

# Productivity Loss and Misallocation of Resources in Southeast Asia

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## Abstract

This paper examines within-sector resource misallocation in three Southeast Asian countries—Indonesia, Malaysia, and Vietnam. The methodology accounts for measurement error in revenues and costs. The firm-level evidence suggests that measurement error is substantial, resulting in an overestimation of misallocation by as much as 30 percent. Nevertheless, resource misallocation across firms within a

sector remains large, albeit declining. The findings imply that there are considerable potential gains from efficient reallocation—above 80 percent for Indonesia and around 20 to 30 percent for Malaysia and Vietnam. Private domestic firms and firms with higher productivity appear to face larger distortions that prevent them from expanding.

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# **Productivity Loss and Misallocation of Resources in Southeast Asia**

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## 1. Introduction

Productivity improvement is the foundation of economic growth and, consequently, development and well-being (Hall and Jones, 1999). Understanding the sources of economic growth is crucial to devise policies that efficiently and effectively promote economic development (Kim and Loayza, 2019). The topic has attracted substantial attention from policy makers and researchers alike. While physical and human capital accumulation are important drivers of economic growth, the evidence indicates that productivity growth accounts for most of the cross-country differences in income per capita growth (Easterly and Levine, 2001, and Caselli, 2005).

Measuring productivity is challenging. First, multiple definitions of productivity exist. Labor productivity (output or value added per worker) is commonly used. The measure does not impose extensive data requirement, and its simplicity allows for easy comparability over time and place (sectors and/or countries). However, it depends on more than efficiency: firms can raise labor productivity by investing in capital and not only by improving the use of their resources. Total factor productivity (TFP) is a more precise but harder to estimate measure. It provides an estimate of economic efficiency, accounting for the contributions from labor, capital, and possibly intermediate products. In practice, this implies that TFP is measured as a residual, carrying, therefore, the measurement errors of outputs, inputs, and production functions. Difficulties arise in measuring the contribution of the factors of production, starting with, for instance, estimating the value of capital and skill-adjusted labor. In the words of Hicks (1981), “the measurement of capital is one of the nastiest jobs that economists have set to statisticians,” and this applies to human capital as well. Data problems also extend to the measure of revenue and output. Measuring gross output relies on sales and inventory data, both prone to statistical errors. Moreover, price data are usually not available for different products at the firm, so that inferring quantities from revenues may be inaccurate as products and their quality change.

Roughly speaking, there are two main sources of productivity growth. The first source is within-firm productivity growth; that is, firms becoming more productive thanks to better technology or management practices. In this case, policy prescriptions to increase productivity are geared towards increasing technological diffusion and innovation, learning and skill upgrading, and infrastructure provision. This conventional understanding of productivity growth has been the subject of a long-standing literature and dominated much of policy discussions until the end of the twentieth century. The second source consists of improving allocative efficiency, that is, the reallocation of resources towards more productive uses. This can imply the transfer of capital and labor across firms and across sectors, as well as the entry and exit of firms. This second source of productivity growth has been emphasized in the literature since the turn of the century (see, for example, Banerjee and Duflo, 2005 and Restuccia and Rogerson, 2008). Policies associated with allocative efficiency emphasize correcting or reducing market distortions. In this paper, we focus on the second source of productivity improvement, concentrating our analysis on resource allocation across firms within a narrowly defined industry.

What is resource misallocation in a narrowly defined industry? It is misallocation of production inputs across firms that produce similar products and compete with each other, while retaining some degree of control over their prices. In an economy with low levels of distortion, more

productive firms will have more resources (capital, labor, and materials) at their disposal compared to less productive ones, leading to an increase in the overall productivity of the sector. In an economy with high levels of distortion, however, unproductive firms have disproportionately large access to resources, hence dragging down the overall productivity of the sector.

The literature proposes two different approaches to detect resource misallocation (see Restuccia and Rogerson, 2017 for an overview and the latest empirical evidence from these methods). On the one hand, the direct approach focuses on specific sources of misallocation and quantifies their impact on productivity, typically through structural models. Specific sources of misallocation considered by the literature include, for example, regulatory restrictions (Song, Storesletten and Zilibotti 2011; Brandt, Tombe, and Zhu, 2013; and Tombe and Zhu, 2015); missing property rights (Adamopoulos and Restuccia, 2014); restrictive trade and competition policies (Khandelwal, Schott, and Wei, 2013; and Edmond, Midrigan, and Xu, 2015); and credit constraints and informational frictions (Midrigan and Xu, 2014; and David, Hopenhayn, and Venkateswaran, 2016).<sup>2</sup> On the other hand, the indirect approach provides a comprehensive measure of misallocation, capturing it from multiple channels and not being limited to pre-identified misallocation sources. This method requires some structure as discussed in Section 2, but it does not involve specifying a full-fledged model as the direct method does. The indirect approach may be, however, especially sensitive to measurement error and/or departures from the assumed market structure in the model economy.

Hsieh and Klenow (2009) (henceforth HK) provide a framework to assess the extent of misallocation under the indirect approach.<sup>3</sup> Their basic idea is that allocative efficiency is maximized when firms within a narrowly defined industry can access resources until their marginal revenue products are equalized. This occurs as more productive firms grow until the decrease in their prices matches their higher total factor productivity. Under the HK framework, large dispersions in marginal revenue products among firms operating within a narrowly defined industry imply misallocation of resources in that industry. Specifically, HK consider an economy where each firm produces according to a standard Cobb-Douglas function (with sector-specific factor shares) and outputs can be aggregated through a CES function for each industry. The firm-specific output and capital/labor may be subject to distortions (or wedges/taxes, in the language of the authors). Bringing their framework to the data allows to compute two measures of aggregate productivity: the “actual” one where distortions are present and the “potential” one where these wedges are eliminated. Comparing these two measures allows to quantify the potential productivity gains by increasing the efficient allocation of resources. This methodology does not

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<sup>2</sup> There is a large literature on each of these potential sources of misallocation; the suggested references rely on data from Southeast Asia, the region at the center of this paper. Interestingly, although not surprisingly, none of the individual channels by itself is able to explain the magnitude of misallocation estimated using the indirect approach discussed later. A given economy may suffer from multiple sources of misallocation at once.

