}. k_{it} and m_{it} refer to (deflated) revenue, labor, capital stock, and materials, ω_{it} stands for firm level productivity and ε_{it} is an i.i.d error term capturing unanticipated shocks to production and measurement error.

Since productivity is unobservable, we follow ACF and use materials to make it observable. Thus, we assume that materials are a function of the following variables:

$$m_{it} = h(l_{it}, k_{it}, \omega_{it}, x_{1,it}, \ldots, x_{K,it}, Z_{it}) \tag{2}$$

Where $x_{k,it}$ for $k = 1, 2, .., K$ are policy variables that affect the business environment and Z is a vector of year and country control variables. Assuming that materials are a strictly monotonic positive function of productivity, we invert function h, to express productivity as a function of materials:

$$\omega_{it} = h^{-1}(l_{it}, k_{it}, m_{it}, x_{1,it}, \ldots, x_{K,it}, Z_{it}) \tag{3}$$

Then, we plug equation (3) into (1) and estimate equation (4) by ordinary least squares (OLS). We approximate equation (3) by using a one-degree polynomial on l, k, and m, while the remaining x and Z variables enter the equation linearly.

$$y_{it} = \beta_L l_{it} + \beta_M m_{it} + \beta_K k_{it} + h^{-1}(l_{it}, k_{it}, m_{it}, x_{1,it}, \ldots, x_{K,it}, Z_{it}) + \varepsilon_{it} \tag{4}$$

In the first step, we cannot identify the labor, capital, or material coefficients. However, we can remove the error term and estimate a composite term, which is output minus the predicted value, and use it in the second step to identify the labor, capital, and material coefficients.

3.3 Second step: estimation procedure

The standard proxy estimator approach (OP, LP, ACF) crucially relies on an exogenous (first-order) Markov process for productivity, where productivity at time $t+1$ consists of expected productivity given a firm's information set and a productivity shock ξ_{it+1}:

$$\omega_{it} = g_0(\omega_{it-1}) + \xi_{it} \tag{5}$$

This law of motion plays a critical role in the proxy estimator approach and guides the identification of the production function coefficients. Following De Loecker (2013), we extend the standard approach and consider a general model in which policy variables shaping the business environment in which firms operate are allowed to impact future productivity as given:

$$\omega_{it} = g_0(\omega_{it-1}) + \sum_{k=1}^{K} g_k(x_{k,it-1}, \omega_{it-1}) + Z_{it}\gamma + \xi_{it} \tag{6}$$

where,

$$g_0(\omega_{it-1}) = \rho\omega_{it-1}, \text{ and } g_k = \delta_{k1}x_{k,it-1} + \delta_{k2}x_{k,it-1}\omega_{it} \tag{7}$$

The approach has the advantage that is flexible enough to allow the marginal effects to be heterogeneous across producers given their TFPR level, which makes a substantial contribution to the policy debate on heterogeneity of policy treatment at the firm-level.

One of the main concerns regarding the use of the Enterprise Survey to estimate the TFPR is the potential endogeneity problem associated with the fact that firms with different levels of TFPR may be more or less exposed to the effects of policy distortions. In order to control for this source of endogeneity, we use lagged policy variables and for each firm we assigned the average value of the policy variable for the firms that belongs to the same country-industry-size group without taking into consideration the information of the specific firm. That is, for each x_k variable we use

$$x_{k,it} = \alpha_{k0} + \alpha_{k1}\tilde{x}_{k_i t} + \upsilon_{it} \tag{8}$$

where $\tilde{x}_{k_i t}$ is the average of x_k excluding the i^{th} observation.

Replacing (8) in (6) we obtain

$$\omega_{it} = \rho\omega_{it-1} + \sum_{k=1}^{K} [\alpha_{k0} + (\alpha_{k0}\delta_{k1})\tilde{x}_{k,it-1} + (\alpha_{k0}\delta_{k2})\tilde{x}_{k,it-1}\omega_{it-1}] + Z_{it}\gamma + \xi'_{it} \tag{9}$$

where ξ'_{it+1} contains now the original productivity shock along with all the υ_k errors.

To estimate the parameters of interest, we assume that lagged "averaged" policy variables are uncorrelated to the productivity shock. Thus:

$$E(\xi_{it}\omega_{it-1}) = 0, E(\xi_{it}\tilde{x}_{1,it-1}) = 0, \ldots, E(\xi_{it}\tilde{x}_{K,it-1}) = 0, E(\xi_{it}Z_{it}) = 0. \tag{10}$$

The identification assumption to estimate the coefficients in equation (9) is that the error term of the Markov process that describes the productivity's law of motion is uncorrelated with any lagged policy variable in average form related to the business environment because these variables are not in a firm's information set at time t. Thus, unexpected shocks to the production process that occur at time $t+1$ are orthogonal to changes in these variables.

Then, the parameters are estimated using the moment conditions presented in equation (10). There have been some concerns in the literature about the validity of the lagged value of materials to instrument for materials and this has encouraged ACF to estimate the value-added production function. Specifically, Bond and Söderbom (IFS WF, 2005) argue that since materials are a fully flexible input, there is no dynamic embedded in the optimal demand for materials, meaning that the first condition to be a valid instrument is not satisfied. To explore this issue, we estimate an autoregressive model of order 1 including l_{it}, k_{it}, $x_{1,it}$, ...,$x_{k,it}$ and Z_{it} in the regression and we found that the coefficient of the autoregressive process is 0.09, significant at any level of confidence and the R^2 of the regression is 0.47, meaning that lagged materials is a valid instrument for contemporaneous materials The coefficients of the production functions are then estimated by minimising the sample counterpart of (11) by GMM.

$$E\left\{\xi_{it}\begin{pmatrix} l_{it-1} \\ k_{it} \\ m_{it-1} \\ \tilde{x}_{1,it-1} \\ \vdots \\ \tilde{x}_{K,it-1} \\ Z_{it} \end{pmatrix}\right\} = 0. \tag{11}$$

The final estimation of input output elasticities is done by industry and income level, these estimations allow us to generate an estimation of ω_{it}. The final marginal effects of the economic distortions on ω_{it} are constrained to be equal for all the firms, that it, we estimate equation(9) for all the firms in the sample, i.e we assume common δ_{k0}, δ_{k1} and δ_{k2} parameters, the results are shown in Table 3 and commented in the next section.

