MISALLOCATION OF RESOURCES AND PRODUCTIVITY: THE CASE OF GHANA

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Abstract

Resource misallocation has recently been identified as one of the causes of lower economic performance in developing countries. It is widely recognized that a number of policies and institutions prevalent in developing countries can distort the allocation of factors of production across productive units, thereby reducing total factor productivity (TFP). In this paper, we analyze the role of allocative inefficiency on TFP in the manufacturing sector of one of Africa's emerging economies – Ghana. The paper estimates the extent of resource misallocation and the sources of misallocation in the Ghanaian manufacturing sector between 2011 and 2015. Our findings suggest that there exists significant resource misallocation in Ghana's manufacturing sector with female-owned firms, older firms and larger firms facing the highest distortions. We also unearth that electricity shortages (*dumsor*) and illicit financial payments (*bribery and corruption*) are significant sources of resource misallocation in Ghana. Finally, we show that TFP could improve by as much as 65% were allocative efficiency enhanced.

JEL classification code: D24, L60, O12.

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1. Introduction

Despite her recent impressive economic performance, mostly owed to - rising commodity prices, stable macroeconomic environment, political stability, and rising demand, Africa's manufacturing sector still commands a smaller proportion of the continent's GDP, churns out fewer exports, and employs fewer people compared with manufacturing sectors of other developing regions. This less than stellar manufacturing performance is a victim of slow total factor productivity (TFP) growth at large in Africa. A common explanation for large differences in TFP across countries that have recently emerged is misallocation of resources (Restuccia and Rogerson, 2013, 2017) which contrasts with the classic view of inadequate factor (labor and capital) accumulation and slow technological diffusion from rich countries to poor countries. In view of the resource misallocation hypothesis, accompanying TFP enhancement is improved allocative efficiency such that the most productive enterprises are allocated more resources. Hence the goal of this paper is to ascertain the degree of resource misallocation and the implications for TFP, on the one hand, and the sources of resource misallocation, on the other hand for the manufacturing sector of an African economy - Ghana.

We rely on the framework of Hsieh and Klenow (2009) and for a sample of 885 manufacturing sector firms, quantify the extent of resource misallocation and the potential TFP gains that could be accrued through enhanced allocative efficiency within sectors and potential sources of distortions. To preview our findings, we find that there exist wide dispersion (heterogeneity) in productivity across firms in Ghana's manufacturing sector. Moreover, there is a significant misallocation of resources across firms, and firms with female ownership, older firms and large firms tend to be those that face these distortions most. Foreign-owned firms, appear to be those that are least affected by distortions. In terms potential sources of misallocation, we unearth that, electricity shortages and illicit financial payments – corruption – play a significant role. Finally, our findings show that were the manufacturing sector in Ghana to see enhanced allocative efficiency, potential gains in TFP in the range of 35–65% could be realised.

Our paper is related to a number of earlier papers in this field. Restuccia and Rogerson (2008) make an ingenious attempt to provide evidence to the effect that distortions could contribute to firms facing different prices. Thus leading to misallocation of resources which could adversely affect TFP. The authors show that dispersion of firm productivity, as a result, these distortions could reduce TFP by up to 50%. Similarly, in a recent study Hsieh and Klenow (2009) utilise a model of monopolistic competition with heterogeneous firms to quantify the potential impact of resource misallocation on TFP in China, India, and the United States (US). Essential in their framework is the need for reallocation of resources to the ablest firms so that there will be equalisation of marginal product revenues implying the absence of resource misallocation. Implementing this framework, Hsieh and Klenow (2009) find substantial resource misallocation in China, India and the US, with those of the former two being paramount. As an extension to Hsieh and Klenow's (2009) work, Bartelsman, Haltiwanger, and Scarpetta (2013) show that the dispersion of within-sector firm TFP is not the only medium to ascertain the impact of misallocation of resources within sectors on TFP, but also, the covariance between firm size and productivity. So far, Hsieh and Klenow's (2009) have been utilised, relatively, widely to quantify the extent of resource misallocation and their TFP implications. Examples include: for China, Ziebarth (2013) and Brandt, Tombe, and Zhu (2013); Calligaris (2015) for Italy; Dias, Robalo Marques, and Richmond (2016) for Portugal; for Latin America, Oberfield (2013), K. Chen and Irarrazabal (2015), and Gustavo and Cristóbal (2009); Ryzhenkov (2016) for Ukraine; Gopinath et al. (2017) for Southern Europe; Kalemli-Ozcan, Kennedy, and Sorensen (2012) and Cirera et al. (2017) for Africa. Of these studies, the closest to our paper are those of Kalemli-Ozcan, Kennedy, and Sorensen (2012) and Cirera et al. (2017), in terms of approach and geographic scope. Our paper departs from these two studies in two ways: first, with the benefit of panel data, we are able to show the dynamics of resource misallocation and its effect on TFP, additionally, we provide evidence, utilising firm-specific characteristics and objective measures of business environment conditions, to inform how firm characteristics and business environment conditions interplay with distortions.

