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MISALLOCATION AND FINANCIAL CONSTRAINTS AMONG FIRMS IN SUB-SAHARAN AFRICA

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Misallocation and Financial Constraints Among Firms in Sub-Saharan Africa

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Abstract. Misallocation has been generally proven to lower aggregate TFP and drive per capita GDP differences across countries. This paper investigates the extent to which financial constraints contribute to the firm-level resource misallocation that I show is present in 12 sub-Saharan African countries. I calibrate a misallocation model (Hsieh and Klenow, 2009) [20] with intermediate inputs as an additional factor input using firm-level data from the enterprise survey of the World Bank to derive measures of capital, labor, and output misallocation. I then conduct an empirical exercise to establish a link between these measures of misallocation and financial constraints. I find that the latter significantly increases output distortions, and that size is the main channel. Smaller firms are more financially constrained and in consequence face more distortions that prevent them from growing to optimal size.

Keywords: Misallocation · TFP · Firms · Africa · Enterprise Financing

1 Introduction

If factors of production such as labor, capital, and intermediate inputs are concentrated in less productive firms at the expense of more productive ones, then these more productive firms will not operate to their fullest potential while the less productive ones will use more resources than they optimally would, therefore creating inefficiencies. These distortions result in lower than optimal firm-level productivity and output, thus reducing aggregate productivity and output [20] [28]. In Africa in particular, firms and their productivity are an important part of economic research. One of the main economic issues in most African countries is the high level of youth unemployment, which is estimated at almost 21% in 2021 by the International Labor Organization. [1] This is due to the very young population in Africa, where in most countries, more than 60% of the population is below the age of 25. [2] Small and medium enterprises account for about 90%

[1] ILO: "Global Employment Trends for Youth 2020: Africa" https://ilo.org/wcmsp5/groups/public/—dgreports/—dcomm/documents/briefingnote/wcms$_7$37670.*pdf*

[2] "Africa's Youth: Action Needed Now To Support the Continent's Greatest Asset" https://mo.ibrahim.foundation/sites/default/files/2020-08/international-youth-day-research-brief.pdf

of all businesses in Africa and create about 80% of jobs. [3] Therefore, these small firms are an integral part of the solutions against the high levels of youth unemployment across the continent. Misallocation however can be a great barrier to firms' growth. As mentioned above, if productive firms use less than optimal resources for their operation due to inefficiencies, then they do not employ as many workers as they would have otherwise. Therefore, understanding firms' dynamics and productivity, and the main drivers of the distortions they face, is crucial in the effort to tackle Africa's high youth unemployment.

There are many factors that lead to misallocation in an economy. Some of these factors stem from government intervention, such as taxes and subsidies, and labor regulations. Particularly, if the government taxes (subsidizes) firms with high (low) productivity, then highly productive firms will be constrained while low productive firms expand. Other factors are institutional challenges, such as corruption and political instability.

The goal of this paper is to provide evidence on the link between institutional obstacles and distortions, with a closer look at financial constraints. I use a misallocation model following Hsieh and Klenow (2009) [20] with capital, labor, and intermediate inputs as factors of production. Calibrating the model using firm-level data from 12 sub-Saharan African countries, I derive measures of capital, labor, and output distortions. I then empirically test the relationship between these measures of misallocation and obstacles firms face, namely in transportation, access to land, access to finance, corruption, tax rates, labor regulations, inadequately educated workforce, and political instability. I first use within- and cross-country firm-level OLS regressions with industry and country fixed effects of these measures of misallocation on the obstacles, to unveil the relationship between them. Preliminary results suggest that financial constraints are the main determinants of distortions, especially output distortions, in most countries considered in my study. I then focus on financial constraints and run, again, within-country firm-level OLS regressions of the three measures of misallocation on financial constraints and a vector of controls, namely size, age, imports, exports, region, whether the firm is in an export processing zone, and the percentage of the firm owned by the government. Additionally, I investigate the role that managers' education and experience play in mitigating (or otherwise) distortions, by controlling for the managers' schooling years and years of experience, interacted with the measure of financial constraints.

I find from the cross-country analysis that financial constraints statistically significantly increase output distortions even after controlling for some confounding factors. I further find that size is the main channel through which financial constraints affect output misallocation. Specifically, smaller firms are more financially constrained, and even after controlling for the same degree of financial obstacles, smaller firms still face higher distortions. In other words, smaller firms have higher levels of misallocation relative to bigger firms, holding the severity of financial constraints constant, meaning that size exacerbates the negative effect

[3] "Why SMEs are key to growth in Africa" https://www.weforum.org/agenda/2015/08/why-smes-are-key-to-growth-in-africa/

that financial constraints have on misallocation. Moreover, there are lower distortions in export processing zones, which are industrial areas in which duty-free imported raw materials are processed for export. This result suggests that the policies and regulations in these zones are efficient in lowering size distortions. The within-country analysis suggests that financial constraints are determinants of output misallocation in three countries out of the twelve in my sample. The weak results in most countries may be due to the small sample sizes. In addition, there is evidence that managers' education and experience decrease output misallocation stemming from poor access to financing. Due to the possibility of bias of my results, I run some robustness checks, notably by using bootstrap standard errors and excluding size from my control variables. My baseline results are robust to such corrections, and these robustness checks strengthen my results.

I include a suggestive model of financial constraints following Midrigan and Xu (2014), Zetlin-Jones and Shourideh (2017), and Buera et al. (2011) [24] [28] [9] in Appendix D to illustrate the growth dynamics of firms when they are financially constrained. The equations characterizing the equilibrium of the model suggest that firms that are financially constrained use less factor inputs and therefore grow more slowly. [4]

The rest of the paper is structured as follows. I review the literature in section 2, outline the model of misallocation in section 3, and describe the main empirical results in section 4. I explore the role of managerial expertise, run robustness checks, develop a simple model of firm dynamics under financial constraints, and conclude in the remainder.

2 Related work

2.1 Misallocation Literature

There is a growing body of literature exploring misallocation of resources among firms both in developed and developing countries. Particularly, since the seminal paper by Hsieh and Klenow (2009) [20], there has been an increasing interest in analyzing the role that misallocation plays in cross-country differences in TFP and economic outcomes.

Several studies have demonstrated the significant and negative effects of misallocation on firm size, aggregate TFP, and GDP in various countries such as China, India, Italy, Portugal, and Mexico [7] [9] [12] [20] [15] [28] [4] [25]. Misallocation across firms within the same industries has been argued to be responsible for as much as 80% of TFP losses in Italy [12], 30-50% of TFP losses in China, and 40-60% in India [20]. Similar evidence is also found in African countries. Particularly, an optimal reallocation of resources across firms would arguably result in aggregate productivity gains of 30% in Côte d'Ivoire and as much as 160% in Kenya [13]. The growth of misallocation over time and its effects on

[4] Unfortunately, I was not able to calibrate the model using data from an African country because it requires firm-level panel data and I have not found adequate data for any sub-Saharan African country.

TFP and GDP have also been documented in Europe, where the degree of misallocation has been increasing over the years [15] [17]. For instance, in Portugal, over the period 1996-2011, it has been found that efficient allocation of resources would have increased gross output by 17% in 1996 and 28% in 2011 [15]. Misallocation accounts for a large proportion of TFP differences across countries and its magnitude is growing in some countries [5].

Given the apparent importance of misallocation in aggregate productivity and GDP, it is relevant to investigate the causes of misallocation, both within country and across industries, and across countries. Several studies have shed light on these drivers of misallocation. Such drivers include policies, obstacles firms face to optimally run their operations, and firm-level frictions such as adjustment costs. Particular attention has been given to capital misallocation, which stems mostly from adjustment costs and informational frictions, and idiosyncratic factors that affect firms' investment decisions such as unobserved heterogeneity in markups and production technologies [14]. For example, Bau's (2020) analysis of India's liberalization of foreign capital shows that policies restricting the use of production factors contribute greatly to misallocation [6]. Similarly, weak contract enforcement which signals weak rule of law has been argued cause misallocation and thus lower aggregate productivity [9]. Management practices, especially as they relate to the managers' education and the delegation of decision making have been documented to be main sources of low productivity among firms in developing countries [8].

In African countries, there is some evidence that points to financial frictions as the main source of misallocation of resources across firms [21] [22] [13]. Firms that face more severe access to finance obstacle have much higher marginal products of capital suggesting inefficiently low capital use. Other important sources of misallocation include trade regulations, the functioning of courts, crime, and corruption. Trade openness can lead to deeper inefficiencies as highly subsidized firms export and produce even more [3], and institutional obstacles such as bad functioning of courts and corruption present obstacles for firms to optimally use inputs and organize production [9] [22]. All these constraints have been documented to prevent firms from growing in productivity and size, and this stagnation has characterized firms in Africa for the past six decades at least [8].

Little research has focused on misallocation in sub-Saharan African countries. Of the papers cited above [21] [22] [13], only one has focused on sub-Saharan Africa [13], specifically on Kenya, Côte d'Ivoire, Ghana, and Ethiopia. My study not only extends this analysis to a broader set of African countries, but it also generalizes extant analyses by including intermediate inputs as a factor of production. All studies that look at African countries ignore intermediate inputs use at the firm level, and in my analysis, I find that intermediate inputs are substantially used by firms as factor inputs and size distortions with intermediate inputs taken into account are large. In addition, I find evidence that financial constraints increase intermediate inputs distortions relative to capital and labor misallocation in at least three African countries. Furthermore, I develop a model of financial frictions following Midrigan and Xu (2015), Zetlin-Jones and

Shourideh (2017), and Buera et al. (2011) [24] [30] [10] to underline the sources of limited financing and analytically suggest the dynamics of limited financing and firm productivity growth.

2.2 Financial Constraints and Firm Growth Literature

Financial constraints have been documented to be a barrier to firms' productivity and output growth and thus a source of misallocation, as reviewed by Buera et al. (2015) [11]. They have also been argued to limit firms' ability to innovate, grow, and invest in their capital stock, and this in turn leads to low capital levels and lower TFP [2] [16] [18] [30] [19]. In African countries, it has been found that low financial development contributes to the poor performance of firms and prevents them from growing, leading to a high concentration of smaller firms [2] [18].

The extent to which financial constraints constitute an obstacle to firms' growth also depends on the firms' own financing capacity. Firms experiencing high and positive productivity shocks can grow out of their financial constraints by using their own funds to finance their use of capital [24] [23] [26]. The aim of this paper is not only to unveil the link between misallocation and financial constraints, but to also study more closely the extent to which African firms are able to generate enough revenues and relax their borrowing constraints. These distortions related to financial constraints are most important in the manufacturing sector, where firms' attainment of large scale is relatively important [10]. As a result, studying the extent to which financial constraints limit firms' production and growth and the degree to which these firms can relax them through enough productivity growth is essential in understanding the potential for African countries to grow their manufacturing sector and industrialize their economies.

3 Model of Misallocation

3.1 Final Output

Final output in the economy is produced combining the output Y_s of S manufacturing industries using a Cobb-Douglas production function:

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

for S industries, where $\sum_{s=1}^{S} \theta_s = 1$. The final output production takes place in a perfectly competitive market, leading to a profit maximizing problem as follows:

$$\max_{Y_s} PY - \sum_{s=1}^{S} P_s Y_s \tag{2}$$

where P_s is the price of industry s' output, Y_s, and P is the price of the final output, Y, which I consider to be the numeraire, thus $P = 1$. Solving this profit maximization problem yields:

$$P_s Y_s = \theta_s PY \tag{3}$$

3.2 Industry-Level Output

The manufacturing sector comprises S industries, and each industry produces an output that is a CES aggregate of the differentiated products produced by the firms within the industry. Specifically, the industry-level production function is:

$$Y_s = [\sum_{i=1}^{I} Y_{si}^{\frac{\sigma-1}{\sigma}}]^{\frac{\sigma}{\sigma-1}} \tag{4}$$

for I firms, where σ governs the elasticity of substitution between different varieties. Assuming free entry and monopolistic competition, profit maximization at the industry level yields the following inverse demand functions:

$$P_{si} = P_s Y_s^{\frac{1}{\sigma}} Y_{si}^{\frac{-1}{\sigma}} \tag{5}$$

3.3 Firm-Level Output

Firms produce output using three inputs, namely capital K, labor L, and intermediate inputs M, using a CES aggregator as in Atalay (2017) [1]:

$$Y_{si} = A_{si}[(1-\mu_s)^{\frac{1}{\epsilon_m}}((\frac{K_{si}}{\alpha_s})^{\alpha_s}(\frac{L_{si}}{1-\alpha_s})^{1-\alpha_s})^{\frac{\epsilon_m-1}{\epsilon_m}} + \mu_s^{\frac{1}{\epsilon_m}} M_{si}^{\frac{\epsilon_m-1}{\epsilon_m}}]^{\frac{\epsilon_m}{\epsilon_m-1}} \tag{6}$$

where A_{si} is the firm's TFP, α_s and μ_s govern the firms' usage of capital, labor, and intermediate inputs, and ϵ_m is the elasticity of substitution between the capital and labor bundle, and intermediate inputs. I allow for firm-level capital, labor, and output distortions, τ_{ksi}, τ_{lsi}, and τ_{ysi} respectively. The output distortions affect all factors of production by increasing their marginal revenue products by the same proportion. The capital and labor distortions, on the other hand, increase the marginal revenue products of capital and labor respectively, relative to intermediate inputs'. Therefore, firms that face higher capital (labor) distortions are constrained in their use of capital (labor) relative to their use of intermediate inputs, and will have higher marginal revenue products of capital (labor) relative to intermediate inputs. Firms therefore solve this profit maximization problem:

$$\max_{K_{si},L_{si},M_{si}} (1-\tau_{ysi})P_{si}Y_{si} - (1+\tau_{ksi})R_sK_{si} - (1+\tau_{lsi})W_sL_{si} - Z_sM_{si} \tag{7}$$

where R_s is the rental rate of capital, W_s the wage rate, and Z_s the unit cost of intermediate inputs in sector s. Solving this profit maximization problem yields the following expressions for the distortions:

$$1-\tau_{ysi}=\frac{\sigma}{\sigma-1}\frac{\psi Z_s M_{si}^{\frac{1}{\epsilon_m}}}{P_{si}Y_{si}\mu_s^{\frac{1}{\epsilon_m}}} \tag{8}$$

$$1+\tau_{ksi}=(\frac{\alpha_s}{1-\alpha_s})^{1-\alpha_s}\frac{1-\mu_s}{\mu_s}^{\frac{1}{\epsilon_m}}\frac{\sigma}{\sigma-1}\frac{M_{si}^{\frac{1}{\epsilon_m}}Z_s(\frac{L_{si}}{K_{si}})^{1-\alpha_s}}{((\frac{K_{si}}{\alpha_s})^{\alpha_s}(\frac{L_{si}}{1-\alpha_s})^{1-\alpha_s})^{\frac{1}{\epsilon_m}}R_s} \tag{9}$$

$$1+\tau_{lsi}=(\frac{1-\alpha_s}{\alpha_s})^{\alpha_s}(\frac{1-\mu_s}{\mu_s})^{\frac{1}{\epsilon_m}}\frac{\sigma}{\sigma-1}\frac{M_{si}^{\frac{1}{\epsilon_m}}Z_s(\frac{K_{si}}{L_{si}})^{\alpha_s}}{((\frac{K_{si}}{\alpha_s})^{\alpha_s}(\frac{L_{si}}{1-\alpha_s})^{1-\alpha_s})^{\frac{1}{\epsilon_m}}W_s} \tag{10}$$

where

$$\psi=(1-\mu_s)^{\frac{1}{\epsilon_m}}((\frac{K_{si}}{\alpha_s})^{\alpha_s}(\frac{L_{si}}{1-\alpha_s})^{1-\alpha_s})^{\frac{\epsilon_m-1}{\epsilon_m}}+\mu_s^{\frac{1}{\epsilon_m}}M_{si}^{\frac{\epsilon_m-1}{\epsilon_m}} \tag{11}$$

In my analysis, I will use the measures of distortions in equations (8)-(10) to predict their determinants. As mentioned above, firm-level TFPs partly predict aggregate TFP and firm-level misallocation lowers aggregate TFP, which is the most important consequence of misallocation as it drives cross-country differences in productivity and growth. The use of intermediate inputs and the CES production function does not make the mapping from firm-level TFPs to aggregate TFP as straight forward as in a Cobb-Douglas production function. In this paper, I have not explored the consequences of firm-level misallocation on aggregate TFP as I have not derived a transformation to link firm-level and aggregate TFPs.