To gain efficiency in the estimation of the production function, we used the general-to-specific (GETS) procedure, see e.g. Hoover and Perez (1999) and Hendry and Krolzig (2001). Estimation of the initial specification, which is called the *general unrestricted model* (GUM) may on the one hand be affected by multicollinearity coming from the set of policy variables that affect the business environment in which firms operate. This potential multicollinearity problem may alter the precision of the estimates making some variables appear as statistically significant or insignificant when the opposite is the case. On the other hand, the initial specification may not be parsimonious meaning that it may contain irrelevant variables. Concretely, we the initial GUM comprises a set of 27 variables out of which we select the final set of 6, see Table 1.[2]

Thus, to gain efficiency and find the best specification, we applied the general-to-specific algorithm. Starting from the general unrestricted model, we removed sequentially and in one-variable steps the polynomial with the lowest F-statistic. We repeated the estimation procedure until we reached a specification with an initial set of all statistically significant variables. However, since some of the variables may had been initially removed due to the multicollinearity problem, we added them again sequentially in the same order as they were removed from the unrestricted model. Next, we keep the variable in the final specification if the null of the F-test associated with it was rejected. In some cases, newly added variables may affect the significance of other variables, so we used the Akaike and Bayesian information criteria to choose between alternative models. The process was repeated until we reached the final model in which all the variables were statistically significant.

Since we worked with survey instead of census data, one key question is whether we need to do sampling estimation. That is, whether we must use sampling weights to estimate the coefficients of the production function and therefore TFPR. As Cameron and Trivedi (1995) explained, sampling schemes such as stratification lead to the conditional density of any variable in the sample differing

[2]The initial GUM captures several dimensions of firms' environment like power outages, transport losses, crime, customs clearance, delays in getting permits, frequency of inspections, use of ITs, training and use of foreign technologies.

from that in the population. If stratification is purely exogenous, which means that it does not take into consideration the dependent variable to stratify the sample, then, despite the difference between sample and population, the estimated parameters are consistent. By contrast, under pure endogenous sampling, the marginal distribution of the dependent variable in the sample differs from that in the population and the estimated coefficients are inconsistent. Since firm sales have not been used to stratify the Enterprise Survey sample, we do not use weights for the estimation of the coefficients of the production function. However, we use them to calculate the aggregate marginal effects of each of the policy variables on TFPR. Last, following the literature on production function estimation using proxy variables, we bootstrapped the standard errors using 1000 replications and country-size stratas.

4 Results

This section presents the main results of the paper. We first start by exploring the relationship between the measures of distortions calculated using the HK framework and the policy variables related to the business environment selected for the analysis. We then present the results from estimating TFPR (level and dispersion) extending the De Loecker (2013) method. The last part displays the results on TFPR and TFPR dispersion from simulating changes in the policy variables.

4.1 Business environment and HK distortions

The HK framework includes distortions in the final good market and in the relative price of capital to labor, see equation (12). Using the first order conditions from a firm's optimization problem, we calculate both types of distortions. Distortions on sales, $t_{Y,it}$, reflect a gap between labor compensation as a share of total firm revenues and the output-labor elasticity, eq. (13), while distortions on factor prices, $t_{K,it}$, reflect a gap between the ratio of factor remuneration and factor elasticities, eq. (14),

$$\pi_{it} = (1 - t_{Y,it})P_{it}Y_{it} - wL_{it} - (1 + t_{K,it})RK_{it} \quad (12)$$

$$1 - t_{Y,it} = \frac{\sigma}{(\sigma - 1)}\frac{wL_{it}}{\beta_L P_{it} Y_{it}} \quad (13)$$

$$1 + t_{K,it} = \frac{\beta_K}{\beta_L}\frac{w}{R}\frac{L_{it}}{K_{it}} \quad (14)$$

We started the analysis by estimating an OLS regression of the economic distortions on our policy variables of interest. Figures 1 and 2 in the Appendix show the coefficients from the OLS regression of distortions on policy variables that are statistically significant at the one or five percent level. The graph bars reflect the OLS estimate for each of the six regions. Figure 3 displays the regional R-squared from both set of regressions.

Three conclusions can be drawn from the figures. First, policy variables related to the business environment have a weak explanatory power on economic distortions. Second, access to credit appears as the most important variable to explain both types of distortions, while product market competition is insignificant for most of the regions. Third, not all the coefficients have the expected signs according to the theory. For example, there is a negative correlation between competition from informal firms and distortions to the price of capital relative to labor, as we would expect that more informality is associated with higher distortions. Overall, distortions seem to be weakly correlated to the business environment.

4.2 Measuring the effect of distortions on TFPR

Table 3 presents the results from estimating equation (9). The Table displays the median regional marginal effect evaluated at the TFPR-median firm. As can be observed, all the signs are in line with economic theory and the variables are statistically significant at the 1 or 5 percent level, except for access to credit that is significant at 10 percent. While access to credit has a positive effect on TFPR, meaning that access to credit increases firm performance probably because firms have external resources to finance innovation, technology adoption, and upgrading of managerial skills, the rest of the policy variables have a negative effect. The results thus indicate that business-related distortions decrease firm performance.

Figure 4 shows the heterogeneous effects of access to credit on TFPR along the productivity distribution for each region. The figures show the median regional percentage contribution of access to credit to TFPR changes. As can be observed, access to credit benefits more firms that are located at the top-40 percent of the TFPR distribution. Figure 5 shows that informality (e.g., competition from informal firms) have differential effects across different types of firms. It decreases TFPR for low-productivity firms and increases it for high-productivity firms. The observed pattern is common across all the analyzed regions. Figure 6 shows that red tape contributes to a reduction in TFPR for all the firms. Although the largest negative effect impact on high-productivity firms in most of the regions. LAC and SA display an inverted-U- and U-shaped patterns, respectively.

Figures 7 shows that informal payments (bribes) affect, primarily, firms that are located at the bottom of the TFPR distribution. The curves display U-shaped and inverted-L patterns for EAP, MENA, SA and ECA, LAC, SSA, respectively. In regions like ECA, LAC, and MENA, tax-related bribes have a large negative impact on the bottom of the TFPR distribution, while in the rest of the regions, middle performers face the largest negative effect (Figure 8). Product market competition is positive for low performers and negative for high-productivity firms (Figure 9). Thus, dissipation of rents discourages top incumbents to innovate, while it has the reverse effects on firms located at the bottom of the TFPR distribution.

We have so far discussed the effects of economic distortions on TFPR. We now want to explore their effects on TFPR dispersion and assess empirically the validity of one of the main implications from the HK framework, that is, that there exists a one-to-one mapping between higher (lower) distortions and higher (lower) TFPR dispersion. Table 4 presents the percentage contribution of each variable to changes in TFPR dispersion; while Table 5 classifies the variables in four groups. The main diagonal of Table 5 displays the variables whose effects on TFPR dispersion are in line the HK prediction.

As can be observed in Table 5, variables related to informality and product market competition deliver results in line with the HK framework. Ceteris-paribus, higher product market competition and lower competition from informal firms, which means a less distorted economy, delivers lower TFPR dispersion as in the HK framework. However, the results also show that economies may exhibit higher TFPR dispersion when they are less distorted if, for example, TFPR dispersion reflects lower frictions in the market for credit. In this case, access to external sources of funding, which disproportionately benefits high-productivity firms, allows more experimentation, finances investments in tangible and intangible assets, and increases the gap between top and bottom firms. Alternatively, it is possible to find highly distorted economies because of red tape and corruption displaying lower TFPR dispersion than less distorted ones. In the case of red tape, since the distortions affects negatively and disproportionately high-productivity firms, more manager?s time spent on bureaucratic procedures trim the right tail of the TFPR distribution and therefore decreases TFPR dispersion.