The remainder of the paper is structured as follows. Section 2 details the theoretical framework employed in quantifying the TFP implications of resource misallocation. Section 3 discusses the data and provides information on how key parameters used for estimations are calibrated. Findings on potential gains from allocative efficiency are discussed in section 4. The interplay of firm characteristics and business environment conditions and magnitude of distortions are looked at in section 5. Finally, section 5 provides a conclusion to the paper.

2. Theoretical framework

This paper employs Hsieh and Klenow (2009) framework to assess the impact of resource misallocation on aggregate TFP. As such, we consider a model of monopolistic competition with heterogeneous firms akin to Melitz (2003). The starting assumption is that a representative firm utilizes a Cobb-Douglas production technology to combine the output, Y_S, of a number of industries to produce a final good, Y, in a perfectly competitive environment:

$$Y = \prod_{s=1}^{s} Y_s^{\theta_s} \text{ where } \sum_{s=1}^{s} \theta_s = 1 \quad (1)$$

Cost minimization then implies

$$P_s Y_s = \theta_s P Y^4 \quad (2)$$

At the sector level, aggregate output, Y_s, is a constant elasticity of substitution aggregate of differentiated products (M_s):

$$Y_s = \left(\sum_{i=1}^{M_s} Y_{si}^{\frac{\sigma-1}{\sigma}} \right)^{\frac{\sigma}{\sigma-1}} \quad (3)$$

Individual firms within a given sector then employ a Cobb-Douglas production technology to produce products:

$$Y_{si} = A_{si} K_{si}^{\alpha_s} L_{si}^{1-\alpha_s} \quad (4)$$

where A_{si}, K_{si}, and L_{si} are, respectively, productivity, capital and labor at the firm level. Given that we have two factor inputs, we can infer two types of distortions that a firm faces - output distortion and (τ_y) capital distortion(τ_k). We can think of output distortions as those distortions that increase the marginal products of capital and labor by an equal proportion, and capital distortions as those that increase the marginal rate of capital relative to labor. Intuitively, these distortions $(\tau_y \; and \; \tau_k)$ feed into a firm's profit function:

$$\pi_{si} = (1 - \tau_{y_{si}}) P_{si} Y_{si} - w L_{si} - (1 - \tau_{k_{si}}) R K_{si}, \quad (5)$$

where $P_{si} Y_{si}$, w and R are, respectively, value added by the firm (indicating that P_{si} is the price level the firm faces while Y_{si} is its output), the wage rate a firm faces, and rental rate of capital. Thus, resources are not allocated (favourably) according to firm TFP levels but also driven by capital and output distortions. By implication, this creates differences in the marginal revenue products of capital and labor across firms hence depressing aggregate TFP.

To gauge the importance of wedges in capital and labor on aggregate TFP, an important first step, following Foster, Haltiwanger, and Syverson (2008), is to distinguish between "physical productivity" (TFPQ) and "revenue productivity" (TFPR) expressed as:

$$TFPQ_{si} = A_{si} = \frac{Y_{si}}{K_{si}^{\alpha_s} (w L_{si})^{1-\alpha_s}} \quad (6)$$

[4] Here, $P_s \; and \; PY$ represent price of sector output and price of the final respectively.

$$TFPR_{si} = P_{si}A_{si} = \frac{P_{si}Y_{si}}{K_{si}^{\alpha_s}(wL_{si})^{1-\alpha_s}} \quad (7),$$

where $TFPQ_{si}$ can be seen as a typical Solow residual term – i.e. how efficiently a firm combines capital and labor inputs to produce a given output, while $TFPR_{si}$ reflects the revenue accruing to a firm for combining capital and labor inputs efficiently. In a natural sense $TFPR_{si}$ should not vary across firms within the same sector since the ablest firms (i.e. firms with higher levels of TFPQ) will be allocated more capital and labor leading to the point where higher output translates into lower prices and the exact same TFPR just as firms (smaller) with lower TFPQ. More formally, Hsieh and Klenow (2009) show the relation between firm TFPR and capital and labor wedges can be expressed as:

$$TFPR_{si} = \frac{\left(1+\tau_{k_{si}}\right)^{\alpha_s}}{1-\tau_{y_{si}}} \quad (8)$$

