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Misallocation and productivity in Costa Rica

Alonso Alfaro Ureña
Jonathan Garita Garita

Photography on the title page: “Presentes" (Present), set of sculptures from the Costa Rican artist Fernando Calvo Sanchez, 1983. Collection of the Central Bank of Costa Rica.

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Alonso Alfaro Ureña[*], Jonathan Garita Garita[†]

The ideas expressed in this paper are those of the authors and not necessarily represent the view of the Central Bank of Costa Rica.

Abstract

This paper documents the effect of resource misallocation on Costa Rica's aggregate total factor productivity (TFP) using the Hsieh and Klenow (2009) methodology. The model suggests theoretical TFP gains of around 50%-60% for the overall economy and 10%-15% for the manufacturing sector when the United States' level of efficiency is used as a benchmark. Evidence of a deterioration in the efficiency of resource allocation over the period 2005-2015 was not found, and misallocation seems to be greater in the agricultural sector. Small and large firms face advantageous output distortions relative to medium-sized firms, and small firms tend to also face disadvantageous capital distortions. Furthermore, our results also suggest that small firms have experienced higher growth in both capital and output wedges. Finally, distortions create incentives for firms to exit the market and thwarts the entrance of new participants in an industry.

Key words: Resource allocation, productivity.
JEL codes: G15.

[*] Department of Economic Research. Email address. alfaroua@bccr.fi.cr
[†] Department of Economic Research. Email address. garitagj@bccr.fi.cr

Mala asignación y productividad en Costa Rica

Alonso Alfaro Ureña‡, Jonathan Garita Garita §,

Resumen

La presente investigación provee evidencia de los efectos de una ineficiente asignación de recursos sobre la productividad agregada de los factores en Costa Rica, utilizando la metodología de Hsieh y Klenow (2009). El modelo sugiere ganancias de 50% - 60% en productividad si se cumplieran las condiciones teóricas plenamente, mientras que dichas ganancias sería de alrededor de 10% - 15% si las empresas manufactureras alcanzaran el nivel de eficiencia de los Estados Unidos en 1997. Asimismo, la evidencia no muestra un deterioro en la asignación de recursos en el país y, además, señala que la asignación de recursos es más ineficiente en las empresas orientadas a la actividad agrícola. Las pequeñas y grandes empresas se favorecen por distorsiones de producto ventajosas, mientras que las pequeñas enfrentan distorsiones desfavorables de capital. La evidencia también sugiere que las empresas pequeñas experimentaron un crecimiento más acentuado en ambas distorsiones. Finalmente, las distorsiones incentivan la salida de las empresas y se encuentran negativamente relacionadas con la proporción de nuevos participantes en la industria

Palabras clave: Asignación de recursos, productividad.
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‡ Department of Economic Research. alfaroua@bccr.fi.cr
§ Department of Economic Research. garitagj@bccr.fi.cr

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1 Introduction

The increased availability of micro-data has been accompanied by a growing economic literature analysing the role of resource allocation in explaining productivity growth. Understanding how productive factors are allocated across heterogeneous agents is vital, as distortions prevent an optimal allocation of resources and have negative consequences for aggregate productivity (Restuccia and Rogerson (2007)).

Hsieh and Klenow (2009) (hereafter HK) provides an empirical framework to analyse the efficiency of resource allocation that has been applied to the microdata of several countries. These results have strongly influenced the debate on the causes and effects of allocative efficiency on economic performance in recent years. Authors, such as Acemoglu and Robinson (2012) and Foster et al. (2017), have also argued that public policies and market imperfections are key factors that explain why some economies have low productivity growth, as the institutional framework of a country can deter the entry of new firms, innovation and the creative destruction process.

This paper provides evidence on the effect of resource misallocation on Costa Rica's aggregate total factor productivity (TFP) based on the HK model. It uses a novel firm-level database from 2005 to 2015 that comprises the universe of formal firms in the Costa Rican economy. This paper not only provides additional evidence from an emerging market economy, but also extends the analysis to sectors others than manufacturing.

Costa Rica is an interesting case to study the problems stemming from the misallocation of resources. During the last 30 years, the country has implemented a set of reforms to attract foreign direct investment (FDI) and incentivise local producers to export to international markets. As a result and as González Pandiella (2016) states, Costa Rica is now characterised as a dual speed economy: an innovative, productive and export-oriented FDI sector exists alongside a low-productivity domestic sector dominated by small firms and focused on less technologically oriented industries (e.g. agriculture, low-skilled manufacturing, tourism).

Given the novelty of the data, this paper is a first step in analysing the role that resource allocation has played in explaining the Costa Ricas productivity performance, which has been lackluster despite an acceleration in productivity growth in recent years. This analysis will provide useful guidance to inform policies aimed at improving the efficiency of markets and achieving inclusive and sustained economic growth.

This paper deals with a set of questions related to productivity performance in Costa Rica in recent years. We measure to what extent resources are misallocated in Costa Rica and how large the TFP gains could be from eliminating distortions. Therefore, the counterfactual distribution of the size of firms in the absence of distortions can be estimated to analyse if distortions are related to firm size and the effects of distortions on firm entry and exit and productivity growth.

The document is organised as follows. In Section 2, we present the model proposed by Hsieh and Klenow (2009). In Section 3 we describe the data and discuss some methodological considerations. Section 4 presents the main results and Section 5 concludes.

2 Model

Hsieh and Klenow (2009) develop a quantitative method to measure the impact of resource misallocation on aggregate total factor productivity (TFP). This paper motivated the proposal of alternative frameworks, for instance, Bartelsman et al. (2013) uses a different method to examine the role of policy-induced distortions in the allocation of resources.[1] However, we base our analysis on HK's approach because its simplicity and minimal data

[1] Cross-country variation in the correlation between firm's size and their productivity within an industry can be explained by the presence of idiosyncratic distortions. Bartelsman et al. (2013) propose a model that can be calibrated to match the observed cross-country patterns of the with-in industry covariance between productivity and size in order to explain observed differences in aggregate performance.

requirements has resulted in a body of literature using the same method, thus allowing us to compare our results with those of other countries.

Consider a representative firm that produces a final good Y in a perfectly competitive final-goods market. The firm produces Y using the output Y_s of S industries, with the following Cobb-Douglas production technology:

$$Y = \prod_{s=1}^{S} Y_s^{\theta_s}, \text{ where } \sum_{s=1}^{S} \theta_s = 1 \tag{2.1}$$

Each industry produces output Y_s in a monopolistic competitive market by combining M_s differentiated goods produced by a firm i with a CES technology:

$$Y_s = \left(\sum_{i=1}^{M_s} Y_{si}^{\frac{\sigma-1}{\sigma}} \right)^{\frac{\sigma-1}{\sigma}}. \tag{2.2}$$

where σ is the elasticity of substitution and Y_{si} is the output of the differentiated good produced by firm i in industry s. Firm i produces Y_{si} combining capital and labour, based on a Cobb-Douglas technology with constant returns to scale:[2]

$$Y_{si} = A_{si} K_{si}^{\alpha_s} L_{si}^{1-\alpha_s} \tag{2.3}$$

Distortions can arise as a result of various factors: trade policies, credit market imperfections, labour regulations, taxes and subsidies, among others. HK introduce two types of distortions that firms could face: The first are output distortions ($\tau_{Y_{si}}$), which affect the marginal product of capital and labour by the same proportion. The second are capital distortions ($\tau_{K_{si}}$), which increase the marginal product of capital relative to labour.[3]

[2]The assumption of constant returns to scale is discussed by Gong and Hu (2016). These authors claim that when this assumption fails, measuring frictions in resource allocation by the variation in revenue productivity (as is done in the HK model - see below) can over- or under-estimate the eventual TFP gains. As a result, they estimate the elasticities of capital and labour allowing decreasing or increasing returns to scale. Unfortunately, we don't have enough information to estimate both elasticities for Costa Rica, so we cannot consider the correction proposed by such authors.