4.3 Simulating TFPR gains and TFPR-dispersion effects from changes in business-related policy variables

This section quantifies the productivity gains economies can obtain at the aggregate level by removing business-related distortions. Thus, using the estimated marginal effects, we simulate the effect of a common shock that changes dichotomous policy variables from 0 to 1 (e.g., access to credit, informality and tax-related bribes) and continuous policy variables by 1 percent in the direction that increases TFPR (e.g., number of competitors, red tape, and informal payments).

Table 6 reports the average regional percentage change on aggregate TFPR from simulating the common shock, where the aggregate TFPR effect is a weighted average of the effects at the firm level and the weights are each firm?s labor share on total labor. Leaving aside the effect of product market competition, Table 6 shows that for all the regions except MENA, a reduction in informality has the largest positive effect on TFPR, followed by a reduction in tax-related bribes and access to credit. In MENA, reducing tax-related bribes appears as the most important priority to boost aggregate TFPR. Aggregate TFPR gains from removing distortions range from 17.07 percent in ECA to 24.245 in MENA. Further, reducing product market competition increases TFPR from 0.83 percent in ECA to 1.32 in SSA. Further, Table 7 shows the average regional percentage change on TFPR dispersion from simulating the common shock. Increasing access to credit and reducing the number of competitors have the largest positive effect on TFPR dispersion for all the regions. Reducing competition from informal firms and informal payments reduces TFPR dispersion, especially for the MENA region.

Simulated gains at the country-level are presented in Table 8. Due to the non-monotonicity of the marginal effects along the TFPR distribution, some changes appear as negative. Results show that productivity gains from removing distortions are high. In the MENA region, these gains range from 14 percent for Egypt to 34.58 percent for Yemen. Gains in SA are large for Pakistan (20.25 percent) and Afghanistan (30.37 percent), while they are high for Botswana (26.58 percent) and Democratic Republic of Congo (29.92 percent) in the SSA region. In LAC, Colombia and Peru are the countries with the largest productivity gains from removing distortions, 30.83 and 28.95 percent, respectively. The largest benefits in ECA are registered for Albania (37.49 percent) and Kyrgyzstan (39.78 percent).

5 Conclusions

This paper quantifies the effect of business environment distortions on revenue total factor productivity (TFPR) and TFPR dispersion using a unique global database that collects information on policy variables related to the business environment at the firm-level for 68 countries and the De Loecker (2013) methodology that allows for an endogenous productivity process. The use of the De Loecker methodology coupled with Enterprise Survey data has four advantages compared to previous approaches. First, it eliminates the bias due to a mis-specified productivity process characteristic of the frequently used two-step approach, which assumes that productivity evolves exogenously. Second, it helps identify which policy variables related to the business environment affect TFPR without imposing restrictive demand- and supply-side assumptions as in the HK framework. Third, the functional form used to estimate TFPR is flexible enough to take into consideration the potential heterogeneity impact of policy distortions on different types of firms as the effects vary along the productivity distribution. Four, coupled with the availability of global data on policy variables at the firm level, it allows to make cross- and within-country comparisons. Our analysis thus provides a new global database with the productivity gains from removing economic distortions and their effect on productivity dispersion for 68 countries.

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Tables and figures

Table 1: Enterprise Survey definition of business-related policy variables

Access to credit	Takes value 1 if the firm has access to a credit line
Access to credit	Takes value one if the firm had access to a credit line last year
Competition from informal firms	Takes value one if the firm dealt with informal competitors last year
Red tape	Percentage of total manager's time spent on dealing with bureaucracy
Informal payments	Percentage sales spent in informal payments to government officials
Tax-related bribes	Value 1 if the firm paid an informal payment to gov. officials in tax inspections
Product market competition	Total number of competitors in firm's main market

Table 2: Summary statistics business-related policy variables

Mean							
Explanatory variables	EAP	ECA	LAC	MENA	SA	SSA	Total
Access to credit	0.069	0.425	0.615	0.127	0.335	0.596	0.407
Competition from informal firms	0.705	0.384	0.678	0.438	0.438	0.382	0.439
Red tape	2.61	16.143	13.381	10.912	4.683	8.17	13.739
Informal payments	0.826	0.904	1.446	3.441	1.344	0.853	0.981
Tax-related bribes	0.026	0.035	0.037	0.307	0.251	0.069	0.05
Product market competition (ln)	1.481	1.736	1.533	1.669	1.764	1.502	1.689
Standard deviation							
Explanatory variables	EAP	ECA	LAC	MENA	SA	SSA	Total
Access to credit	0.253	0.494	0.487	0.333	0.472	0.491	0.491
Competition from informal firms	0.456	0.486	0.467	0.496	0.496	0.486	0.496
Red tape	8.375	21.106	18.62	17.8	10.689	11.591	19.852
Informal payments	6.906	3.601	4.066	7.502	6.141	3.714	4.261
Tax-related bribes	0.16	0.184	0.188	0.461	0.434	0.254	0.217
Product market competition (ln)	0.096	0.299	0.083	0.311	0.796	0.203	0.336

Table 3: Median Marginal Effects from Business-related Distortions, estimation of equation (9)

	Coefficient		Median marginal effect							
Explanatory variables	δ_{k1}	δ_{k2}	EAP	ECA	LAC	MENA	SA	SSA	F stat.	p-value
Access to credit	0.003	0.105	0.015	0.034	0.019	0.015	0.059	0.091	5.567	0.062
Comp. from informal firms	-0.205	0.234	-0.256	-0.211	-0.245	-0.256	-0.151	-0.073	22.811	0
Red tape	-0.004	-0.001	-0.007	-0.007	-0.007	-0.007	-0.007	-0.007	12.589	0.002
Informal payments	-0.024	0.036	-0.061	-0.053	-0.059	-0.061	-0.042	-0.027	24.055	0
Tax-related bribes	-0.263	0.035	-0.35	-0.342	-0.349	-0.35	-0.332	-0.318	20.744	0
Product market comp. (ln)	-0.004	-0.159	-0.022	-0.049	-0.028	-0.022	-0.087	-0.135	13.593	0.001
N	7505									
$R2$	0.492									

Table 4: Effects of business-related policy distortions on TFPR dispersion (%)

Explanatory variables	EAP	ECA	LAC	MENA	SA	SSA
Access to credit	1.277	7.945	11.519	4.198	9.978	16.108
Competition from informal firms	24.604	15.687	29.05	13.608	13.06	17.638
Red tape	-3.666	-7.362	-6.826	-10.191	0.636	-2.937
Informal payments	-107.787	2.111	-4.702	-33.962	-21.091	3.142
Tax-related bribes	-1.862	0.247	-0.155	14.807	-1.118	2.527
Product market comp. (ln)	-53.014	-61.965	-53.804	-64.296	-93.875	-52.795

