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# Impact of the business environment on output and productivity in Africa

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# Impact of the Business Environment on Output and Productivity in Africa

El-hadj Bah and Lei Fang

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**Abstract:** We develop a general equilibrium model to assess the quantitative impact of distorting institutions and policies related to the poor business environment in 30 sub-Saharan African countries. A subset of the distortions—namely, regulation, crime, corruption, and poor infrastructure—is modeled as a tax on output. From the data, we find that, on average, firms in Africa lose a fifth of their sales as a result of those distortions. On the other hand, low access to credit affects the reallocation of resources across firms and capital formation. We find that the quantitative effects of these areas on the business environment are large. They lead to decreases in the range of 40 to 77 percent for output and from 18 to 44 percent for total factor productivity. Overall, the distortions explain about 67 percent of the variation in income per worker relative to the United States.

JEL classification: O16, O47, L23

Key words: entry business environment, investment climate, African development, productivity

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# 1 Introduction

Africa is by far the poorest part of the world. Although a few African countries have experienced good economic development outcomes, it is clear that there have been a failure to develop sound policies in many African countries. In particular, African countries are poorly ranked in most dimensions of the business environment that are key for long term business success. Collier (2000) argues that the poor business environment leads to misallocation of resources and high transactions costs in Africa, affecting particularly manufacturing firms. Bigsten and Soderbom (2006) find that the poor business environment limits the export growth of manufacturing firms.

In this paper, we focus on African institutions and policies related to the business environment that create inefficiencies at the firm level and distortions in the allocation of resources across firms. The development literature has shown that both channels are important in accounting for cross-country income and TFP differences.[1] In particular, Restuccia and Rogerson (2008) argue that a country's policies and institutions can create "taxes" or "subsidies" on output that distort the allocation of resources across firms. We follow this idea and measure most of our indicators for business environment as a tax on output.

We specifically focus on five areas of the business environment: the regulatory environment, crime, corruption, access to infrastructure, and financial development. The first four dimensions is modeled as a tax on output and the last dimension as a contract enforcement problem. The World Bank Enterpriser Surveys (ES) ask firms to estimate the loss in sales due to various polices and institutions (regulatory environment, crime, corruption and access to infrastructure). We use those losses to construct a measure of the "tax" on output emphasized by Restuccia and Rogerson (2008). We view this as one of the contributions of this paper. We find that the tax rates are sizeable along all the four dimensions and vary greatly across countries. Specifically, the average tax rates for regulatory, crime, corruption and infrastructure are 6.42%, 3.69%, 5.93%, and

[1] See Parente and Prescott (1994); Howitt (2000); Herrendorf and Teixeira (2009); Fang (2009) for the first channel and Hsieh and Klenow (2009); Amaral and Quintin (2009) for the second channel.

6.57% respectively so the average total tax rate along all four dimensions is 22.61%. This implies that businesses in Africa lose on average more than 20% of their sales due to the poor state of these four aspects of the business environment. Financial development is measured as domestic credit to the private sector relative to GDP. The average value for African countries is only 10.35% of the U.S. level.

To quantify the effects of the five areas of the business environment on African economic development, we introduce the policy distortions as modeled by Restuccia and Rogerson (2008) in the general equilibrium model studied by Amaral and Quintin (2009). In the model, workers are born with a managerial ability and decide wether to operate a business. If they choose to do so, they can either use their own savings or borrow to finance capital for production. Financial development is modeled as enforcement of contracts. A lower enforcement, corresponding to poor financial development, creates tighter borrowing constraint. This leads to a smaller scale of operation and more smaller firms being operated, hence to lower aggregate level of capital and lower TFP. The other four dimensions of the business environment are aggregated and modeled as a tax on output. The tax on firms's output lowers measured aggregate TFP and output directly. Our baseline experiments rely on an aggregate measure of the tax for each country with a homogenous effect on all firms.

However, as discussed by Restuccia and Rogerson (2008), the tax rates could differ across firms; which can lead to a reallocation of resources. Our use of the homogenous tax is motivated by data limitations as most of the countries in our sample don't have enough information to directly measure the distribution of taxes across firms. As a robustness check, we use the countries with enough data to measure taxes at the firm level. Heterogenous taxes may lead to quantitative implications that differ from those of the homogenous tax through several channels. For instance, if taxes are correlated with firm size there will be a reallocation of resources across firms and this effect will not be captured by the homogenous tax rate. Also, if the distribution is very skewed, the quantitative implication of the heterogenous tax might be different. Fortunately, we find that taxes are largely uncorrelated with the level of employment, hence productivity. In

addition, the skewness of the distributions in our testing cases are not large enough to change greatly the quantitative effects of the homogenous tax.

From our baseline experiments, we find that the quantitative effects of the areas of the business environment considered here are large. A country with 10% financial intermediation relative to the US (which is about the average for Africa) has only 62% of the US output, a relative capital to output ratio of 34% and a relative average firm size of 31%. The "tax" decreases output and TFP significantly with no effects on capital to output ratio and firm size. With a 20% tax rate (which is about the average for Africa), output relative to the US declines to 73% and relative TFP to 80%. We simulate the model for each of the thirty African countries we study and find that the five areas of the business environment together are able to explain about 67% of the variation in income per worker relative to the US.

For the average African country, improving one or more dimensions of the business environment can have large effects on the level of development. Improving financial development alone by one standard deviation leads to a 7% increase in relative output per worker. Cutting the tax rate by one standard deviation leads to 15% increase in relative income per worker. A simultaneous improvement will lead to 22 percentage points increase in relative income and to 15 percentage points increase in relative TFP. Such improvements can go a long way in helping Africa decrease poverty and reach its Millennium Development Goals.

Our robustness tests with heterogenous taxes use the data for Ghana and Senegal. For each country, we use the inverse of the kernel distribution to draw samples of taxes that mimic the distribution of the data as closely as possible. We then simulate the model 100 times and compute the average of the outcomes. We find that our results are very close to the findings with the homogenous taxes.

In addition to the papers mentioned above, our paper is closely related to Alfaro et al. (2008) that tries to account for the role of distortions on income differences across-countries. They introduce the type of distortions emphasized by Restuccia and Rogerson (2008) in a model of heterogenous firms based on Melitz (2003). Using firm data from

79 countries, they infer from the model the distortions needed to match the plant-size distribution in each country. They then use these distortions to calculate the aggregate loss in output. Our analysis differs from their paper in that we use a direct measure of the distortions instead of inferring them from the model. Another related paper is Bartelsman et al. (2009) that uses firm data in a model with idiosyncratic distortions to study the aggregate effects of the resulting misallocation.