<sup>3</sup> HK measures misallocation without precisely identifying the sources of misallocation. They broadly classified the sources of distortions as capital and output market related distortions. The essence of their findings is that resource misallocation affects productive firms’ access to sufficient resources (in terms of capital and labor) needed for expansion, and this results in lower aggregate productivity. Therefore, reallocation of resources through the elimination of distortions in the markets is productivity enhancing as this allows productive firms to grow larger, and the less productive ones to either contract their operations or exit from the sector.

identify the amount of misallocation derived from specific sources but provides an all-encompassing measure.

HK find sizeable misallocation of resources, which decreases aggregate TFP. If the distortions that cause the misallocation were to be eliminated, TFP in the manufacturing sector in China would increase by 86%-115%; in India by 100%-128% and in the United States by 30%-43%. Interestingly, their analysis allows to take a step towards the direct method. While sources of misallocation are not identified, the extent of misallocation is correlated with various observables to shed more light on the underlying mechanisms. Through this analysis, HK show that high-productivity firms in all three countries are smaller than efficiency would dictate, while some low-productivity firms (such as state-owned enterprises in China) are too large. The low estimation requirements coupled with the capacity to inform about potential sources have contributed to the popularity of the HK approach. It has been widely applied –see, for example, Busso, Madrigal, and Pagés (2013) for Latin American countries; Nguyen, Taskin, and Yilmaz (2016) for Turkey; Cirera, Fattal Jaef, and Maemir (2020) for African countries; and Chuah, Loayza, and Nguyen (2020) for Malaysia.

While being a valuable first step toward measuring resource misallocation, the HK approach depends on rather strong assumptions.<sup>4</sup> One important assumption is that firms' inputs and revenue are free of measurement error. Since the HK approach uses revenue and inputs to estimate marginal productivity, this assumption could bias the estimated resource misallocation. Mismeasurement is likely present in most firm-level data sets, especially in developing countries, because of weak capacity at firms' accounting systems and at national statistical agencies.

Bils, Klenow, and Ruane (2020) (henceforth BKR) propose a methodology that exploits the panel structure of the data to correct for potential measurement error. The authors build on the HK approach and allow for additive<sup>5</sup> measurement error in revenues and intermediate inputs. When measurement error is additive but *i.i.d.* over time, the levels and first differences of revenue relative to inputs provide independent signals of the true dispersion in marginal revenue products. Hence, by taking the covariance between first differences and levels of average revenue products, one could estimate the variance of the true marginal products, which captures resource misallocation within a narrowly defined industry.

We apply both HK and BKR frameworks, highlighting the differences in estimation driven by accounting for measurement error. We rely on firm-level data available from three developing Southeast Asian countries: Indonesia, Malaysia, and Vietnam. These three large and diverse economies are considered to have good panel firm-level data. Yet, results indicate that measurement error may play an important role, and accounting for it can substantially affect the extent of estimated misallocation in these economies.

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<sup>4</sup>As acknowledged by HK, their approach relies on restrictive assumptions such as CES aggregation of differentiated products within a narrowly defined sector (allowing to derive TFPQ from revenue data in the absence of information on input and output quantities), and hence constant mark-ups within the same sectors. Under these conditions, any variation in TFPR is attributable to resource misallocation.

<sup>5</sup> Assuming additive rather than multiplicative measurement error yields more conservative estimates.

Developing East Asia has undergone dramatic transformation over the past few decades thanks to a combination of policies that fostered outward-oriented and labor-intensive growth, investments in basic human capital, and sound economic governance. However, slowing growth and shifting patterns in global trade, rapid technological change, and evolving country circumstances present challenges to sustaining past productivity growth and ensuring that future growth remains. Thus, understanding the extent of misallocation and the elements that correlate with it is an important step towards identifying the types of policies that can improve domestic productivity and the competitiveness of firms.

Our results are three-fold. First, measurement error is substantial. Among the data for the three countries, the Vietnamese data have the largest measurement error. This results in an overestimation of misallocation by the HK approach. In other words, resource misallocation estimated using the BKR approach is overall smaller than that estimated using the HK approach. We discuss the potential measurement error that BKR corrects in Section 4. Second, after the correction for measurement error, resource misallocation across firms within a sector is large, albeit declining over time. Third, examining the firms' characteristics that correlate with distortions, we find that firms with higher productivity face larger distortions, pointing to potential structural constraints and inefficient allocation of resources. Foreign firms (in Indonesia and Vietnam) and state-owned enterprises, or SOEs (in Vietnam) have lower distortions (or “taxes”), which reflects either a less constrained environment or a more privileged status.

The rest of the paper is organized as follows. Section 2 summarizes the theoretical framework by HK and BKR. Section 3 presents the firm level data for the three countries. Section 4 discusses the results. Section 5 concludes.

## 2. Methodology framework

### 2.1 Hsieh and Klenow (2009) framework

This section provides a simplified discussion of the HK framework. Consider an economy with many sectors, denoted  $s$ . Final output  $Y$  is produced in each country using a Cobb-Douglas production technology:

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

where  $\theta_s$  is the value added share of sector  $s$  and  $\sum_{s=1}^S \theta_s = 1$ .

Each sector's output  $Y_s$  is the aggregate of the individual firms' output  $Y_{si}$ , using the Constant Elasticity of Substitution (CES) technology:

$$Y_s = \left[ \sum_{i=1}^{M_s} Y_{si}^{\frac{\sigma-1}{\sigma}} \right]^{\frac{\sigma}{\sigma-1}}$$

where  $Y_{si}$  is the differentiated product by firm  $i$  in sector  $s$ , and  $\sigma$  is the elasticity of substitution across firms within the sectors.