Table 5: Relationship between economic distortions and TFPR dispersion

	TFPR dispersion	
	Increase	**Decrease**
More distorted economy	HK: Informality	Red tape, Informal payms., Tax-rel. bribes (EAP, SSA)
Less distorted economy	Access to credit	HK: Product market comp., Tax-rel. bribes (ECA, LAC, MENA, SA)

Table 6: Aggregate TFPR gains from simulating a common shock to business-related policy variables (%)

Explanatory variables	EAP	ECA	LAC	MENA	SA	SSA
Access to credit	3.522	0.818	0.531	1.781	1.329	1.946
Competition from informal firms	11.685	8.556	13.621	7.789	8.121	10.748
Red tape	0.404	0.711	1.088	0.962	0.651	0.832
Informal payments	0.474	0.438	0.227	1.864	0.743	1.159
Tax-related bribes	3.433	5.715	1.252	10.619	6.254	4.679
Product market comp. (ln)	1.203	0.83	0.853	1.23	0.959	1.328
Total TFPR gains net of PMC effect	**20.721**	**17.068**	**17.571**	**24.245**	**18.057**	**20.692**

Table 7: TFPR dispersion changes from simulating a common shock to business-related policy variables (%)

Explanatory variables	EAP	ECA	LAC	MENA	SA	SSA
Access to credit	4.515	5.849	3.466	4.447	3.307	3.988
Competition from informal firms	-5.043	-7.637	-9.244	-3.992	-3.09	-9.539
Red tape	0.1	0.196	0.243	0.223	0.216	0.19
Informal payments	-0.186	-0.435	-2.093	-0.906	-0.2	-0.568
Tax-related bribes	0.055	0.017	-0.146	-1.271	-0.094	0.041
Product market comp. (ln)	1.196	2.273	1.686	1.401	1.807	1.539

Table 8: Simulated Aggregate TFPR Gains from a Common Shock

For all the country groups	**Aggregate TFPR change due to the simulated shock (%)**						
1. EAP	**Credit**	**Informal**	**Red tape**	**Inf. Paym.**	**Bribes**	**Comp.**	**Total**
Indonesia	1.7	12.27	0.47	1.05	2.27	0.79	18.55
Laos	2.41	19.8	0.12	0.07	0.8	0.89	24.09
Philippines	6.46	2.98	0.61	0.31	7.23	1.93	19.52
Average EAP	3.52	11.68	0.4	0.47	3.43	1.2	20.72
2. ECA	**Credit**	**Informal**	**Red tape**	**Inf. Paym.**	**Bribes**	**Comp.**	**Total**
Albania	-0.02	20.22	0.92	1.7	14.76	-0.09	37.49
Armenia	2.45	4.55	0.69	0.21	7.97	1.21	17.08
Azerbaijan	-1.51	8.26	0.32	0.91	3.72	-0.31	11.38
Belarus	-0.28	11.87	0.84	0.01	0.69	-0.03	13.11
BiH	3.1	7.15	0.88	0.08	4.44	1.73	17.38
Bulgaria	-2.88	17.87	0.54	0.16	7.27	-0.96	22
Croatia	7.42	-2.29	0.58	0.02	0.15	4.62	10.49
Czechia	10.98	0.83	1.29	0.02	2.31	5.75	21.18
Estonia	1.2	3.88	0.2	0.1	0	0.1	5.48
Georgia	-2.25	22.12	0.44	0.41	2.54	-1.78	21.46
Hungary	2.3	-0.36	0.54	0.07	0.38	2.45	5.38
Kazakhstan	-4.22	5.34	0.34	2.48	12.5	-0.67	15.77
Kosovo	0.28	3.69	1.85	0.86	0.17	1.32	8.16
Kyrgyzstan	-0.99	20.02	0.76	0.56	19.64	-0.22	39.78
Latvia	-0.52	6.19	0.45	0.26	5.88	-0.05	12.2
Lithuania	3.22	4.19	0.51	0.12	9.22	0.99	18.25
Macedonia	1.28	12.61	1.05	0.23	1.95	1.23	18.35
Moldova	0.46	4.92	0.56	0.16	4.53	0.4	11.05
Mongolia	-0.96	18.23	0.99	0.16	4.39	-0.2	22.61
Montenegro	0.14	16.36	0.53	0.36	0.13	0.32	17.84
Poland	0.55	6.94	0.45	0.24	8.58	1.79	18.55
Romania	0.9	8.35	0.41	0.44	9.7	0.48	20.27
Russia	-0.4	8.43	0.87	0.63	9.56	-0.02	19.07
Serbia	-1.45	4.12	0.88	0.14	7.83	-0.52	11.01
Slovakia	1.69	0.54	0.3	0.14	1.76	2.86	7.3
Slovenia	5.06	5.4	0.26	0.12	0.64	1.84	13.33
Tajikistan	-0.75	10.53	0.48	0.9	13.83	-0.04	24.94
Turkey	0.57	10.88	1.18	0.14	0.29	1.25	14.31
Ukraine	1.32	5.33	1.37	0.45	10.23	1.89	20.6
Uzbekistan	-2.14	10.52	0.86	1.06	6.37	-0.44	16.22
Average ECA	0.82	8.56	0.71	0.44	5.71	0.83	17.07

Table 8: Simulated Aggregate TFPR Gains from a Common Shock (cont.)