There are a number of other authors who emphasize the effect of specific distortions on TFP and output. Parente and Prescott (1994) and Herrendorf and Teixeira (2004) argue that vested interests in the labor market can prevent firms from adopting more efficient technologies. Lagos (2006) also studies the effects of frictions in the labor market on aggregate TFP. Fang (2009) instead studies the role of entry barriers and competition in the product market. Greenwood et al. (2010) and Buera and Shin (2010) study the misallocation caused by poor financial development. Closely related to Restuccia and Rogerson (2008), Guner et al. (2008) study the misallocation due to restrictions on firm size.

The rest of the paper is organized as follows. Section 2 reviews the literature on the effects of different dimensions of the business environment. Section 3 describes the model which is calibrated to the US economy in section 4. In section 5, we first construct the tax rate for each country and then use the calibrated model to assess the quantitative importance of business environment on output and TFP for African countries. We highlight the conclusion and policy implications in section 6.

# 2 Literature Review on Areas of the Business Environment

In this section, we review the literature on a few areas of the business environment. The availability of cross-country data from the World Bank enterpriser surveys since the 1990s has allowed researchers to analyze how firms and the aggregate economy are affected by a poor business environment. The data has been mostly used to empirically test the

relationship of one area of the business environment with measures of firm success[2].

The literature on the relationship between financial development and economic growth and development is very large. Levine (2005) conducts a comprehensive review of the theoretical and empirical work on this area. Finance has many functions among which are the pooling and allocation of savings, the production of information and monitoring of projects, diversification of risks and the facilitation of exchange of goods and services. Each of these functions affects savings and investment, and the efficient allocation of resources, hence economic growth. The theoretical papers model some of these functions and show that financial frictions or poor financial development lead to low TFP and output (Greenwood and Jovanovic, 1990; Bencivenga and Smith, 1991).

On the empirical side, many authors have shown that there is a strong correlation between measures of financial development and economic growth (King and Levine, 1993; Ndikumana, 2000) and this correlation is not due to simultaneity bias (Levine et al., 2000). Financial development affects economic growth through increases in TFP, savings rate and capital accumulation (Beck et al., 2000b). However, the effects of poor financial development are not uniform across industries and size distribution of firms. Industries that require more external financing grow faster in more financially developed countries (Rajan and Zingales, 1998). Also, small firms are more severely affected by low financial development and industries dominated by small firms for technological reasons grow faster in countries with better financial development (Beck et al., 2008).

Another topic that has received a lot attention in the literature is corruption. While few authors emphasize the positive effect of corruption through a decrease of the burden of regulation and a potential increase in efforts by corrupted government officials (Leff, 1964); most authors argue that corruption cannot be limited to specific activities and is overall very damaging to economic growth[3]. Moreover, when talented people put their efforts in rent-seeking instead of productive activities, overall efficiency and output decrease (Krueger, 1974; Murphy et al., 1991). Mauro (1995, 1996) and Knack and Keefer (1995), using cross-country data, find that higher levels of corruption are associated with

[2]See Aterido et al. (2009) for a recent exception.
[3]See Shleifer and Vishny (1993); Bardhan (1997); Blackburn et al. (2006).

lower investment shares and GDP growth rates; and the effects are large. Mauro (1995) finds that a reduction in corruption by one standard deviation leads to five percentage points increase in the investment to GDP ratio and to half percentage point increase in GDP growth rate. For Africa, Gyimah-Brempong (2002) finds that a unit increase in corruption reduces the level and growth rate of GDP per capita by respectively 0.4 and 0.66 percentage points.

Corruption affects output growth trough various channels but also has a direct link. Mauro (1995, 1996) finds strong correlations with the investment rate and some components of government expenditure like education and transfer payments. For Africa, Baliamoune-Lutz and Ndikumana (2008) finds that corruption increases public investment but discourages private investment, and has a negative effect on income growth. Other transmission channels are: lower government revenues, lower expenditures on operations and maintenance, lower quality of public infrastructure and lower productivity for public government expenditure (Tanzi and Davoodi, 1997).

The effects of infrastructure provision is another issue that has attracted a lot of attention in the literature. It is generally agreed that adequate supply benefits firms and increases productivity growth (Morisson and Scwartz, 1996). The effects on the aggregate economy is also found to be positive and significant but there is some debate on the magnitude and the net effects (Esfahani and Ramirez, 2003; Canning and Pedroni, 2008). Fernald (1999) finds evidence from the US that investment in roads enhances productivity. Fan and Chan-Kang (2005) finds that the huge investments in roads in China helped GDP growth and the effects on poverty reduction in rural areas are very large.

In Africa, the supply of infrastructure is very low. Poor infrastructure increases transaction costs and makes African firms less competitive than their international counterparts. The costs of transportation, logistics, telecommunication, water, electricity, security, bribes are high and firms suffer great losses due to transportation problems, outages of power and water and crime (Eifert et al., 2005). Collier and Gunning (2000) argues that the poor infrastructure is a serious constraint to growth in Africa. A recent economic brief by the African Development Bank (Mafusire, 2010) argues that Africa

has large deficit in infrastructure and its improvement can have large spillover effects for development and poverty reduction in the continent. Gollin and Rogerson (2010) suggests that decreasing transportation costs would be important for improving agricultural productivity in Uganda. Using cross-country data, Calderon (2009) finds that increasing infrastructure stock will have a large payoff for Africa.

# 3 The Model

The model is based on Amaral and Quintin (2009), which quantifies the effects of poor financial development on output and productivity. The framework is a discrete-time overlapping generations model. In each period, a mass one of two-period lived agents are born. Each agent is endowed with one unit of time each period. An agent is born with managerial ability $z \in Z$, which is constant over an agent's life. Managerial talent is public information and the distribution $g(z)$ is the same across generations. In the first period, the agent can only be a worker, but has the option to be a manager in the second period. The utility function of an agent is given by:

$$U(c_1, c_2) = \log(c_1) + \beta \log(c_2)$$

where $\beta \in (0, 1)$ is the discount factor.