Each firm produces a differentiated product with the standard Cobb-Douglas production function:

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

where  $A_{si}$  stands for firm-specific productivity;  $L_{si}$  is the firm's labor;  $K_{si}$  is the firm's capital; and  $\alpha_s$  is the sector-specific capital share.

Each firm maximizes current profits:

$$\pi_{si} = (1 - \tau_{Y_{si}}) P_{si} Y_{si} - w_{si} L_{si} - (1 + \tau_{K_{si}}) R K_{si}$$

where  $P_{si} Y_{si}$  is the firm's value added (which is the firm's revenue minus the cost of intermediate inputs), and  $w_{si}$  and  $R$  are the cost of one unit of labor and capital, respectively. The term  $\tau_{Y_{si}}$  denotes firm-specific output distortions that reduce firms' revenues. The firm-specific "capital" distortions, which raise the cost of capital (relative to labor), are denoted as  $\tau_{K_{si}}$ .

HK differentiate two productivity measures: TFPQ, which captures "physical productivity"; and TFPR, which captures "revenue productivity":

$$TFPQ_{si} = \frac{Y_{si}}{L_{si}^{1-\alpha_s} K_{si}^{\alpha_s}} \text{ and } TFPR_{si} = \frac{P_{si} Y_{si}}{L_{si}^{1-\alpha_s} K_{si}^{\alpha_s}}$$

In the absence of distortions, TFPR should not vary across firms within each sector. This is so because more capital and labor are allocated to firms with higher physical productivity (TFPQ) such that their higher output results in a lower price,  $P_{si}$ ; this occurs up to the point where  $TFPR_{si}$  is equalized for all firms in the sector. On the contrary, it is normal for  $TFPQ_{si}$  to vary across firms because different firms may have different productivity levels.

Assuming monopolistic competition and CES technology, HK derive  $TFPQ_{si}$  in terms of revenue data as:

$$TFPQ_{si} = A_{si} = \kappa \frac{(P_{si} Y_{si})^{\frac{\sigma}{\sigma-1}}}{K_{si}^{\alpha_s} L_{si}^{1-\alpha_s}},$$

where  $\kappa$  is a function of output quantity and price and can be normalized to 1. In line with HK, let's define the efficient sector's productivity level (when all marginal products are equalized) as:

$$\bar{A}_s = (\sum_{i=1}^{M_s} A_{si}^{\sigma-1})^{\frac{1}{\sigma-1}}.$$

TFPQ is calculated from  $P_{si}$ , which contains elements of distortions, and is typically not observed in the data:

$$P_{si} = \frac{\sigma}{\sigma-1} \frac{(1 + \tau_{k_{si}})^{\alpha_s}}{A_{si} (1 - \tau_{y_{si}})} \left( \frac{R}{\alpha_s} \right)^{\alpha_s} \left( \frac{w_{si}}{1 - \alpha_s} \right)^{1-\alpha_s}$$



HK choose the elasticity of substitution  $\sigma=3$  and capital rental rate  $R=10\%$ , assuming a real interest rate of 5% and a depreciation rate of 5%.<sup>6</sup> Capital share,  $\alpha_s$ , and labor share  $(1 - \alpha_s)$  are taken from the U.S. manufacturing sectors. The authors assume U.S. firms operate in an environment of minimal distortions. Thus, the U.S. shares represent an efficient utilization of resources, and any deviation would suggest distortions.

Using the “optimal” capital and labor share from the United States, distortions represented by the output and capital wedges can be derived as:

$$1 - \tau_{Ysi} = \frac{\sigma}{\sigma - 1} \frac{w_{si} L_{si}}{(1 - \alpha_s) P_{si} Y_{si}}$$

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

Where  $\tau_{Ysi}$  is firm  $i$ 's output wedge,  $\tau_{Ksi}$  is firm  $i$ 's capital wedge. Firm  $i$ 's wage bill is represented by  $w_{si} L_{si}$ , and  $P_{si} Y_{si}$  represents the firm's value added. Both values are taken from the data.

HK show that

$$TFPR_{si} = \frac{\sigma}{\sigma - 1} \left( \frac{R}{\alpha_s} \right)^{\alpha_s} \left( \frac{w_{si}}{1 - \alpha_s} \right)^{1 - \alpha_s} \frac{(1 + \tau_{Ksi})^{\alpha_s}}{1 - \tau_{Ysi}}$$

This implies that in the absence of distortions (that is,  $\tau_{Ksi} = 0$  and  $\tau_{Ysi} = 0$ ),  $TFPR$  will be the same for all firms  $i$  within a sector  $s$ . Using this equation, we can infer that a firm with higher  $\tau_{Ksi}$  and/or higher  $\tau_{Ysi}$  also has a higher  $TFPR$ .

The industry average level  $\overline{TFPR}_s$  corresponds to:

$$\overline{TFPR}_s = \frac{\sigma}{\sigma - 1} \left( \frac{R}{\alpha_s \sum_{i=1}^{M_s} \left( \frac{1 - \tau_{Ysi}}{1 + \tau_{Ksi}} \right) \left( \frac{P_{si} Y_{si}}{P_s Y_s} \right)} \right)^{\alpha_s} \left( \frac{w_{si}}{(1 - \alpha_s) \sum_{i=1}^{M_s} (1 - \tau_{Ysi}) \left( \frac{P_{si} Y_{si}}{P_s Y_s} \right)} \right)^{1 - \alpha_s}$$

If all distortions are removed, then marginal products are equalized across plants in each industry. Comparing the actual to the efficient level of output, respectively  $Y$  and  $Y^{efficient}$ , the level of TFP gains can be expressed as  $100(Y^{efficient}/Y - 1)$ , where

$$\frac{Y}{Y^{efficient}} = \prod_{s=1}^S \left\{ \left[ \sum_{i=1}^{M_s} \left( \frac{A_{si}}{A_s} \frac{\overline{TFPR}_s}{TFPR_{si}} \right)^{\sigma - 1} \right]^{\frac{\theta_{st}}{\sigma - 1}} \right\}.$$

The magnitude of the TFP gains depends on the improvements in allocative efficiency, measured as  $Y^{efficient}/Y$ . Allocative efficiency is maximized when this ratio is equal to one, so that actual and efficient output coincides. An economy thus becomes more efficient when more productive plants are larger and more productive firms expand, and consequently allocative efficiency improves.