Intuitively, higher TFPR indicates that a firm faces barriers that raise its marginal products of capital and labor, rendering the firm smaller than its optimal size. Aggregate (sector) TFP can then be expressed as:

$$TFP_s = \left[\left(\sum_{i=1}^{M_s} A_{si} \cdot \frac{\overline{TFPR_s}}{TFPR_{si}}\right)^{\sigma-1}\right]^{\frac{1}{\sigma-1}} \quad (9),$$

where for a given sector, s, $\overline{TFPR_s}$ is the geometric average of average marginal revenue product of capital and labor in that sector. If it were the case that distortions were absent, implying marginal products (or $TFPR_{si}$) were equalized, then the efficient TFP for at the sectoral level will simply be:

$$\overline{A_s} = \left(\sum_{i=1}^{M_s} A_{si}^{\sigma-1}\right)^{\frac{1}{\sigma-1}} \quad (10)$$

In a situation where $TFPQ_{si}$ and $TFPR_{si}$ are jointly lognormally distributed, then sectoral TFP is given by:

$$\log TFP_s = \frac{1}{\sigma-1}\log\left(\sum_{i=1}^{M_s} A_{si}^{\sigma-1}\right) - \frac{\sigma}{2} var(\log TFPR_{si}) \quad (11),$$

in which case greater dispersion of marginal products (higher variance of $\log TFPR_{si}$) enfeebles sector TFP.

3. Data, key parameters and estimating distortions

3.1 Data

The data we use for this study was obtained from a survey of Ghanaian manufacturing firms[5]. The sampling frame was the Ghana Integrated Business Establishment Survey (IBES), which is an economic census of non-household enterprises conducted by the Ghana Statistical Service (GSS) in 2014-2015. The sampling methodology used to collect the data is similar to that – stratified random sampling – of the World Bank used for its Enterprise Surveys. As such, we considered the firm as the sampling unit, and stratified firms by size, manufacturing sub-sector and location. Stratification by size followed that employed by the World Bank (World Bank, 2009) using small (6-30 employees) and medium (31-100 employees).

Our sampling from the IBES was all small and medium-sized manufacturing firms located in the main industrial clusters in the country – the cities of Accra, Tema, Kumasi and Sekondi-Takoradi. The universe of small and medium-sized manufacturing firms obtained from the IBES was 1,244 firms. We attempted to survey all of these firms. Of these, 73 firms refused to participate in the survey, 55 had folded up and 231 could not be located using the contact information obtained from the GSS. We, therefore, ended up surveying 885 firms. These firms operated in 20 distinct ISIC Rev. 4 2-digit industries in the following sectors: food and beverage products, textiles and wearing apparel, chemicals, metal, machinery and equipment, wood and wood products, and other manufacturing. Data collection took place from August to September 2016 and retrospectively collected firm-level information from 2011 through 2015.

The survey collected information on firms' output and inputs, production processes, assets and investments, employment activities, costs of operations, ownership type, and form of operation. Given that our primary focus is to examine the extent and impact (on aggregate TFP) of resource misallocation in the Ghanaian manufacturing sector, we utilize firms' information on wages, materials cost, capital, and labor for computations of resource misallocation. Sectoral producer price indices are used to deflate capital and material cost to 2010 constant prices. Similarly, wages are deflated to 2010 constant prices using consumer price index, also, obtained from the GSS. To enhance the robustness of our findings firms with missing information or negative values for value added, capital, materials, and labor are dropped. Further, 1% tails of TFPQ and TFPR are trimmed to account for outliers. This results in a final sample of about 3,479 observations.

[5] The survey was conducted to ascertain the impact of energy shortages on Ghanaian firms.

Table 1, provides information on the significant industries, firm size group, and firm age group in Ghana's manufacturing sector in terms of value addition, employment, and capital utilisation. Manufacture of food products, manufacture of furniture, and manufacture of wearing apparel appear to be the most significant industries, as these sectors command the largest shares (%) of value added, employment and capital utilization. Coming to the relevance of firm size, unsurprisingly, micro firms make up the largest firms in the manufacturing sector in Ghana. However, these firms (micro), surpass only larger firms in terms of manufacturing sector value addition but lag any other size group in terms employment generation and capital utilization. Finally, the results also reveal that although young firms utilize more capital than mature firms, they (young) contribute less, compared with mature and older firms, when it comes to manufacturing sector value creation and employment.

Table 1: Sector, firm characteristic, output and factor shares

	N	Value-added share (%)	Employment share (%)	Capital share (%)
Sector				
Manufacture of food products	358	19.08	15.48	16.97
Manufacture of beverages	75	7.78	7.53	9.57
Manufacture of textiles	13	0.02	0.27	0.01
Manufacture of wearing apparel	2134	16.92	39.68	22.91
Manufacture of leather and related products	9	0.01	0.15	0.02
Manufacture of wood and of products of wood and cork, except furniture; manufacture of articles of straw and plaiting materials	314	9.11	10.17	3.20
Manufacture of chemicals and chemical products	5	0.68	0.60	0.04
Manufacture of rubber and plastics products	5	0.17	0.91	0.13
Manufacture of other non-metallic mineral products	32	2.13	0.86	0.86
Manufacture of basic metals	31	0.85	0.73	0.04
Manufacture of fabricated metal products, except machinery and equipment	69	7.11	4.29	7.79
Manufacture of machinery and equipment, not elsewhere classified	52	0.43	1.10	0.24
Manufacture of furniture	328	24.72	9.83	29.42
Other manufacturing	54	10.99	8.40	8.80
Firm size				