A manager with ability $z$ combines labor and capital into a single consumption good using a decreasing return to scale technology described as follows:

$$F(k, l) = zk^{\theta} l^{\mu} \tag{1}$$

where $\theta + \mu < 1$. To incorporate the effects of distortions emphasized by Restuccia and Rogerson (2008), we assume that a fraction $\tau$ of output is lost due to poor business environment. Initially, we assume that $\tau$ is the same for all firms in a country. $\tau$ acts like a proportional tax on output where the proceeds are thrown away. In this paper, we use $\tau$ to denote the sales lost due to red-tape regulations, poor infrastructure, crime and

corruption. In reality, $\tau$ might be different across firms and this may distort the allocation of resources across firms and therefore has an impact on TFP and output as discussed by Restuccia and Rogerson (2008). Later, we use a tax rate distribution generated from the data to show that our results are not driven by the use of a homogenous tax rate.

We assume that capital needs to be paid before production takes place. A manager can finance capital either through personal savings $a$ from the first period or through external borrowing at rate $r$.[4] We assume that capital fully depreciates after each period. As it becomes clear in the calibration, one period in the model is twenty years, hence this assumption is not unreasonable.

The solution to this problem has been discussed by Amaral and Quintin (2009). Here, we formulate the problem and discuss a few predictions before turning to the quantitative experiments. Let $b$ be the amount borrowed by a manager and $w$ be the wage rate. The profit for a manager with ability $z$, savings $a$, and capital $k = a + b$ is giving by[5]:

$$\pi(k, z; w, r, \tau) = \max_{l} (1 - \tau) z k^{\theta} l^{\mu} - wl - k(1 + r)$$

The financial market is imperfect as managers have the option to default. If a manger defaults, a fraction $\eta$ of his assets is lost. Since there is no uncertainty in this model, the financial intermediary will impose a debt limit so that the managers find it rational not to default in equilibrium. Therefore a financial contract for a manger of ability $z$ with savings $a \geq 0$ solves:

$$\begin{aligned} &\max_{b \geq 0} \pi(a + b, z; w, r, \tau) \\ \text{s.t} \quad &\pi(a + b, z; w, r, \tau) + a(1 + r) \geq \\ (1 - \eta) &\left[\pi(a + b, z; w, r, \tau) + (a + b)(1 + r)\right] \end{aligned}$$

[4] Amaral and Quintin (2009) explored a version where the interest rate is endogenously determined and found that the patterns of output resembles to the benchmark formulation but the effect of financial constraint is larger with the endogenous interest rate.

[5] We implicitly assume that firms will use all their savings to finance capital before turning to the financial market. The reason for this are two folds. First, it is generally cheaper to use the internal funds to finance capital. Second, Amaral and Quintin (2009) proves that the financially constrained firm will use all their savings to finance capital.

Simple manipulation of the above constraint gives:

$$b \leq \frac{\eta}{1-\eta} \frac{\pi(k, z; w, r, \tau) + a(1+r)}{1+r}$$

This inequality defines a debt limit for a manager with ability $z$ and savings $a$. It is easy to see that lower financial development (low $\eta$) and higher taxes (poor business environment) both lead to lower borrowing limit, hence to lower capital and output.

The problem of young agents is as follows:

$$\begin{aligned} & \max_{c_1, c_2, a} && \log(c_1) + \beta \log(c_2) \\ \text{s.t:} \quad & c_1 + a &=& \ w \\ & c_2 &=& \ a(1+r) + \max(w, \pi(a+b, z; w, r, \tau)) \end{aligned}$$

where $\pi(a+b, z; w, r, \tau)$ is the net profit for a manager with savings $a$ and ability $z$ subject to the borrowing constraint.

The income in the second period takes into account that an agent has a choice of occupation. Since $\pi(a+b, z; w, r, \tau)$ is increasing in $z$, the young agent's problem implies that there is an ability threshold, $\underline{z}(\eta, w, r, \tau)$, such that below which agents become workers and above which agents become managers.

# 4 Calibration

In this section we calibrate the model to the US economy. The calibration procedure follows Amaral and Quintin (2009) and Restuccia and Rogerson (2008).

A period in the model is 20 years corresponding to 40 years of work life for an individual. The yearly interest rate is set to 4% implying $r = 1.04^{20} - 1$ and $\beta = \left(\frac{1}{1.04}\right)^{20}$. According to the literature, the return to scale of the production function, $\alpha + \mu$, is around 0.85 and we set $\alpha$ and $\mu$ to match the capital and labor shares of income. From US data, capital share is 1/3 of the return to scale which implies that $\alpha = 0.85/3 = 0.283$ and $\mu = 0.85 * 2/3 = 0.567$.

The distribution of managerial talent will determine the size distribution of establishments. We assume that managerial talent follows a log-normal distribution with 100 grid points. We choose the range of skills to match the range of employment in the data. Normalizing the lowest skill to be one, the maximum skill is chosen to get a maximum employment to be 10,000 as in the 2007 US census data. The data also shows that 73% of establishments have less than 10 employees while only 2.3% have more than 100 employees and the average employment level is 15.65. We choose the mean and standard deviation of the distribution to match these features of the data. Although we only target a few moments of the establishment size distribution, the implied distribution from the calibration matches the data well as shown in figures 1 and 2.

The last parameter to calibrate is the degree of contract enforcement ($\eta$) which determines the ratio of intermediated capital to output. From the model's perspective, capital is financed by own savings and external borrowing, therefore intermediated capital is just the borrowed funds. The corresponding statistic in the data is hard to measure. Amaral and Quintin (2009) used data from Beck et al. (2000a) and added credit from banks and other financial institutions, outstanding debt securities issued by private institutions and new equity issues. Deducting the portion of credit from banks going to consumers, they find a ratio of intermediated capital to output of 2.2.

For our sample of countries, it is hard to use this data because of the lack of information on credit going to consumers. Instead, we use the variable *domestic credit to the private sector* (% GDP) from the World Bank Global Development Finance database which measures financial resources provided to the private sector (e.g loans, purchases of nonequity securities, and trade credits) that establish a claim for repayment. For the US, the average ratio from 2000 to 2005 is 1.8[6]. This value is close to the estimation by McGrattan and Prescott (2000) of 1.84.

Table 1 summarizes the parameter values.

[6]This value does not include new equity issues because its not available in World development finance database. However, data from both Beck et al. (2000a) and Federal Reserve Board indicate that for the US, new issues of equity is around 1% of GDP. This omission will underestimate the quantitative difference between African countries and the US but by very little.

