Impact of the Business Environment on Output and Productivity in Africa

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Abstract: We develop a general equilibrium model to assess the quantitative effects of the business environment, including regulation, crime, corruption, infrastructure and access to finance, on output and total factor productivity (TFP) for thirty Sub-Saharan African countries. The first four dimensions create inefficiencies at the firm level and are modeled as a tax on output. This tax has not only a direct effect but also causes misallocation of resources due to differences across firms. Poor access to credit also affects the allocation of resources across firms, capital formation and production scale. We find that the quantitative effects of these five dimensions of the business environment are large, leading to decreases in output and TFP in the range of 20 to 58 percent and 7 to 19 percent respectively. The interaction between the tax and low level of financial development magnifies the misallocation of resources in 28 out of the 30 countries. Overall, the model explains 54 percent of the variation in income per worker relative to the US.

Keywords: Productivity, misallocation, Business environment, Africa

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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. Table 1 in the appendix compares different indicators of the business environment from the World Bank Enterprise Surveys (ES) for the OECD and Sub-Saharan Africa (SSA).\(^1\) It is clear that firms in SSA are highly constrained compared to their counterparts in the OECD. For instance, on average, 36.6% of firms in SSA are expected to give gifts to public officials to get things done. The corresponding number for the OECD sample is 12.1%, which is mostly driven by Greece and Portugal. In addition, more than 50% of firms in SSA identifies electricity as a major constraint.

Not only individual areas of the business environment prevent the expansion of firms but there seems to be compounding effects as the constraints are positively related. Table 2 shows the correlation coefficients between the five areas of the business environment that are the focus of this paper: the regulatory environment, crime, corruption, access to infrastructure, and financial development.\(^2\) High burden of regulation, losses due to crime, corruption and poor infrastructure are all positively correlated. It has long been 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 functioning law and judicial system. This leads to high level of insecurity and larger losses due to crime. Moreover, 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 road\(^3\). As we

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\(^{1}\)The numbers in the table are simple averages across firms and countries. The OECD include 9 countries (Czech Republic, Germany, Greece, Hungary, Ireland, Korea, Portugal, Slovak and Spain) and SSA include 39 countries. In the detailed analysis, the sample for SSA will be reduced to 30 countries for data reasons.

\(^{2}\)The sample consists of 123 countries mostly from developing countries and Eastern Europe. The positive correlations imply that a quantitative experiment based on the sum of losses at the country level would be underestimating the true effects of the distortions. Instead, our main quantitative exercise uses the distribution of firm-level aggregate losses for each country.

\(^{3}\)Tanzi and Davoodi (1997) finds that high levels of corruption lowers government revenues, expen-
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 from banks and other financial institutions
as shown in Table 1.

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. Our objective is
to build a model that specifies the links between areas of the business environment and
firm output and to quantify their aggregate effects on income per worker and total factor
productivity for thirty Sub-Saharan African countries.

Restuccia and Rogerson (2008) argues 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 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 whether 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’ output lowers measured aggregate TFP and output directly
but also through misallocation of resources and lower use of capital.

Our baseline experiments show that the quantitative effects of the areas of the business
environment considered here can be large. A country with 10% financial intermediation

\footnote{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.}
relative to the US (which is about the average for Africa) has only 59% of the US output, a relative capital to output ratio of 29% and a relative average firm size of 28%. It also causes more entrepreneurs to become managers while lowering the average productivity of producing firms. By imposing the same tax rate to all firms, there is no misallocation of resources but output and TFP decline by a proportional factor. Output is also affected through lower use of capital per firm even though capital to output ratio and firm size remain constant. With a 20% tax rate, output relative to the US declines to 73% and relative TFP to 80%. Using the average tax for all firms and the average level of financial intermediation for all thirty African countries, the model implies a 62 percentage points reduction in output and 34 percentages points reduction in TFP. Improving financial development alone by one standard deviation leads to 8% increase in relative output per worker while cutting the tax rate by one standard deviation leads to 15% increase from the above baseline. A simultaneous improvement will lead to 25% increase in relative income and to 15% increase in relative TFP.