[3]Hsieh and Klenow (2009) show in Appendix III that these two distortions are equivalent to a combination of capital ($\tau_{K_{si}}$) and labour ($\tau_{L_{si}}$) distortions

For instance, firms that face a high output distortion are those that face government restrictions on size or high transportation costs. Such distortions would be low or negative in firms that benefit from output subsidies or other preferential treatment. Similarly, capital distortions would be high for firms that face difficulty accessing credit. HK introduce such firm-specific distortions as wedges that affect total production and capital, essentially modeled as "taxes" in the firm's profit function:

$$\pi_{si} = \max_{L_{si},K_{si}} \{(1-\tau_{Y_{si}})P_{si}Y_{si} - wL_{si} - (1+\tau_{K_{si}})RK_{si}\} \tag{2.4}$$

where P_{si} is the price of output Y_{si}. From the profit maximisation problem, we can see that:

$$P_{si} = \frac{\sigma}{\sigma-1}\left(\frac{R}{\alpha_s}\right)^{\alpha_s}\left(\frac{w}{1-\alpha_s}\right)^{1-\alpha_s}\frac{(1+\tau_{K_{si}})^{\alpha_s}}{A_{si}(1-\tau_{Y_{si}})} \tag{2.5}$$

In other words, the firm's output price is a fixed markup over its marginal costs. Note that the above equation also states that both capital and output distortions affect the firm's marginal cost and, therefore, its factor allocation decisions. More precisely, the capital-labour ratio, labour allocation and output are then:

$$\frac{K_{si}}{L_{si}} = \frac{\alpha_s}{1-\alpha_s}\frac{W}{R}\frac{1}{1+\tau_{K_{si}}}$$

$$L_{si} \propto \frac{A_{si}^{\sigma-1}(1-\tau_{Y_{si}})^{\sigma}}{(1+\tau_{K_{si}})^{\alpha_s(\sigma-1)}}$$

$$Y_{si} \propto \frac{A_{si}^{\sigma}(1-\tau_{Y_{si}})^{\sigma}}{(1+\tau_{K_{si}})^{\alpha_s(\sigma)}}$$

Therefore, the allocation of resources across firms depends not only on each firm's TFP level, but also on the output and capital distortions they face. As HK discuss, to the extent that resource allocation is driven by distortions rather than firm TFP, this will result in differences in the marginal revenue products of labour and capital across firms. HK show that, since the marginal revenue product of labour is proportional to the revenue per worker and the marginal revenue product of capital is proportional to the revenue-capital ratio, we have:

$$\text{MRPL}_{si} \triangleq (1-\alpha_s)\frac{\sigma-1}{\sigma}\frac{P_{si}Y_{si}}{L_{si}} = w\frac{1}{1-\tau_{Y_{si}}},$$
$$\text{MRPK}_{si} \triangleq \alpha_s\frac{\sigma-1}{\sigma}\frac{P_{si}Y_{si}}{K_{si}} = R\frac{1+\tau_{K_{si}}}{1-\tau_{Y_{si}}}.$$

MRPK_{si} and MRPL_{si} denote the marginal revenue products of capital, $\partial(P_{si}Y_{si})/\partial K_{si}$, and labour, $\partial(P_{si}Y_{si})/\partial L_{si}$, respectively. In other words, after-tax marginal revenue products of capital and labour are equalised across firms. This in turn implies that before-tax marginal revenue products must be higher in firms that face disincentives and can be lower in firms that benefit from subsidies.

HK argues that firm-specific distortions can be extracted from the data using the firm's revenue productivity. Typically, as it is our case, industry price deflators are available, but firm-specific deflators are not. When industry deflators are used, differences in firm-specific prices show up in the customary measure of firm TFP, the physical productivity (TFPQ). Due to the availability of data, HK prefer to use revenue productivity (TFPR), defined as the TFPQ multiplied by the firm-specific price:

$$\text{TFPQ}_{si} \triangleq A_{si} = \frac{Y_{si}}{K_{si}^{\alpha_s}(wL_{si})^{1-\alpha_s}} \tag{2.6}$$

$$\text{TFPR}_{si} \triangleq P_{si}A_{si} = \frac{P_{si}Y_{si}}{K_{si}^{\alpha_s}(wL_{si})^{1-\alpha_s}} \tag{2.7}$$

Under the assumption of constant returns to scale, revenue productivity can be expressed as:

$$\begin{aligned} \text{TFPR}_{si} \equiv P_{si}A_{si} &= \frac{P_{si}Y_{si}}{K_{si}^{\alpha_s}L_{si}^{1-\alpha_s}} \\ &\propto (\text{MRPK}_{si})^{\alpha_s}(\text{MRPL}_{si})^{1-\alpha_s} \\ &\propto \frac{(1+\tau_{K_{si}})^{\alpha_s}}{1-\tau_{Y_{si}}} \end{aligned} \tag{2.8}$$

The expression above implies that revenue productivity does not vary within an industry unless firms face capital and/or labour distortions. A high firm TFPR is, therefore, a sign that the firm has to deal with barriers that raise the firm's marginal products of capital and/or labour, rendering the firm smaller than optimal. Therefore, the dispersion of TFPR_{si} can be used to measure the distortions, and indirectly, the extent of misallocation. The TFP of each industry can be expressed as:

$$\text{TFP}_s = \left[\sum_{i=1}^{M_s} \left(A_{si} \frac{\overline{\text{TFPR}}_s}{\text{TFPR}_{si}} \right)^{\sigma-1} \right]^{\frac{1}{\sigma-1}}, \tag{2.9}$$

where $\overline{\text{TFPR}}_s$ [4] is the geometric average of the marginal revenue products of labour and capital in industry s. Note that if marginal products were equalised across firms, TFP would be $\overline{A}_s = \left(\sum_{i=1}^{M_s} A_{si}^{\sigma-1} \right)^{\frac{1}{\sigma-1}}$.

An important conclusion from the model is that more variance in firms' revenue productivity (TFPR_{si}) decreases aggregate productivity (TFP). More precisely, fixing A_{si} and since $\sigma > 1$, from Equation 2.5 we can see that a firm with higher revenue productivity has a higher marginal cost and, hence, (proportionally) higher prices. This will induce the firm to produce less than it would in the absence of distortions. If TFPR_{si} and A_{si} are positively correlated —as the data for Costa Rica confirms and as we will discuss later —then the distortions render firms with high physical productivity (high A_{si}) to be smaller than optimal, hurting aggregate TFP (since those firms get less weight).

To be more specific, HK show that if TFPQ and TFPR are jointly log-normally distributed, there is a simple closed-form expression for aggregate TFP:

$$\log \text{TFP}_s = \frac{1}{\sigma - 1} \log \left(\sum_{i=1}^{M_s} A_{si}^{\sigma-1} \right) - \frac{\sigma}{2} \text{var}(\log \text{TFPR}_{si}). \tag{2.10}$$

In this case, the industry TFP would decline if the elasticity of substitution σ or TFPR dispersion increases.