Micro (5 or less)	2308	18.55	22.35	9.39
Small (6 – 19)	979	38.94	38.36	17.57
Medium (20-99)	177	30.28	26.03	52.48
Large (100 and above)	15	12.23	13.26	20.57
Firm age				
Young (5 or less)	594	13.89	16.90	23.14
Mature (6-15)	1674	48.66	39.34	21.38
Older (16 and above)	1054	29.16	38.43	32.35

3.2. Key parameters and estimates of distortions

To empirically examine the degree of misallocation and its TFP implications, certain parameters – elasticity of substitution, the rental price of capital, and the capital shares - have to calibrated. Following Hsieh and Klenow (2009) we set the elasticity of substitution = 3. On the rental price of capital, R, again we follow Hsieh and Klenow (2009) and set this value to 10% which reflects 5% depreciation and 5% interest rate[6]. Finally, capital shares (i.e. the elasticity of output with respect to capital), for each sector s is computed as 1 – labor share in the corresponding sector in the United States. Labor shares from US industries are used because it is presumed the US is relatively (to Ghana) less undistorted. Data on US industries' labor shares are extracted from the NBER productivity - usSic 1987 - database. Given that the data used in this study was collected from industries under the category – ISIC rev 4 – we used suitable correspondence to match these industries with their corresponding industries in the US. As such, sectors for which we could not find a corresponding match in the US were dropped. Finally, following Hsieh and Klenow (2009) labor shares obtained from the NBER productivity database are scaled (inflated) by a factor of 1.5 in order to cater for nonwage forms of compensation were used. We then proceed to compute distortions and productivity as follows:

$$1 + \tau_{k_{si}} = \frac{\alpha_s}{1-\alpha_s}\frac{wL_{si}}{RK_{si}}, \tag{12}$$

$$1 - \tau_{y_{si}} = \frac{\sigma}{\sigma-1}\frac{wL_{si}}{(1-\alpha_s)P_{si}Y_{si}}, \tag{13}$$

[6] Since for each sector we compute the average capital distortion, any misspecification of the rental price of capital affects the sector average of capital distortions and not estimations of potential gains from efficient resource allocation.

$$TFPQ = A_{si} = \kappa_s \frac{(P_{si}Y_{si})^{\frac{\sigma}{\sigma-1}}}{K_{si}^{\alpha_s} L_{si}^{1-\alpha_s}}. \tag{14}$$

Equation 12 highlights capital distortions which arise from a sub-optimal combination of production inputs (labor and capital); simply, when the capital-labor ratio is distorted – i.e. when the capital-labor ratio is high relative to output elasticities. Output distortions, as captured in equation 13, are observed when a firm's labor share is low relative to the optimal level – i.e. sector elasticity of output with respect to labor. Equation 14 measures firm-level productivity. The scalar κ_s in that equation (14) is only a constant which can be set to 1 without having any significant impact on relative productivities, - and hence reallocation gains in each sector. The challenge in measuring firm level productivity is that we do not observe firm real output but rather nominal output – $P_{si}Y_{si}$ – or prices in this case. Therefore, in order to tease out firm level physical output from observed output (i.e. value added, $P_{si}Y_{si}$), we simply raise $P_{si}Y_{si}$ to $\frac{\sigma}{\sigma-1}$.

We then follow Hsieh and Klenow (2009) and pool all industries and trim the 1% tails of $\log\left(\frac{TFPR_{si}}{\overline{TFPR_s}}\right)$ and $\log\left(\frac{A_{si}}{\overline{A_s}}\right)$ in each year then recalculate each firm's wage bill, capital, and value added (revenue) as well as sector average revenue productivity $(\overline{TFPR_s})$ and physical productivity $(\overline{A_s})$.