In addition to the channels above, heterogenous taxes across firms can lead to misallocation of resources. Whether the misallocation have a positive or negative effect on TFP depends on the correlation structure between the tax and productivity. Distorting the most productive firms are more devastating than distorting the least productive firms. Using sales per worker as a proxy for productivity, we use an empirical copula to fit the joint distribution of productivity and total losses of output due to distortions at the firm level. Then with the country level financial development and a sample of firm-level taxes drawn from the inverse of the copula, we simulate the model for each country. We find that the five areas of the business environment have large effects. They cause output to drop by 20% to 58%. This drops is due to lower TFP, lower capital per firm, lower average size of firms and a misallocation of resources. African countries have 3 to 6 times more entrepreneurs managing smaller firms with low output per establishment. We also find that there is an interaction of the low financial development and distribution of taxes. Except for two countries, the effects are reinforcing each other by causing more negative misallocation. Overall, the model is able to explain about 54% of the variation in income.
per worker relative to the US.

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 study 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. Barseghyan and DiCecio (2010) study the effects of entry costs on income and TFP differences across countries while Boedo et al. (2011) evaluate the effects of entry regulations and firing costs. 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 Enterprise 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.

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, generally measured as liabilities of the financial system divided by GDP, 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).

\(^5\)See Aterido et al. (2009) for a recent exception.
Another topic that has received a lot of attention in the literature is corruption. While few authors emphasize the positive effects of corruption from a decrease in 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\(^6\). Corruption is a rent-seeking activity that affects output through various channels. It distorts incentives and market signals leading to misallocation of resources. When talented people put their efforts in rent-seeking instead of productive activities, overall efficiency and output decrease (Krueger, 1974; Murphy et al., 1991). It also raises the costs of production and transaction costs since it is an uncertain and inefficient tax. Mauro (1995, 1996) and Knack and Keefer (1995), using cross-country data, find that higher levels of corruption, measured as an index from subjective assessments, are associated with lower investment shares and GDP growth rates; and the effects are large. Mauro (1995) finds that a reduction in the corruption index 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 one unit increase in the Transparency International index, measuring the perception for corruption, reduces the level and growth rate of GDP per capita by respectively 0.4 and 0.66 percentage points.

Corruption of government officials also alters government spending and investment allocation. Mauro (1995, 1996) finds that corruption is strongly correlated with the investment rate and some components of government expenditure like education and transfer payments. For Africa, Baliamoune-Lutz and Ndikumana (2008) finds that high levels of 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).

Infrastructure services (transport, energy, water and sanitation) are consumed by

\(^{6}\text{See }\)Shleifer and Vishny (1993; Bardhan (1997; Blackburn \textit{et al.}, 2006).
households and used by firms in their production processes and delivery of goods and services. It is often modeled as a public capital included in the production function as distinct to other types of physical capital. As an input in the production function, investment in infrastructure will increase growth in the transition and lead to higher steady state income per worker. However, we know that it has no growth effects in the long-run unless it improves productivity and many studies found that differences in income across countries cannot be explained by differences in inputs. There is a large empirical literature that estimate the elasticity of output with respect to infrastructure, so every few years there is a review of this literature (Romp and de Haan 2007; Duarte Bom and Ligthart 2008; Straub 2011).

It is generally agreed that adequate supply benefits firms and increases productivity growth (Morisson and Schwartz 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. Duarte Bom and Ligthart (2008) uses a meta analysis and estimate the average output elasticity of public capital at 0.08 after controlling for publication bias. In his review, Straub (2011) highlights the shortcomings of modeling and estimation techniques used in the literature. Calderon et al. (2011) try to overcome the shortcoming of the previous literature in terms of measurement an estimation methods. They construct a principal analysis index and find that the long-run output elasticity ranges between 0.07 and 0.10.

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. Calderon (2009) uses principal components analysis to construct an infrastructure index, which they use to rank countries. He finds that increasing the index for Sub-Saharan Africa to the level of the leader, Mauritius, would accelerate GDP growth by 2.3 percentage points.

3 The Model

The model is built 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 become 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:

\[
F(k, l) = z^\theta l^\mu
\]

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. We refer to $\tau$ as a tax because it acts like a proportional tax on output where the proceeds are thrown away. The tax rate for each firm will be measured as the share of sales lost due to red-tape regulations, poor infrastructure, crime and corruption.