When applied to the data, distortions and productivity for each firm can be inferred from:

[4] $\overline{\text{TFPR}}_s = \left[\frac{R}{\alpha_s} \sum_{i=1}^{M_s} \left(\frac{1+\tau_{K_{si}}}{1-\tau_{Y_{si}}} \right) \left(\frac{P_{si} Y_{si}}{P_s Y_s} \right) \right]^{\alpha_s} \left[\frac{1}{1-\alpha_s} \sum_{i=1}^{M_s} \left(\frac{1}{1-\tau_{Y_{si}}} \right) \left(\frac{P_{si} Y_{si}}{P_s Y_s} \right) \right]^{1-\alpha_s}$

$$1 - \tau_{Y_{si}} = \frac{\sigma}{\sigma - 1} \frac{wL_{si}}{(1-\alpha_s) P_{si} Y_{si}} \tag{2.11}$$

$$1 + \tau_{K_{si}} = \frac{\alpha_s}{1-\alpha_s} \frac{wL_{si}}{RK_{si}} \tag{2.12}$$

$$A_{si} = \kappa_s \frac{(P_{si} Y_{si})^{\frac{\sigma}{\sigma-1}}}{K_{si}^{\alpha_s} L_{si}^{1-\alpha_s}} \tag{2.13}$$

For Equation 2.13, the scalar $\kappa_s = w^{1-a_s}(P_s Y_s)^{-\frac{1}{\sigma-1}}/P_s$, is not observable. However, relative productivities—and hence reallocation gains—are unaffected by normalising $\kappa_s = 1$. In the data we do not observe each firm's real output Y_{si}, rather its nominal output $P_{si} Y_{si}$. Hsieh and Klenow (2009) claim that firms with high real output, however, must have a lower price to explain why buyers would demand the higher output. To get a proxy for output Y_{si} they take $P_{si} Y_{si}$ raised to $\frac{\sigma}{\sigma-1}$, which is the markup that comes from the assumed demand elasticity.

A counterfactual "efficient" output in each country is computed to compare it with the actual output levels. As previously mentioned, if marginal products were equalised across firms within an industry, TFP would be $\overline{A}_s = \left(\sum_{i=1}^{M_s} A_{si}^{\sigma-1}\right)^{\frac{1}{\sigma-1}}$. For each industry, the ratio of actual TFP (2.9) to this efficient level of TFP is estimated and then aggregated across sectors:

$$\frac{Y}{Y*} = \prod_{s=1}^{S} \left[\sum_{i=1}^{M_s} \left(\frac{A_{si}}{\overline{A}_s} \frac{\overline{\text{TFPR}_s}}{\text{TFPR}_{si}} \right)^{\sigma-1} \right]^{\frac{\theta_s}{\sigma-1}}. \tag{2.14}$$

This exercise, however, makes no allowance for measurement error and factors omitted from the model. For instance, adjustment costs and markup variations may explain observed differences in TFPR. Therefore, efficiency gains resulting from a better allocation can be over estimated. In order to deal with that problem, we use the United States—a presumptively less distorted economy—as a benchmark.

3 Data

The Central Bank of Costa Rica collects firm-level information from different public entities in order to estimate macroeconomic and financial indicators. Such information was used to construct a panel database from 2005 to 2015 that provides firm-level characteristics such as output, the total wage bill, employment, the book value of capital stock, exports, imports and the industry of activity at a 5-digit level of ISIC 4. Variables are recorded in nominal terms.This database represents the universe of formal firms that operated in Costa Rica during the period of study.

Raw data consists of 209,731 firm-year observations. The database includes firms with business identification and individuals that report an income derived from a productive activity. We excluded observations with personal identification that report less or equal than 1 workers with the aim of avoiding subsistence activities.

We defined industry as the ISIC 4 identifier at the four-digit level and $P_{si}Y_{si}$ as the total sales reported by the firm. While the studies applying the HK model typically measure $P_{si}Y_{si}$ as the firm's value added, firms do not report information on value added and our information on sales and costs is not sufficiently robust to estimate a good proxy for value added. In particular, the main problem is the variables related to costs, because some inconsistencies are found in the raw data. We proceed by using the available data on income and later TFP gains are estimated as a robustness exercise. Since results do not differ significantly, we chose to use reported sales as our variable of interest. As our misallocation measures are computed within each 4-digit industry, we dropped observations for industries with less than 10 firms per year.

Following Hsieh and Klenow (2009), we used the wage bills instead of the number of workers to measure L_{si} to capture potential differences in human capital. The book value of the fixed capital stock was used as proxy of K_{si}. We set the rental price of capital (excluding distortions) to $R = 10$, considering a 5% real interest rate and a 5% depreciation rate. As HK discuss, the counterfactuals shown collapse $\tau_{K_{si}}$ to its average in each industry, so the efficiency gains do not depend on R. Therefore, this parameter affects only the average capital distortion, not the estimation of the TFP gains.

Similar to HK and other Latin American countries that used the described model [5], we

[5] See Busso et al. (2013)

set the elasticity of substitution to $\sigma = 3$. Gains from equating TFPR across industries are increasing in σ, so our results are conservative. In addition, we set the elasticity of output with respect to capital in each industry (α_s) as 1 minus the labour share in the corresponding industry in the United States for comparability. Even though we do not have elasticities at the industry-level for Costa Rica, adopting the U.S. shares as the benchmark is justified as the U.S. is presumed to be comparatively undistorted (both across firms and, more important, across industries). Such information was collected from the NBER, and it is the usual approach taken in the literature.

Finally, we trimmed the 1% tails of $\log(\text{TFPR}_{si}/\overline{\text{TFPR}_s})$, $\log(A_{si}M_s^{\frac{1}{\sigma-1}}/\overline{\text{A}_s})$ and re-estimate industry aggregates. Considering our requierements, we are left with around 11,000-15,000 observations per year.[6] Appendix A presents descriptive statistics for the 28,084 firms that are included in the final sample.

4 Results

4.1. To what extent are resources misallocated in Costa Rica?

As previously discussed, the dispersion of TFPR_{si} can be used as a measure of misallocation. Tables 1 and 2 show the ratios of 90th and 10th percentiles of TFPR and TFPQ relative to industry means. For simplicity, we present aggregate numbers as well as industry aggregations, which are described in detail in Appendix B.

First, we can observe that the dispersion differs across sectors: productivity in agricultural firms is more disperse, while the productivity of manufacturing firms is more homogeneous. In addition, these measures of dispersion are relatively stable over time. Comparing 2005 with 2015 levels, a small decline in overall dispersion is observed, with manufacturing and services experiencing the largest decline.

[6] Alfaro-Urena et al. (2018) impose similar restrictions for a sample of domestic firms, and find that they keep around 80% of the data for the economy. In the following section we discuss in more detail the implications of the quantity of firms that we have in our sample.