<sup>6</sup> Elasticity of substitution between products is related to the mark-ups  $\frac{\sigma_s}{\sigma_s - 1} = 1 + \mu_s$ , where  $\mu_s$  is the markup. An elasticity of substitution of 3 corresponds to a markup of 50%.

## 2.2 Bils, Klenow and Ruane (2020) framework

HK have attracted large attention partly because their study relies on model assumptions that allow for straightforward implementation of its framework across countries. With increasing attention, however, has also come stronger scrutiny of the robustness of their distortion metrics. A key concern of the HK framework is that what is perceived as misallocation could be confounded by measurement error, as acknowledged in the original paper. BKR develop a new methodology adapted from HK to address the concerns of measurement error in revenues and intermediate inputs.

BKR argue that, in a standard monopolistic competitive context, a firm's *true* revenues and costs respond in the same proportion to productivity shocks. In the absence of measurement error, therefore, revenue growth would move in the same proportion as inputs cost growth across all firms. In contrast, measurement error dampens the response of *measured* revenues and costs to productivity shocks. Then, in the presence of measurement error, revenue growth would be less responsive to input cost growth. Moreover, assuming that measurement error is additive and orthogonal to the true marginal products, BKR show that measurement error dampens the response of revenue growth to input cost growth more than proportionally for firms with higher average revenue products (TFPR). This allows them to back out the measurement error and, most importantly, quantify the extent to which measured misallocation reflects true misallocation.

BKR propose estimating:

$$\Delta R_i = \Psi \Delta I_i + \Phi f(\ln(TFPR_i)) - \Psi(1 - \lambda) g(\ln(TFPR_i)\Delta I_i) + D_s + \xi_i$$

where  $R_i$  and  $I_i$  are firm-specific log of revenue and inputs cost (labor, capital, and intermediates),  $\ln(TFPR_i)$  is the Tornqvist average for current and previous year,  $f(\cdot)$  and  $g(\cdot)$  are polynomials, and  $D_s$  are sector-year fixed effects.<sup>7</sup> The parameter of interest is  $\lambda$  which is defined as the ratio of the variances of true distortions and revenue productivity, i.e.  $\lambda \equiv \frac{\sigma_{\ln \tau}^2}{\sigma_{\ln TFPR}^2}$ , where  $\tau$  is the firm-level distortion. If the response of measured revenue with respect to inputs cost varies with the level of TFPR, then  $\lambda$  is different from one and the presence of measurement error is implied. Indeed, the presence of additive measurement error in either or both revenue and inputs costs can explain observing a marginal change in inputs but not a corresponding change in revenue. Note that  $\lambda$  is a country-specific value.

We can then estimate revenue productivity explicitly accounting for measurement error,

$$\widehat{TFPR}_i = \exp(\hat{\lambda} \ln(TFPR_i) + \epsilon_i) \text{ where } \epsilon_i \sim N(0, (\hat{\lambda} - \lambda^2)\sigma_{\ln(TFPR)}).^8$$

Using the estimated  $\widehat{TFPR}_i$  for all firms, and following the HK framework, BKR estimate allocative efficiency. This measure accounts for measurement error. Analogously to the HK framework, the estimated allocative efficiency is used to back out potential TFP gains from moving toward the efficient allocation.

<sup>7</sup> The subscript t for time is omitted, to simplify the notation.

<sup>8</sup> The circumflex sign indicates *measured* values.



### 3. Data

Table 1 provides an overview of the data sources used. For robustness, we exclude from the sample 4-digit sectors with fewer than 5 firms.

**Table 1 Overview of data sources**

<b>Indonesia</b>	The sample includes information from the Manufacturing Survey of Large and Medium-Sized Firms (Statistik Industri). It provides plant-level data of all firms with at least 20 employees from 2000 to 2015. The sample focuses on a subset of Indonesian enterprises. The 2016 economic census indicates that 98.3% of enterprises are micro and small business with fewer than 20 employees. However, the remaining 1.7% of firms interviewed in Statistik Industri, employ a non-negligible amount (23.7%) of workers.
<b>Malaysia</b>	The sample is based on the 2000, 2005, 2010 and 2015 census of manufacturing firms with at least 10 workers. A representative sample of firms is constructed for each wave by the Malaysian Statistical Office. The final sample including only non-negative values for firms with at least 10 workers includes 37,206 observations across the four waves of census
<b>Vietnam</b>	The sample is from the enterprise surveys conducted by the Vietnamese General Statistical Office (GSO) from 2009 to 2014. During this period, there are 259,721 manufacturing firms. The survey includes manufacturing firms with at least 1 worker, but for consistency the final sample includes only firms with at least 10 workers.

Table 2 reports basic summary statistics for the main variables used in the analysis. TFPR levels are comparable across countries, irrespective of the estimation method used (HK or BKR). Conversely, there is more dispersion in TFPQ -proxy for true productivity- both within and across countries. Accounting for measurement error substantially lowers productivity estimates, except in Indonesia. Foreign firms are a tiny fraction in Malaysia, while they account for 7% and 18% of the Indonesia and Vietnam samples, respectively. SOEs account for as much as 12% of the Indonesia sample but only 2% of the Vietnam's, possibly reflecting differences in the construction of the two data sets.