4 Misallocation in Sub-Saharan Africa- An Empirical Analysis

The first part of my analysis consists of quantitatively and empirically analyzing the degree of misallocation in sub-Saharan African countries and estimating the extent to which financial constraints (and other obstacles) drive these distortions. I use data from the Enterprise Survey by the World Bank.

4.1 Data

The Enterprise Survey study is conducted by the World Bank and covers small, medium, and large firms in the manufacturing, the services, the transportation, and the construction sectors. The firms are interviewed, and the questionnaires cover questions ranging from firms' characteristics such as age, size, and industry group, to firms' operations such as their sales, costs of production, and assets. These surveys have been conducted for a couple of rounds in most African countries, in different years, and are largely cross-sectional with some smaller panels available for some countries.

For each of the countries included in my analysis, I use data from the 2005, 2006, or 2007 surveys, which are when most African countries were covered for the first time. I include countries for which all the variables needed for the analysis are reported. My study includes firms in the manufacturing sector only because capital data are not reported for firms in the services sector. To make sure the analysis is not biased by outliers on revenue, labor costs, replacement costs of capital, and costs of materials, I drop observations that are three standard deviations away from their means in each country. Finally, I include only countries that have more than 100 observations. See Table 1 for a list of the 12 sub-Saharan African countries in my final sample along with the years of survey and the sample sizes.

Table 1: List of Countries

Country	Year	Sample Size
Angola	2006	189
Cameroon	2006	102
Ethiopia	2006	229
Ghana	2007	268
Guinea	2006	121
Madagascar	2005	117
Mali	2007	251
Mozambique	2007	336
Nigeria	2007	884
Senegal	2007	244
Uganda	2006	290
Zambia	2007	279

Notes: List of countries included in my analysis, after excluding countries with less than 100 observations and countries with missing variables. The sample size is the size of the data with manufacturing firms only and after eliminating outliers, specifically, observations that are 3 standard deviation away from the mean of sales, capital, labor, intermediate inputs.

For my analysis, I use the firms' reported sales as their revenues ($P_{si}Y_{si}$), the replacement value of all machinery and equipment as their level of capital (K_{si}), their total cost of labor, including wages, salaries and bonuses, and social payments as the amount of labor hired (L_{si}), and their total spending on raw materials and intermediate inputs as the level of intermediate inputs used (M_{si}). Firms are also asked to determine, on a scale of 0 to 4, the extent to which a specific factor is an obstacle to them, higher values meaning more severe obstacles. Such factors include access to infrastructure and to services such as transportation and financing; taxes; weak institutions such as corruption and political instability. I use these variables in my regression analysis to estimate the extent to which they drive firm-level distortions. Table 2 presents summary statistics. We can see that access to finance constitutes the most severe obstacle with an average value of 2.4, followed by tax rates with an average of 1.8. Labor regulations seem to be the least severe obstacles in these sample countries, with an average of .5. Figure 1 plots the firms' ratings of access to finance as an obstacle. Most firms, over 55%, reported access to finance to be a very severe or a major obstacle.

Table 2: Obstacles

Variable	Observations	Mean	Stand Dev.	Min	Max
Access to finance	3,383.00	2.36	1.50	0.00	4.00
Tax rates	3,386.00	1.84	1.38	0.00	4.00
Transportation	3,386.00	1.51	1.30	0.00	4.00
Corruption	3,387.00	1.29	1.41	0.00	4.00
Access to land	3,379.00	1.24	1.39	0.00	4.00
Inadequately educated workforce	3,386.00	0.86	1.12	0.00	4.00
Political instability	3,219.00	0.75	1.11	0.00	4.00
Labor regulations	3,387.00	0.54	0.90	0.00	4.00

Notes: Firms are asked to rank, on a scale from 0 to 4, the extent to which each of these presents an obstacle to their operations, 0 being not an obstacle at all and 4 being very severe obstacles. Countries: Madagascar (2005); Angola, Cameroon, Ethiopia, Guinea, and Uganda (2006); Ghana, Mali, Mozambique, Nigeria, Senegal and Zambia (2007)

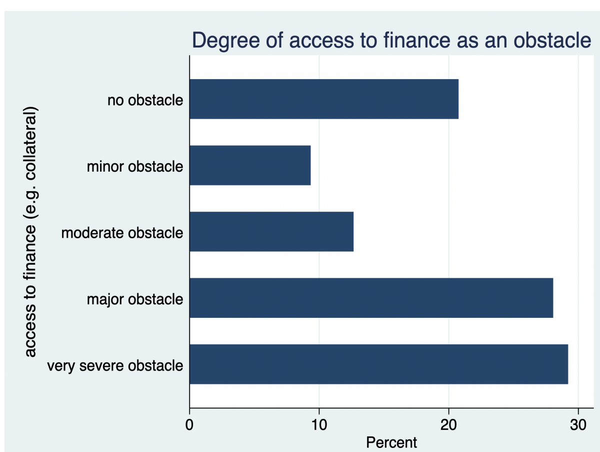

Fig. 1: Degree of access to finance obstacle

Notes: Countries: Madagascar 2005; Angola, Cameroon, Ethiopia, Guinea, Uganda and 2006; Ghana, Mali, Mozambique, Nigeria, Senegal and Zambia 2007.

Additional variables used in my analysis are size, age, whether the firm is in an export processing zone, the percentage of sales that are directly exported, the percentage of inputs imported, the percentage of the firm owned by the government, and the region in which the firm is located. The size variable ranges from 0 to 2, for small, medium, and big firms respectively. Small enterprises are defined as enterprises with less than 10 employees, medium ones are enterprises with employees between 11 and 100, and large enterprises are those with more than 100 employees. Figure 2 plots the size distribution of the firms, and we can see that the distribution is highly skewed to the right. There are many small firms and very few large ones. The export processing zone variable is a dummy that takes the value of 1 if the firm is in an export processing zone and 0 otherwise.

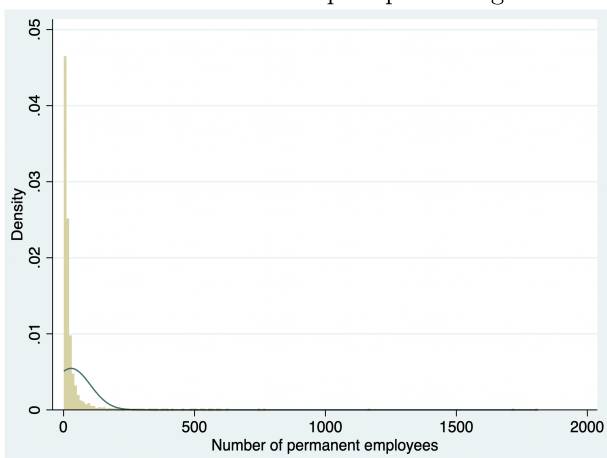

Fig. 2: Firm size distribution

Notes: Bin size is 10.

4.2 Calibration

To calibrate parameters in the model, I follow the literature in setting some parameter values, and use firms' optimization problem to derive expressions for the parameters governing the shares of inputs in the total costs. Specifically, I set $\sigma = 3$ and assume $R_s = \delta_s + r_s$, where $\delta_s = r_s = .05$. Following Atalay (2017) [1], I set $\epsilon_m = .84$, which is the lower bound found by Atalay as the interval for the values of ϵ_m is between .84 and .88. Moreover, I assume $W_s = 1$ so total labor compensation is L_{si} and is my labor inputs, and similarly, $Z_s = 1$ so intermediate input costs$=M_{si}$. Finally, from the firms' optimization problem, I obtain the following:

$$\alpha_s = \frac{R_s K_{si}}{R_s K_{si} + L_{si}} \tag{12}$$

$$\mu_s = \frac{\frac{Z_s M_{si}}{R_s K_{si} + W_s L_{si}}^{\epsilon_m} VA^{\epsilon_m - 1}}{\frac{Z_s M_{si}}{R_s K_{si} + W_s L_{si}}^{\epsilon_m} VA^{\epsilon_m - 1} + M_{si}^{\epsilon_m - 1}} \tag{13}$$

where

$$VA = (\frac{K_{si}}{\alpha_s})^{\alpha_s} (\frac{L_{si}}{1 - \alpha_s})^{1 - \alpha_s} \tag{14}$$

I included in Appendix B the derivation of α_{si} and μ_s.

4.3 Misallocation and Firms' Obstacles

I use the calibrated model to derive measures of output, capital, and labor misallocation, namely τ_{ysi}, τ_{ksi}, and τ_{lsi} respectively. I first conduct a general diagnosis of the extent to which different obstacles that firms face contribute to the degree of misallocation in these countries. I run OLS regressions for each country with industry fixed effects of the different measures of misallocation on eight sources of obstacles: access to finance, transportation, access to land, tax rates, labor regulations, corruption, workforce education, and political instability, as follows:

$$log(1 - \tau_{ysi}) = \alpha_1 + \alpha_2 O_i + \delta_s + \mu_i \tag{15}$$

$$log(1 + \tau_{ksi}) = \beta_1 + \beta_2 O_i + \delta_s + \epsilon_i \tag{16}$$

$$log(1 + \tau_{lsi}) = \lambda_1 + \lambda_2 O_i + \delta_s + \theta_i \tag{17}$$

for firm i in industry s, where O_i is the vector of obstacles and δ_s is industry fixed effects. I report the results for each country in Appendix C. Note that since the dependent variable in equation (15) is $log(1 - \tau_{ysi})$, a negative coefficient indicates higher output misallocation (the dependent variable is essentially a measure of allocative efficiency). Access to finance is by far the obstacle that contributes most significantly to output misallocation among firms in half of the countries. Some other factors increase output distortions, such as corruption in Nigeria, labor regulations in Ethiopia, and political instability in Zambia and Uganda. Capital and labor distortions are not affected by these obstacles, I therefore focus on output misallocation.

Furthermore, I look at the effects of each of these obstacles separately on output misallocation using the cross-section of all countries in my sample. Specifically, I run the following regression:

$$log(1 - \tau_{ycsi}) = \alpha_1 + \alpha_2 O_i + \alpha_3 X_i + \delta_{sc} + \epsilon_i \tag{18}$$

for firm i in sector s in country c, where O_i is an obstacle; X_i is the vector of controls: size, age, whether the firm is in an export processing zone, the percentage of sales that are directly exported, the percentage of inputs imported, the percentage of the firm owned by the government, and the region in which the firm is located; δ_{sc} are sector and country fixed effects.

Table 3 reports the results from specification (18). These cross-country results again show that access to financing remains important in predicting output distortions in Africa. Specifically, firms facing more access to financing obstacles are more distorted. Another obstacle that statistically significantly affects output misallocation, but decreases it, is labor regulations. Given the importance of financial constraints in driving misallocation in Africa, I decided to focus on such obstacles for the purpose of my study.

I therefore run the following regressions, for each country and at the firm level:

$$log(1 - \tau_{ysi}) = \alpha_1 + \alpha_2 F_i + \alpha_3 X_i + \delta_s + \mu_i \tag{19}$$

$$log(1 + \tau_{ksi}) = \beta_1 + \beta_2 F_i + \lambda_3 X_i + \delta_s + \epsilon_i \tag{20}$$

$$log(1 + \tau_{lsi}) = \lambda_1 + \lambda_2 F_i + \lambda_3 X_i + \delta_s + \theta_i \tag{21}$$

where F_i is the degree to which the firm faces financial constraints; X_i is my vector of controls; and δ_s is industry fixed effects. Tables 4 to 17 show the results of the regressions for the 12 countries in my analysis. Models 1, 2, and 3 in tables 6 to 17 are equations (19), (20) and (21) respectively without the controls, Model 4 is equation (19) with only size and its interaction with F_i as controls, and Model 5 is equation (19) with all controls, along with interactions of size with F_i and whether the firm is in an export processing zone. Model 5 is my preferred specification given it focuses on output distortions which seem to be more relevant and includes all the variables I deem important in determining output distortions. I reported the results from Model 5 for all countries in Tables 4 and 5. I focus on output misallocation since it seems to be more significantly driven by financial constraints relative to labor and capital misallocation. Although capital misallocation has been documented in the literature as a main consequence of market inefficiencies and an important source of distortions, the evidence from African countries suggests that financial constraints do not play an important role in predicting it.

Looking at Tables 4 and 5, we can see that under Model 5, financial constraints increase output misallocation in Mozambique, Senegal, and Ghana. Size is an important determinant of distortions in many countries, with bigger firms being less distorted. In Mozambique and Senegal, bigger firms are disproportionately less affected by financial constraints relative to smaller ones. Being in an export processing zone (EPZ=1) decreases distortions in Senegal and Ethiopia, after holding size constant. My results may not be statistically significant in some countries due to the small sample sizes, especially in Guinea, Cameroon, and Angola. That is why the cross-country analysis gives stronger results on the effect of financial constraints on output distortions.

Tables 6 to 17 give more granular analysis of the determinants of distortions in each country. There is considerable cross-country heterogeneity in the sources of misallocation and importance of financial constraints. Without controlling for size and the other firm characteristics, financial constraints are drivers of output misallocation in Ethiopia, Ghana, Mali, Mozambique, Nigeria, and Senegal (Model 1). But once I control for size and its interaction with F_i (Model 4), financial constraints become statistically significant in fewer countries while size becomes a statistically significant predictor of the degree of misallocation. The differential effect of financial constraints on misallocation between smaller and bigger firms in Model 4 is given by the coefficient on the interaction between size and financial constraints. This coefficient is significant in Madagascar, Mozambique, Nigeria, and Senegal. A significant and positive coefficient means that the disproportionate effect of financial constraints on distortions is larger on smaller firms relative to bigger ones. That is the case in Mozambique and Senegal.