Table 1: Dispersion of TFPR_{si}

	2005-2006	2007-2008	2009-2012	2013-2015
All	2,49	2.50	2,38	2,40
Agriculture	3,49	3,51	3,33	3,46
Manufacturing	2,15	2,17	2,06	1,98
Commerce	2,24	2,26	2,25	2,33
Services	2,47	2,49	2,34	2,34
N	**10.464**	**11.890**	**12.919**	**13.827**

Notes: Statistics are the deviation of log (TFPR) from industry means, measured as the 90th-10th percentile ratio. Industries are weighted by their production shares and N denotes the number of firms.
Source: Authors'estimations

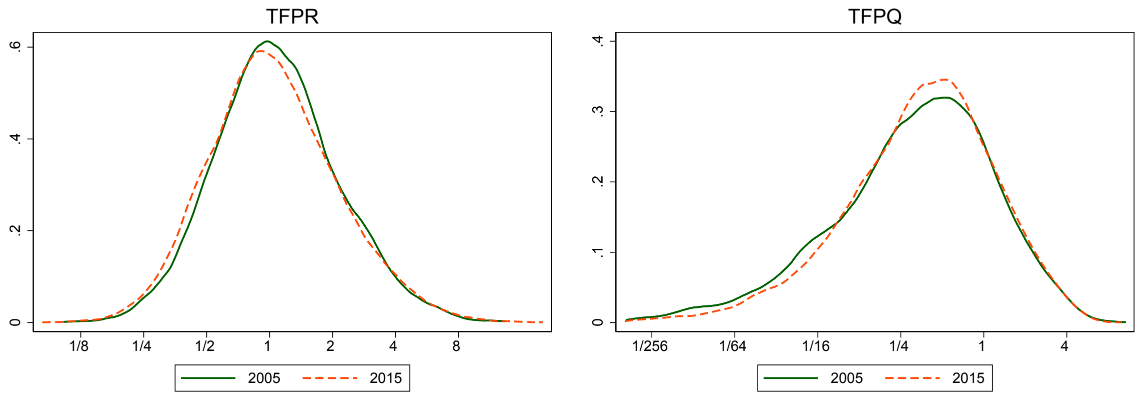
Table 2: Dispersion of TFPQ_{si}

	2005-2006	2007-2008	2009-2012	2013-2015
All	3,44	3,42	3,22	3,19
Agriculture	4,20	4,29	4,05	4,13
Manufacturing	3,11	3,05	2,95	2,81
Commerce	3,13	3,07	3,04	3,10
Services	3,45	3,48	3,20	3,13
N	**10.464**	**11.890**	**12.919**	**13.827**

Notes: Statistics are the deviation of log (TFPR) from industry means, measured as the 90th-10th percentile ratio. Industries are weighted by their production shares and N denotes the number of firms.
Source: Authors'estimations

Figure 1 plots the distribution of TFPR and TFPQ for 2005 and 2015, showing the information summarised in the above tables. In particular, a higher TFPQ and TFPR dispersion can be observed for Costa Rica with respect to the results obtained by HK for the United States. Hence, our results suggest that Costa Rica's economy has more distortions than the United States, as expected, but misallocation has not increased during the last decade, and has rather decreased.

Figure 1: Distribution of TFPR and TFPQ



Distribution of TFPR | Distribution of TFPQ

Table 3 puts in perspective Costa Rica's result for the manufacturing sector with other countries' TFPR dispersion. Costa Rica's manufacturing dispersion in 2005 (2.17) was similar to the Latin American region but higher than reported for high-income economies such as the United States, Japan and France.

4.2. The role of capital and output distortions on aggregate productivity

One key question is how large productivity gains would be in the absence of distortions. Following Equation 2.14, we estimate the aggregate TFP gains from fully equalising TFPR across firms in each industry. Simultaneously, we were able to calculate the TFP boost if the allocation of resources in Costa Rica's manufacturing industry were as efficient as that observed in the United States' manufacturing sector in 1997.[7] Table 4 presents our results for Costa Rica, indicating that a full equalisation would improve aggregate TFP by 50%-60%. Gains from reallocation are significantly higher in agriculture, while gains in services are slightly below manufacturing and commerce. Moreover, for manufacturing industries TFP gains would be around 10%-15% if capital and labour were reallocated to equalise marginal products to the extent observed in United States in 1997, a gap that decreased during the period analysed. Finally, there is no evidence of a deterioration of the efficiency of factor allocation between 2005 and 2015, since TFP gains tend to reduce across years. On the contrary, there have been gains in efficiency in the overall economy

[7] In this case, U.S. information is obtained from Hsieh and Klenow (2009)

over time, with the exception of the agriculture sector, where the gains have been minimal (Figure 2).

Table 3: Dispersion of $TFPR_{si}$

Country	**Period**	**Initial**	**Final**
Latin America			
Venezuela	(1995-2001)	2.60	3.28
Colombia	(1982-1998)	2.50	2.90
Uruguay	(1997-2005)	2.12	2.47
Mexico	(1999-2004)	2.57	2.27
Bolivia	(1988-2001)	2.16	2.06
*Costa Rica**	*(2005-2015)*	*2.17*	*1.97*
Chile	(1996-2006)	1.57	1.77
Argentina	(1997-2002)	1.04	1.56
Ecuador	(1995-2005)	1.49	1.48
El Salvador	(2004)	n.a.	1.35
Asia			
Thailand	(2006)	n.a.	2.09
Vietnam	(2000-2009)	n.a.	2.00
India	(1987-1994)	1.73	1.60
China	(1998-2005)	1.87	1.59
Japan	(1981-2008)	n.a.	1.40
Europe and US			
United States	(1977-1997)	1.04	1.19
France	(1998-2005)	0.92	1.00

Source: Hsieh and Klenow (2009) for India, China and the U.S., Hosono and Takizawa (2015) for Japan, Ha and Kiyota (2015) for Vietnam, Bellone and Mallen-Pisano (2013) for France, Dheera-Aumpon (2014) for Thailand, García-Santana et al. (2016) for Spain, Busso et al. (2013) for Latin America and own estimations for Costa Rica. For comparability, all results, including for Costa Rica, are for the manufacturing sector only.

Figure 2: Costa Rica: TFP gains from equalizing TFPR within industries by sector

Source: Authors'estimations

Our results contrast with those presented in Dias et al. (2016) and Benkovskis (2015), where the authors find greater misallocation in the services sector. Alfaro Ureña and Vindas Quesada (2015) have previously documented that the productivity of the services sector in Costa Rica –relative to the USA– is much lower in recent years. The quantitative difference in the results presented in this paper for services with respect to manufacturing is likely the result of fewer observations for the services sector with respect to the number of such firms in the economy. This is particularly true for for smaller firms in the services sector, and the restrictions we impose on the micro data, especially on the size of firms. Additionally, we do not observe any information relating to the informal sector, which possibly encompasses smaller and less efficient firms. This would imply lower measured distortions, something particularly true for the services sector.[8] The data used for Portugal and Latvia presented in the aforementioned papers is less restrictive. Appendix A shows how many firms we use for our estimation given those restrictions.

Table 4: TFP gains from Equalising TFPR within industries and relative to 1997 U.S. gains

	Within industries			**Relative to U.S. 1997**		
	2005-2008	**2009-2012**	**2013-2015**	**2005-2008**	**2009-2012**	**2013-2015**
All	**59,6**	**56,7**	**55,6**			
Agriculture	96,5	90,9	134,8			
Manufacturing	64,6	63,5	58,1	15,2	14,4	10,6
Commerce	57,3	57,8	55,0			
Services	50,8	46,5	46,5			

Source: Authors' estimations

Tables 5 and 6 make a cross-country comparison of the estimated manufacturing TFP gains. Costa Rica's reallocation gains are similar to those calculated for other Latin American countries, but greater than the gains in high-income countries.