**Table 2 Descriptive statistics**

	N	Mean	SD	Min	Max
<b><i>Indonesia</i></b>					
ln(TFPQ)	223,635	7.69	1.55	4.24	12.18
ln(TFPR) (HK)	194,850	0.56	0.81	-2.07	3.49
ln(TFPR) (BKR)	194,850	0.47	0.75	-2.47	3.75
ln(Age)	223,635	2.63	0.79	0.00	4.72
ln(Employment)	223,635	4.11	1.12	3.00	10.46
Foreign owned?	223,635	0.07	0.25	0	1
SOE?	223,635	0.12	0.33	0	1
<b><i>Malaysia</i></b>					
ln(TFPQ)	35,730	4.87	1.06	2.53	7.89
ln(TFPR) (HK)	22,061	0.86	0.55	-0.85	3.04

ln(TFPR) (BKR)	22,061	0.56	0.44	-1.14	2.31
ln(Age)	35,723	2.72	0.69	0.00	5.61
ln(Employment)	35,730	4.02	1.18	2.30	9.61
Foreign owned?	35,730	0.002	0.04	0	1
<b><i>Vietnam</i></b>					
ln(TFPQ)	142,630	5.18	1.82	0.04	9.2
ln(TFPR) (HK)	106,413	0.71	0.96	-2.99	3.41
ln(TFPR) (BKR)	106,413	0.56	0.85	-2.99	3.72
ln(Age)	106,967	1.98	0.69	0.00	4.23
ln(Employment)	142,630	3.93	1.30	2.30	11.35
Foreign owned?	142,630	0.18	0.38	0	1
SOE?	142,630	0.02	0.15	0	1

Source: Country data as detailed in Table 1 and authors' calculation.

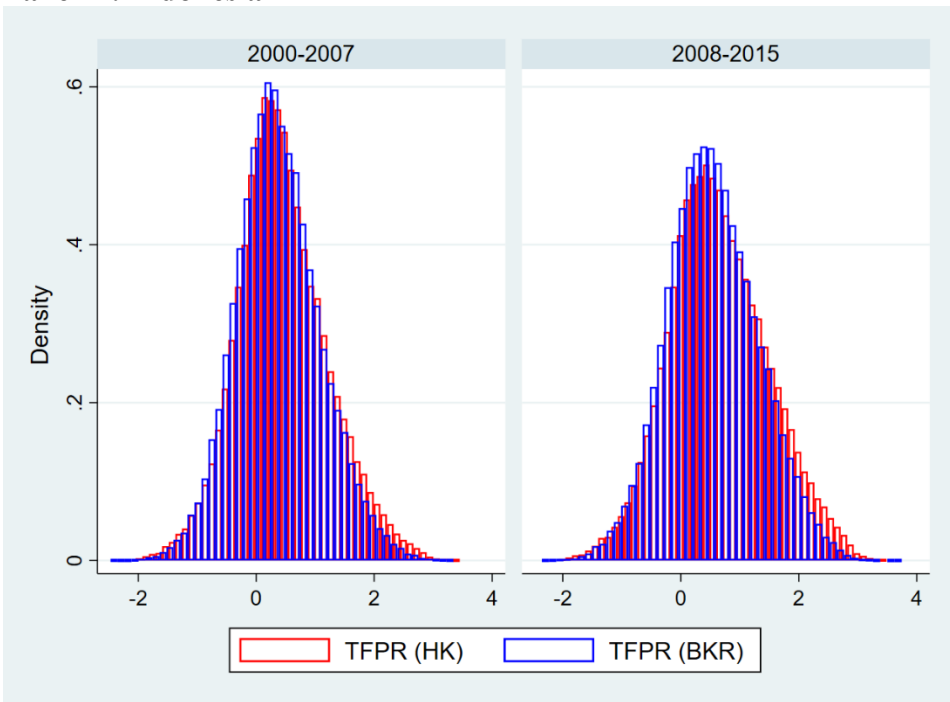
## 4. Results

### 4.1 Baseline results

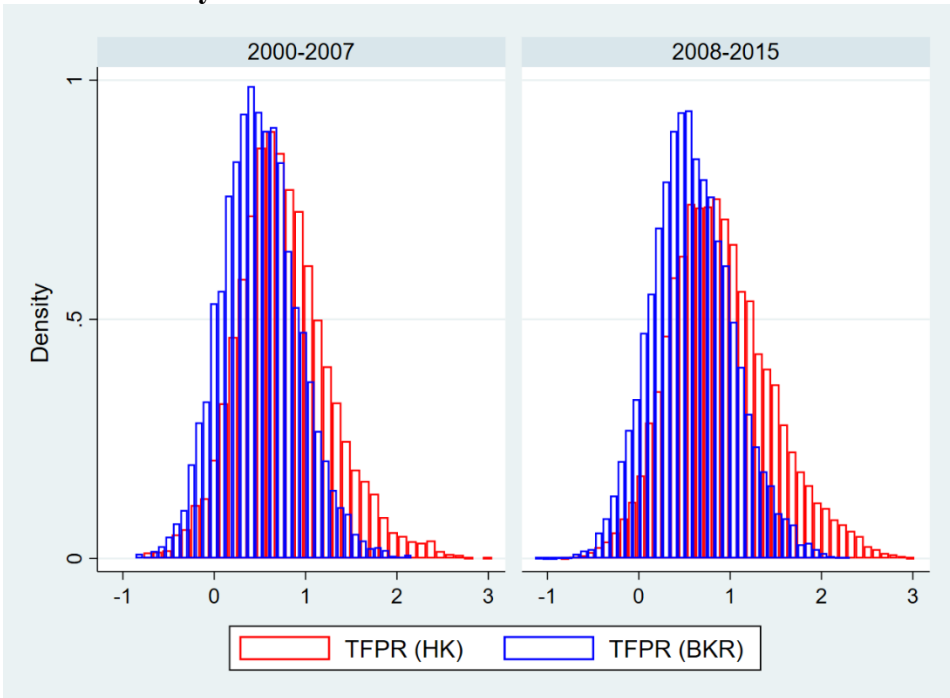
The descriptive statistics in Table 2 suggest a few discrepancies between TFPR obtained using HK or BKR. A more nuanced picture emerges from inspecting the full distributions of TFPR for each country (HK, in red, and BKR, in blue) in Figure 1. In line with the HK approach, a transformation of TFPR is plotted,  $\log\left(\frac{TFPR_{si}}{TFPR_s}\right)$ , that is the log of the ratio between firm-specific TFPR and its 4-digit industry average.