# 5 Quantitative Implications for African Countries

## 5.1 Business Environment for Sub-Saharan Africa

Before we turn to the quantitative implications of the model, we discuss the business environment data for 30 Sub-Saharan countries. The data on GDP per worker is from the Penn World Table 7.0. As noted above, our measure of financial development is from the World Bank Global Development Finance database, and is the average domestic credit to the private sector as a percentage of GDP for the years 2000-2005. The rest of the data for the business environment comes from the World Bank Enterprize Surveys (ES). The ES database contains firm level data for more than 10000 firms across 125 countries. The core questionnaire of the survey is the same across all countries. We focus on the impact of regulation, crime, access to infrastructure, and corruption. For most of these dimensions, the database contains the percentage of total sales lost due to a specific policy or institution.

The impact of red-tape regulation on firms is measured by the time managers spent dealing with various government regulations. The effect of crime is measured by the percentage of sales lost due to theft, robbery, vandalism and arson, the percentage of sales paid for security, and the percentage of products shipped to domestic markets lost due to theft. We use the percentage of sales lost due to power outages and the percentage of shipment lost during transit to measure poor infrastructure. Corruption is measured by informal payments as a percentage of sales.

These four dimensions of the business environment act like a tax and affect output directly through lower TFP. In our baseline analysis, we compute the country average for each dimension and add them to measure the total "homogenous tax rate" used in the model. Later, we will analyze the effects of heterogenous tax rates across establishments.

Table 2 shows the statistics for the 30 countries. In most countries, managers spend a large fraction of their time dealing with government regulations. The average is 6.4% with a large variation across countries. Managers in Côte d'Ivoire spend the least time, 1.81% while in Madagascar they spend up to 17.12% of their time dealing with the

regulations. Crime is the least costly factor to firms among the factors considered here. The average security costs and percentage of sales lost due to various crimes is 3.70% with a minimum of 1.16% in Benin and a maximum of 9.89% in Côte d'Ivoire. The most costly dimension of the business environment is poor infrastructure. Firms on average lose 6.60% of their sales due to power outages and transportation failures. The minimum losses are in Ethiopia and the maximum in Guinea, where power outages occur daily and variation in voltage causes fires. Corruption is also costly to firms in Africa. On average, firms spend almost 6.00% of annual sales on informal payment. The sum of these four dimensions are quite high. Businesses lose on average one fifth of their sales. The variation across countries is also high. The standard deviation is 8.6 percentage points.

Access to finance is a huge issue for African firms. Beck et al. (2009) points to the shallowness of the financial system in Africa despite recent progress. The average financial intermediation of capital is 10.35% of the US level if we include South Africa, otherwise it is 8.23%. The variation across countries are also large: 13.56% with South Africa and 7.14% without it. South Africa is by far the most financially developed African country. Other countries with high levels of capital intermediation include Cape Verde, Mauritius, Kenya and Côte d'Ivoire.

Table 3 shows the correlation coefficients between the five areas of the business environment and with log of GDP per worker in 2005. Given that the sample from Africa is relatively small, we used a larger sample to calculate the correlations[7]. Our larger sample includes 123 countries and most of them are developing countries from Africa, Asia, Latin America and Eastern Europe.

From the table, we see that high burden of regulation, losses due to crime, corruption and poor infrastructure are all positively correlated. It has been long argued that one source of corruption is heavy regulation, which gives opportunities to bureaucrats to demand informal payments. High level of corruption is also an indication of a poor

[7]We used the aggregate indicators from the ES database. For regulation, we used the average number of visits or required meetings with tax officials. For corruption, we used the percentage of firms expected to make informal payments to get things done. The payments as a share of sales is not available as an aggregate indicator.

functioning law and judicial system. This leads to high level of insecurity and larger losses due to crime. A country with high level of informal payments by firms is an indication that corruption maybe rampant in other sectors like government projects. This leads to low effective investment in power generation and roads. As noted earlier, Tanzi and Davoodi (1997) finds that high levels of corruption lowers government revenues, expenditures on operations and maintenance, quality of public infrastructure and productivity for public government expenditure. As we may expect all of these four areas are negatively correlated with income per worker. On the other hand, the level of financial development is positively correlated with income. Firms in richer countries get more financing form banks and other financial institutions.

## 5.2 Impact of the Homogenous Tax and Poor Financial Development

In this section, we feed the statistics of the business environment discussed above to the calibrated model to assess their impact for each of the 30 African countries. The "homogenous tax" is the sum of the average for regulation, crime, infrastructure and corruption. At the same time, we also recalibrate $\eta$ for each country to match the corresponding debt to GDP ratio in the data.

Before discussing the results for all countries, we first conduct a few experiments to highlight the general effects of the tax channel and financial development using the calibrated economy. The results are reported in table 4. In the first experiment, we look at the effects of tax rates ranging from 10% to 40%, which correspond roughly to the range for African countries[8]. When the tax rate increases to 10%, output and TFP decline respectively to 86% and 90% of the benchmark. Output is more than halved with 40% tax rate while TFP declines to 60% of the benchmark. These values show that the impact of these dimensions of the business environment are large and they affect both output and productivity. However, they do not affect capital to output ratio and the average size of firms.

[8]The tax rate for the US economy is set to zero.

In the second experiment, we vary financial intermediation relative to the benchmark economy. The effects on output are sizable. When relative financial intermediation is at 40%, output declines to 77% of the benchmark. The transmission channels are lower TFP and lower capital to output ratio with a much bigger effect on the latter. We also see that there is a substantial decline in average firm size. When financial intermediation is at 5% of the US level, output and TFP decline respectively to 56% and 86% of the benchmark with capital to output ratio at 31% and average firm size at 30% of the benchmark.

In the last panel of table 4, we show the effects of the business environment using the average statistics for the thirty African countries [9]. With a tax rate of 23% and relative financial development of 8.23% , output falls to 42% of the US. While TFP (68% of the benchmark) contributes to lower output, capital to output ratio plays a bigger role, it falls to 32% of the benchmark. Decreasing the tax rate by one standard deviation to 15% raises relative output to 48% and relative TFP to 75% with no change on capital to output ratio and average firm size. A one standard deviation improvement of the financial development increases relative output to 45%, relative TFP to 71% and capital to output ratio to 35%. However, if we make a simultaneous one standard deviation improvement of the tax and financial development, output for Africa will increase to 51% and productivity to 78% of the US level. This is a 22% increase in income per capita and 15% increase in TFP. Such increases can have big effects on poverty reduction and economic development.