For all the country groups	**Aggregate TFPR change due to the simulated shock (%)**						
3. LAC	**Credit**	**Informal**	**Red tape**	**Inf. Paym.**	**Bribes**	**Comp.**	**Total**
Argentina	0.39	17.73	1.38	0.08	2.31	0.95	22.83
Bolivia	3.45	9.53	1.03	0.16	2.16	1.92	18.26
Brazil	0.06	20.65	1.24	0.82	3.77	0.26	26.8
Chile	0.06	11.76	0.7	0.03	0.4	1.05	13.99
Colombia	-0.13	30.05	1.04	0.17	0.02	-0.32	30.83
Ecuador	0.02	15.39	1.48	0.05	0.24	0.12	17.29
Guatemala	1.2	8.37	1.19	0.02	2.87	2.73	16.39
Honduras	1.72	2.05	1.08	0.06	0.95	2.18	8.04
Mexico	1.53	-6.67	0.97	0.03	1.57	2.36	-0.19
Nicaragua	-1.8	4.35	0.62	0.08	0.02	-0.34	2.93
Panama	1.58	10.04	1.61	0.07	0.02	0.97	14.29
Paraguay	-0.55	25.39	0.97	1.27	0.39	-0.36	27.1
Peru	-0.47	26.31	0.91	0.12	2.55	-0.47	28.95
Uruguay	0.36	15.75	1	0.21	0.25	0.9	18.48
Average LAC	0.53	13.62	1.09	0.23	1.25	0.85	17.57
5. MENA	**Credit**	**Informal**	**Red tape**	**Inf. Paym.**	**Bribes**	**Comp.**	**Total**
Egypt	2.48	7.94	0.66	0.32	0.91	1.61	13.91
Yemen	1.08	7.64	1.26	3.41	20.33	0.86	34.58
Average MENA	1.78	7.79	0.96	1.86	10.62	1.23	24.24
4. SA	**Credit**	**Informal**	**Red tape**	**Inf. Paym.**	**Bribes**	**Comp.**	**Total**
Afghanistan	-1.41	19.55	0.63	2.4	9.77	-0.56	30.37
Bangladesh	1.4	3.16	0.28	0.4	6.18	1.89	13.3
Bhutan	2.05	4.76	1.37	0.5	0	1.44	10.11
Nepal	-0.9	9.96	0.53	0.52	8.79	-0.16	18.74
Pakistan	2.25	7.03	0.45	0.28	8.65	1.59	20.25
Vietnam	4.59	4.28	0.65	0.36	4.14	1.56	15.58
Average SA	1.33	8.12	0.65	0.74	6.25	0.96	18.06
6. SSA	**Credit**	**Informal**	**Red tape**	**Inf. Paym.**	**Bribes**	**Comp.**	**Total**
Angola	8.32	0.97	1.07	-0.06	3.99	2.05	16.34
Botswana	-3.35	23.78	0.38	3.47	3.35	-1.06	26.58
Burkina Faso	3.19	10.85	1.17	0.43	1.54	1.61	18.8
Cameroon	1.69	6.88	0.91	4.7	10.74	1.9	26.82
DRC	4.46	9.19	1.98	0.67	12.14	1.48	29.92
Ethiopia	-0.37	11.91	0.41	0.86	0.41	0.07	13.29
Kenya	3.12	3.12	0.83	0.31	6.96	2.6	16.94
Malawi	0.94	16.13	0.32	0.39	1.71	0.54	20.02
Mali	1.07	10.33	0.97	1.06	8.43	1.19	23.05
Senegal	1.64	11.79	0.98	0.33	3.6	1.37	19.71
South Africa	4.39	-1.76	1	0	1.72	4.51	9.87
Tanzania	1.04	10.41	0.37	0.93	2.6	0.94	16.29
Uganda	-0.85	26.13	0.43	1.96	3.63	0.07	31.39
Average SSA	1.95	10.75	0.83	1.16	4.68	1.33	20.69

FIGURE 1: DISTORTION ON SALES (COEFFICIENTS SIGNIFICANT AT THE 1% OR 5% LEVEL)

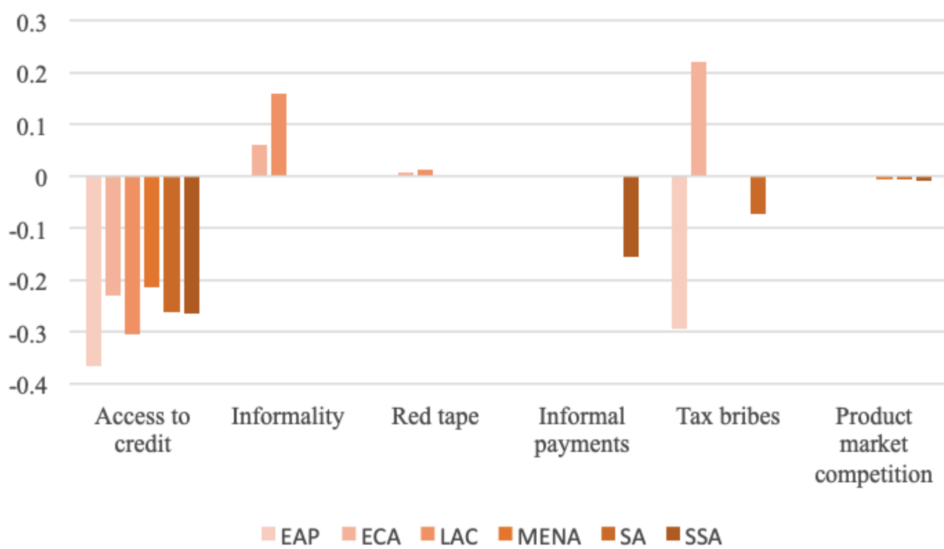

FIGURE 2: DISTORTIONS ON THE PRICE OF CAPITAL RELATIVE TO LABOR (COEFFICIENTS SIGNIFICANT AT THE 1% OR 5% LEVEL)