Figure 1 Distribution of TFPR by HK and by BKR

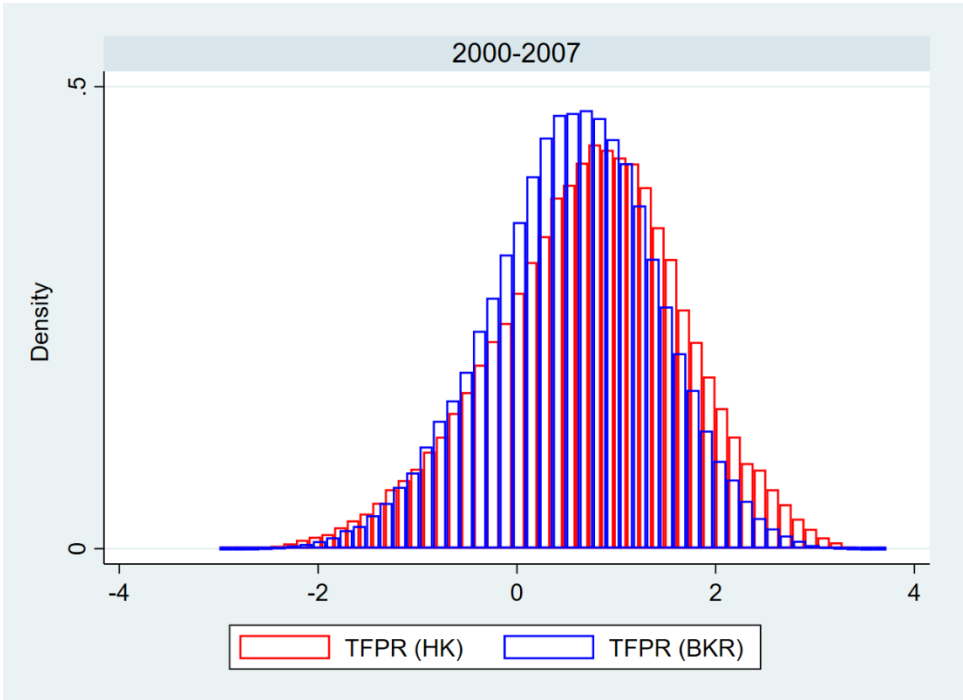
Panel A: Indonesia



Panel B: Malaysia



**Panel C: Vietnam**



Source: Authors' calculations

All countries show substantial heterogeneity in the measures of TFPR, thus pointing towards substantial distortions in their economy. A distribution centered at zero would imply absence of distortions. Conversely, higher variance in the distribution is indicative of deeper resource misallocation within the narrowly defined industry. However, distributions are more concentrated around zero when measurement error is removed, through the BKR approach. This implies that more firms are estimated to face smaller distortions when measurement errors are removed. The differences in estimated TFPR by HK and BKR are the more noticeable for Malaysia and Vietnam. In both cases, removing measurement error yields a TFPR distribution less skewed to the right and less dispersed, implying smaller distortions.

Documenting the evolution of measurement error over time and across country further corroborates the observational evidence from Figure 1. To this end, Table 3 reports the average level of measurement error which is derived as the annual proportional difference between allocative efficiency measured without and with the BKR correction, averaged across firms and time periods. In line with the evidence from Figure 1, measurement error plagues the estimate of allocative efficiency. Accounting for measurement error would increase allocative efficiency by as much as 30 percentage points, as shown by data from Vietnam.

**Table 3 Measurement error over time for the 3 countries**

	<b>Indonesia</b>	<b>Malaysia</b>	<b>Vietnam</b>
<b>2000-2007</b>	-0.16	-0.13	
<b>2008-2015</b>	-0.18	-0.28	-0.3
Source: Authors' calculations			

All these insights are combined in the calculation of the potential gains from reallocation, which provides (i) a comprehensive measure of distortions that affect an economy and (ii) the significance of measurement error. The potential gains from reallocation are large, even after accounting for measurement error (Table 4).

**Table 4 Potential TFP gains from removing misallocation**

	<b>Indonesia</b>	<b>Malaysia</b>	<b>Vietnam</b>
<i>Panel A: without correction (HK)</i>			
<b>2000-2007</b>	169.7	59.3	-
<b>2008-2015</b>	176.2	74.2	91.3
<i>Panel B: with correction for measurement error (BKR)</i>			
<b>2000-2007</b>	89.6	31.2	-
<b>2008-2015</b>	86.1	18.7	22.3
Note: Entries are the percent TFP gains from equalizing TFPR across plants in each industry. Source: Authors' calculations			

We present different measures of the potential productivity gains that can be achieved from reallocation. First, Panel A of Table 4 provides the estimates of potential gains if distortions to both revenue and inputs are removed, and factors of production (labor, capital and intermediate inputs) are reallocated towards their most productive uses, using the HK approach. Second, Panel B of Table 4 accounts for the presence of measurement error, based on BKR. Accounting for measurement error significantly reduces the magnitude of the potential gains from reallocation. These changes are as low as 28 percentage points in Malaysia and up to as high as 90 percentage points in Indonesia. Yet, even after accounting for measurement error, the estimates indicate that productivity can substantially increase when distortions are removed. Interestingly, accounting for measurement error affects the trajectory of the potential productivity gains from removing misallocation. Gains are declining (growing) over time based on the BKR (HK) approach.

Interestingly, the potential gains in Malaysia or Vietnam are lower than the potential gains estimated by BKR for India. Without and with the measurement error correction, these gains are 102% and 65.2% in India during the period 1985-2011. While BKR is mute on this, HK assess the gains also for China. They appear declining over time, from 115.5% in 1998 to 95.8% in 2001 to 86.6% in 2005.

A complementary view comes from looking at the variance. If the variance of the true distortions is smaller than the variance of TFPR, then measurement error exaggerates misallocation. To shed light on this, in Table 5, we turn to estimates of the parameter  $\lambda$ , which by construction is the ratio



of the variances of true distortions and revenue productivity. The higher is  $\lambda$ , the lower the ratio of (dispersion in) measurement error. For example, a  $\lambda = 0.93$  as in the case of Malaysia implies that only 7% of the dispersion in TFPR reflects measurement error, rather than true differences in  $\ln(\tau)$ .