The sum of the coefficients on size and the interaction between size and financial constraints is the effect of being a big firm on output misallocation relative to being smaller, conditional on being financially constrained. This sum is positive and statistically significant in Madagascar, Mozambique, Nigeria, and Senegal, meaning that in these countries, conditional on being financially constrained, bigger firms face lower distortions. These results suggest that size is the main channel through which financial constraints affect output misallocation. Particularly, in Madagascar, Mozambique, Nigeria, and Senegal, a firm is more able to overcome its financial challenges the bigger it is.

In Angola (Table 6), age and imports seem to be important determinants of firms' output distortions, which decrease with higher imports but increase with age (Model 5).

Financial constraints are not drivers of misallocation in Cameroon (Table 7) but trade matters a lot. Both imports and exports decrease misallocation, and being in an EPZ also decreases output distortions.

In Ethiopia (Table 8), the location of the firm is a strong determinant of output misallocation. Firms in export processing zones are less distorted, even after controlling for size.

Being in an export processing zone does not decrease the degree of output misallocation for firms in Ghana (Table 9), but financial constraints and size affect misallocation. More financially constrained and smaller firms have higher output distortions. The region in which the firm is located also seems to predict the level of misallocation.

In Guinea, neither financial constraints nor size affect misallocation (Table 10). Only the region in which the firm is located and imports play an important role in how much misallocation it experiences. Although my analysis in Madagascar is limited due to the small number of observations, the results are nonetheless very interesting (Table 11). In Model 1, financial constraints increase output distortions but once I control for size in Models 4 and 5, financial constraints are no longer important, suggesting that size is the channel through which financial constraints affect misallocation. Specifically, the coefficient on the interaction between financial constraints and size is statistically significant and negative, meaning that financial constraints disproportionately affect bigger firms more relative to small ones. Older firms experience lower distortions.

Size is a determinant of output distortions in Mali (Table 12), as bigger firms face lower output distortions. I also find that financial constraints decrease capital misallocation. This suggests that being financially constrained decreases the marginal revenue product of capital relative to intermediate inputs, which means financial constraints affect the firm's use of intermediate inputs relative to capital.

Mozambique is subject to multiple factors that distort allocations, where both capital and labor distortions decrease with financial constraints (Table 13). These results suggest that difficulty accessing financing constrains the firms' use of intermediate inputs relative to labor and capital, thus decreasing the marginal revenue products of capital and labor relative to intermediate inputs'. Financial constraints, size, imports, government ownership, and region all affect output distortions. Again, firms that are more financially constrained and smaller face more output distortions, and holding the degree of financial obstacles constant, bigger firms face lower distortions relative to small ones.

Size, age, exporting, and region are the main determinants of firms' output distortions in Nigeria (Table 14). Bigger and older firms are less confronted with output distortions, and exporting also reduces distortions. Moreover, being in an EPZ decreases output misallocation.

Most of the factors considered in my analysis seem to play important roles in output distortions in Senegal, except for age and region (Table 15). The results in Senegal are consistent with most of the results stated above, with tighter financial constraints leading to higher misallocation. On the other hand, both importing and exporting as well as having larger establishments lower the levels of misallocation. Not being in an export processing zone disproportionately increases output distortions for smaller firms more than for bigger firms.

Only size and trade seem to matter in Uganda in predicting output distortions (Table 16). Consistent with results found in several countries, bigger firms and those that export and import more are less likely to face distortions.

Finally, in Zambia, size is the strongest determinant of output misallocation, with bigger firms facing significantly lower distortions (Table 17). Older firms and those that trade more also experience lower distortions.

Overall, financial constraints are non-negligible factors driving output misallocation in some sub-Saharan African countries, even after controlling for other confounding factors. Size is the main channel through which these financial constraints affect misallocation. In other words, firms that are more financially constrained are smaller, and potentially grow more slowly, which leads to size distortions. Even given the same degree of financial constraints, bigger firms are less distorted, suggesting that their size allows them to overcome distortions despite the financial obstacles. Export processing zones are generally favorable as there are significantly lower distortions in those zones even after controlling for size. This is an important result as it suggests that the policy environment in these zones, if expanded to more areas, have the potential to decrease misallocation in a given country. Trade is also a favorable factor in many countries where exporting and/ or importing lessen the degree of distortions.

Given the importance of size, I conduct my analysis above on output distortions by firm size. Specifically, I run equation (19) by firm size, bundling small and medium enterprises, and big enterprises. The results are reported in Table 18, where we can clearly see that financing constraints are drivers of output distortions for small and medium enterprises only. However, it is important to note that the sample size for the large firms is very small, and that may be the reason why the coefficients are not statistically significant.

5 The Role of Managers' Education and Experience

Literature dating back to the 1960s has documented the importance of education and human capital in economic growth, and particularly in stimulating production [27] [29]. Here, I investigate the role that the managers' education and experience play in the extent to which their firms are constrained financially and face distortions as a result. The rationale is that experienced, and highly educated managers may be able to better use financial institutions to finance their firms' activities, innovate, and invest in technology, and as a result, are less constrained in their use of factor inputs. In Tables 19 and 20, I run specification (19) using the cross-section of all countries, with country and sector fixed effects (column 1 Table 19), and for each country individually with sector fixed effects.

With the cross-section of countries, we can see from Table 19 that the manager's education decreases output distortions, while their experience does not have a significant effect on misallocation. The same results on manager's education are found in Ethiopia, Ghana, Mozambique, Uganda, and Zambia. Additionally, the sum of the coefficients on education and the interaction between education and financial constraint is the effect of manager's education for firms that are financially constrained. This sum is positive in all countries except in Guinea, meaning that holding the level of financial constraints constant, managers' education has a negative effect (decreases) output misallocation. Furthermore, in Senegal, financial constraints have a disproportionate negative effect on output misallocation for firms with more highly educated managers relative to firms with less educated managers, while in Ghana the opposite is found. On the other hand, managers' experience lowers output distortions in Angola and Mozambique only. Holding the degree of financial constraints constant however, managers' experience lowers output misallocation in all countries except in Cameroon, Guinea, Senegal, and Zambia. Therefore, there is evidence that management practices stemming from education and experience matter when it comes to firms' production and distortions. In sum, common results on the effect of managers' education on output distortions are found in Ethiopia, Ghana, Mozambique, Uganda, and Zambia, and in Angola and Mozambique for managers' experience. There is cross-country heterogeneity however between Senegal and Ghana on the disproportionate effect of financial constraints on misallocation for firms with managers of different educational attainments.

6 Robustness Checks

6.1 Bootstrap Standard Errors

I run some robustness checks to verify that my results are strong and insensitive to some confounding factors. First, I run the same specifications (18 and 19) but using bootstrap standard errors to correct for the standard errors and control for any possible bias of my coefficients. The results are reported in Tables 33, 34, and 35 in Appendix D. In Table 33, access to financing remains the only obstacle that statistically significantly increases output distortions. There is also still evidence that labor regulations decrease misallocation as found previously. Additionally, the bootstrap standard errors strengthen my results as now, financial constraints increase output distortions in Mozambique, Senegal, and Ghana, as found in my baseline model, but also in Madagascar. Size, being in an export processing zone, and trade all still strongly predict whether firms face more or less output distortions in most of my sample countries. My baseline results are therefore robust to correcting for the standard errors.

6.2 Excluding Size as a Control

Another concern from my analysis is the endogeneity of size. Specifically, the explanatory variable size as measured by the number of employees in the firm is correlated with the measure of output distortions that includes a measure of labor costs. To check whether this endogeneity issue biases my results, I run the same regressions with the same controls excluding size. The results are reported in Tables 36 and 37 in Appendix C. Excluding size strengthens my baseline results. Particularly, now financial constraints increase output misallocation in Ethiopia and Mali in addition to Mozambique, Senegal, and Ghana. However, I find evidence that in Guinea firms that are more financially constrained have lower output distortions.

7 Sources of Financing

Financial constraints seem to be relatively important obstacles in the cross-section of my sample sub-Saharan African countries. A more granular look into the different sources of financing for firms in all the sample countries reveals that firms barely use financial institutions to finance their working capital. As shown in Figure 3, the main source of financing for firms is their internal funds and retained earnings which finance 72% of their working capital. This is followed by the funds raised from purchases on credit from suppliers and advances from customers that cover 19.5% of the working capital. Banks finance a very small proportion of the firms' working capital, at 4.5%, being the third least important source of financing after non-bank financial institutions and other, that includes informal sources of financing such as money borrowed from family and friends.

I plot the sources of financing by firm size in Figure 4. Not surprisingly, bigger firms use financial institutions to finance their working capital more relative to smaller firms. Banks finance 2.4% of small firms' working capital, 8.3% of medium-sized firms' working capital, and 14.8% of big firms' working capital. Banks finance bigger firms more probably because the latter have more assets and so have higher collateral resources. This explains why bigger firms are less constrained financially and face lower distortions due to financial constraints. These figures expose the weak financial development in these countries and suggest why smaller firms are more financially constrained and face more distortions. Given that smaller firms tend to raise less revenue, they will have less means to finance their own working capital if they do not use financial institutions. Figures 5 and 6 further show that firms really do not use banks to fund their activities, as less than 20% of all firms in the sample had applied for a loan in the year before they were interviewed, and less than 15% had a line of credit at the time of the interview. Again, bigger firms are more likely to have applied for a loan and to have a line of credit. Among those that applied for a line of credit and got rejected, most of them, over 50%, were rejected because of a lack of collateral (Figure 6).

Given these findings, for firms to be less constrained financially, they need to be able to generate high revenues so they can use their funds to expand. In

Appendix E, I solve a suggestive model of financial constraints to illustrate mechanisms by which productivity and size determine firms' (in)ability to overcome financial challenges and show the growth dynamics when firms are financially constrained.