We assume that capital has 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 $r$. Capital fully depreciates after each period, which is not unreasonable since one period is calibrated to twenty years.

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 given by

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

The financial market is imperfect as managers have the option to default. If a manager 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 manager of ability $z$ with savings $a \geq 0$ solves:

$$
\max_{b \geq 0} \pi(a + b, z; w, r, \tau)
$$

s.t

$$
\pi(a + b, z; w, r, \tau) + a(1 + r) \geq (1 - \eta) [\pi(a + b, z; w, r, \tau) + (a + b)(1 + r)]
$$

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

8We implicitly assume that firms will use all their savings to finance capital before turning to the financial market. The reasons 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:

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

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:

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

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, \( z(\eta, w, r, \tau) \), 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 [Basu and Fernald (1997)] [Guner et al. (2008)], the return to scale of the production function, \( \alpha + \mu \), is between 0.8 and 1 and [Atkeson and Kehoe (2005)] argue for a value around 0.85. Therefore, we use this value of 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 $\mu = 0.85 \times 2/3 = 0.567$.

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 3 and 4.

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, intermediated capital is the portion of capital that was financed through external sources like borrowing from banks, issuance of bonds and equity. It is hard to find a very accurate measure for this in the data. Amaral and Quintin (2009) used data from Beck et al. (2000a), which includes both credit from banks and other financial institutions and 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 the US. Using the latest update of the finance structure dataset (Beck et al., 2000a), we also add private credit by deposit money banks and other financial institutions over GDP (pcrdbofgdp) and the ratio of private bond market capitalization to GDP (prbnd) and subtract the ratio of household debt to GDP obtained from the Federal Reserve Bank flow of funds (Z.1 release). We use the average from 2000 to 2005 to minimize short term fluctuations and obtain a ratio of 2.05 for the US. This value does not include financing from new equity issuance, which was not included in this version of the database. The estimated value in the earlier version of the database was 1% of GDP but such data is not available for most African countries that will be analyzed in the next section. Table 3 summarizes the parameter values.
5 Quantitative Effects for African Countries

5.1 The 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 intermediation is from Beck et al. (2000a), and is the average of domestic credit to the private sector and the private bond market capitalization as percentages of GDP for the years 2000-2005. As can be expected, the bond market is very limited in Sub-Saharan Africa and data is not available for most countries. Moreover, data on consumer credit is not available for Africa but would be very small for the majority of countries. Having subtracted consumer credit from domestic credit to the private sector for the US, we are therefore overestimating Africa’s relative financial intermediation.

The rest of the data for the business environment comes from the World Bank Enterprise Surveys (ES). The ES database contains firm level data for more than 10000 firms across 125 countries. The sample sizes vary by country and all firms surveyed operate in the industrial and service sectors. The distribution of firms between industry and services are consistent with the value added shares of these sectors (see figure 1).

While the model may appear not to represent the economies of Sub-Saharan Africa, often viewed as based primarily on agriculture, the agricultural value added shares are below 50 percent for most countries. Figure 2 plots the non-agricultural share of output for the 30 countries. It shows that only two countries have non-agricultural shares of output below 50% and most have shares above 60%. In fact the cross-country average is 73.5%. The low shares of agriculture in value added is due to the well documented low agricultural productivity and the fact that the sector largely consists of unregistered family farms. Therefore, firms in industry and services are representative of the formal economy in most countries, which is the focus of this paper. Nevertheless, as a robustness

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9 Our measure of private credit is similar to what is available from the World Bank Global Development Finance database.
10 The core questionnaire of the survey is the same across all countries.
check, output per worker from the model will be compared to aggregate GDP per worker
and non-agriculture GDP per worker[^1].

The ES database contains objective measures of the impact of regulation, crime, access
to infrastructure, and corruption. The impact of red-tape regulation on firms is measured
by the time managers spent dealing with various government regulations[^12]. 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. The percentage of sales lost due to power outages and
the percentage of shipment lost during transit measure poor infrastructure. Corruption
is measured by informal payments as a percentage of sales.