Table 5 reports relative output and TFP for each of the 30 countries. While the model is too stylized to match the data on relative income per worker for each country, it is able to explain a large variation of income across countries. Following Amaral and Quintin (2009), we use $v = 1 - \frac{\sum_i (\hat{y}_i - y_i)}{\sum_i (1 - y_i)}$ as a measure of the dispersion of output captured by the model, where $\hat{y}_i$ is relative income per worker in the model and $y_i$ the corresponding value in the data. With this measure, the model explains 67% of dispersion of income per worker. With only financial development in their model, Amaral and Quintin (2009) was able to explain a third of the income variation in their sample which included only middle

[9] We exclude South Africa when measuring the average relative capital intermediation.

and high income countries. Adding the other dimensions of the business environment increases the explanatory power of the model.

## 5.3 Impact of the Heterogenous Taxes

In the previous section, we used the average losses for the four dimensions of the business environment acting like a tax. But our model features firms with heterogenous productivities and can easily include heterogenous tax rates across firms. Here we show that our results don't hinges on our use of homogenous taxes.

Our use of homogenous taxes in the previous section was motivated by data constraints. While the Enterpriser surveys contain information at the firm level, it is not straightforward for many countries to figure out the distribution of the total tax due to missing data. In any country, a given firm $i$ may indicate losses due to regulation and infrastructure but has missing data for crime and corruption. Therefore if we restrict our sample to firms with data in all of the areas of the business environment, we end up with a much smaller sample. In practice, we find that the majority of missing data is related to crime and subset of infrastructure. We therefore use the areas with the least missing data to infer the distribution. We add a constant to this initial distribution such that the mean of the final distribution is equal to the homogenous tax used in the previous section.

After computing the distribution of taxes, we ask if it is correlated with firm size. This question is important because Restuccia and Rogerson (2008) found that the quantitative effects of correlated distortions are much larger than those of uncorrelated distortions. In our data, we find that while specific distortions may be positively correlated with firm size, the correlations don't hold at the aggregate level for most countries[10].

Despite the fact that our distortions are uncorrelated with firm size, heterogenous taxes can lead to different results if the distribution is highly skewed on one side. For instance, if the majority of firms have small taxes but few have large ones, using a homogenous tax overestimates the loss in output.

To illustrate the effects of heterogenous distortions, we show the cases of Ghana and

[10]For example, managers in large firm spend more time dealing with government regulation compared to their counterparts in small firms.

Senegal. These two countries have large population of firms in the database. Therefore, large samples remain even after eliminating the missing data. For each country, we use the inverse of a kernel distribution to draw a sample of 100 tax rates corresponding to the 100 grid points for managerial skill. We simulate the model 100 times and report the average outcomes.

For Ghana, there is no correlation between distortions and employment. Therefore, our distribution of taxes is not correlated with managerial skill. We use the kernel distribution to draw random samples very close to the data in a flexible manner. Figure 3 shows that the distributions of the tax from the data and a random sample are very similar. The figure also shows that the distribution is slightly skewed to the left. Table 6 reports the results of the simulation. It shows that the difference between the homogenous and heterogenous tax is quite small. Relative GDP increases from 46% in the case of the homogenous tax to 47% in the case of heterogenous tax. This small change is due to the speediness of the distribution.

For Senegal, the distortions are positively correlated with employment but with a correlation coefficient of 0.12. We conduct two experiments. First, as the case for Ghana, we simulate the model 100 times with random samples of taxes non correlated with skill. Second, we sort each random sample in ascending order such that less productive firms face lower taxes. The second panel of table 6 shows that heterogenous taxes non correlated with skill lead to the same relative GDP per worker as the homogenous case. But when small firms face lower taxes, as in the second experiment, relative income per worker increases from 48% to 52%. This result confirm the finding by Restuccia and Rogerson (2008). However, the data for Senegal does not really point to such a case as the correlation between distortions and employment is only 0.12. In figure 4, we plot the distribution of taxes by firm size in the data and in the model. For each simulation, we calculate the average tax rate for a size category, then take the averages for the 100 simulations. The figure shows that taxes from the uncorrelated case are much closer to the data than those from the correlated case. The average of the 100 samples for non-correlated taxes are 18% for each size category while the average homogenous tax is

17.8%.

Given that none of the countries in our sample has a high correlation between distortions and employment, we feel confident that our results with homogenous taxes don't exaggerate the amount of losses from the areas of the business environment considered here.

# 6 Conclusion and Policy Implications

This paper shows how various dimensions of the business environment affect income per capita in thirty African countries. We find that the poor business environment discussed in various papers in the literature are quite damaging for African development. Businesses lose large shares of their sales due to government regulation, poor infrastructure, corruption and crimes. The implications of the losses are lower aggregate output and total factor productivity for the countries. Low financial development measured as intermediated capital relative to output contributes greatly to the poor performance of Africa. It leads to low aggregate capital, hence a predominance of small firms and low total factor productivity.

While some improvements of the business environment are costly and will take long time to achieve, others can be achieved with little costs if there is strong political will. For example, the time managers spend dealing with government regulation can be decreased by simplifying the regulatory environment. Governments can simplify their tax codes and make it easier to pay taxes, reform labor laws and decrease the number of licenses and various inspections. The more regulation and bureaucracy a government puts in place, the more opportunities for bureaucrats to be involved in corruption. At the same time it gives incentive to firms to be involved in corruption especially if the chances of being caught and punished are low. Also reforming the judicial system to make it more efficient in punishing corrupt officials and criminals can decrease the levels of corruption and crime.

Improving the quantity and quality of infrastructure has great potential for African's

long term development but it is costly. Building more roads, rail and generating more electrical power require large investments. Countries need to explore new financing mechanisms, like public private partnerships, instituting toll roads, mineral deposits versus infrastructure and so on. The improvements will take a long time to achieve but they have to be in the continent's long term development strategy.

Improving access to credit for businesses is another difficult but necessary ingredient for Africa's long term development. This can be achieved by changes in the banking and financial regulations to encourage more savings, to make the resolution of disputes between lenders and borrowers more efficient, and to provide more information on the borrower's background. Moreover, for finance to play an important role in African economies, costs and interest rates spreads have to decrease substantially. Governments have an important role to play in making this sector more efficient. Beck et al. (2009) points to some necessary institutional and policy changes for the sector.

In summary, this paper points to key institutions and policies making the business environment in Africa unfriendly and quantifies their effects on output and TFP. To achieve the Millennium Development Goal of halving poverty by half by 2015, the African countries need to make changes to make the business environment friendly for business creation and growth.