One important feature of the model is that it constructs a measure for capital and output distortions. Taking advantage of such measures, this paper studies the relationship between these distortions and some sectoral and firm characteristics. One limitation, however, is that τ_k and τ_Y are variables that capture the effect of several distortions on the purchase price of capital and labour as production factors.

Figures 3 and 3 plot the distribution of the logarithms of capital and output wedges, suggesting that the capital distortions are more dispersed than the output ones. Furthermore, the distribution of output distortions is more symmetrical, while the distribution of capital distortions is concentrated on the positive side of the x-axis. Hence, firms face, on average, greater disadvantageous capital distortions than output ones. However, when making a comparison between 2005 and 2015, the most recent distribution of output distortions is less scattered around zero, in contrast to the distribution of capital distortions, which has increased over the same period of time.

Table 7 presents the average output distortion by main industries, suggesting important

[8] This is something that should be taken into consideration for the comparisons with other countries.For example, there is data for Mexico on both types of firms, and the results show that informal firms contribute significantly to overall misallocation as shown in IMF (2017).

Table 5: TFP Gains from equalising TFPR within industries

Country	**Period**	**Initial**	**Final**
Latin America			
Mexico	(1999-2004)	127.0	95.0
Venezuela	(1995-2001)	55.2	64.7
Bolivia	(1988-2001)	52.5	60.6
Uruguay	(1997-2005)	61.8	60.2
Argentina	(1997-2002)	52.2	60.0
Ecuador	(1995-2005)	52.7	57.6
El Salvador	(2004)	n.a.	56.7
Costa Rica*	**(2005-2015)**	**63.8**	**55.7**
Chile	(1996-2006)	45.0	53.8
Colombia	(1982-1998)	48.9	50.5
Asia			
Thailand	(2006)	n.a.	147.8
India	(1987-1994)	100.4	127.5
China	(1998-2005)	115.1	86.6
Japan	(1981-2008)	n.a.	39.6
Europe and US			
Spain	(1995-2007)	29.0	43.0
United States	(1977-1997)	36.1	42.9
France	(1998-2005)	30.5	30.5

Source: Hsieh and Klenow (2009) for India, China and the U.S., Hosono and Takizawa (2015) for Japan, Ha and Kiyota (2015) for Vietnam, Bellone and Mallen-Pisano (2013) for France, Dheera-Aumpon (2014) for Thailand, García-Santana et al. (2016) for Spain, Busso et al. (2013) for Latin America and own estimations for Costa Rica.
*For comparability, all results, including for Costa Rica, are for the manufacturing sector only.

differences not only in the levels, but also in the behaviour of both wedges. First, the manufacturing and commerce sectors show a higher level of output distortions than the aggregated average. This is an expected result, since both sectors are particularly sensitive to transportation costs, regulations, market failures and weak institutions that alter the decision making process of the firm. Second, agriculture's average output distortion is very close to zero. As equation 2.4 indicates, this implies that agricultural firms are facing advantageous output distortions in the form of subsidies that increase their prices. This is

Table 6: TFP Gains from equalising TFPR relative to U.S gains

Country	Period	Initial	Final
China	(1998-2005)	50.5	30.5
Colombia	(1982-1998)	4.2	5.3
Costa Rica*	(2005-2015)	14.6	9.0
France	(1998-2005)	-4.4	-8.7
India	(1987-1994)	40.2	59.2
Japan	(1999-2004)	n.a.	6.2
Thailand	(2006)	n.a.	73.4
Uruguay	(1997-2005)	13.2	12.1
Vietnam	(2000-2009)	n.a.	30.7

Source: Hsieh and Klenow (2009) for India, China and the U.S., Hosono and Takizawa (2015) for Japan, Ha and Kiyota (2015) for Vietnam, Bellone and Mallen-Pisano (2013) for France, Dheera-Aumpon (2014) for Thailand, García-Santana et al. (2016) for Spain, Busso et al. (2013) for Latin America and own estimations for Costa Rica.
*For comparability, all results, including for Costa Rica, are for the manufacturing sector only.

Table 7: Average output distortion by economic sector

	2005-2006	2007-2008	2009-2012	2013-2015
Aggregated	**0.53**	**0.55**	**0.53**	**0.49**
Agriculture	0.01	0.02	0.03	0.00
Manufacturing	0.66	0.68	0.65	0.61
Commerce	0.81	0.82	0.79	0.76
Services	0.42	0.46	0.42	0.38

also an expected result, since Costa Rica has implemented subsidies, support policies and price controls to help these firms to survive external competition, to neutralise competitive problems and to promote exports.

Similarly, Table 8 displays the average capital distortions. A positive capital distortions may correspond to a firm that has limited access to external financing and, hence, is subject to a higher-than-average capital goods price. In this case, manufacturing firms face, on average, lower capital distortions than firms in the other sectors. Many factors can explain this gap: manufacturing firms tend to have higher access to credit as these

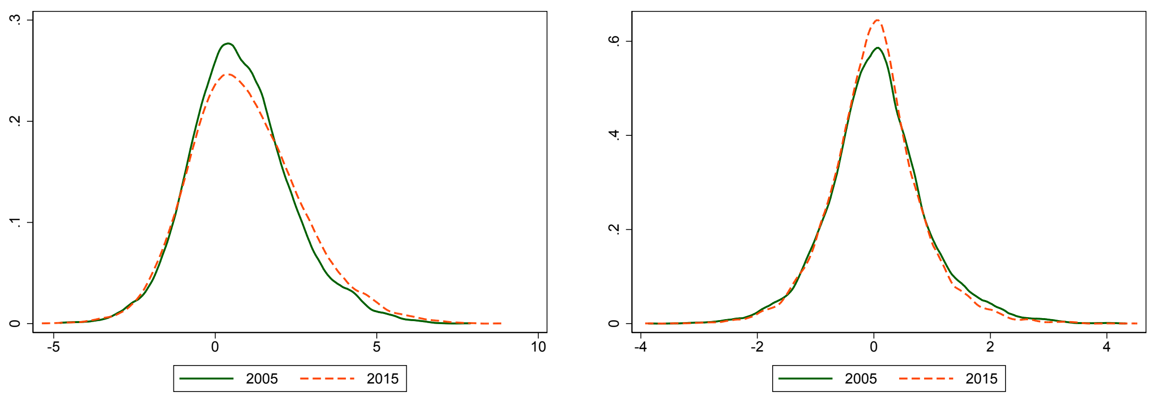
Table 8: Average capital distortion by economic sector

	2005-2006	2007-2008	2009-2012	2013-2015
All sectors	**5.31**	**5.23**	**5.13**	**4.82**
Agriculture	6.68	6.36	5.50	4.96
Manufacturing	2.87	2.92	2.51	2.83
Services	5.28	5.49	5.93	5.49
Commerce	5.77	5.25	4.58	4.56

productive units maintain better information about their economic performance and also can use machineries and equipment as collateral in formal financial institutions. On the contrary, agricultural industries suffer from higher capital wedges. These results also show that average distortions have decreased over time, more significantly in output distortions, and especially in the agriculture sector.

The following subsections will provide more detailed context into the elements that have an impact on productivity, and the dynamics of the firms given the distortions that they face.