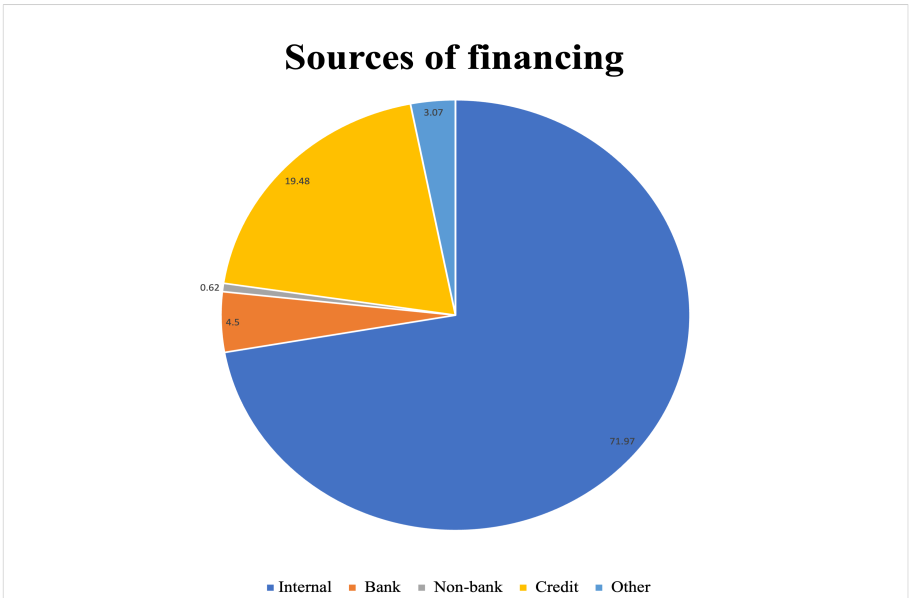

Fig. 3: Sources of financing working capital

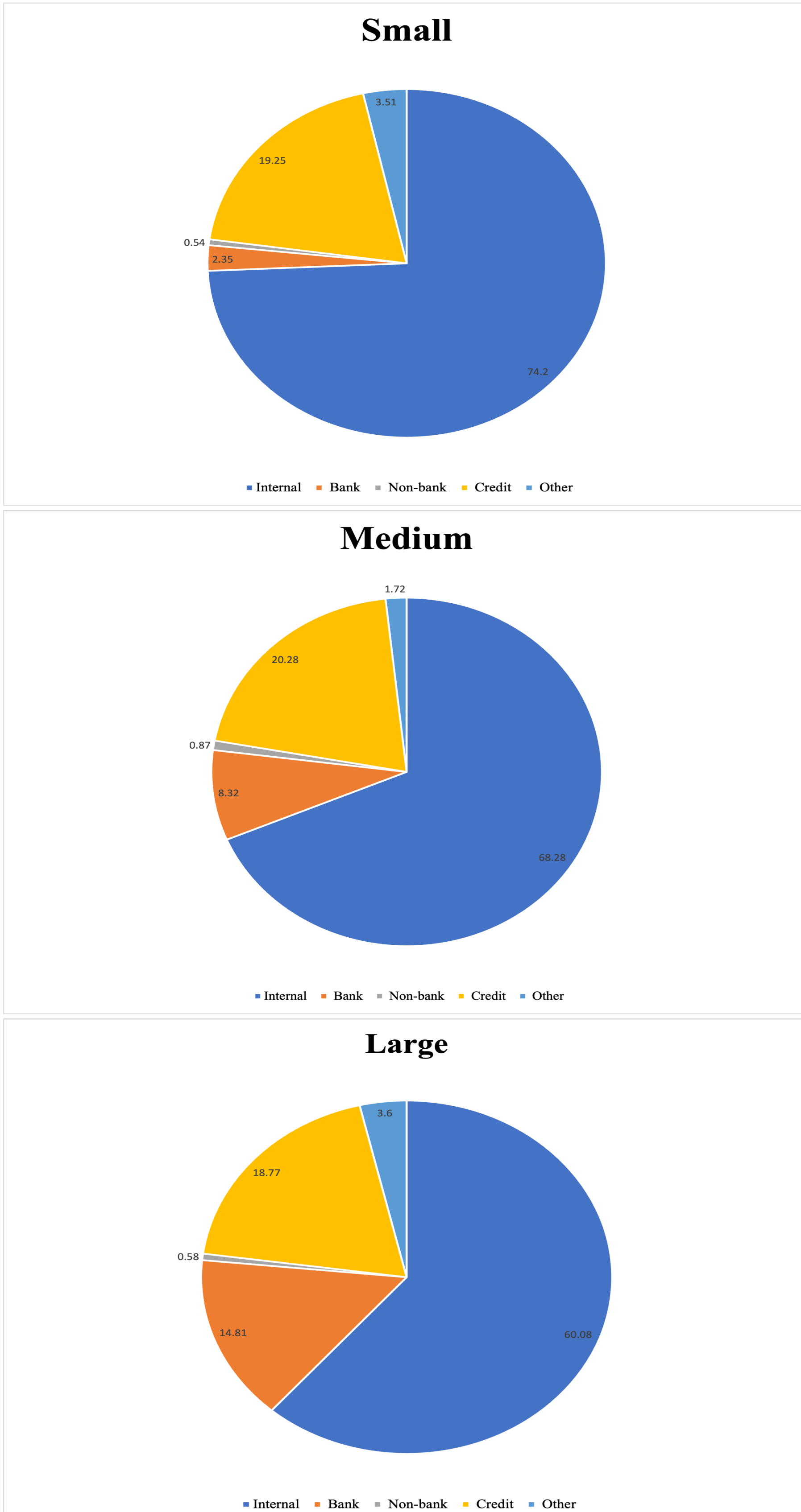

Fig. 4: Sources of financing working capital by firm size

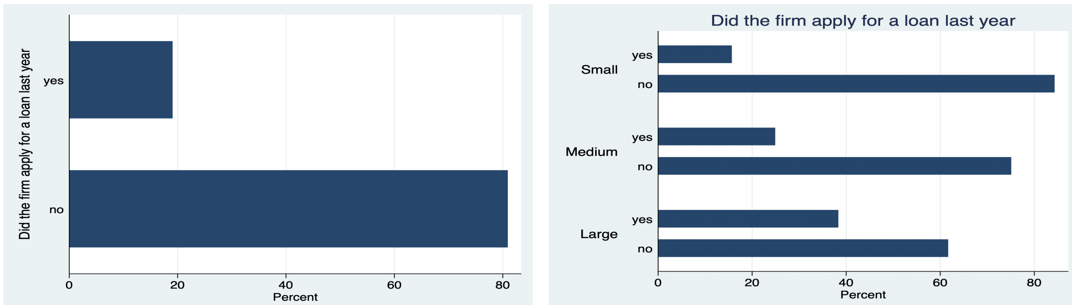

Fig. 5: Loan application

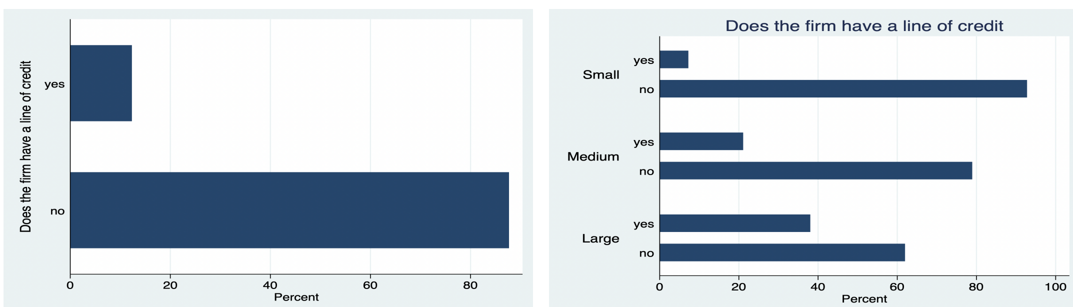

Fig. 6: Existence of a line of credit

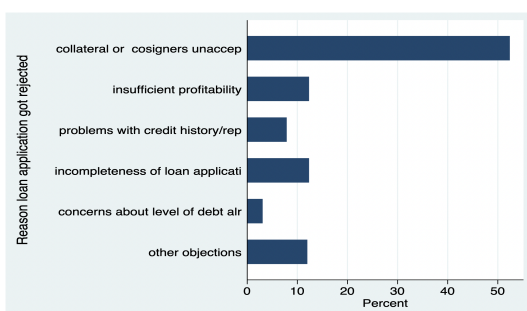

Fig. 7: Loan application rejection- reasons

8 Conclusion

In this paper, I provided evidence that in various countries across sub-Saharan Africa, financial obstacles are main drivers of misallocation of resources across firms. These financial obstacles constrain smaller firms from growing and therefore they face even more distortions compared to bigger firms. And even holding the degree of financial constraint constant, smaller firms face higher distortions than bigger ones, suggesting that bigger firms are able to overcome their financial obstacles more relative to smaller ones. I also find evidence that export processing zones are favorable in lowering output distortions, as are managers' education level and experience.

The main limitation of this study is the lack of adequate firm-level panel data in African countries. To show the growth dynamics of firms and the ways in which productivity and size allow them to overcome their borrowing constraint using the model of financial constraint, it is necessary to have firm-level panel data for firms of all sizes. I leave the development of such data to future research.

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Appendix A

Tables of Results

Table 3: Regressions of output distortions on all obstacles

	Financing	Transportation	Labor Reg	Land	Tax	Corruption	Education
Obstacle	-0.089****	-0.012	0.16****	-0.034	0.042	-0.022	0.025
	(0.023)	(0.028)	(0.041)	(0.025)	(0.025)	(0.026)	(0.032)
Size	1.63****	1.76****	1.79****	1.73****	1.74****	1.68****	1.68****
	(0.1)	(0.094)	(0.076)	(0.084)	(0.01)	(0.083)	(0.08)
Obstacle × size	0.066*	0.01	-0.041	0.045	0.027	0.092**	0.13**
	(0.036)	(0.041)	(0.061)	(0.042)	(0.041)	(0.042)	(0.049)
Age	0.0034	0.0032	0.0036	0.003	0.003	0.003	0.003
	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)
EPZ	0.40****	0.40****	0.38****	0.40****	0.41****	0.41****	0.40****
	(0.095)	(0.096)	(0.095)	(0.096)	(0.095)	(0.096)	(0.096)
EPZ × size	0.07	0.061	0.065	0.065	0.063	0.044	0.036
	(0.13)	(0.13)	(0.13)	(0.13)	(0.13)	(0.13)	(0.13)
Percentage of inputs imported	0.0048****	0.0048****	0.0047****	0.0049****	0.0047****	0.0048****	0.0046****
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
Percentage of sales exported	0.010****	0.010****	0.010****	0.010****	0.010****	0.010****	0.0098***
	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)
Percentage owned by state	0.0069**	0.0069**	0.0066**	0.007**	0.007**	0.0074**	0.0047
	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)
Region	0.016	0.019	0.027*	0.017	0.02	0.02	0.023*
	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)
Observations	3091	3091	3091	3091	3091	3091	3091

Standard errors in parentheses

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$, **** $p < 0.001$

Notes: OLS regressions with industry and country fixed effects. Dependent variable is a measure of output allocative efficiency, $log(1 - \tau_{ysi})$, so a negative coefficient indicates higher output misallocation.

Table 4: Output distortions and financial constraints

	Mozambique	Senegal	Ghana	Madagascar	Nigeria	Zambia
Financial constraint	-0.30****	-0.14*	-0.24**	0.23	0.034	0.019
	(0.072)	(0.074)	(0.093)	(0.22)	(0.038)	(0.098)
Size	1.75****	0.84**	1.26***	1.56***	1.57****	1.47****
	(0.33)	(0.39)	(0.44)	(0.52)	(0.19)	(0.23)
Financial constraint × size	0.35****	0.33**	0.12	-0.32*	-0.11	0.071
	(0.10)	(0.15)	(0.14)	(0.17)	(0.069)	(0.11)
Age	0.00099	-0.012	0.0042	0.043**	0.016**	0.025***
	(0.008)	(0.012)	(0.0097)	(0.019)	(0.0064)	(0.0084)
EPZ	0.27	0.3	0.3	1.18	0.52**	0.16
	(0.25)	(0.47)	(0.43)	(1.19)	(0.21)	(0.39)
EPZ × size	-0.045	0.96*	-0.22	-0.15	-0.14	0.10
	(0.33)	(0.57)	(0.52)	(0.76)	(0.32)	(0.35)
Percentage of inputs imported	0.0059**	0.0055*	-0.0049		-0.00072	0.011****
	(0.0029)	(0.003)	(0.0038)		(0.0023)	(0.0032)
Percentage of sales exported	-0.0006	0.018*	0.013		0.026**	0.016*
	(0.0079)	(0.0098)	(0.01)		(0.011)	(0.0092)
Observations	336	244	268	117	884	279
Adjusted R^2	0.439	0.301	0.287	0.092	0.245	0.406

Standard errors in parentheses
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$, **** $p < 0.001$

Notes: OLS regressions with industry fixed effects. Dependent variable is a measure of output allocative efficiency, $log(1 - \tau_{ysi})$, so a negative coefficient indicates higher output misallocation.

Table 5: Output distortions and financial constraints

	Angola	Cameroon	Ethiopia	Uganda	Guinea	Mali
Financial constraint	0.028	-0.0064	-0.18	-0.13	0.16	-0.058
	(0.072)	(0.25)	(0.12)	(0.086)	(0.12)	(0.057)
Size	0.42	1.16*	2.09****	1.8****	1.18	1.27***
	(0.57)	(0.59)	(0.39)	(0.39)	(1.17)	(0.44)
Financial constraint × size	0.23	-0.11	0.069	0.078	0.2	0.0026
	(0.17)	(0.18)	(0.14)	(0.13)	(0.48)	(0.16)
Age	-0.027**	-0.018	0.0017	-0.0068	-0.01	-0.0036
	(0.011)	(0.016)	(0.013)	(0.012)	(0.021)	(0.012)
EPZ	0.28	1.48*	2.67****	0.22	-0.31	0.47*
	(0.18)	(0.76)	(0.52)	(0.24)	(0.51)	(0.26)
EPZ × size	0.73	0.07	-1.32**	-0.089	0	-0.021
	(0.54)	(0.53)	(0.54)	(0.34)	(.)	(0.66)
Percentage of inputs imported	0.0062**	0.025****	0.0007	0.018****	0.0085*	-0.00065
	(0.0025)	(0.0052)	(0.0046)	(0.0036)	(0.0045)	(0.0028)
Percentage of sales exported	0.24	0.022***	-0.0075	0.017**	-0.012	0.0086
	(0.24)	(0.0076)	(0.012)	(0.007)	(0.017)	(0.0078)
Observations	189	102	229	290	121	251
Adjusted R^2	0.174	0.535	0.397	0.439	0.046	0.082

Standard errors in parentheses

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$, **** $p < 0.001$

Notes: OLS regressions with industry fixed effects. Dependent variable is a measure of output allocative efficiency, $log(1 - \tau_{ysi})$, so a negative coefficient indicates higher output misallocation.

Table 6: Angola

	Model 1	Model 2	Model 3	Model 4	Model 5
Financial constraint	0.0091	-0.058	-0.026	-0.015	0.028
	(0.067)	(0.1)	(0.05)	(0.069)	(0.072)
Size				0.93*	0.42
				(0.54)	(0.57)
Financial constraint × size				0.18	0.23
				(0.17)	(0.17)
Age					-0.027**
					(0.011)
EPZ					0.28
					(0.18)
EPZ × size					0.73
					(0.54)
Percentage of inputs imported					0.0062**
					(0.0025)
Percentage of sales exported					0.24
					(0.24)
Region					-0.16
					(0.145)
Observations	189	189	189	189	189
Adjusted R^2	-0.027	-0.025	-0.026	0.091	0.174

Standard errors in parentheses
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$, **** $p < 0.001$

Notes: OLS regressions with industry fixed effects. Models 1, 4 and 5: dependent variable is the degree of output allocative efficiency, $log(1 - \tau_{ysi})$, so a negative coefficient indicates higher output misallocation. Model 2: dependent variable is capital misallocation, $log(1 + \tau_{ksi})$. Model 3: dependent variable is labor misallocation, $log(1 + \tau_{lsi})$.

Table 7: Cameroon

	Model 1	Model 2	Model 3	Model 4	Model 5
Financial constraint	-0.29	-0.21	-0.13	-0.25	-0.0064
	(0.2)	(0.13)	(0.11)	(0.31)	(0.25)
Size				1.35^{*}	1.16^{*}
				(0.7)	(0.59)
Financial constraint × size				0.21	-0.11
				(0.22)	(0.18)
Age					-0.018
					(0.016)
EPZ					1.48^{*}
					(0.76)
EPZ × size					0.07
					(0.53)
Percentage of inputs imported					0.025^{****}
					(0.0052)
Percentage of sales exported					0.022^{***}
					(0.0076)
Observations	103	103	103	103	102
Adjusted R^2	-0.024	-0.025	-0.039	0.282	0.535

Standard errors in parentheses
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$, **** $p < 0.001$

Notes: OLS regressions with industry fixed effects. Models 1, 4 and 5: dependent variable is the degree of output allocative efficiency, $log(1 - \tau_{ysi})$, so a negative coefficient indicates higher output misallocation. Model 2: dependent variable is capital misallocation, $log(1 + \tau_{ksi})$. Model 3: dependent variable is labor misallocation, $log(1 + \tau_{lsi})$.

Table 8: Ethiopia

	Model 1	Model 2	Model 3	Model 4	Model 5
Financial constraint	-0.24*	0.067	-0.049	-0.18	-0.18
	(0.13)	(0.092)	(0.073)	(0.13)	(0.12)
Size				2.24****	2.087****
				(0.34)	(0.39)
Financial constraint × size				0.091	0.069
				(0.15)	(0.14)
Age					0.0017
					(0.013)
EPZ					2.67****
					(0.52)
EPZ × size					-1.32**
					(0.54)
Percentage of inputs imported					0.0007
					(0.0046)
Percentage of sales exported					-0.0075
					(0.012)
Percentage owned by state					0.0053
					(0.0069)
Region					-0.12****
					(0.035)
Observations	229	229	229	229	229
Adjusted R^2	0.004	-0.015	-0.014	0.325	0.397

Standard errors in parentheses

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$, **** $p < 0.001$

Notes: OLS regressions with industry fixed effects. Models 1, 4 and 5: dependent variable is the degree of output allocative efficiency, $log(1 - \tau_{ysi})$, so a negative coefficient indicates higher output misallocation. Model 2: dependent variable is capital misallocation, $log(1 + \tau_{ksi})$. Model 3: dependent variable is labor misallocation, $log(1 + \tau_{lsi})$.

Table 9: Ghana

	Model 1	Model 2	Model 3	Model 4	Model 5
Financial constraint	-0.27***	0.0036	-0.05	-0.24**	-0.24**
	(0.087)	(0.077)	(0.065)	(0.095)	(0.093)
Size				1.42****	1.26***
				(0.42)	(0.44)
Financial constraint× size				0.085	0.12
				(0.14)	(0.14)
Age					0.0042
					(0.0097)
EPZ					0.303
					(0.43)
EPZ × size					-0.22
					(0.52)
Percentage of inputs imported					-0.00485
					(0.0038)
Percentage of sales exported					0.013
					(0.010)
Percentage owned by state					0.011
					(0.015)
Region					-0.460****
					(0.103)
Observations	268	268	268	268	268
Adjusted R^2	0.021	-0.015	-0.013	0.234	0.287

Standard errors in parentheses
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$, **** $p < 0.001$

Notes: OLS regressions with industry fixed effects. Models 1, 4 and 5: dependent variable is the degree of output allocative efficiency, $log(1 - \tau_{ysi})$, so a negative coefficient indicates higher output misallocation. Model 2: dependent variable is capital misallocation, $log(1 + \tau_{ksi})$. Model 3: dependent variable is labor misallocation, $log(1 + \tau_{lsi})$.