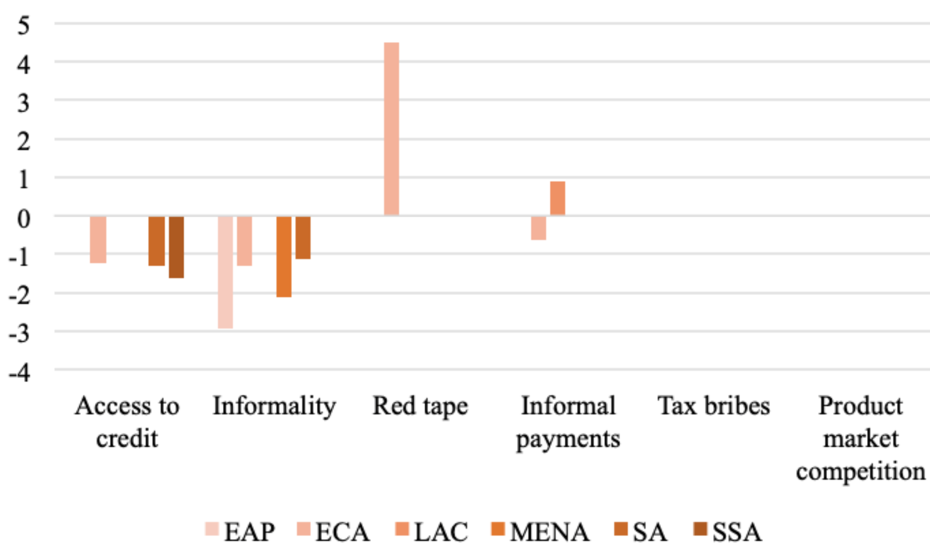

Figure 3: R^2 from the OLS regressions of distortions on policy variables

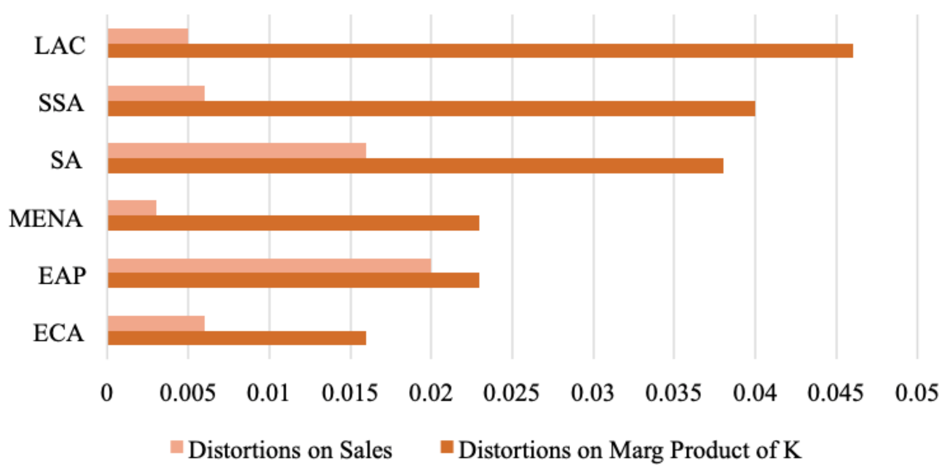

Figure 4: Access to credit percentage contributions

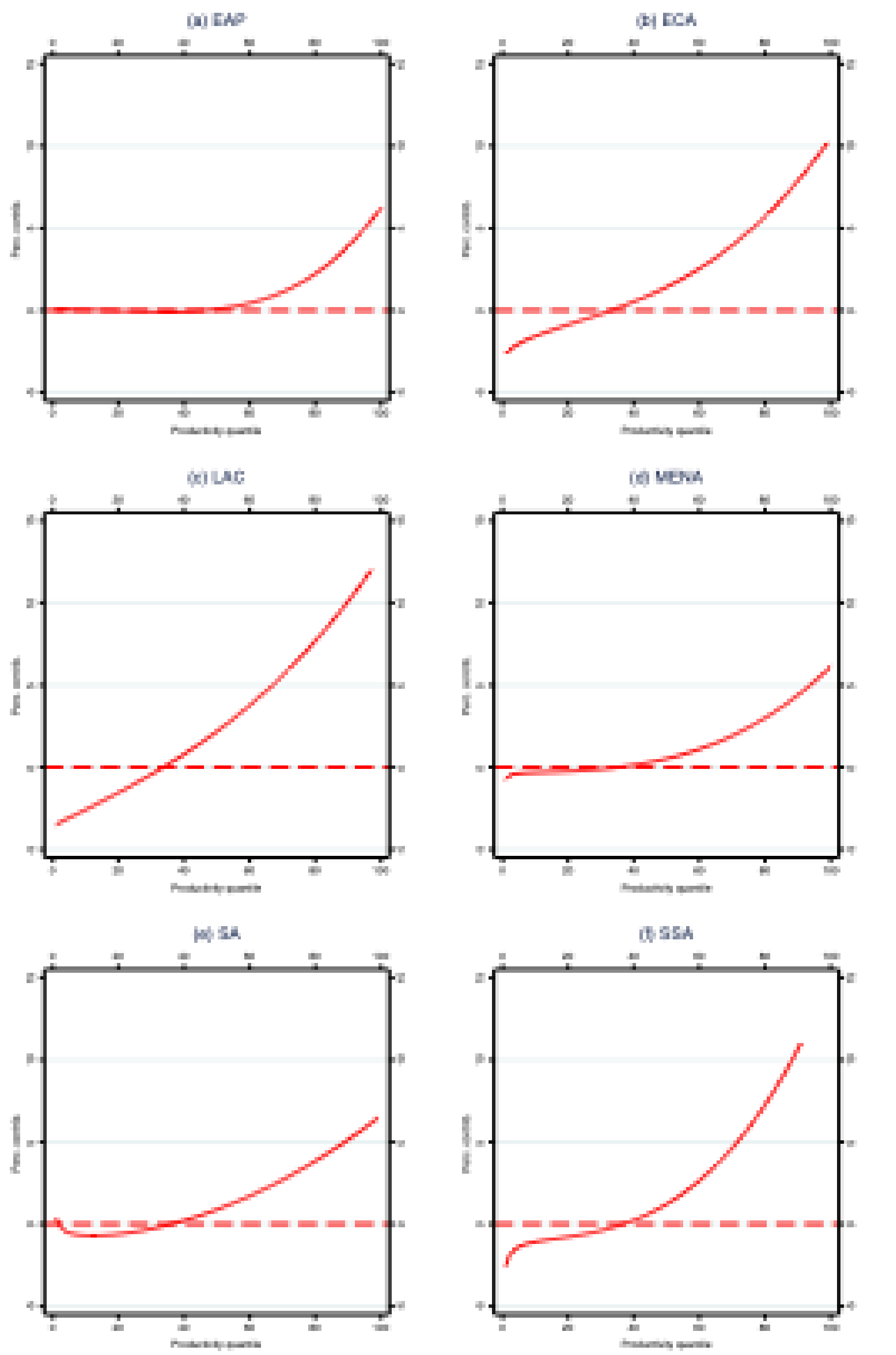