Figure 3: Distribution of log of distortions



Distribution of log of capital distortions   Distribution of log of output distortions

4.3. Distortions and firm size

With the notion that micro and small firms (henceforth MSEs) play a leading role in job creation and social inclusion, many countries have implemented policies to promote the entry and productivity growth of these economic agents. Costa Rica passed Law 8262 in 2002 on Small and Medium Enterprise Promotion (*Fortalecimiento de las Pequeñas y Medianas Empresas*), which gives MSEs access to technical assistance and business support programs to increase their competitiveness and to incentive them to export.

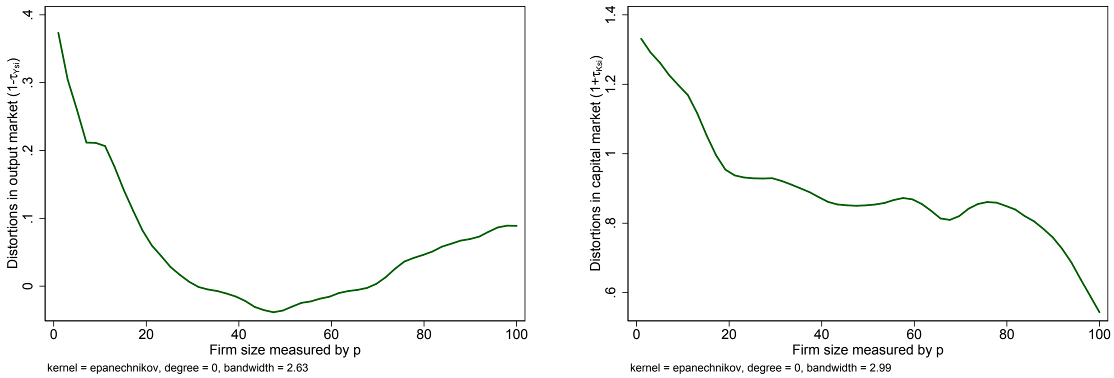
In this section, we explore some hypothesis about correlation between firm size and output and capital distortions. The first hypothesis is that small firms face greater distortions, especially on capital. We created a variable on firm size following the quantitative guides in Costa Rica's Law 8262. More precisely, a parameter p is defined as a weighted average firm's sales, assets and labour.[9] Costa Rica's Ministry of Economy, Industry and Commerce uses it to determine those firms that can access benefits that the Law for MSEs offers. We estimate this parameter for each firm and then we estimate the respective percentile based on this indicator.

Figure 4 plots the relationship between the distortions in output and capital and firm size percentile. In particular, output distortions are strongly decreasing in percentiles of firm size until the 40th percentile, when the trend is reversed. As output distortions are measured as $(1 - \tau_{Ysi})$, this result suggests that the smaller and larger firms face positive output distortions, while medium firms face low or even negative output distortions. Many factors can explain this situation. On one hand, smaller firms may be taking advantage of subsidies and programmes that the government offers to promote MSEs firms while the behaviour of larger firms could be related to market power concentration, and tax subsidies to Free Trade Zone (FTZ) firms.

Similarly, Figure 4 plots $(1+\tau_{Ksi})$, a distortion on the price of capital. Notice that the level of distortion decreases with the size. The correlation turns clearly negative for larger firms. As expected, smaller firms are facing higher prices for capital because of the distortions while larger firms are not. This result is in line with the asymmetries in credit access that small firms suffer.

[9] For example, for the year 2010, a manufacturing firm with sales of more than $3 million, assets close to 2$ million and 100 employees would qualify as large since the parameter p would take a value of more than 100. A firm with a value of p of less than 10 qualifies as micro, above 10 but below 35 as small, and between 35 and 100 as medium sized. The weight of each variable is: 60% for the number of employees, 30% for total sales and 10% for total assets. More weight is given to the number of employees for ITC and retail/other services. Values are updated for each year.

Figure 4: Relationship between distortions and firm size
(local polynomial smoothing)



Distortions in output markets $(1-\tau_{Ysi})$ Distortions in capital markets $(1+\tau_{Ksi})$

Source: Authors'estimations

Following García-Santana et al. (2016), we now turn our attention to the firm-level characteristics behind the increases in misallocation over the period. Defining the firm-specific growth rates of $\tau_{Ki,t}$ and $\tau_{Yi,t}$ as $\Delta ln(1+\tau_{Ki,t}) = ln(1+\tau_{Ki,t}) - ln(1+\tau_{Ki,t-1})$ (a postitive value showing an increase in distortion) and $\Delta ln(1-\tau_{Yi,t}) = ln(1-\tau_{Yi,t}) - ln(1+\tau_{Yi,t-1})$ (a negative value showing an increase in distortion). We regress both variables on firm size, a dummy indicating exporting status (1 if the firm exports) and year and industry (ISIC 4) controls. Both regressions are corrected for potential heteroscedasticity using clustered standard errors. Table 9 reports the main results. First, we considered the parameter p as an indicator for firm size and the results suggest that there is a positive and statistically significant relationship between size and the growth of both distortions. Moreover, we included dummy variables for firm size (small, medium and large, with micro the baseline category). In this case, not only do micro firms tend to have higher growth in the two distortions, but also the gap seems to increase. Finally, the estimations show that exporting firms experience smaller changes in distortions than the others.

An important result is the direct correlation between productivity and the growth of both distortions: the most productive firms are facing faster-growing distortions. As previously discussed, when revenue productivity (that is, a proportion of both capital and output wedges) and A_{si} are correlated, then distortions reduce aggregate TFP as the most productive firms produce less than is optimal. Therefore, these results suggest that not only are the most productive firms facing disadvantageous barriers, but also the conditions they

Table 9: Changes in firm-level distortions, firm size and exporting status

	Dep Variable: $\Delta ln(1+\tau_{K_{si}})$ (1)	(2)	Dep Variable: $\Delta ln(1-\tau_{Y_{si}})$ (3)	(4)
Size	-0.00001***		0.00001*	
	(0.00001)		(0.00001)	
Small		-0.05442***		0.01312
		(0.01274)		(0.01031)
Medium		-0.07279***		0.07082***
		(0.01484)		(0.01392)
Large		-0.13435***		0.10672***
		(0.02037)		(0.01723)
Exporting dummy		-0.03524***		0.01779**
		(0.00920)		(0.00554)
Productivity		0.08255***		-0.08084***
		(0.00410)		(0.00756)
Industry dummies	Yes	Yes	Yes	Yes
Time dummies	Yes	Yes	Yes	Yes
R-squared	0.02	0.02	0.05	0.05
Observations	109,807	109,807	109,807	109,807

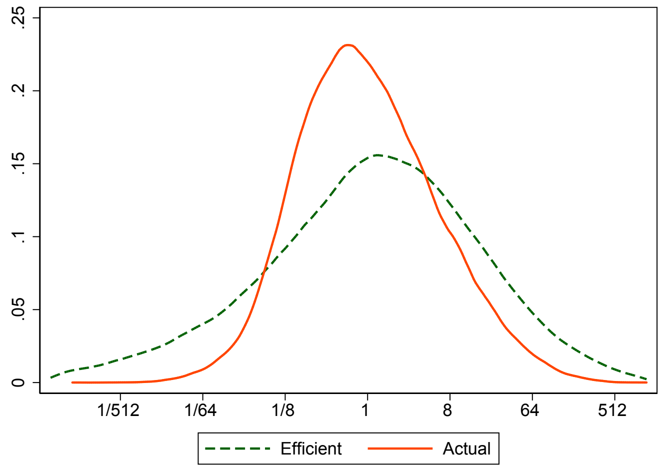
Notes:
*** Significant at the 1 percent level
** Significant at the 5 percent level
* Significant at the 10 percent level

face have worsened over time.