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# Appendix: Tables and Figures

Table 1: Parameter Values

| $\beta$ | $\alpha$ | $\mu$ | r | $\eta_{US}$ | $g_{mean}$ | $g_{std}$ |
|---|---|---|---|---|---|---|
| 0.4565 | 0.2833 | 0.5667 | 1.1911 | 0.582 | -0.45 | 1.05 |

Table 2: Business Environment Statistics for Africa

| Country | regulation | Crime | Infra-structure | Corrup-tion | Total "Tax" | Finance rel. to US (%) |
|---|---|---|---|---|---|---|
| AGO | 7.14 | 2.84 | 5.03 | 6.92 | 21.93 | 2.4 |
| BEN | 6.46 | 1.16 | 6.45 | 0.00 | 14.07 | 7.38 |
| BWA | 4.96 | 3.46 | 2.58 | 8.35 | 19.35 | 9.64 |
| BFA | 9.53 | 1.46 | 3.86 | 0.00 | 14.85 | 7.48 |
| BDI | 5.70 | 2.53 | 10.94 | 7.83 | 27.00 | 14.77 |
| CMR | 12.80 | 2.97 | 5.59 | 0.00 | 21.36 | 4.96 |
| CPV | 12.17 | 2.46 | 4.31 | 0.00 | 18.94 | 20.23 |
| ZAR | 6.31 | 2.89 | 5.55 | 6.08 | 20.83 | 0.63 |
| COG | 5.92 | 7.73 | 15.70 | 19.21 | 48.56 | 2 |
| CIV | 1.81 | 9.89 | 6.53 | 11.32 | 29.55 | 8.13 |
| ETH | 3.77 | 3.27 | 1.53 | 0.00 | 8.57 | 11.85 |
| GAB | 3.02 | 3.00 | 1.80 | 9.64 | 17.46 | 5.49 |
| GMB | 7.31 | 6.93 | 12.92 | 9.50 | 36.66 | 7.79 |
| GHA | 4.03 | 2.84 | 7.13 | 3.36 | 17.36 | 7.32 |
| GIN | 2.65 | 3.01 | 15.27 | 6.63 | 27.56 | 2.35 |
| GNB | 2.87 | 2.62 | 5.25 | 7.54 | 18.28 | 1.55 |
| KEN | 5.12 | 6.06 | 7.81 | 4.61 | 23.60 | 14.49 |
| LSO | 5.73 | 7.42 | 5.95 | 6.77 | 25.87 | 6.37 |
| LBR | 8.51 | 7.06 | 3.67 | 7.18 | 26.42 | 2.58 |
| MDG | 17.12 | 3.98 | 8.88 | 0.00 | 29.98 | 4.98 |
| MLI | 2.39 | 1.30 | 2.71 | 5.74 | 12.14 | 10.13 |
| MRT | 5.84 | 1.50 | 2.91 | 8.17 | 18.42 | 14.02 |
| MUS | 9.36 | 4.56 | 3.54 | 7.13 | 24.59 | 36.53 |
| NER | 11.45 | 1.23 | 4.50 | 0.00 | 17.18 | 3.02 |
| NGA | 6.06 | 5.91 | 12.16 | 5.27 | 29.40 | 7.48 |
| RWA | 5.92 | 3.30 | 9.93 | 6.31 | 25.46 | 5.86 |
| SEN | 2.90 | 1.71 | 6.38 | 6.82 | 17.81 | 10.90 |
| ZAF | 5.95 | 2.59 | 1.60 | 9.84 | 19.98 | 71.810 |
| UGA | 5.21 | 2.58 | 11.65 | 7.28 | 26.72 | 4.28 |
| ZMB | 4.55 | 2.47 | 4.87 | 6.52 | 18.41 | 4.14 |
| Mean | 6.42 | 3.69 | 6.57 | 5.93 | 22.61 | 10.350 |
| Std. dev | 3.47 | 2.24 | 3.96 | 4.27 | 7.78 | 13.56 |

Table 3: Correlation Coefficients

| | regulation | crime | infras-tructure | corrup-tion | finance | logGDP |
|---|---|---|---|---|---|---|
| regulation | 1.00 | 0.18 | 0.15 | 0.43 | -0.06 | -0.15 |
| crime | | 1.00 | 0.45 | 0.20 | -0.26 | -0.32 |
| infrastructure | | | 1.00 | 0.36 | -0.30 | -0.43 |
| corruption | | | | 1.00 | - 0.31 | -0.42 |
| finance | | | | | 1.00 | 0.53 |

Table 4: Benchmark Experiments

| | Relative GDP | Relative TFP | Rel. Capi-tal Output ratio | Relative Average firm size |
|---|---|---|---|---|
| Taxes | | | | |
| 10% | 0.86 | 0.90 | 1.00 | 1.00 |
| 20% | 0.73 | 0.80 | 1.00 | 1.00 |
| 30% | 0.61 | 0.70 | 1.00 | 1.00 |
| 40% | 0.49 | 0.60 | 1.00 | 1.00 |
| Financial intermediation relative to US | | | | |
| 40% | 0.77 | 0.99 | 0.49 | 0.54 |
| 20% | 0.66 | 0.94 | 0.36 | 0.40 |
| 10% | 0.62 | 0.89 | 0.34 | 0.31 |
| 5% | 0.56 | 0.86 | 0.31 | 0.30 |
| Average Africa | | | | |
| Mean finance and tax | 0.42 | 0.68 | 0.32 | 0.31 |
| Decrease tax by 1 std. dev. | 0.48 | 0.75 | 0.32 | 0.31 |
| Increase finance by 1 std. dev. | 0.45 | 0.71 | 0.35 | 0.35 |
| Improve both | 0.51 | 0.78 | 0.35 | 0.35 |