As a precursor to our investigation into the importance of resource misallocation for TFP, we first consider the dispersion of TFPR and TFPQ. In an environment where resources are allocated efficiently, we would expect the most productive firms to employ the largest share of resources which will result in higher output and consequently lower prices compared to those of smaller firms with a potential final outcome being an equalization of marginal returns and/or TFPR. Hence, any (significant) dispersion indicates evidence of resource misallocation. *Figure 1,* plots the dispersion of TFPR and TFPQ demeaned by sector-specific averages. As shown in the left panel of *Figure 1,* the distribution of TFPR shows that there is a wide dispersion in TFPR. Providing some evidence that some firms with lower marginal returns command a significant proportion of resources, and also, that, possible gains could be made through improved allocative efficiency. The right panel of *Figure 1,* also, shows the distribution of TFPQ over the years. Again, we can observe a wide productivity across firms over the years. Moreover, TFPQ is skewed to the left (tail) indicating that some policies (and at large, a weak business environment) favour the survival of some inefficient firms. To emphasize, *Table 2,* provides further evidence of significant dispersion of both TFPR and TFPQ in Ghana's manufacturing sector considering all measures of dispersion – standard deviation, the ratio of the 75$^{\text{th}}$ to 25$^{\text{th}}$ percentile, and the ratio of the 90$^{\text{th}}$ to the 10 percentile. Specifically, over the years, dispersion generally takes a dip in the years 2012 and 2013 and recovers afterwards. The observed results of TFPR and TFPQ dispersion show that there is more resource misallocation in Ghana than there is in the US, China or India as reported by Hsieh and Klenow (2009); and in Portugal as reported by Dias, Robalo Marques, and Richmond (2016).