Table 10: Guinea

	Model 1	Model 2	Model 3	Model 4	Model 5
Financial constraint	0.16	-0.0041	0.0016	0.16	0.16
	(0.11)	(0.11)	(0.087)	(0.11)	(0.12)
Size				0.64	1.18
				(1.086)	(1.17)
Financial constraint × size				0.08	0.21
				(0.43)	(0.48)
Age					-0.010
					(0.021)
EPZ					-0.31
					(0.51)
Percentage of inputs imported					0.0085*
					(0.0045)
Percentage of sales exported					-0.012
					(0.017)
Percentage owned by state					-0.038
					(0.032)
Region					-1.005**
					(0.49)
Observations	121	121	121	121	121
Adjusted R^2	-0.024	-0.043	-0.043	-0.014	0.046

Standard errors in parentheses
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$, **** $p < 0.001$

Notes: OLS regressions with industry fixed effects. Models 1, 4 and 5: dependent variable is the degree of output allocative efficiency, $log(1 - \tau_{ysi})$, so a negative coefficient indicates higher output misallocation. Model 2: dependent variable is capital misallocation, $log(1 + \tau_{ksi})$. Model 3: dependent variable is labor misallocation, $log(1 + \tau_{lsi})$.

Table 11: Madagascar

	Model 1	Model 2	Model 3	Model 4	Model 5
Financial constraint	-0.22	0.076	0.04	0.16	0.23
	(0.15)	(0.14)	(0.11)	(0.22)	(0.22)
Size				1.57***	1.56***
				(0.51)	(0.52)
Financial constraint × size				-0.29*	-0.32*
				(0.17)	(0.17)
Age					0.043**
					(0.019)
EPZ					1.18
					(1.19)
EPZ × size					-0.15
					(0.76)
Observations	117	117	117	117	117
Adjusted R^2	-0.011	-0.032	-0.031	0.077	0.092

Standard errors in parentheses
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$, **** $p < 0.001$

Notes: OLS regressions with industry fixed effects. Models 1, 4 and 5: dependent variable is the degree of output allocative efficiency, $log(1-\tau_{ysi})$, so a negative coefficient indicates higher output misallocation. Model 2: dependent variable is capital misallocation, $log(1+\tau_{ksi})$. Model 3: dependent variable is labor misallocation, $log(1+\tau_{lsi})$.

Table 12: Mali

	Model 1	Model 2	Model 3	Model 4	Model 5
Financial constraint	-0.11**	-0.076	-0.03	-0.072	-0.058
	(0.054)	(0.052)	(0.046)	(0.056)	(0.057)
Size				1.29***	1.27***
				(0.41)	(0.44)
Financial constraint × size				0.0043	0.0026
				(0.16)	(0.16)
Age					-0.0036
					(0.012)
EPZ					0.47*
					(0.26)
EPZ × size					-0.021
					(0.66)
Percentage of inputs imported					-0.00065
					(0.0028)
Percentage of sales exported					0.0086
					(0.0078)
Region					-0.026
					(0.094)
Observations	251	251	251	251	251
Adjusted R^2	0.002	-0.004	-0.012	0.078	0.082

Standard errors in parentheses

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$, **** $p < 0.001$

Notes: OLS regressions with industry fixed effects. Models 1, 4 and 5: dependent variable is the degree of output allocative efficiency, $log(1 - \tau_{ysi})$, so a negative coefficient indicates higher output misallocation. Model 2: dependent variable is capital misallocation, $log(1 + \tau_{ksi})$. Model 3: dependent variable is labor misallocation, $log(1 + \tau_{lsi})$.

Table 13: Mozambique

	Model 1	Model 2	Model 3	Model 4	Model 5
Financial constraint	-0.27****	-0.14*	-0.14***	-0.31****	-0.30****
	(0.077)	(0.081)	(0.047)	(0.073)	(0.072)
Size				1.92****	1.75****
				(0.26)	(0.33)
Financial constraint × size				0.29***	0.35****
				(0.10)	(0.10)
Age					0.00099
					(0.008)
EPZ					0.27
					(0.25)
EPZ × size					-0.045
					(0.33)
Percentage of inputs imported					0.0059**
					(0.0029)
Percentage of sales exported					-0.0006
					(0.0079)
Percentage owned by state					0.081**
					(0.038)
Region					-0.38****
					(0.10)
Observations	336	336	336	336	336
Adjusted R^2	0.024	-0.003	0.013	0.410	0.439

Standard errors in parentheses
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$, **** $p < 0.001$

Notes: OLS regressions with industry fixed effects. Models 1, 4 and 5: dependent variable is the degree of output allocative efficiency, $log(1 - \tau_{ysi})$, so a negative coefficient indicates higher output misallocation. Model 2: dependent variable is capital misallocation, $log(1 + \tau_{ksi})$. Model 3: dependent variable is labor misallocation, $log(1 + \tau_{lsi})$.

Table 14: Nigeria

	Model 1	Model 2	Model 3	Model 4	Model 5
Financial constraint	-0.11***	0.032	-0.03	-0.011	0.034
	(0.036)	(0.037)	(0.026)	(0.039)	(0.038)
Size				1.69****	1.57****
				(0.19)	(0.2)
Financial constraint × size				-0.12*	-0.11
				(0.071)	(0.069)
Age					0.016**
					(0.0064)
EPZ					0.52**
					(0.21)
EPZ × size					-0.14
					(0.32)
Percentage of inputs imported					-0.00072
					(0.0023)
Percentage of sales exported					0.026**
					(0.011)
Region					0.134****
					(0.0153)
Observations	884	884	884	884	884
Adjusted R^2	0.005	-0.005	-0.004	0.165	0.245

Standard errors in parentheses
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$, **** $p < 0.001$

Notes: OLS regressions with industry fixed effects. Models 1, 4 and 5: dependent variable is the degree of output allocative efficiency, $log(1 - \tau_{ysi})$, so a negative coefficient indicates higher output misallocation. Model 2: dependent variable is capital misallocation, $log(1 + \tau_{ksi})$. Model 3: dependent variable is labor misallocation, $log(1 + \tau_{lsi})$.

Table 15: Senegal

	Model 1	Model 2	Model 3	Model 4	Model 5
Financial constraint	-0.13*	-0.098	-0.022	-0.15**	-0.14*
	(0.079)	(0.063)	(0.051)	(0.074)	(0.074)
Size				1.19****	0.84**
				(0.34)	(0.39)
Financial constraint × size				0.4***	0.33**
				(0.14)	(0.15)
Age					-0.012
					(0.012)
EPZ					0.3
					(0.47)
EPZ × size					0.96*
					(0.57)
Percentage of inputs imported					0.0055*
					(0.003)
Percentage of sales exported					0.018*
					(0.0098)
Region					-0.07
					(0.1)
Observations	244	244	244	244	244
Adjusted R^2	-0.005	-0.006	-0.016	0.265	0.301

Standard errors in parentheses

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$, **** $p < 0.001$

Notes: OLS regressions with industry fixed effects. Models 1, 4 and 5: dependent variable is the degree of output allocative efficiency, $log(1 - \tau_{ysi})$, so a negative coefficient indicates higher output misallocation. Model 2: dependent variable is capital misallocation, $log(1 + \tau_{ksi})$. Model 3: dependent variable is labor misallocation, $log(1 + \tau_{lsi})$.

Table 16: Uganda

	Model 1	Model 2	Model 3	Model 4	Model 5
Financial constraint	-0.1	0.03	-0.025	-0.15*	-0.13
	(0.096)	(0.077)	(0.054)	(0.089)	(0.086)
Size				2.31****	1.8****
				(0.37)	(0.39)
Financial constraint × size				0.015	0.078
				(0.13)	(0.13)
Age					-0.0068
					(0.012)
EPZ					0.22
					(0.24)
EPZ × size					-0.089
					(0.34)
Percentage of inputs imported					0.018****
					(0.0036)
Percentage of sales exported					0.017**
					(0.007)
Region					-0.025
					(0.09)
Observations	290	290	290	290	290
Adjusted R^2	-0.014	-0.017	-0.017	0.385	0.439

Standard errors in parentheses
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$, **** $p < 0.001$

Notes: OLS regressions with industry fixed effects. Models 1, 4 and 5: dependent variable is the degree of output allocative efficiency, $log(1 - \tau_{ysi})$, so a negative coefficient indicates higher output misallocation. Model 2: dependent variable is capital misallocation, $log(1 + \tau_{ksi})$. Model 3: dependent variable is labor misallocation, $log(1 + \tau_{lsi})$.

Table 17: Zambia

	Model 1	Model 2	Model 3	Model 4	Model 5
Financial constraint	-0.07	0.037	-0.07	0.037	-0.12**
-0.045	0.019				
	(0.095)	(0.071)	(0.05)	(0.1)	(0.098)
Size				1.74****	1.47****
				(0.22)	(0.23)
Financial constraint × size				0.14	0.071
				(0.11)	(0.11)
Age					0.025***
					(0.0084)
EPZ					0.16
					(0.39)
EPZ × size					0.10
					(0.35)
Percentage of inputs imported					0.011****
					(0.0032)
Percentage of sales exported					0.016*
					(0.0092)
Percentage owned by state					-0.004
					(0.008)
Region					0.21**
					(0.10)
Observations	279	279	279	279	279
Adjusted R^2	-0.013	-0.014	0.006	0.346	0.406

Standard errors in parentheses
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$, **** $p < 0.001$

Notes: OLS regressions with industry fixed effects. Models 1, 4 and 5: dependent variable is the degree of output misallocation, $log(1-\tau_{ysi})$, so a negative coefficient indicates higher output misallocation. Model 2: dependent variable is capital misallocation, $log(1-\tau_{ksi})$. Model 3: dependent variable is labor misallocation, $log(1+\tau_{ksi})$.

Table 18: Regressions of output distortions by size

	All	Small and Medium	Large
Financing constraint	-0.12****	-0.12****	0.024
	(0.03)	(0.034)	(0.21)
Age	0.017***	0.012***	0.032
	(0.0052)	(0.0044)	(0.026)
EPZ	0.61****	0.54****	0.36
	(0.11)	(0.11)	(0.31)
Percentage of inputs imported	0.0086****	0.0079****	0.001
	(0.002)	(0.0019)	(0.0074)
Percentage of sales exported	0.025****	0.022****	0.0011
	(0.0028)	(0.0047)	(0.0066)
Percentage owned by state	0.022***	0.015**	-0.015
	(0.0084)	(0.0066)	(0.013)
Region	0.0071	0.018	-0.24
	(0.045)	(0.045)	(0.2)
Observations	3091	2978	113

Standard errors in parentheses
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$, **** $p < 0.001$

Notes: OLS regressions with industry and country fixed effects, by size of enterprises. Dependent variable is the degree of output allocative efficiency, $log(1-\tau_{ysi})$, so a negative coefficient indicates higher output misallocation.

Table 19: Regressions of output distortions on financial constraint

	All	Angola	Cameroon	Ethiopia	Ghana	Guinea
Financial constraint	-0.0019	0.18	0.21	-0.054	0.16	-0.094
	(0.066)	(0.29)	(0.57)	(0.28)	(0.29)	(0.29)
Size	1.80****	1.40****	2.04****	1.65****	1.45****	1.11**
	(0.070)	(0.29)	(0.32)	(0.27)	(0.20)	(0.50)
Manager education	0.21****	0.13	0.33	0.50****	0.41***	-0.11
	(0.032)	(0.15)	(0.22)	(0.14)	(0.14)	(0.13)
Financial constraint × manager education	-0.0064	-0.0030	-0.071	0.027	-0.094**	0.032
	(0.010)	(0.048)	(0.069)	(0.059)	(0.047)	(0.042)
Manager experience	0.0053	0.050*	-0.094	0.017	0.0038	-0.058
	(0.0067)	(0.030)	(0.078)	(0.023)	(0.023)	(0.042)
Financial constraint × Manager experience	-0.0032	-0.021**	0.016	-0.0098	0.0038	0.0084
	(0.0024)	(0.0095)	(0.024)	(0.010)	(0.0076)	(0.016)
Observations	2376	189	100	229	268	121
Adjusted R^2	0.316	0.118	0.318	0.392	0.276	-0.003

Standard errors in parentheses

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$, **** $p < 0.001$

Notes: OLS regressions with industry fixed effects (and country fixed effects for the first column). Dependent variable is the degree of output allocative efficiency, $log(1 - \tau_{ysi})$, so a negative coefficient indicates higher output misallocation.

Table 20: Regressions of output distortions on financial constraint

	Mali	Mozambique	Nigeria	Senegal	Uganda	Zambia
Financial constraint	-0.074	-0.024	0.18	-0.53****	0.42	0.35
	(0.13)	(0.19)	(0.65)	(0.15)	(0.30)	(0.31)
Size	1.12****	1.94****	1.27***	1.44****	2.13****	1.72****
	(0.29)	(0.19)	(0.38)	(0.23)	(0.18)	(0.17)
Manager education	0.11	0.33****	0.072	0.064	0.39***	0.35***
	(0.075)	(0.096)	(0.26)	(0.068)	(0.13)	(0.11)
Financial constraint × manager education	0.0035	0.00088	-0.055	0.078***	-0.066	-0.050
	(0.025)	(0.031)	(0.093)	(0.026)	(0.041)	(0.048)
Manager experience	0.0024	0.027*	0.015	-0.018	0.040	0.0023
	(0.021)	(0.015)	(0.047)	(0.017)	(0.035)	(0.017)
Financial constraint × Manager experience	-0.00014	-0.010*	-0.0064	0.011*	-0.011	0.00080
	(0.0068)	(0.0053)	(0.021)	(0.0063)	(0.012)	(0.0080)
Observations	251	336	69	244	290	279
Adjusted R^2	0.092	0.458	0.105	0.337	0.413	0.403

Standard errors in parentheses
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$, **** $p < 0.001$

Notes: OLS regressions with industry fixed effects. Dependent variable is the degree of output allocative efficiency, $log(1 - \tau_{ysi})$, so a negative coefficient indicates higher output misallocation.