**Table 5 Estimated ratio of the variances of true distortions and revenue productivity ( $\lambda$ )**

	$\lambda$ -Indonesia	$\lambda$ -Malaysia	$\lambda$ -Vietnam
2000-2007	0.94	0.68	
	(0.08)	(0.09)	
2008-2015	0.78	0.93	0.78
	(0.06)	(0.32)	(0.04)

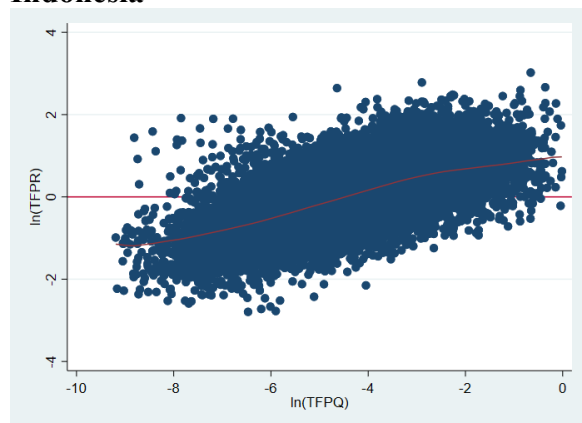
Source: Authors' calculations

#### 4.2 Which firms face larger distortions?

As shown below, more productive firms face higher distortions (or “taxes”) than other comparable firms within a narrowly defined industry. In the HK framework, distortions are measured by the dispersion of TFPR (revenue TFP), while productivity is measured by TFPQ (quantity TFP). We plot  $\log \frac{TFPR_i}{\overline{TFPR}}$  against  $\log \frac{TFPQ_i}{\overline{TFPQ}}$ , where  $\overline{TFPR}$  and  $\overline{TFPQ}$  are the sector averages (Figure 2). In a frictionless world, firms with higher (lower) TFPR would grow (shrink) up to the point where TFPR are equalized ( $TFPR_i = \overline{TFPR}$ ). This occurs as the output prices of growing (shrinking) firms decrease (increase). For all the Southeast Asian countries studied, we observe a positive relationship between revenue and physical productivity. The result is consistent with the evidence emerging from other developed and developing countries. It suggests that more productive firms (i.e. those that have larger TFPQ) face larger idiosyncratic distortions that prevent them from growing (resulting in higher than average TFPR). In other words, more productive firms are “taxed” at a higher rate (either explicitly or implicitly), hence capital and output wedges absorb resources that would have otherwise been used to expand production. This results in lower productivity for the overall economy.