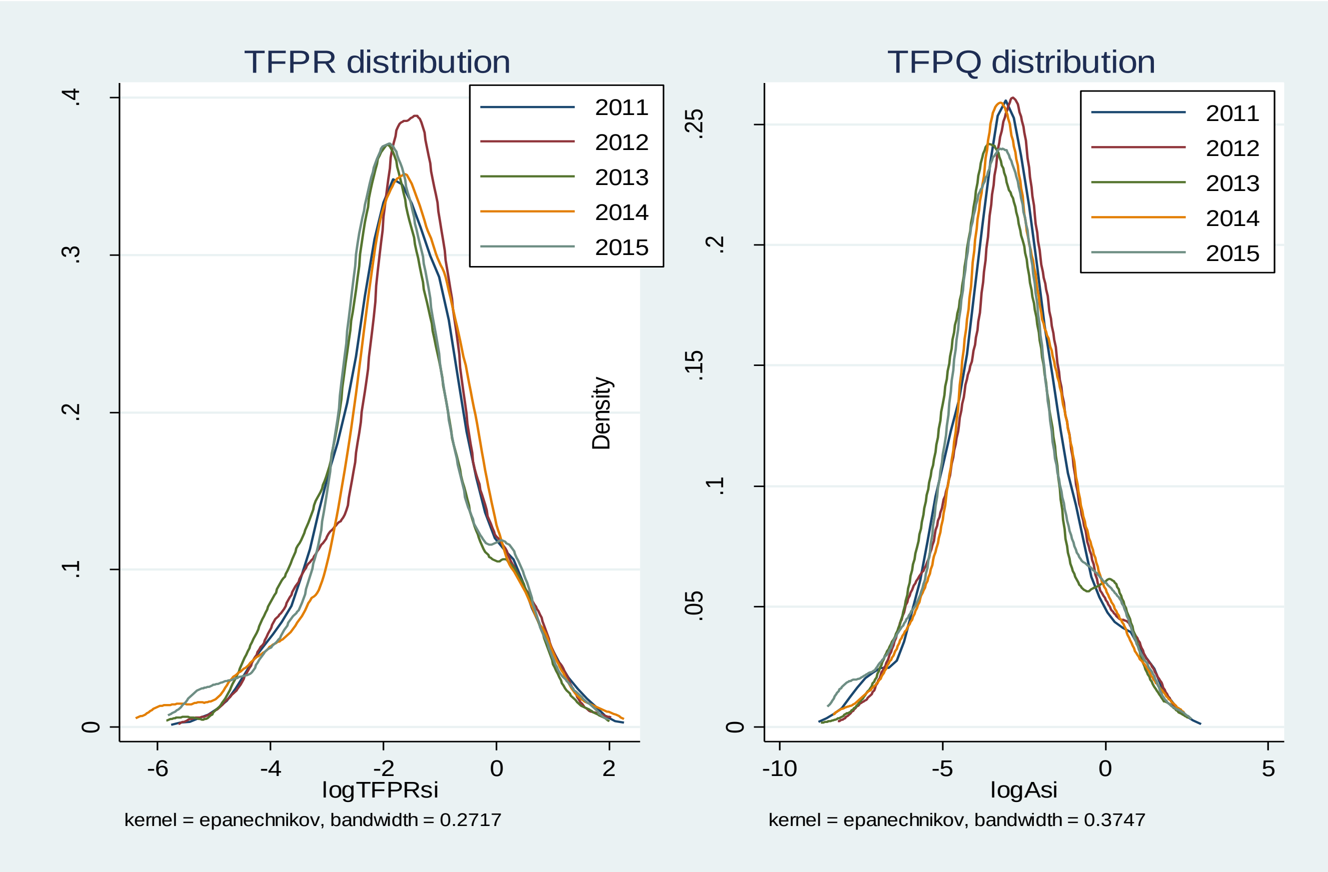

Figure 1. Distribution of TFPR and TFPQ

Table 2: Distribution of TFPR and TFPQ

	2011	2012	2013	2014	2015
TFPR					
SD	1.267	1.230	1.190	1.375	1.394
75% - 25%	1.635	1.407	1.331	1.514	1.506
90% - 10%	3.389	3.291	3.040	3.359	3.708
TFPQ					
SD	1.886	1.789	1.735	1.782	2.017
75% - 25%	2.267	2.185	2.077	2.164	2.301
90% - 10%	4.606	4.585	4.146	4.356	5.166
N	692	701	693	702	691

To further investigate for which firms, premised on productivity levels, resource misallocation (higher TFPR) is important, we regress TFPR on TFPQ. The results reported in *Table 3,* show that there is a significant and positive correlation between TFPR and TFPQ in all years. Indicating that the most productive firms are the hardest hit in terms of resource misallocation.

Table 3: Relation between TFPR and TFPQ

	2011	2012	2013	2014	2015
TFPQ	0.635***	0.642***	0.640***	0.687***	0.649***
	(0.0105)	(0.0103)	(0.0102)	(0.0162)	(0.0101)
Constant	0.281***	0.281***	0.236***	0.389***	0.274***
	(0.0377)	(0.0351)	(0.0366)	(0.0500)	(0.0383)
No. of firms	692	701	693	702	691
R-squared	0.886	0.872	0.868	0.815	0.899

Robust standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1

4. TFP gains from eliminating distortions

In this section, we compute the potential TFP gains that would have been obtained were resources allocated optimally within a given sector. To do this, we first of all, compute the actual levels of TFP and then compute the efficient level of TFP. With the benefit of efficient levels of TFP, actual levels of TFP can then be compared with this (efficient TFP) in order to infer potential gains from optimal allocative efficiency within a sector. By way of implementation, we expressed the actual level of TFP (which contains distortions as can be gleaned from equation 9) as a ratio of the effects for each sector, and then aggregate this ratio across industries, hence:

$$\frac{Y}{Y_{efficient}} = \prod_{S=1}^{S} \left[\sum_{i=1}^{M_S} \left(\frac{A_{si}}{\bar{A}_S} \frac{\overline{TFPR}_S}{TFPR_{si}} \right)^{\sigma-1} \right]^{\frac{\theta_S}{\sigma-1}} \tag{15}$$

where Y is actual output and $Y_{efficient}$ efficient output[7]. In addition to computing TFP gains by utilizing the ratio of actual TFP against efficient TFP, we also compute TFP gains relative to the US efficiency in 1997. Formally, TFP gains are computed as:

[7] Note (recall) that in the absence of idiosyncratic distortions sector TFP = $TFP = \bar{A}_S = \left(\sum_{i=1}^{M_S} A_{si}^{\sigma-1}\right)^{\frac{1}{\sigma-1}}$ implying that marginal products have equalized for a given sector.

$$TFP\ gains = \left(\frac{TFP_{efficient}}{Y} - 1\right) \times 100 \tag{16}$$

Table 4, provides findings on potential aggregate TFP gains that could be realised were distortions eliminated within the Ghanaian manufacturing sector. The findings reported showing that full liberalization would yield manufacturing gains in the range of 35%-65%. These figures are lower compared with those (China: 86% - 115%; India: 100% - 128%) Hsieh and Klenow (2009) report for China and India. Impressively, the results, overall, show a decline in the potential TFP gains over the years albeit an increase for the year 2015. Putting these results into perspective, allocative efficiency, from 2011 – 2015, improved by 6.7%[8], or by 1.7% per year. Similarly, the results also indicate that, were allocative efficiency in the Ghanaian manufacturing sector at par with what prevailed in the US in 1997, the manufacturing sector (of Ghana) could see (modest) gains in aggregate TFP – i.e. from a nadir of no gains (or loss in gains) -5.8% - 15.3%. At the sectoral level, the results highlighted in *Table 4,* indicate that the sectors that would have benefited and contributed the most in aggregate TFP are food producers, wearing apparel producers, beverage producers and furniture and wood producers.