Table 5: Results for 30 African Countries

| | Rel. GDP | Rel. TFP | Rel. Capital Output ratio | Rel. Average firm size |
|---|---|---|---|---|
| Angola | 0.41 | 0.66 | 0.32 | 0.27 |
| Benin | 0.48 | 0.75 | 0.32 | 0.31 |
| Botswana | 0.46 | 0.71 | 0.34 | 0.31 |
| Burkina Faso | 0.48 | 0.75 | 0.32 | 0.31 |
| Burundi | 0.41 | 0.67 | 0.34 | 0.35 |
| Cameroon | 0.40 | 0.68 | 0.31 | 0.30 |
| Cape Verde | 0.50 | 0.77 | 0.36 | 0.40 |
| D.R. Congo | 0.41 | 0.67 | 0.31 | 0.27 |
| Rep. of Congo | 0.23 | 0.43 | 0.32 | 0.27 |
| Cote d'Ivoire | 0.37 | 0.62 | 0.33 | 0.31 |
| Ethiopia | 0.57 | 0.82 | 0.35 | 0.31 |
| Gabon | 0.44 | 0.72 | 0.31 | 0.30 |
| Gambia | 0.32 | 0.56 | 0.32 | 0.31 |
| Ghana | 0.46 | 0.72 | 0.32 | 0.31 |
| Guinea | 0.37 | 0.61 | 0.32 | 0.27 |
| Guinea-Bissau | 0.43 | 0.69 | 0.32 | 0.27 |
| Kenya | 0.44 | 0.70 | 0.34 | 0.35 |
| Lesotho | 0.39 | 0.65 | 0.31 | 0.31 |
| Liberia | 0.38 | 0.62 | 0.32 | 0.27 |
| Madagascar | 0.37 | 0.60 | 0.33 | 0.27 |
| Mali | 0.52 | 0.78 | 0.34 | 0.31 |
| Mauritania | 0.48 | 0.75 | 0.34 | 0.35 |
| Mauritius | 0.51 | 0.74 | 0.46 | 0.54 |
| Niger | 0.45 | 0.70 | 0.32 | 0.27 |
| Nigeria | 0.37 | 0.62 | 0.32 | 0.31 |
| Rwanda | 0.41 | 0.64 | 0.33 | 0.28 |
| Senegal | 0.48 | 0.73 | 0.35 | 0.31 |
| South Africa | 0.66 | 0.80 | 0.74 | 0.85 |
| Uganda | 0.39 | 0.63 | 0.33 | 0.27 |
| Zambia | 0.45 | 0.70 | 0.33 | 0.27 |

Table 6: Impact of Heterogenous Tax

| | Relative GDP | Relative TFP | Rel. Capital Output ratio | Relative Average firm size |
|---|---|---|---|---|
| | | Ghana | | |
| Homogenous 17.36% | 0.46 | 0.72 | 0.32 | 0.31 |
| Heterogenous, non correlated with skill | 0.47 | 0.74 | 0.32 | 0.27 |
| | | Senegal | | |
| Homogenous 17.81% | 0.48 | 0.73 | 0.35 | 0.31 |
| Heterogenous, non correlated with skill | 0.48 | 0.75 | 0.33 | 0.30 |
| Heterogenous, correlated with skill | 0.52 | 0.78 | 0.34 | 0.31 |