Appendix B

Derivation of Cost Shares

From the prodution function:

$$Y_{si} = A_{si}[(1-\mu_s)^{\frac{1}{\epsilon_m}}((\frac{K_{si}}{\alpha_s})^{\alpha_s}(\frac{L_{si}}{1-\alpha_s})^{1-\alpha_s})^{\frac{\epsilon_m-1}{\epsilon_m}} + \mu_s^{\frac{1}{\epsilon_m}} M_{si}^{\frac{\epsilon_m-1}{\epsilon_m}}]^{\frac{\epsilon_m}{\epsilon_m-1}} \tag{22}$$

I derive:

$$\frac{\partial Y_{si}}{\partial K_{si}} = \frac{Y_{si}}{\psi}(1-\mu_s)^{\frac{1}{\epsilon_m}} VA^{\frac{-1}{\epsilon_m}}(\frac{K_{si}}{\alpha_s})^{\alpha_s-1}(\frac{L_{si}}{1-\alpha_s})^{1-\alpha_s} \tag{23}$$

$$\frac{\partial Y_{si}}{\partial L_{si}} = \frac{Y_{si}}{\psi}(1-\mu_s)^{\frac{1}{\epsilon_m}} VA^{\frac{-1}{\epsilon_m}}(\frac{K_{si}}{\alpha_s})^{\alpha_s}(\frac{L_{si}}{1-\alpha_s})^{-\alpha_s} \tag{24}$$

$$\frac{\partial Y_{si}}{\partial M_{si}} = \frac{Y_{si}}{\psi}\mu_s^{\frac{1}{\epsilon_m}} M_{si}^{\frac{-1}{\epsilon_m}} \tag{25}$$

where

$$\psi = (1-\mu_s)^{\frac{1}{\epsilon_m}}((\frac{K_{si}}{\alpha_s})^{\alpha_s}(\frac{L_{si}}{1-\alpha_s})^{1-\alpha_s})^{\frac{\epsilon_m-1}{\epsilon_m}} + \mu_s^{\frac{1}{\epsilon_m}} M_{si}^{\frac{\epsilon_m-1}{\epsilon_m}} \tag{26}$$

$$VA = (\frac{K_{si}}{\alpha_s})^{\alpha_s}(\frac{L_{si}}{1-\alpha_s})^{1-\alpha_s} \tag{27}$$

From the profit function, assuming a frictionless environment:

$$Y_{si} = \frac{\pi}{P_{si}} + \frac{R_s K_{si}}{P_{si}} + \frac{W_s L_{si}}{P_{si}} + \frac{Z_s M_{si}}{P_{si}} \tag{28}$$

I have:

$$\frac{\partial Y_{si}}{\partial K_{si}} = \frac{R_s}{P_{si}} \tag{29}$$

$$\frac{\partial Y_{si}}{\partial L_{si}} = \frac{W_s}{P_{si}} \tag{30}$$

$$\frac{\partial Y_{si}}{\partial M_{si}} = \frac{Z_s}{P_{si}} \tag{31}$$

Equating equations 15, 16, 17 to equations 20, 21, 22 respectively, I get:

$$\frac{R_s}{P_{si}} = \frac{Y_{si}}{\psi}(1-\mu_s)^{\frac{1}{\epsilon_m}} VA^{\frac{-1}{\epsilon_m}}(\frac{K_{si}}{\alpha_s})^{\alpha_s-1}(\frac{L_{si}}{1-\alpha_s})^{1-\alpha_s} \tag{32}$$

$$\frac{W_s}{P_{si}} = \frac{Y_{si}}{\psi}(1-\mu_s)^{\frac{1}{\epsilon_m}} VA^{\frac{-1}{\epsilon_m}}(\frac{K_{si}}{\alpha_s})^{\alpha_s}(\frac{L_{si}}{1-\alpha_s})^{-\alpha_s} \tag{33}$$

$$\frac{Z_s}{P_{si}} = \frac{Y_{si}}{\psi}\mu_s^{\frac{1}{\epsilon_m}} M_{si}^{\frac{-1}{\epsilon_m}} \tag{34}$$

Denote by A, B, C the capital, labor and intermediate inputs cost shares respectively. I obtain:

$$A \equiv \frac{\frac{R_s}{P_{si}}K_{si}}{Y_{si}} = \frac{1}{\psi}(1-\mu_s)^{\frac{1}{\epsilon_m}} VA^{\frac{-1}{\epsilon_m}} (\frac{K_{si}}{\alpha_s})^{\alpha_s - 1} (\frac{L_{si}}{1-\alpha_s})^{1-\alpha_s} K_{si} \tag{35}$$

$$B \equiv \frac{\frac{W_s}{P_{si}}L_{si}}{Y_{si}} = \frac{1}{\psi}(1-\mu_s)^{\frac{1}{\epsilon_m}} VA^{\frac{-1}{\epsilon_m}} (\frac{K_{si}}{\alpha_s})^{\alpha_s} (\frac{L_{si}}{1-\alpha_s})^{-\alpha_s} \tag{36}$$

$$C \equiv \frac{\frac{Z_s}{P_{si}}M_{si}}{Y_{si}} = \frac{1}{\psi}\mu_s^{\frac{1}{\epsilon_m}} M_{si}^{\frac{-1}{\epsilon_m}} \tag{37}$$

Now, I take the ratio between A and B and get:

$$\frac{A}{B} = \frac{\alpha_s}{1-\alpha_s} \tag{38}$$

Which yields:

$$\alpha_s = \frac{A}{A+B} \equiv \frac{R_s K_{si}}{R_s K_{si} + W_s L_{si}} \tag{39}$$

And to derive μ_s, I take the ratio between A and C and simplify to obtain:

$$(\frac{1-\mu_s}{\mu_s})^{\frac{1}{\epsilon_m}} = (\frac{VA}{M_{si}})^{(}\frac{1-\epsilon_m}{\epsilon_m})\frac{A}{C} \tag{40}$$

Simplifying this equation gives:

$$\mu_s = \frac{M_{si}^{1-\epsilon_m} C^{\epsilon_m}}{M_{si}^{1-\epsilon_m} C^{\epsilon_m} + VA^{1-\epsilon_m} A^{\epsilon_m}} \tag{41}$$

Note that if I set $\epsilon_m = 1$, the expression breaks down to:

$$\mu_s = \frac{Z_s M_{si}}{Z_s M_{si} + R_s K si} \tag{42}$$

Appendix C

Regressions with multiple selected obstacles

Table 21: Angola: Distortions and Obstacles Regressions

	Output Distortions	Capital Distortions	Labor Distortions
Access to finance (availability and cost)	-0.0206	0.000339	0.00207
	(0.0715)	(0.104)	(0.0524)
Transportation	0.0155	-0.159	-0.0484
	(0.0817)	(0.119)	(0.0598)
Access to land	0.0919	0.273^{**}	0.152^{***}
	(0.0773)	(0.113)	(0.0566)
Tax rates	0.00962	-0.204	-0.0973
	(0.0915)	(0.133)	(0.0670)
Labor Regulations	-0.254^{*}	-0.526^{**}	-0.163
	(0.141)	(0.206)	(0.103)
Corruption	0.0315	0.335^{***}	-0.0279
	(0.0849)	(0.124)	(0.0621)
Workforce education	0.0596	-0.122	0.0322
	(0.123)	(0.179)	(0.0898)
Political instability	0.258^{**}	0.137	0.259^{***}
	(0.111)	(0.161)	(0.0810)
Constant	18.12^{****}	1.573^{***}	0.243
	(0.350)	(0.511)	(0.257)
Observations	189	189	189
Adjusted R^2	-0.003	0.077	0.049

Standard errors in parentheses
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$, **** $p < 0.001$

Notes: OLS regressions with industry fixed effects. Dependent variables: Output distortions is the degree of output allocative efficiency, $log(1 - \tau_{ysi})$, so a negative coefficient indicates higher output misallocation; Capital distortions is $log(1 + \tau_{ksi})$; Labor distortions is $log(1 + \tau_{lsi})$. Independent variables: on a scale of 0 to 4, degree to which each factor constitutes an obstacle to the firm, higher values meaning more severe obstacles.

Table 22: Cameroon: Distortions and Obstacles Regressions

	Output Distortions	Capital Distortions	Labor Distortions
Access to finance	-0.582**	-0.314**	-0.246*
	(0.225)	(0.148)	(0.127)
Transportation	0.568***	0.265*	0.224*
	(0.216)	(0.142)	(0.122)
Access to land	-0.348	-0.160	-0.111
	(0.237)	(0.156)	(0.134)
Tax rates	0.192	0.0867	0.283**
	(0.239)	(0.157)	(0.135)
Labor regulations	-0.289	0.108	-0.157
	(0.300)	(0.197)	(0.169)
Corruption	0.00575	0.0130	0.0104
	(0.0271)	(0.0179)	(0.0153)
Workforce education	0.0192	-0.238	-0.0401
	(0.256)	(0.169)	(0.145)
Political instability	0.302	-0.0433	-0.0844
	(0.224)	(0.147)	(0.126)
Constant	22.97****	1.416*	0.412
	(1.266)	(0.833)	(0.714)
Observations	102	102	102
Adjusted R^2	0.033	-0.019	0.015

Standard errors in parentheses

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$, **** $p < 0.001$

Notes: OLS regressions with industry fixed effects. Dependent variables: Output distortions is the degree of output allocative efficiency, $log(1 - \tau_{ysi})$, so a negative coefficient indicates higher output misallocation; Capital distortions is $log(1 + \tau_{ksi})$; Labor distortions is $log(1 + \tau_{lsi})$. Independent variables: on a scale of 0 to 4, degree to which each factor constitutes an obstacle to the firm, higher values meaning more severe obstacles.

Table 23: Ethiopia: Distortions and Obstacles Regressions

	Output Distortions	Capital Distortions	Labor Distortions
Access to finance	-0.151	-0.00273	-0.0800
	(0.124)	(0.0936)	(0.0728)
Transportation	0.200	-0.0941	-0.0884
	(0.164)	(0.124)	(0.0964)
Access to land	-0.360***	0.169*	-0.0332
	(0.119)	(0.0896)	(0.0696)
Tax rates	0.198	0.100	0.147*
	(0.129)	(0.0977)	(0.0759)
Labor regulations	0.763***	-0.141	0.205
	(0.236)	(0.178)	(0.138)
Corruption	-0.115	-0.0209	0.0666
	(0.141)	(0.107)	(0.0829)
Workforce education	0.311**	-0.157	-0.138*
	(0.136)	(0.103)	(0.0799)
Political instability	-0.00460	0.0178	0.0167
	(0.146)	(0.110)	(0.0856)
Constant	7.990****	0.653**	0.653***
	(0.409)	(0.309)	(0.240)
Observations	229	229	229
Adjusted R^2	0.097	-0.004	0.002

Standard errors in parentheses

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$, **** $p < 0.001$

Notes: OLS regressions with industry fixed effects. Dependent variables: Output distortions is the degree of output allocative efficiency, $log(1 - \tau_{ysi})$, so a negative coefficient indicates higher output misallocation; Capital distortions is $log(1 + \tau_{ksi})$; Labor distortions is $log(1 + \tau_{lsi})$. Independent variables: on a scale of 0 to 4, degree to which each factor constitutes an obstacle to the firm, higher values meaning more severe obstacles.

Table 24: Ghana: Distortions and Obstacles Regressions

	Output Distortions	Capital Distortions	Labor Distortions
Access to finance	-0.219**	0.0259	-0.0142
	(0.0888)	(0.0762)	(0.0643)
Transportation	0.188*	0.263***	0.302****
	(0.0995)	(0.0854)	(0.0721)
Access to land	-0.0421	-0.0561	-0.0539
	(0.0884)	(0.0759)	(0.0640)
Tax rates	0.105	-0.117	0.0147
	(0.0909)	(0.0780)	(0.0659)
Labor regulations	0.456**	0.0147	0.241*
	(0.195)	(0.168)	(0.142)
Corruption	-0.169	-0.298***	-0.229***
	(0.120)	(0.103)	(0.0870)
Workforce education	-0.312**	-0.307**	-0.106
	(0.149)	(0.128)	(0.108)
Political instability	0.0889	0.111	0.0120
	(0.208)	(0.178)	(0.151)
Constant	23.20****	0.998****	0.300
	(0.340)	(0.292)	(0.246)
Observations	268	268	268
Adjusted R^2	0.055	0.073	0.068

Standard errors in parentheses
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$, **** $p < 0.001$

Notes: OLS regressions with industry fixed effects. Dependent variables: Output distortions is the degree of output allocative efficiency, $log(1-\tau_{ysi})$, so a negative coefficient indicates higher output misallocation; Capital distortions is $log(1+\tau_{ksi})$; Labor distortions is $log(1+\tau_{lsi})$. Independent variables: on a scale of 0 to 4, degree to which each factor constitutes an obstacle to the firm, higher values meaning more severe obstacles.

Table 25: Guinea: Distortions and Obstacles Regressions

	Output Distortions	Capital Distortions	Labor Distortions
Access to finance (availability and cost)	0.0735	-0.0909	-0.0979
	(0.124)	(0.124)	(0.0978)
Transportation	0.146	0.227*	0.114
	(0.130)	(0.131)	(0.103)
Access to land	0.0662	0.141	0.0914
	(0.136)	(0.137)	(0.108)
Tax rates	-0.00463	-0.0639	-0.0188
	(0.122)	(0.123)	(0.0969)
Labor Regulations	0.319	0.145	0.226
	(0.228)	(0.230)	(0.181)
Corruption	0.0639	0.305**	0.154
	(0.128)	(0.129)	(0.102)
Inadequately educated workforce	0.0316	-0.327**	-0.0706
	(0.161)	(0.163)	(0.128)
Political instability	-0.0881	-0.0138	0.0353
	(0.135)	(0.136)	(0.107)
Constant	19.64****	0.0118	-0.316
	(0.670)	(0.675)	(0.531)
Observations	121	121	121
Adjusted R^2	-0.047	-0.012	-0.041

Standard errors in parentheses
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$, **** $p < 0.001$

Notes: OLS regressions with industry fixed effects. Dependent variables: Output distortions is the degree of output allocative efficiency, $log(1-\tau_{ysi})$, so a negative coefficient indicates higher output misallocation; Capital distortions is $log(1+\tau_{ksi})$; Labor distortions is $log(1+\tau_{lsi})$. Independent variables: on a scale of 0 to 4, degree to which each factor constitutes an obstacle to the firm, higher values meaning more severe obstacles.

Table 26: Madagascar: Distortions and Obstacles Regressions

	Output Distortions	Capital Distortions	Labor Distortions
Access to finance	-0.286**	-0.0737	-0.102
	(0.142)	(0.129)	(0.116)
Transportation	0.204	0.247	0.206
	(0.176)	(0.160)	(0.144)
Access to land	0.0856	0.110	0.135
	(0.159)	(0.144)	(0.129)
Tax rates	0.155	0.206	0.233*
	(0.163)	(0.148)	(0.133)
Labor regulations	0.0819	0.225	-0.0793
	(0.189)	(0.172)	(0.154)
Corruption	-0.428***	-0.462****	-0.244**
	(0.143)	(0.130)	(0.117)
Workforce education	0.239	0.138	0.100
	(0.153)	(0.139)	(0.125)
Constant	24.44****	0.540	0.315
	(0.539)	(0.490)	(0.439)
Observations	117	117	117
Adjusted R^2	0.038	0.063	0.012

Standard errors in parentheses
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$, **** $p < 0.001$

Notes: OLS regressions with industry fixed effects. Dependent variables: Output distortions is the degree of output allocative efficiency, $log(1 - \tau_{ysi})$, so a negative coefficient indicates higher output misallocation; Capital distortions is $log(1 + \tau_{ksi})$; Labor distortions is $log(1 + \tau_{lsi})$. Independent variables: on a scale of 0 to 4, degree to which each factor constitutes an obstacle to the firm, higher values meaning more severe obstacles.