4.4. Distribution of firms in absence of distortions

A natural exercise that emerges from this model is to compare the actual firm-size distribution with the efficient scenario that would arise from equalising TFP within industries. For such purposes, we approximated the firm's size by using its output level. As Figure 5 shows, the hypothetical efficient distribution is more dispersed than the actual one. In particular, the model suggests that there should be fewer mid-size firms and more small and large firms if TFPR were equalised within industries.

Figure 5: Distribution of actual vs. efficient firm size



Source: Authors'estimations

Table 10 reports how the size of firms would change under an efficient scenario, in a similar fashion to HK. The entries are unweighted shares of firms. The rows are initial (actual) firm size quartiles and the columns are bins of efficient firm size relative to actual size. In particular, 0%-50% means that firms should shrink by a half or more, 50%-100% should shrink by less than a half, 100%-200% shoud double or triple in size and 200%+ should at least triple in size. In Costa Rica, the total share of firms that should reduce their size is approximately 56.6%, with 40.4% that should shrink by more than a half. On the contrary, around 43.5% should increase in size, with 28.2% that should at least triple in size.

Table 10: Actual size vs. efficient size, percentage of firms

	0%-50%	50%-100%	100%-200%	200%+	**Total**
Top size quartile	10.6	3.6	3.5	7.4	**25.0**
2nd quartile	9.8	3.8	3.6	7.8	**25.0**
3rd quartile	9.8	3.9	3.9	7.4	**25.0**
Bottom quartile	10.2	4.9	4.3	5.6	**25.0**
Total	**40.4**	**16.2**	**15.3**	**28.2**	**100.0**

Notes: The rows are the actual firm size quartiles with equal number of firms. The columns are the bins of efficient firm size relative to actual firm size. 0%-50% means that the firm size would be less than half of the actual firm size of all distortions were removed. Similarly, 200+% means that the firm size would be more than triple without distortions. The entries are the share of firms.
Source: Authors' estimations.

4.5. Firm size, exporting status and productivity

Literature suggests that under appropriate and competitive conditions, more productive firms will increase their market share at expense of the less productive firms. Labour and capital flow to the most efficient firms because these agents have the conditions and incentives to expand their production. As a result, firm size is expected to be strongly and positively correlated with firm productivity.

Furthermore, several authors such as De Loecker (2007) have noted the empirical regularity that exporting firms are characterised by being more productive than non-exporters. This positive correlation between exporting status and productivity is traditionally related to the self-selection hypothesis: there are additional costs of selling goods in foreign countries, such as transportation costs, marketing and international regulation, among others. These costs pose an entry barrier that less successful firms cannot overcome. Similarly, competition is usually fiercer in foreign markets, a feature that would again allow only the most productive firms to do well abroad.

However, the relationship between size, exporting status and productivity can become weaker if government policies favour some firms over others, allowing them to gain market share even if they are less efficient. Similarly, particular restrictions can preclude some firms from gaining market share even if they have the conditions to do so. As Busso et al. (2013) discuss, the presence of distortions reduce the efficiency of resource allocation across firms, reducing aggregate output.

Table 11 presents the result of OLS and pooled OLS regressions of $log(A_{si}/\overline{A_s})$ on firm size and exporting status dummies. Micro firms are the baseline category for the size dummies. Productivity is strongly correlated with firm size. Productivity is more than twice as high in large firms. In addition, exporting firms seem to be 14% more productive than non-exporting firms. Interaction terms for firm size and exporting status were evaluated but were not significant.

4.6. The role of distortions in firm entry, exit and productivity growth

Distortions are likely to have an impact on firm dynamics within an industry. On one hand, distortions can lower a firm's profits and, thus, potentially reduce the share of new

Table 11: Regressions of log(TFPQ) on Selected Dummies

	OLS	Pooled OLS
Small	0.52***	0.45***
	(0.02)	(0.02)
Medium	1.05***	0.81***
	(0.02)	(0.03)
Large	1.67***	1.25***
	(0.02)	(0.03)
Exporting firm	0.28***	0.14***
	(0.01)	(0.01)
Year dummies	Yes	Yes
Industry dummies	Yes	Yes
R-squared	0.56	0.21
Observations	137,860	137,860

Notes:
*** Significant at the 1 percent level
** Significant at the 5 percent level
* Significant at the 10 percent level

entrants and increase the probability of exit. On the other hand, entry restriction can hinder potential new entrants and give incumbents high rents. In this section, we analyse how distortions affect firm entry and exit using the baseline estimations of output and capital distortions.

Bartelsman et al. (2013), calibrating a general equilibrium model of firm dynamics, find that distortions have a significant impact on endogenous selection, i.e., the entry and exit of firms. Hosono and Takizawa (2015) use the following probit model to examine this relationship:

$$\begin{aligned} Prob(Exit_{sit} = 1) \quad = \quad & \beta_1 \overline{\text{TFPRS}}_{st-1} + \beta_2 \frac{\text{TFPQ}_{sit-1}}{\text{TFPQ}_{st-1}} + \beta_3 log(1 - \tau_{Y_{sit-1}}) + \\ & \beta_4 log(1 + \tau_{K_{sit-1}}) + T_t + I_s + \epsilon_{sit} \end{aligned}$$

where s denotes industry, i the firm and t the year. T_t and I_t denote year and industry dummies, respectively. The dependent variable is an exit dummy that takes one if the firm i in industry s exits in year t and zero if it survives. The first term on the right side ($\overline{\text{TFPRS}}_{st-1}$) is average industry-level TFPR in year t. The second term ($\frac{\text{TFPQ}_{sit-1}}{\text{TFPQ}_{st-1}}$) is the firm's TFPQ relative to the industry average. A negative coefficient is expected as more efficient firms are expected to be more competitive and have better economic performance, and therefore be less likely to exit. The third and fourth term represent both the capital and output distortions.

Table 12 shows the estimation results. Firstly, the marginal effect of the industry-level TFPR is not significant. However, both distortions are positively correlated to the probability of exit (here again, output distortion is measured as the logarithm of $(1 - \tau_Y)$). As a result, both output and capital distortions depress the firm's profit level and increase the probability of exit. Finally, the marginal effect of firm-level TFPQ relative to its industry average is negative and significant, which is consistent with the natural selection hypothesis. In conclusion, capital and output distortions affect not only the size distribution, but also the entry and exit of firms. The larger the output and capital distortions the firm faces, the higher the probability that the firm exits.