Table 4: TFP gains by year

Gains (%)	2011	2012	2013	2014	2015
Full liberalization	64.761	58.416	59.584	34.612	48.907
Relative to the US	15.298	10.858	11.675	-5.800	4.204
N	692	701	693	702	691

Table 5: TFP gains by sector

Sector	Gains (%)
Manufacture of food products	30.394
Manufacture of beverages	20.622
Manufacture of textiles	0.047
Manufacture of wearing apparel	103.945
Manufacture of leather and related products	0.026
Manufacture of wood and of products of wood and cork, except furniture; manufacture of articles of straw and plaiting materials	23.263
Manufacture of chemicals and chemical products	1.429
Manufacture of rubber and plastics products	0.385
Manufacture of other non-metallic mineral products	4.987

[8] $\left(\frac{1.6}{1.5} - 1\right) \times 100$

Manufacture of basic metals	2.169
Manufacture of fabricated metal products, except machinery and equipment	14.735
Manufacture of machinery and equipment, not elsewhere classified	0.867
Manufacture of furniture	65.253
Other manufacturing	1.023

5. Determinants of misallocation

Our findings, as detailed in the previous section, provide evidence of significant resource misallocation with the Ghanaian manufacturing sector and potential gains that could achieve through enhanced allocative efficiency. This naturally motivates the quest to ascertain the sources of distortions, particularly for practical policy recommendations. In this regard, it will be important to find out which firms and business environment conditions correlate with distortions

As a starting point, we assess the relationship between firm characteristics, business environment conditions and productivity (TFPQ). Thus, we regress $\log\left(\frac{A_{si}}{A_s}\right)$ on firm-specific characteristics and business environment variables. The results reported in *Table 5,* provide evidence that firm size is positively and significantly correlated with productivity showing that productivity (or efficiency) improves as firms get bigger. Contrary to an earlier finding for African firms reported by Van Biesebroeck (2005), older firms are found to be more productive than young and less mature firms. A finding which shows evidence of a "learning effect" (Jovanovic, 1982) among Ghanaian firms[9]. Surprisingly, foreign ownership is negatively correlated with productivity but without any statistical significance. The sign of the coefficient of corruption shows that bribery extortions act as an additional tax on firms which constrains their efficiency (although this coefficient is insignificant), an outcome which dovetails those of an initial study by Fisman and Svensson (2007) for Ugandan firms. Similarly, another business environment constraint – electricity shortages – exhibits a negative and significant association with firm efficiency. Impressively, female ownership is associated with higher productivity. Also, we do find evidence supporting the predictions (Melitz, 2003; Bernard *et al.*, 2007) that the most productive firms self-select into exporting. Finally, firms that have access to formal finance have lower levels of productivity, a finding which contradicts evidence provided elsewhere (Beck and Demirguc-Kunt 2006).

[9] This finding corroborates those reported by (Harrison, Lin and Xu, 2014) for a sample of African firms.

We now turn to the association between firm characteristics, business environment characteristics and distortions. All estimations are weighted least squares with sector-specific value added shares used as weights. The sign on the coefficient of firm size reveals that small and medium-sized firms face more distortions compared with large firms. Implying that the marginal product revenue of small and medium-sized firms is higher than that of large firms, thus in an optimal setting, small and medium-sized firms should be allocated more resources. Busso, Madrigal, and Pagés (2013) report similar findings for Chilean and Uruguayan firms. The results also show that, nonetheless, large firms face more capital and output distortions compared with small and medium-sized firms. Evidencing that large firms, compared with small and medium firms, face more constraints in size expansion and employ less capital compared with the optimal capital level. In terms of firm age, older firms are found to face more distortions (6%) compared with young and mature firms. Implying that they (older firms) have higher marginal returns to capital and labor comparatively. Further, the distortions faced by older firms appear not to be output distortions, informing that older firms do not necessarily face constraints in the expansion. Firms with some foreign ownership are found to be those that face the least (46%) distortions. This is unsurprising given that foreign-owned firms often possess superior technology, have easy access to credit, and have access to external markets among others. Again, firms with foreign owners are those that face the least capital distortions. Another interesting finding is that firms with some form of female ownership tend to face modest (0.02%) distortions; however, most of this does not come in the form of a size tax or constraint on their expansion. The negative and significant coefficient on the impact of corruption on capital distortions tells us that a corruption acts as a burden on labor relative to labor. Implying corruption acts as an additional cost to firm capital relative to labor hence constraining expenditure on labor. Surprisingly, electricity shortages appear to have a negative and significant impact on distortions. A result which could be interpreted, prima facie, as more electricity shortages or infrastructural challenges reducing distortions. However, electricity shortages are found to have a positive and significant effect on output distortions. Hence electricity shortages could still be seen as growth enfeebling in this context. Finally, access to formal finance is associated with a higher cost share of capital relative to labor implying the use of formal serves as a size tax and does not constrain firms from acquiring more capital.