Table 27: Mali: Distortions and Obstacles Regressions

	Output Distortions	Capital Distortions	Labor Distortions
Access to finance	-0.0920*	-0.0650	-0.0317
	(0.0550)	(0.0541)	(0.0464)
Transportation	-0.0176	-0.0138	0.0596
	(0.0735)	(0.0724)	(0.0620)
Access to land	-0.0501	-0.0438	-0.0679
	(0.0718)	(0.0707)	(0.0606)
Tax rates	-0.0415	-0.0375	0.000116
	(0.0579)	(0.0570)	(0.0489)
Labor regulations	0.0737	-0.0485	0.0158
	(0.142)	(0.139)	(0.119)
Corruption	0.123*	0.0339	0.0326
	(0.0747)	(0.0735)	(0.0630)
Workforce education	0.0684	0.0276	0.0786
	(0.0985)	(0.0970)	(0.0831)
Political instability	-0.0461	-0.000835	0.0113
	(0.159)	(0.156)	(0.134)
Constant	19.96****	0.968****	0.454**
	(0.212)	(0.209)	(0.179)
Observations	251	251	251
Adjusted R^2	-0.007	-0.026	-0.027

Standard errors in parentheses
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$, **** $p < 0.001$

Notes: OLS regressions with industry fixed effects. Dependent variables: Output distortions is the degree of output allocative efficiency, $log(1 - \tau_{ysi})$, so a negative coefficient indicates higher output misallocation; Capital distortions is $log(1 + \tau_{ksi})$; Labor distortions is $log(1 + \tau_{lsi})$. Independent variables: on a scale of 0 to 4, degree to which each factor constitutes an obstacle to the firm, higher values meaning more severe obstacles.

Table 28: Mozambique: Distortions and Obstacles Regressions

	Output Distortions	Capital Distortions	Labor Distortions
Access to finance	-0.283****	-0.150*	-0.150***
	(0.0779)	(0.0847)	(0.0495)
Transportation	-0.103	0.0417	-0.0310
	(0.0953)	(0.104)	(0.0606)
Access to land	-0.0190	-0.228**	-0.0302
	(0.105)	(0.114)	(0.0666)
Tax rates	0.00108	0.0146	0.0408
	(0.0915)	(0.0994)	(0.0582)
Labor regulations	0.374***	-0.109	0.00390
	(0.138)	(0.150)	(0.0876)
Corruption	0.259***	0.0598	0.0945
	(0.0936)	(0.102)	(0.0595)
Workforce education	0.150	0.0879	0.0105
	(0.106)	(0.115)	(0.0671)
Political instability	-0.341**	-0.307**	-0.118
	(0.142)	(0.155)	(0.0905)
Constant	17.25****	1.232****	0.727****
	(0.265)	(0.288)	(0.169)
Observations	336	336	336
Adjusted R^2	0.081	0.006	0.009

Standard errors in parentheses
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$, **** $p < 0.001$

Notes: OLS regressions with industry fixed effects. Dependent variables: Output distortions is the degree of output allocative efficiency, $log(1 - \tau_{ysi})$, so a negative coefficient indicates higher output misallocation; Capital distortions is $log(1 + \tau_{ksi})$; Labor distortions is $log(1 + \tau_{lsi})$. Independent variables: on a scale of 0 to 4, degree to which each factor constitutes an obstacle to the firm, higher values meaning more severe obstacles.

Table 29: Nigeria: Distortions and Obstacles Regressions

	Output Distortions	Capital Distortions	Labor Distortions
Access to finance (e.g. collateral)	-0.0296	0.0502	-0.0158
	(0.0399)	(0.0411)	(0.0291)
Transportation	-0.0553	-0.0304	-0.0195
	(0.0467)	(0.0482)	(0.0341)
Access to land	-0.0809*	-0.0236	-0.00413
	(0.0416)	(0.0429)	(0.0304)
Tax rates	0.00283	0.0410	0.0585*
	(0.0439)	(0.0452)	(0.0320)
Labor regulations	0.120*	0.107	0.0330
	(0.0690)	(0.0711)	(0.0504)
Corruption	-0.150****	0.0352	-0.0266
	(0.0446)	(0.0460)	(0.0326)
Workforce education	-0.0262	-0.168**	-0.0436
	(0.0648)	(0.0668)	(0.0473)
Political instability	-0.0169	-0.0938*	-0.0410
	(0.0527)	(0.0543)	(0.0384)
Constant	18.74****	0.910****	0.546****
	(0.133)	(0.137)	(0.0970)
Observations	884	884	884
Adjusted R^2	0.027	0.001	-0.004

Standard errors in parentheses
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$, **** $p < 0.001$

Notes: OLS regressions with industry fixed effects. Dependent variables: Output distortions is the degree of output allocative efficiency, $log(1 - \tau_{ysi})$, so a negative coefficient indicates higher output misallocation; Capital distortions is $log(1 + \tau_{ksi})$; Labor distortions is $log(1 + \tau_{lsi})$. Independent variables: on a scale of 0 to 4, degree to which each factor constitutes an obstacle to the firm, higher values meaning more severe obstacles.

Table 30: Senegal

	Output Distortions	Capital Distortions	Labor Distortions
Access to finance	-0.172**	-0.0993	-0.0519
	(0.0837)	(0.0669)	(0.0534)
Transportation	-0.0540	0.0335	0.0616
	(0.0939)	(0.0751)	(0.0599)
Access to land	-0.110	-0.0720	0.0140
	(0.0969)	(0.0774)	(0.0618)
Tax rates	0.162*	0.0539	0.0749
	(0.0959)	(0.0767)	(0.0612)
Labor regulations	-0.233	-0.0369	-0.155
	(0.150)	(0.120)	(0.0959)
Corruption	0.0906	0.0177	0.0836
	(0.111)	(0.0884)	(0.0705)
Workforce education	0.182	-0.0906	0.0976
	(0.129)	(0.103)	(0.0826)
Political instability	0.253	0.116	0.0360
	(0.158)	(0.126)	(0.101)
Constant	20.98****	1.079****	0.387**
	(0.245)	(0.196)	(0.156)
Observations	244	244	244
Adjusted R^2	0.010	-0.024	-0.005

Standard errors in parentheses

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$, **** $p < 0.001$

Notes: OLS regressions with industry fixed effects. Dependent variables: Output distortions is the degree of output allocative efficiency, $log(1 - \tau_{ysi})$, so a negative coefficient indicates higher output misallocation; Capital distortions is $log(1 + \tau_{ksi})$; Labor distortions is $log(1 + \tau_{lsi})$. Independent variables: on a scale of 0 to 4, degree to which each factor constitutes an obstacle to the firm, higher values meaning more severe obstacles.

Table 31: Uganda

	Output Distortions	Capital Distortions	Labor Distortions
Access to finance (availability and cost)	-0.0738	0.0565	-0.0171
	(0.0935)	(0.0762)	(0.0550)
Transportation	0.0445	0.180^{**}	0.0276
	(0.0986)	(0.0803)	(0.0580)
Access to land	-0.275^{***}	0.000322	-0.0219
	(0.104)	(0.0843)	(0.0609)
Tax rates	-0.0589	-0.0247	-0.0108
	(0.107)	(0.0869)	(0.0628)
Labor Regulations	0.616^{***}	-0.0718	0.172
	(0.229)	(0.187)	(0.135)
Corruption	0.379^{****}	0.0750	0.0772
	(0.101)	(0.0823)	(0.0594)
Workforce education	-0.161	-0.274^{***}	-0.0677
	(0.129)	(0.105)	(0.0759)
Political instability	-0.306^{**}	-0.266^{***}	-0.152^{**}
	(0.118)	(0.0962)	(0.0695)
Constant	22.39^{****}	1.000^{**}	0.572
	(0.595)	(0.485)	(0.350)
Observations	290	290	290
Adjusted R^2	0.066	0.026	-0.015

Standard errors in parentheses
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$, **** $p < 0.001$

Notes: OLS regressions with industry fixed effects. Dependent variables: Output distortions is the degree of output allocative efficiency, $log(1 - \tau_{ysi})$, so a negative coefficient indicates higher output misallocation; Capital distortions is $log(1 + \tau_{ksi})$; Labor distortions is $log(1 + \tau_{lsi})$. Independent variables: on a scale of 0 to 4, degree to which each factor constitutes an obstacle to the firm, higher values meaning more severe obstacles.

Table 32: Zambia

	Output Distortions	Capital Distortions	Labor Distortions
Access to finance	-0.117	0.0729	-0.0889*
	(0.0996)	(0.0768)	(0.0532)
Transportation	-0.0380	-0.0145	-0.0148
	(0.127)	(0.0981)	(0.0679)
Access to land	-0.0187	0.0808	0.0565
	(0.116)	(0.0895)	(0.0620)
Tax rates	0.164	-0.0205	-0.0136
	(0.114)	(0.0876)	(0.0607)
Labor regulations	0.443**	0.151	0.0763
	(0.181)	(0.139)	(0.0964)
Corruption	0.00748	-0.157*	-0.0813
	(0.121)	(0.0935)	(0.0648)
Workforce education	0.381***	0.134	0.0932
	(0.139)	(0.107)	(0.0740)
Political instability	-0.587**	-0.322	-0.317**
	(0.273)	(0.211)	(0.146)
Constant	23.69****	0.756****	0.745****
	(0.239)	(0.184)	(0.128)
Observations	279	279	279
Adjusted R^2	0.046	-0.004	0.019

Standard errors in parentheses
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$, **** $p < 0.001$

Notes: OLS regressions with industry fixed effects. Dependent variables: Output distortions is the degree of output allocative efficiency, $log(1 - \tau_{ysi})$, so a negative coefficient indicates higher output misallocation; Capital distortions is $log(1 + \tau_{ksi})$; Labor distortions is $log(1 + \tau_{lsi})$. Independent variables: on a scale of 0 to 4, degree to which each factor constitutes an obstacle to the firm, higher values meaning more severe obstacles.

Appendix D

Robustness Checks

Table 33: Regressions of output distortions on financial constraint with bootstrap SEs

	Financing	Transportation	Labor Reg	Land	Tax	Corruption	Education
Obstacle	-0.089***	-0.012	0.16****	-0.034	0.042	-0.022	0.025
	(0.0323)	(0.027)	(0.042)	(0.039)	(0.043)	(0.029)	(0.033)
Size	1.63****	1.76****	1.79****	1.73****	1.74****	1.68****	1.68****
	(0.19)	(0.16)	(0.15)	(0.15)	(0.22)	(0.13)	(0.17)
Obstacle × size	0.066	0.01	-0.041	0.045	0.027	0.092*	0.13**
	(0.054)	(0.062)	(0.063)	(0.052)	(0.065)	(0.051)	(0.063)
Age	0.0034	0.0032	0.0036	0.0031	0.0031	0.0028	0.003
	(0.0045)	(0.0049)	(0.0041)	(0.0042)	(0.0045)	(0.0042)	(0.0041)
EPZ	0.4***	0.4***	0.38**	0.4***	0.41***	0.41***	0.4***
	(0.13)	(0.13)	(0.16)	(0.13)	(0.14)	(0.15)	(0.15)
EPZ × size	0.07	0.061	0.065	0.065	0.063	0.044	0.036
	(0.15)	(0.16)	(0.19)	(0.18)	(0.18)	(0.17)	(0.18)
Percentage of inputs imported	0.0048****	0.0048***	0.0047**	0.0049**	0.0047**	0.0048***	0.0046**
	(0.0015)	(0.0017)	(0.002)	(0.002)	(0.0019)	(0.0016)	(0.0019)
Percentage of sales exported	0.01***	0.01***	0.01****	0.01****	0.01****	0.01****	0.0098****
	(0.0032)	(0.0032)	(0.003)	(0.0031)	(0.0031)	(0.0023)	(0.0027)
Percentage owned by state	0.0069*	0.0069	0.0066	0.007	0.007	0.0074	0.0047
	(0.0042)	(0.0056)	(0.0062)	(0.0079)	(0.0055)	(0.007)	(0.0047)
Region	0.016	0.019	0.027	0.017	0.02	0.019	0.023
	(0.039)	(0.039)	(0.034)	(0.041)	(0.048)	(0.034)	(0.031)
Observations	3091	3091	3091	3091	3091	3091	3091

Standard errors in parentheses
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$, **** $p < 0.001$

Notes: OLS regressions with industry and country fixed effects. Dependent variable is the degree of output allocative efficiency, $log(1 - \tau_{ysi})$, so a negative coefficient indicates higher output misallocation. Standard errors are bootstrap SEs.

Table 34: Regressions of output distortions on financial constraint with bootstrap SEs

	Mozambique	Senegal	Ghana	Madagascar	Nigeria	Zambia
Financial constraint	-0.3***	-0.14**	-0.24****	0.23*	0.034	0.019
	(0.1)	(0.07)	(0.072)	(0.13)	(0.042)	(0.11)
Size	1.75****	0.84	1.26	1.56****	1.57****	1.47***
	(0.46)	(0.86)	(0.81)	(0.37)	(0.32)	(0.5)
Financial constraint × size	0.35***	0.33	0.12	-0.32****	-0.11*	0.071
	(0.11)	(0.66)	(0.21)	(0.067)	(0.057)	(0.13)
Age	0.00099	-0.0120	0.0042	0.043***	0.016	0.025****
	(0.0064)	(0.01)	(0.0064)	(0.016)	(0.016)	(0.0076)
EPZ	0.27	0.3	0.3	1.18****	0.52**	0.16
	(0.2)	(0.66)	(0.27)	(0.28)	(0.21)	(0.58)
EPZ × size	-0.045	0.960	-0.22	-0.15	-0.14	0.1
	(0.099)	(1.49)	(0.71)	(0.2)	(0.32)	(0.53)
Percentage of inputs imported	0.0059**	0.0055	-0.0049		-0.00072	0.011****
	(0.0028)	(0.0039)	(0.0064)		(0.0031)	(0.0014)
Percentage of sales exported	-0.0006	0.018	0.013		0.026	0.016**
	(0.0085)	(0.019)	(0.011)		(0.016)	(0.0062)
Percentage owned by state	0.081		0.011*			-0.004****
	(0.14)		(0.0068)			(0.00073)
Region	-0.38****	-0.07	-0.46*		0.13****	0.21****
	(0.1)	(0.16)	(0.24)		(0.025)	(0.049)
Observations	336	244	268	117	884	279
Adjusted R^2	0.439	0.301	0.287	0.105	0.245	0.406

Standard errors in parentheses
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$, **** $p < 0.001$

Notes: OLS regressions with industry and country fixed effects. Dependent variable is the degree of output allocative efficiency, $log(1-\tau_{ysi})$, so a negative coefficient indicates higher output misallocation. Standard errors are bootstrap SEs.