Table 12: Probit estimation of the probability of exit

	Marginal effect	Robust Std. Err.
$\overline{\text{TFPRS}}_{st-1}$	-0.00020	0.0012
$\frac{\text{TFPQ}_{sit-1}}{\text{TFPQ}_{st-1}}$	-0.00522***	0.0007
$\log(1 + \tau_{K_{si}})$	0.00222***	0.0004
$\log(1 - \tau_{Y_{si}})$	-0.00616***	0.0010
Year dummy	Yes	
Industry dummy	Yes	
Observations	119,037	
Pseudo R-squared	0.0827	

Notes:
*** Significant at the 1 percent level
** Significant at the 5 percent level
* Significant at the 10 percent level

Finally, we analyse the effect of distortions on firm-level physical productivity growth. Hosono and Takizawa (2015) use the following regression to identify the correlation between distortions and the firm's physical productivity growth:

$$\text{Growth}_{si} = \beta_0 + \beta_1 \frac{\text{TFPQ}_{si0}}{\text{TFPQ}_{s0}} + \beta_2 \tau_{Y_{si0}} + \beta_3 \tau_{K_{si0}} + year_0 + I_s + \epsilon_{it}$$

Similarly to previous estimations, subscripts s, i and t respectively denote industry, firm and year. The subscript 0 denotes the year when the firms enters the market. The dependent variable is the average growth rate of firm i's physical productivity. The second and third variables represent the output and capital distortions in the year of entry. The regression is corrected for potential heteroscedasticity using clustered standard errors .

The estimation results are summarised in Table 13, and show that the productivity level at the year of entry and the output distortion in that same year have a negative effect on the future productivity growth of firms.

Table 13: Estimation results of firm-level TFPQ growth rates

	Coeff.	**Std.Err.**
$\text{TFPQ}_{si0}/\text{TFPQ}_{s0}$	-0.11763***	0.0337
$\tau_{K_{si0}}$	-0.00002	0.0000
$\tau_{Y_{si0}}$	-0.09153***	0.0089
Year dummy	Yes	
Industry dummy	Yes	
Observations	2,043	
Pseudo R-squared	0.02	

Notes:
*** Significant at the 1 percent level
** Significant at the 5 percent level
* Significant at the 10 percent level

5 Conclusion

This paper provides evidence of a negative impact of resource misallocation on Costa Rica's total factor productivity. Using the methodology proposed by HK, we estimate that Costa Rica's aggregate TFP would be 50% higher if capital and labour were allocated to equalise marginal products across firms within an industry, an hypothetical optimal scenario according to the model. For manufacturing industries, productivity gains of more than 10% could be achieved if factors were allocated to equalise marginal products to the extent observed in the United States in 1997, used as a benchmark in order to deal with the potential limitations of the model. More importantly, our estimations do not suggest an increase in factor misallocation between 2005 and 2015. On the contrary, the efficiency of resource allocation in the Costa Rican economy increased over this period.

Output distortions are less dispersed than capital wedges, suggesting a greater heterogeneity in the capital distortions that firms face. Similarly, most of the firms face disadvantageous capital distortions. Results suggest that the efficient size distribution in the absence of distortions would be more dispersed. Almost half of firms should reduce their size. Small and large firms seem to have advantageous output distortions, but small firms tend to face greater capital distortions. Small firms face, on average, large increases in capital and output distortions. On the contrary, the growth of both distortions is lower for exporting firms.

Finally, a positive relationship between productivity, firm size and exporting status was found. Distortions have a significant impact of the firm's endogenous selection by increasing the probability of exit and by limiting the share of new entrants in a particular industry. Future research can contribute to this initial analysis aimed at disentangling the distortions to shed light on the particular elements that are precluding an optimal allocation of resources.

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A Descriptive statistics of the firms in the sample

Table A1: Firms by sector

Sector	Firms	Percentage
Agriculture	1,079	3.84
Manufacturing	2,901	10.33
Commerce	7,578	26.98
Services	15,339	54.62
Other	1,187	4.23
Total	**28,084**	**100**

Table A2: Foreign and national firms

	Firms	Percentage
National	26,477	94.28
Foreign	1,607	5.72
Total	**28,084**	**100**

Table A3: Firms by size

	Firms	Percentage
Micro	2,310	7.72
Small	18,373	65.42
Medium	4,840	17.23
Large	2,561	9.12
Total	**28,084**	**100**

Table A4: Firms by birthyear

	Firms	Percentage
$\leq$ 2005	16,621	59,18
2006	1,791	6.38
2007	1,670	5.95
2008	1,571	5.59
2009	1,383	4.92
2010	1,229	4.38
2011	1,083	3.86
2012	1,017	3.62
2013	874	3.11
2014	615	2.19
2015	230	0.82
Total	**28,084**	**100**

Table A5: Labour by firm size

Size	**Mean**	**Freq.**
Micro	6.75	2,310
Small	8.09	18,373
Medium	22.48	4,840
Large	174.96	2,561
Total	**25.68**	**28,084**

Table A6: Labour by sector

Sector	**Mean**	**Freq.**
Agriculture	70.77	1,079
Manufacturing	40.30	2,901
Services	24.47	15,339
Commerce	17.77	7,578
Other	23.35	1,415
Total	**25.68**	**28,084**

B Industries included in the broad classifications

Table B7: Industries in Agriculture

	Description
1	Crop and animal production, hunting and related service activities

Table B8: Industries in Manufacturing

	Description
10	Manufacture of food products
11	Manufacture of beverages
13	Manufacture of textiles
14	Manufacture of wearing apparel
15	Manufacture of leather and related products
16	Manufacture of wood and of products of wood and cork, except furniture; manufacture of articles of straw and plaiting materials
17	Manufacture of paper and paper products
18	Printing and reproduction of recorded media
20	Manufacture of chemicals and chemical products
21	Manufacture of basic pharmaceutical products and pharmaceutical preparations
22	Manufacture of rubber and plastics products
23	Manufacture of other non-metallic mineral products
25	Manufacture of fabricated metal products, except machinery and equipment
26	Manufacture of computer, electronic and optical products
29	Manufacture of motor vehicles, trailers and semi-trailers
31	Manufacture of furniture
32	Other manufacturing

Table B9: Industries in Commerce

	Description
45	Wholesale and retail trade and repair of motor vehicles and motorcycles
46	Wholesale trade, except of motor vehicles and motorcycles
47	Retail trade, except of motor vehicles and motorcycles

Table B10: Industries in Services

	Description
33	Repair and installation of machinery and equipment
35	Electricity, gas, steam and air conditioning supply
36	Water collection, treatment and supply
38	Waste collection, treatment and disposal activities; materials recovery
41	Construction of buildings
42	Civil engineering
43	Specialized construction activities
49	Land transport and transport via pipelines
51	Air transport
52	Warehousing and support activities for transportation
53	Postal and courier activities
55	Accommodation
56	Food and beverage service activities
58	Publishing activities
59	Motion picture, video and television programme production, sound recording and music publishing activities
60	Programming and broadcasting activities
61	Telecommunications
62	Computer programming, consultancy and related activities
63	Information service activities
64	Financial service activities, except insurance and pension funding
65	Insurance, reinsurance and pension funding, except compulsory social security
66	Activities auxiliary to financial service and insurance activities
68	Real estate activities
69	Legal and accounting activities
70	Activities of head offices; management consultancy activities
71	Architectural and engineering activities; technical testing and analysis
72	Scientific research and development
73	Advertising and market research
74	Other professional, scientific and technical activities
75	Veterinary activities
77	Rental and leasing activities
78	Employment activities
79	Travel agency, tour operator, reservation service and related activities
80	Security and investigation activities
81	Services to buildings and landscape activities
82	Office administrative, office support and other business support activities
85	Education
86	Human health activities
87	Residential care activities
88	Social work activities without accommodation
91	Libraries, archives, museums and other cultural activities
92	Gambling and betting activities
93	Sports activities and amusement and recreation activities
94	Activities of membership organizations
95	Repair of computers and personal and household goods
96	Other personal service activities