Figure 5: Informal product market competition percentage contributions

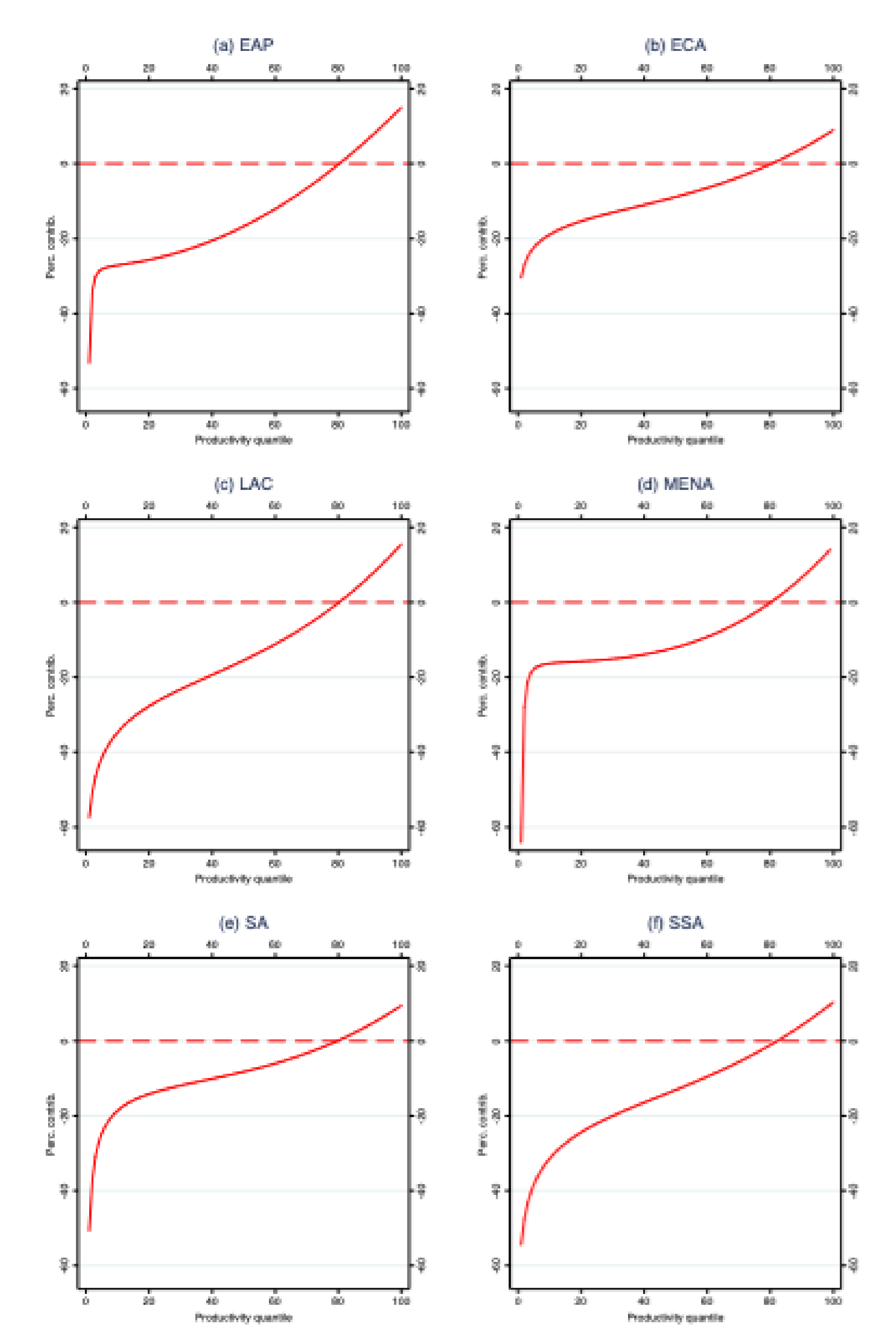

Figure 6: Red tape percentage contributions

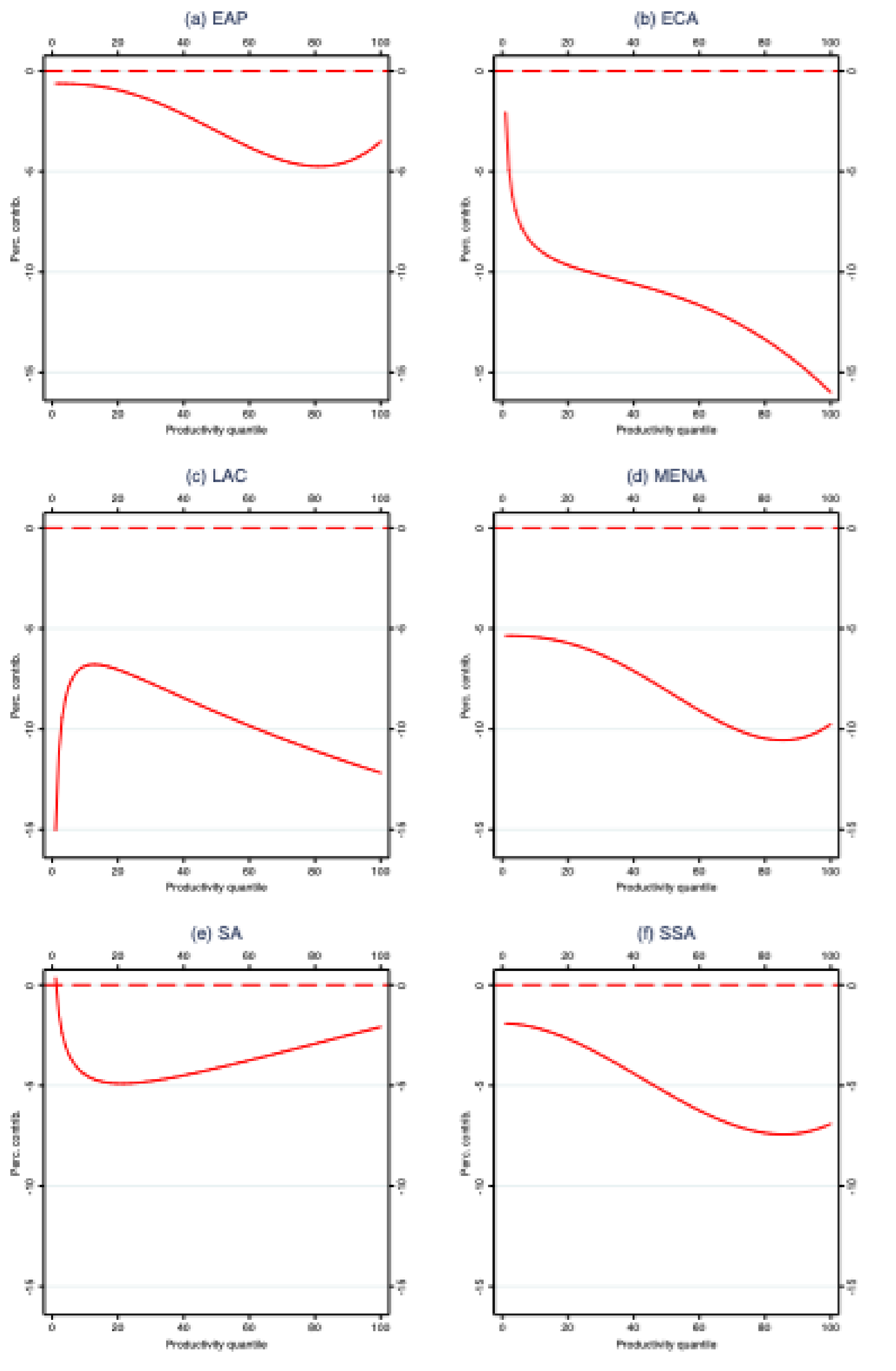