Table 6: Determinants of TFPQ and distortions

	TFPQ	TFPR	Capital distortion	Output distortion
Size	0.403***	-0.0207	0.299***	0.114***
	(0.0389)	(0.0272)	(0.0408)	(0.0253)
Age	0.0993**	0.0570*	-0.0551	-0.0675**
	(0.0468)	(0.0323)	(0.0434)	(0.0322)
Foreign	-0.573	-0.464*	-1.775***	-0.373
	(0.428)	(0.278)	(0.450)	(0.390)
Corruption	-0.102	-0.0916	-0.672***	-0.154
	(0.210)	(0.150)	(0.196)	(0.139)
Electricity	-0.117***	-0.0414**	0.00941	0.0425**
	(0.0263)	(0.0182)	(0.0253)	(0.0169)
Female ownership	0.00127*	0.00171***	-0.000334	-0.00169***
	(0.000771)	(0.000542)	(0.000703)	(0.000515)
Exports	0.00403	0.00105	0.000560	-0.000791
	(0.00343)	(0.00251)	(0.00364)	(0.00228)
Bank	-0.000959	-0.00213	-0.0132***	-0.00240
	(0.00295)	(0.00201)	(0.00293)	(0.00225)
Constant	-4.593***	-2.604***	1.370***	1.212***
	(0.221)	(0.158)	(0.193)	(0.145)
N	2,615	2,615	2,615	2,615
R-squared	0.118	0.121	0.123	0.141
Year FE	Yes	Yes	Yes	Yes
Sector FE	Yes	Yes	Yes	Yes

Generally, our findings suggest that large firms, relative to small and medium firms, face more output and capital distortions despite been the most productive firms. To motivate this finding further, we conduct an exercise to gauge the proportion of firms across the various years that will see their size augmented were distortions eliminated – i.e. TFPRs equalized across firms within the same sector. We report the findings of this exercise in *table 6*. The rows are the initial firm actual size quartiles while the columns are bins of the efficient firm size relative to the actual size: 0-50% implies the plant should at least shrink by half, 50-100%, 100-200%, and greater than 200% indicate that the firm should at least double in size. As shown in the table, the most populous column is the first column. Which indicates that most firms in Ghana's manufacturing sector, particularly the large ones (i.e. top quartiles), would be more than twice downsized. This result is consistent over the years under study.

Table 7: Percentage of firm - efficient size vs actual size

Year and quartile	[0-50%]	[50-100%]	[100-200%]	[200% and above]
2011				
Top Quartile	24.6	0.2	0.1	0.1
2nd Quartile	24.3	0.3	0.3	0.1
3rd Quartile	23.2	0.7	0.3	0.8
Bottom Quartile	18.2	2.3	1.9	2.5
2012				
Top Quartile	24.7	0.3	0	0.2
2nd Quartile	24.5	0.4	0	0
3rd Quartile	23.8	0.3	0.6	0.3
Bottom Quartile	18.4	1.7	2.3	2.3
2013				
Top Quartile	24.9	0	0.1	0
2nd Quartile	24.3	0.3	0.4	0
3rd Quartile	23.5	0.9	0.1	0.4
Bottom Quartile	18.0	2.3	3.3	1.3
2014				
Top Quartile	24.9	0	0.1	0
2nd Quartile	24.1	0.6	0.3	0
3rd Quartile	23.6	0.6	0.4	0.4
Bottom Quartile	18.5	2.0	2.4	2.0
2015				
Top Quartile	24.9	0.1	0	0
2nd Quartile	24.0	0.9	0.1	0
3rd Quartile	23.3	1.0	0.4	0.3
Bottom Quartile	18.1	2.2	2.6	2.0

6. Conclusion

In this paper we make the first attempt to assess the extent of resource misallocation and their TFP implications for the manufacturing sector of an African country (Ghana) by way of contributing to our understanding the potential causes of the slow TFP growth and consequently weak manufacturing sector performance in Africa. We employ the framework of Hsieh and Klenow (2009) for data collected from a sample of 885 manufacturing firms over the period 2011-2015.

Our findings provide evidence to the effect that substantial resource misallocation exists in Ghana's manufacturing sector. A finding which dovetails those of Hsieh and Klenow (2009); Cirera et al. (2017); Kalemli-Ozcan, Kennedy, and Sorensen (2012). Further, we reveal that the most productive firms are the ones that face the largest distortions. By way of potential gains from enhanced allocative efficiency, we show that about 35-65% TFP gains could have been realised. To emphasise, this implies that allocative efficiency in Ghana's manufacturing sector improved by 6.7% between 2011 and 2015. In this regard, large firms are big relative to their efficiency levels, hence the need for such firms to shrink in size in order to create room for improved allocative efficiency. On the firms that are affected most by distortions, our findings indicate that firms with some form of female ownership, firms that are older, and large firms are those that face the most distortions. Foreign-owned firms appear to be the least affected by distortions. Further, we find out that electricity shortages and corruption are significant drivers of distortions.

A caveat to our study is the scalability of the findings to the entire Ghanaian economy as we do not perform our analyses to include firms from the services sector (the leading sector in the Ghanaian economy) and the agricultural sector.

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