Table 35: Regressions of output distortions on financial constraint with bootstrap SEs

	Angola	Cameroon	Ethiopia	Uganda	Guinea	Mali
Financial constraint	0.028	-0.0064	-0.18	-0.13	0.16****	-0.058
	(0.022)	(0.27)	(0.16)	(0.12)	(0.032)	(0.08)
Size	0.42	1.16	2.087****	1.8****	1.18	1.27***
	(0.61)	(1.21)	(0.24)	(0.35)	(1.53)	(0.44)
Financial constraint × size	0.23***	-0.11	0.069	0.078	0.21	0.0026
	(0.072)	(0.27)	(0.13)	(0.13)	(0.54)	(0.068)
Age	-0.027****	-0.018	0.0017	-0.0068	-0.01	-0.0036
	(0.0062)	(0.012)	(0.0044)	(0.0073)	(0.0073)	(0.014)
EPZ	0.28**	1.48*	2.67****	0.22*	-0.31	0.47****
	(0.12)	(0.77)	(0.55)	(0.12)	(0.55)	(0.093)
EPZ × size	0.73*	0.07	-1.32*	-0.089	0	-0.021
	(0.4)	(0.53)	(0.69)	(0.1)	(0)	(0.7)
Percentage of inputs imported	0.0062****	0.025****	0.0007	0.018****	0.0085***	-0.00065
	(0.0017)	(0.0071)	(0.0028)	(0.0037)	(0.003)	(0.0022)
Percentage of sales exported	0.24****	0.022****	-0.0075	0.017	-0.012	0.0086
	(0.02)	(0.0038)	(0.013)	(0.022)	(0.025)	(0.022)
Region	-0.16**		-0.12****	-0.025	-1.005**	-0.026
	(0.072)		(0.017)	(0.15)	(0.49)	(0.2)
Percentage owned by state		0	0.0053**		-0.038****	
		(0)	(0.0023)		(0.011)	
Observations	189	102	229	290	121	251
Adjusted R^2	0.174	0.539	0.386	0.439	0.046	0.077

Standard errors in parentheses
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$, **** $p < 0.001$

Notes: OLS regressions with industry and country fixed effects. Dependent variable is the degree of output allocative efficiency, $log(1 - \tau_{ysi})$, so a negative coefficient indicates higher output misallocation. Standard errors are bootstrap SEs.

Table 36: Regressions of output distortions excluding size

	Mozambique	Senegal	Ghana	Madagascar	Nigeria	Zambia
Financial constraint	-0.21***	-0.13*	-0.27***	-0.16	-0.05	-0.018
	(0.074)	(0.075)	(0.086)	(0.15)	(0.035)	(0.086)
Age	0.013	-0.0019	0.01	0.042**	0.023****	0.045****
	(0.0099)	(0.013)	(0.011)	(0.02)	(0.0068)	(0.0094)
EPZ	0.33	0.96**	0.41	1.46**	0.65****	0.56**
	(0.26)	(0.41)	(0.38)	(0.63)	(0.18)	(0.28)
Percentage of inputs imported	0.0127****	0.0093***	-0.00024		-0.0013	0.017****
	(0.0035)	(0.0032)	(0.0042)		(0.0025)	(0.0036)
Percentage of sales exported	0.031****	0.042****	0.026**		0.032***	0.03***
	(0.0092)	(0.0099)	(0.011)		(0.011)	(0.01)
Region	-0.27**	-0.16	-0.53****		0.15****	0.17
	(0.13)	(0.11)	(0.11)		(0.017)	(0.12)
Observations	336	244	268	117	884	279
Adjusted R^2	0.124	0.153	0.116	0.032	0.114	0.208

Standard errors in parentheses
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$, **** $p < 0.001$

Notes: OLS regressions with industry fixed effects. Dependent variable is the degree of output allocative efficiency, $log(1 - \tau_{ysi})$, so a negative coefficient indicates higher output misallocation.

Table 37: Regressions of output distortions excluding size

	Angola	Cameroon	Ethiopia	Uganda	Guinea	Mali
Financial constraint	0.035	-0.23	-0.2*	-0.047	0.2*	-0.091*
	(0.07)	(0.14)	(0.11)	(0.086)	(0.12)	(0.055)
Age	-0.023**	-0.0078	0.01	0.018	0.0066	0.0039
	(0.012)	(0.016)	(0.014)	(0.014)	(0.021)	(0.012)
EPZ	0.36*	1.8****	2.52****	0.21	-0.47	0.44*
	(0.19)	(0.45)	(0.44)	(0.24)	(0.52)	(0.25)
Percentage of inputs imported	0.0089****	0.029****	0.001	0.03****	0.0082*	0.00089
	(0.0025)	(0.0051)	(0.005)	(0.004)	(0.0046)	(0.0028)
Percentage of sales exported	0.22	0.029****	-0.0068	0.034****	-0.011	0.011
	(0.25)	(0.0073)	(0.013)	(0.0079)	(0.017)	(0.008)
Region	-0.091		-0.19****	-0.075	-0.42	-0.047
	(0.15)		(0.037)	(0.11)	(0.45)	(0.096)
Observations	189	102	229	290	121	251
Adjusted R^2	0.068	0.503	0.257	0.211	-0.017	0.011

Standard errors in parentheses
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$, **** $p < 0.001$

Notes: OLS regressions with industry fixed effects. Dependent variable is the degree of output allocative efficiency, $log(1 - \tau_{ysi})$, so a negative coefficient indicates higher output misallocation.

Appendix E

Model of Financial Constraints

In light of the findings above, I solve a suggestive model of financial constraints following Midrigan and Xu (2014), Zetlin-Jones and Shourideh (2017), and Buera et al. (2011) [24] [30] [10]. The goal of this exercise is to suggest mechanisms by which productivity and size determine firms' (in)ability to overcome financial challenges and show the growth dynamics when firms are financially constrained.

There is a final output and an industry-level output produced in the economy, as in the misallocation model above, except this time the model has a time dimension. From the profit maximization problem at the industry-level in the misallocation model, I had:

$$P_{sit}Y_{sit}^{1/\sigma} = P_{st}Y_{st}^{1/\sigma} \tag{43}$$

Following the assumption made by Hsieh and Klenow (2009) [20] that $P_{st}Y_{st}^{1/\sigma} = 1$ and setting $-\sigma = \tilde{\eta}$, I obtain:

$$P_{sit} = Y_{sit}^{1/\tilde{\eta}} \tag{44}$$

The economy is inhabited by individuals who decide at the beginning of each period to work for a wage or become entrepreneurs. Their choice is based on the quality of their entrepreneurial ideas, $\overrightarrow{Q}$. The vector of entrepreneurial ideas is drawn from a distribution $\mu(\overrightarrow{Q})$ and they die with a constant hazard rate of $(1-\gamma)$ in which case a new vector of ideas is independently drawn from $\mu(\overrightarrow{Q})$. Individuals maximize their lifetime utility:

$$U(C) = E[\sum_{t}^{\infty} \beta^t u(c_t)] \tag{45}$$

where c_t is the consumption at time t for workers, and for entrepreneurs, they maximise their utility over their dividends, D_t.

Entrepreneurs own plants that produce the following output, as in the misallocation model:

$$Y_{sit} = A_{sit}[(1-\mu_s)^{\frac{1}{\epsilon_m}}((\frac{K_{sit}}{\alpha_s})^{\alpha_s}(\frac{L_{sit}}{1-\alpha_s})^{1-\alpha_s})^{\frac{\epsilon_m-1}{\epsilon_m}} + \mu_s^{\frac{1}{\epsilon_m}} M_{sit}^{\frac{\epsilon_m-1}{\epsilon_m}}]^{\frac{\epsilon_m}{\epsilon_m-1}} \tag{46}$$

A_{sit} grows at rate g, which is deterministic and endogenous. Entrepreneurs own their capital stock, buy intermediate inputs and hire labor. Their profits are given by:

$$\pi_{sit} = P_{sit}Q_{sit}Y_{sit} - K_{sit} - L_{sit}W_{st} - M_{sit}Z_{st} - f_s \tag{47}$$

where P_{sit} is the price of firm i's output, Q_{sit} is the quality of the entrepreneur's idea, K_{sit} is capital owned by the entrepreneur, L_{sit} is labor inputs, W_{st} is the wage paid to workers, M_{sit} is intermediate inputs, Z_{st} is the price of intermediate inputs, and f_s is the fixed cost of entry to each sector s. The profit function can be rewritten as:

$$\pi_{sit} = Q_{sit}Y_{sit}^{\eta} - K_{sit} - L_{sit}W_{st} - M_{sit}Z_{st} - f_s \tag{48}$$

where $\eta = \frac{\sigma-1}{\sigma} = \frac{\tilde{\eta}+1}{\tilde{\eta}}$

Financial side of model: There are competitive financial intermediaries that receive deposits from workers and lend the money to entrepreneurs in the form of bonds. Entrepreneurs use that money to pay for factors of production and the fixed cost, and produce. They receive proceeds from sales at the beginning of next period and pay back their debt.

Suppose N_{sit-1} is the plant's net worth at the beginning of period t and after the entrepreneur repays their debt:

$$N_{sit-1} = Q_{sit-1}Y_{sit-1}^{\eta} + (1-\delta)K_{sit-1} - B_{sit-1}(1+r) \tag{49}$$

where B_{sit-1} is firm's borrowing at time $t-1$. The plant's borrowing constraint at time t is:

$$B_t \leq \lambda[Q_{sit}Y_{sit}^{\eta} + (1-\delta)K_{sit}] = \lambda(N_{sit} + B_{sit}) \tag{50}$$

and its dividends are given by:

$$D_{sit} = Q_{sit-1}Y_{sit-1}^{\eta} + (1-\delta)K_{sit-1} - B_{sit-1}(1+r) - K_{sit} - L_{sit}W_{st} - M_{sit}Z_{st} + B_{sit} - P_{sit}f_s \tag{51}$$

Recursive problems: An Individual's state depends on their net worth N, or assets for workers, a, and their ideas, $\overrightarrow{Q}$.

Value function of being a worker:

$$V^w(N,Q) = max_{C,a'}U(C) + \beta[\gamma V(N',Q) + (1-\gamma)E_{Q'}[V(N',Q')]] \tag{52}$$

s.t.

$$PC + a' \leq W + (1+r)a \tag{53}$$

where a is asset of the individual worker saved with the financial intermediaries.

Value function of being an entrepreneur:

$$V^e(N,Q) = max_{K,N',M,L}U(D) + \beta[\gamma V(N',Q) + (1-\gamma)E_{Q'}[V(N',Q')]] \tag{54}$$

s.t.

$$D \leq QY^{\eta} + (1-\delta)K - (1+r)B - K - WL_MZ + B' - Pf \tag{55}$$

$$B \leq \lambda[QY^{\eta} + (1-\delta)K] \tag{56}$$

Rewriting the constraints on the entrepreneur's problem, I obtain:

$$V^e(N,Q) = max_{K,N',M,L}U(D) + \beta[\gamma V(N',Q) + (1-\gamma)E_{Q'}[V(N',Q')]] \tag{57}$$

s.t.

$$D = N - K - WL - ZM + \frac{1}{1+r}(QY^{\eta} + (1-\delta)K - N') \tag{58}$$

$$N' \geq (1-(1+r)\lambda)(QY^{\eta} + (1-\delta)K) \tag{59}$$

Definition of a recursive competitive equilibrium: A recursive competitive equilibrium is a distribution of $\overrightarrow{Q}$ denoted with $\mu(\overrightarrow{Q})$; policy functions K(N, Q), N'(N, Q), M(N, Q), L(N, Q), C(N, Q), a'(N, Q); and prices W, Z, R P such that:

1. given prices, the policy functions K(N, Q), N'(N, Q), M(N, Q), L(N, Q), C(N, Q), a'(N, Q) solve (29), (30), (31), (32) and (33);
2. financial market clears: $a' = B'$

Solving the entrepreneur's recursive problem, I get the following first order conditions:

$$U'(D) = (1+r)\beta(1-\gamma)E_{Q'}[V_1^e(N', Q')] + (1+r)\theta \tag{60}$$

$$R_K(1+r)\lambda + (1-(1+r)\lambda)\frac{1}{U'(D)}\beta(1-\gamma)(1+r)E_{Q'}(V_1^e(N', Q')) = 1+r \tag{61}$$

$$R_L(1+r)\lambda + (1-(1+r)\lambda)\frac{1}{U'(D)}\beta(1-\gamma)(1+r)E_{Q'}(V_1^e(N', Q')) = W(1+r) \tag{62}$$

$$R_M(1+r)\lambda + (1-(1+r)\lambda)\frac{1}{U'(D)}\beta(1-\gamma)(1+r)E_{Q'}(V_1^e(N', Q')) = Z(1+r) \tag{63}$$

where θ is the multiplier on the borrowing constraint, and R_K, R_L and R_M are as follows:

$$R_K = \eta(1-\mu)^{1/\epsilon_m} Y^{\eta} Q \frac{1}{\psi} VA^{\frac{\epsilon_m - 1}{\epsilon_m}} (\frac{K}{\alpha})^{-1} + 1 - \delta \tag{64}$$

$$R_L = \eta(1-\mu)^{1/\epsilon_m} Y^{\eta} Q \frac{1}{\psi} VA^{\frac{\epsilon_m - 1}{\epsilon_m}} (\frac{L}{1-\alpha})^{-1} \tag{65}$$

$$R_M = \eta\mu^{1/\epsilon_m} Y^{\eta} Q \frac{1}{\psi} M_s^{-1/\epsilon} \tag{66}$$

and

$$VA = (\frac{K}{\alpha})^{\alpha} (\frac{L}{1-\alpha})^{1-\alpha} \tag{67}$$

Comparative statics: Equations (37) to (40) summarize the dynamics of firms' growth under borrowing constraints. Equation (37) relates the marginal utility of today's consumption for the entrepreneur and the discounted marginal utility of its future value function. If the entrepreneur is constrained and $\theta \neq 0$, then marginal utility of consuming today is higher than the discounted marginal utility of its future value function. This implies entrepreneurs will invest less in input factors and shows the ways in which financial constraint can limit firms' use of factor inputs and create distortions.

Equation (38), (39), and (40) show the relationship between the returns to the factors or production R_K, R_L, and R_M and the interest rate. If the borrowing constraint does not bind and $\theta = 0$, then the returns to the factors of production equal to (1+r). However, if the entrepreneur is constrained and $\theta \neq 0$, then $(1+r) \leq$ the returns to the factors of production, meaning that the entrepreneur is using below optimal levels of the input factors. As λ increases, meaning that the entrepreneur's borrowing constraint is loosening, then (1+r) increases and thus the gap between (1+r) and R_K, R_L, and R_M decreases and the equilibrium outcome gets closer to optimality.

The model can be calibrated using firm-level panel data. Unfortunately, I have not found adequate panel data for African countries. The Orbis database has very comprehensive and rich firm-level data on most countries, but for African countries, it is mostly very large firms that report their financial accounts information and so Orbis only has data on very large firms in Africa. Therefore, using that data would not be adequate for my analysis given that I am mostly interested in showing how small firms in Africa are constrained from expanding.