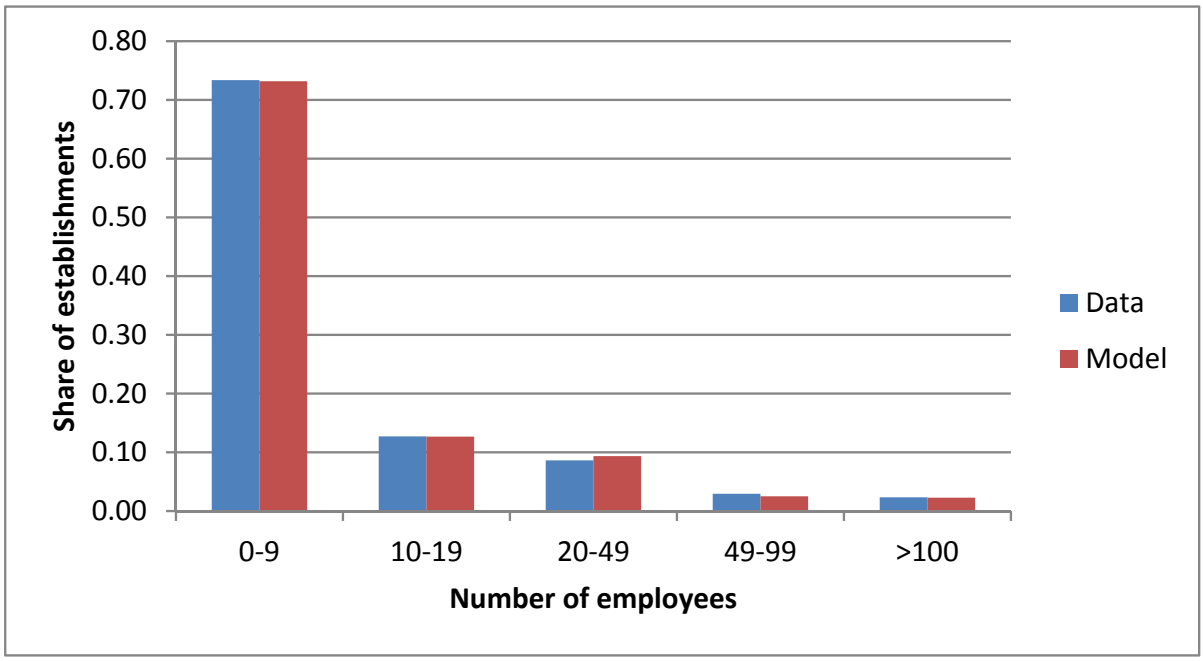


Figure 1: Distribution of establishments by employment levels-Model vs. Data

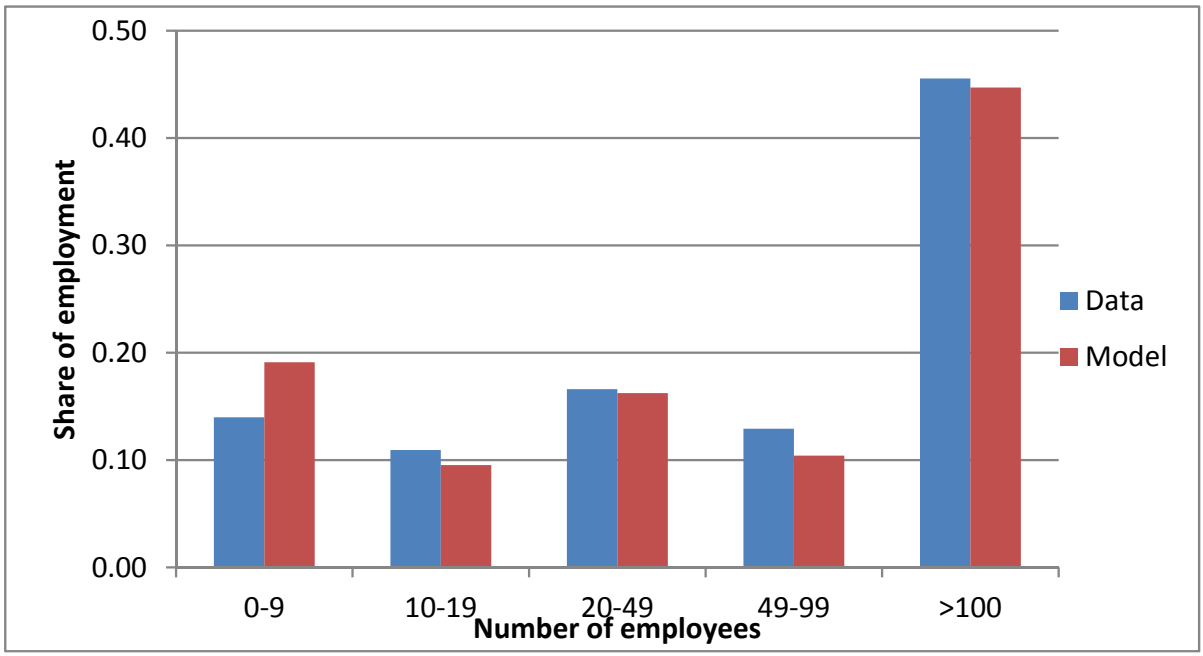


Figure 2: Distribution of employment-Model vs. Data

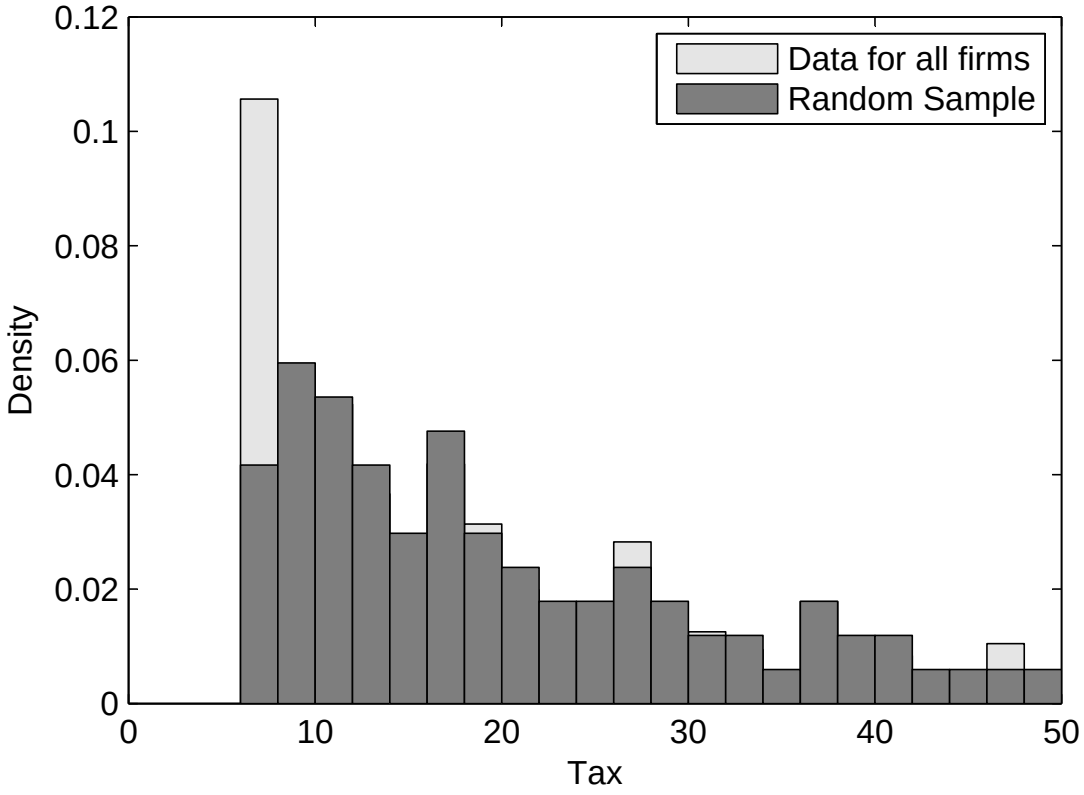


Figure 3: Tax distribution for Ghana

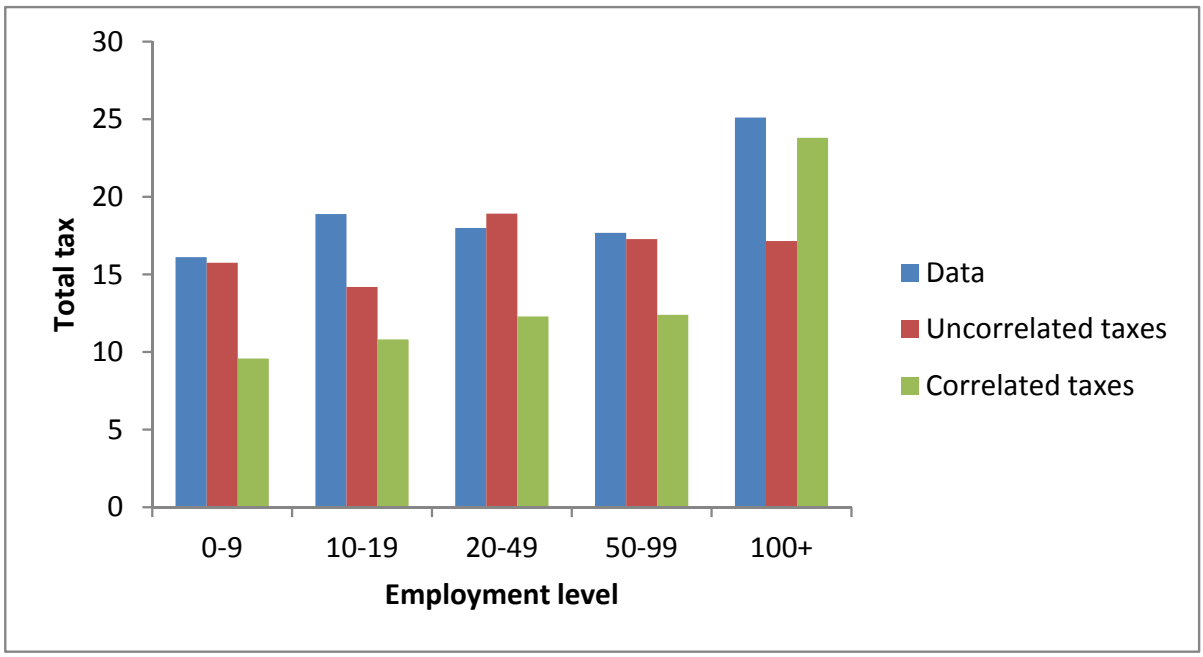


Figure 4: Taxes by firm size for Senegal