Figure 7: Informal payments percentage contributions

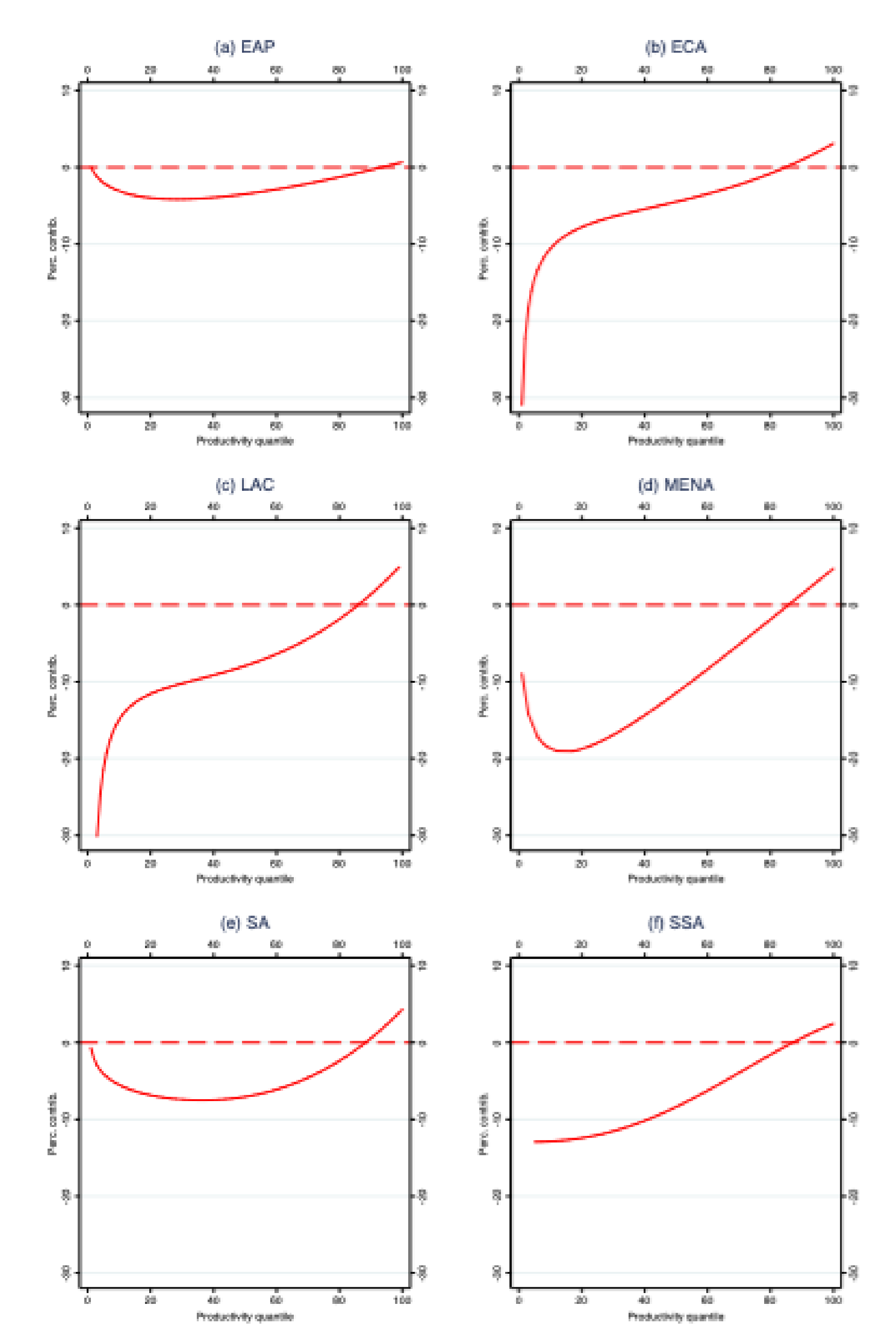

Figure 8: Tax related bribes percentage contributions

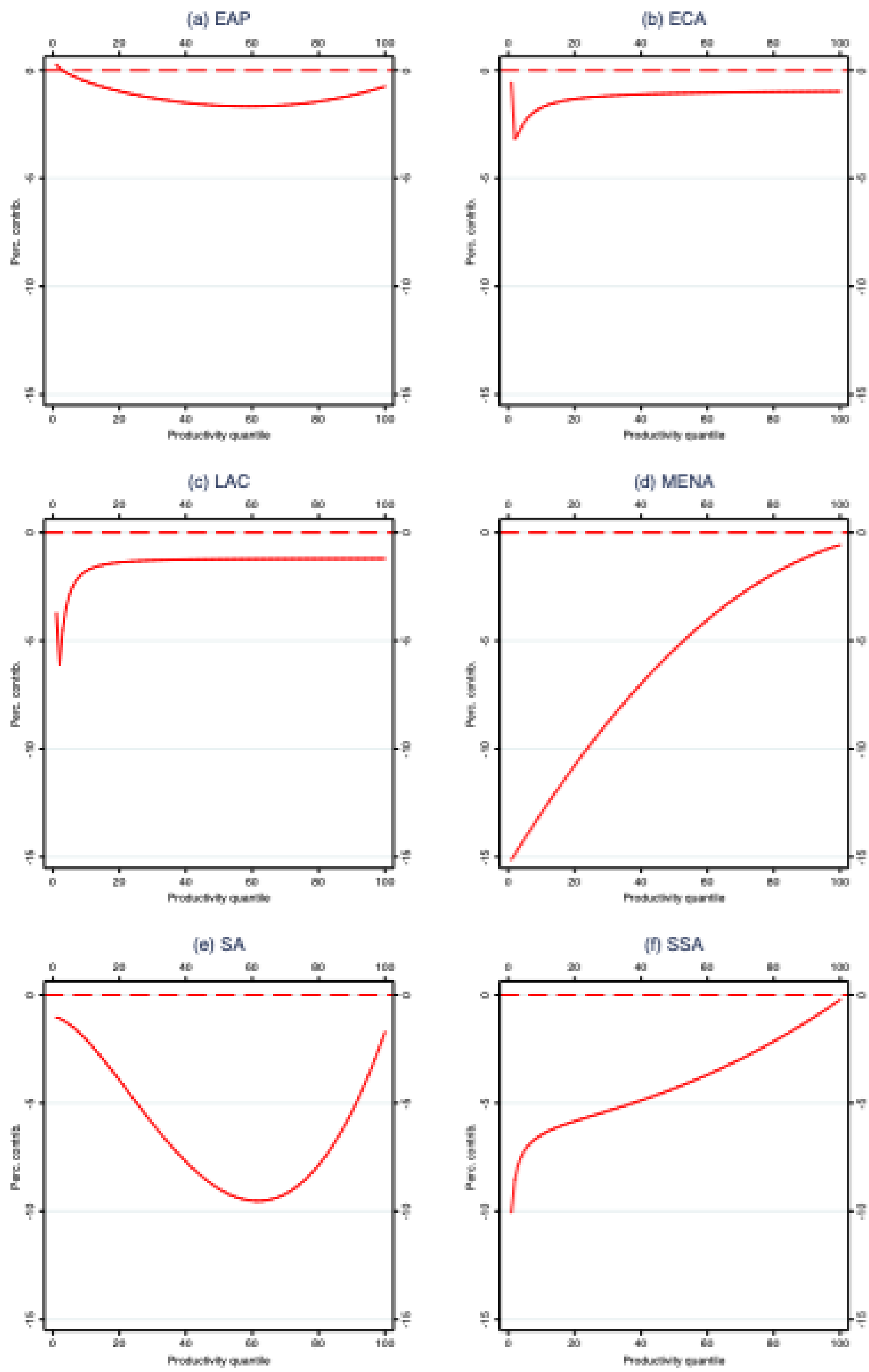

Figure 9: Product market competition percentage contributions