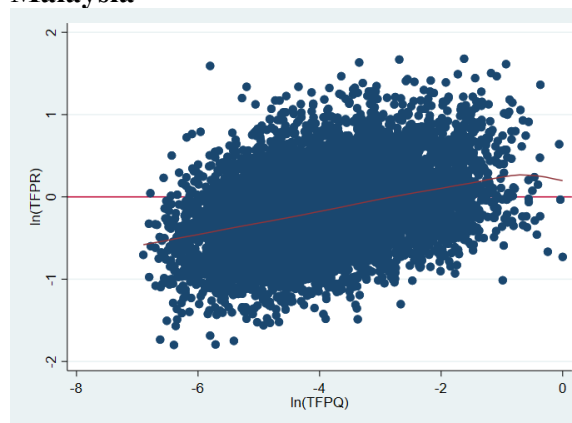
**Figure 2 TFPR and TFPQ**

##### Indonesia



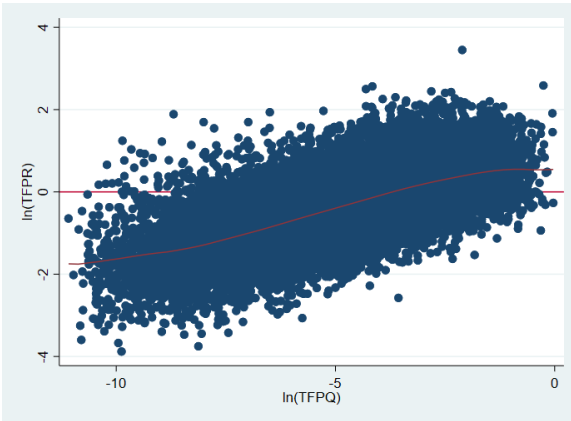
Correlation: 0.64\*\*\*

##### Malaysia



Correlation: 0.40\*\*\*

## Vietnam



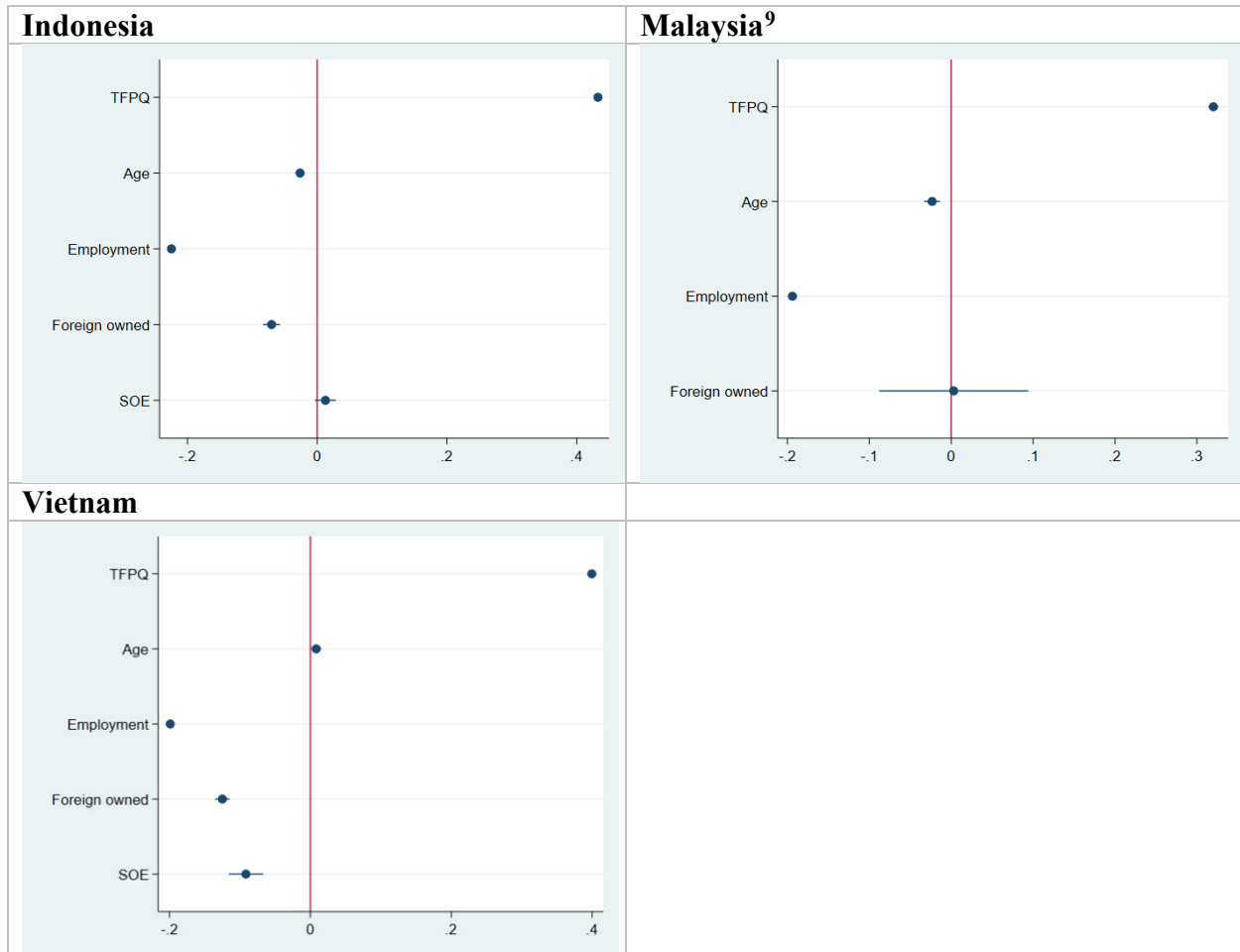
Correlation: 0.65\*\*\*

Source: Authors' calculations using the BKR approach.

Note: For each country, the latest available data are plotted (2014 in Vietnam, 2015 in Indonesia and Malaysia).

In addition, foreign firms (in Indonesia and Vietnam) and SOEs (in Vietnam) have lower “taxes”, which reflects their relative privilege in these economies. Figure 3 plots the coefficients (scatter dots) and the related 90% confidence interval (horizontal line) when regressing log of TFPR on firms' characteristics selected based on data availability. Table 6 presents these regression results. Controlling for sector-year fixed effects and firms' characteristics, revenue (TFPR) and physical (TFPQ) productivity are positively related. In the absence of distortions, there should be no significant relationship between TFPR and TFPQ. A positive coefficient implies that more productive firms face an impediment to growth, while less productive ones are too large. We find some evidence that firm ownership (foreign or state-owned) significantly correlates with distortions (TFPR), indicating that regulatory restrictions that affect these dimensions hamper achieving an efficient allocation of capital and labor. For example, in Vietnam, foreign-owned and SOEs are found to have lower than average TFPR, implying that they are less productive than an average firm and are larger than they should be.

Figure 3 TFPR and firms' characteristics



Source: Authors' calculation.

Note: For firm size, the base category is having at least 100 employees. Sector-year fixed effects included in all regressions.

Table 6 TFPR and firms' characteristics: regression results

	Indonesia	Malaysia	Vietnam	All
<b>Ln(TFPQ)</b>	0.43*** (0.00)	0.32*** (0.00)	0.40*** (0.00)	0.41*** (0.00)
<b>Ln(Age)</b>	-0.03*** (0.00)	-0.02*** (0.00)	0.01* (0.00)	-0.02*** (0.00)
<b>Ln(Employment)</b>	-0.22*** (0.00)	-0.19*** (0.00)	-0.20*** (0.00)	-0.21*** (0.00)
<b>Foreign</b>	-0.07*** (0.01)	0 (0.05)	-0.12*** (0.01)	-0.09*** (0.00)
<b>SOE</b>	0.01 (0.01)		-0.09*** (0.01)	
<b>Constant</b>	-1.87***	-0.16***	-0.76***	-1.40***

<sup>9</sup> Malaysia firm surveys do not have data on SOEs.

	(0.01)	(0.02)	(0.01)	(0.01)
<b>Country fixed effects</b>	No	No	No	Yes
<b>R2</b>	0.59	0.39	0.65	0.59
<b>N</b>	194,850	22,060	85,074	301,983

**5. Conclusion**

This paper examines within-sector resource misallocation using firm-level data for three large Southeast Asian countries: Indonesia, Malaysia, and Vietnam. We build on Hsieh and Klenow (2009) and integrate the methodological correction proposed by Bils, Klenow and Ruane (2020) to explicitly account for the presence of measurement error. Our results document the level of (in)efficiency in these economies that have been playing an increasingly important role in the world economy. We find that the degree of measurement error affecting the estimated allocative efficiency varies by country and changes over time.

Second, the evidence suggests that resource misallocation across firms within a sector is large, albeit declining over time. Private domestic firms and firms with higher productivity face distortions that prevent them from growing. Foreign firms in Indonesia and Vietnam, and SOEs in Vietnam face lower “taxes”, that is, enjoy preferential conditions that make them larger.

Taken together, these results provide valuable insights on the areas where policy makers' attention could focus to improve resource allocation and raise firms' productivity. These lessons can be relevant for developing East Asian economies looking for ways to sustain their economic growth.

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