Table 4 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 5.5%
with a large variation across countries. Managers in Côte d’Ivoire spend the least time,
1.9% while in Niger they spend up to 13.0% of their time dealing with the regulations.
While on average more than 33% of firms in Sub-Saharan Africa are expected to give
gifts to government officials to get things done, the average costs represents only 3.5%
of total sales with a standard deviation of 2.5%. Countries like, Botswana, Cape Verde
and Ethiopia have very low costs while Madagascar and Côte d’Ivoire have very high
costs. Crime is the most costly factor to firms and a majority of them pay to secure their
businesses. The average security costs and percentage of sales lost due to various crimes
is 9.7% with a minimum of 1.3% in Kenya and a maximum of 20.3% in Guinea[^13]. The
second most costly dimension of the business environment is poor infrastructure. Firms
on average lose 7.1% of their sales due to power outages and transportation failures. The
minimum losses are in Ethiopia and the maximum in Guinea, where daily power outages
are routine and variation in voltage causes fires. The sum of these four dimensions are
quite high. Businesses lose on average one fifth of their sales. The variation across

[^1]: The latter is calculated by multiplying GDP per worker by the share of non-agriculture value added.
[^12]: This assumes that the opportunity cost of one unit of time spent by management dealing with regu-
lation is equal to one unit of sales.
[^13]: As an example of high losses due to lack of security, a rally by opposition parties in February 26,
2013 led to the destruction of businesses in the biggest market estimated at around 6 millions of US
dollars.
countries is also high. The standard deviation is 8.5 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 9.2% of the US level if we include South Africa, otherwise it is 7.2%. The variation across countries are also large: 12.6% with South Africa and 7.2% 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 Ethiopia.

5.2 Baseline experiments

In this section, we conduct a few experiments to highlight the general effects of the tax channel and financial development using the calibrated economy. In the baseline experiments, we impose a homogenous tax rate on all firms. The case with heterogenous tax rates will be discussed in the next section. The baseline results are reported in table 5. The statistics shown, all relative to the US, are GDP per worker, TFP, aggregate capital to output ratio, average employment, cut-off value of managerial talent to become a manager ($Z_{cut}$), average managerial talent for producing firms ($Z_{avge}$), and output per establishment. In these exercise and subsequent simulations, TFP is approximated using an aggregate production function with the assumption that only workers contribute to production.

$$TFP = \frac{Y}{K^{\alpha}N^{\mu}}$$

where $Y$ is aggregate output, $K$ aggregate capital and $N$ aggregate number of workers.

In the first experiment, we look at the effects of tax rates ranging from 10% to 40% while maintaining the financial development at the benchmark level$^{14}$ When the tax rate increases to 10%, output and TFP decline respectively to 86% and 90% of the benchmark. Output per worker is more than halved with 40% tax rate while TFP declines to 60% of the benchmark. With a homogenous tax, there is no misallocation across firms but a

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$^{14}$The tax rate for the US economy is assumed to be zero. The 10-40% ranges roughly corresponds to the range found in Africa.
proportional drop in TFP and output. The decline in output is larger than the increase in the tax because the level of capital used in production declines even though capital to output ratio remains unchanged. Moreover, there is no change in the distribution of producing firms and the average size of firms.

In the second experiment, we vary financial intermediation relative to the benchmark economy with a zero tax rate. The effects on output are sizable. When relative financial intermediation is at 5%, output per worker declines to 56% and TFP to 86% of the benchmark. With a low ability to borrow, capital and capital to output ratio declines. This lowers the wage and more firms enter because the cut-off value for managerial talent declines. Therefore, the average talent for operating firms also declines. With low capital and low talent, managers hire fewer workers which leads to lower firm size. Overall, the low financial development causes misallocation of resources and lower production scale by a large number of inefficient producers. The table shows that the share of managers increase to about five times the share for the US. However, the output per establishment declines dramatically.

In the last panel of table 5, we show the effects of the business environment using the average statistics for the thirty African countries. With a tax rate of 25.6% and relative financial development of 9.2%, output falls to 38% and TFP falls to 68% of the U.S. level. Capital to output ratio falls to 28% of the benchmark. Decreasing the tax rate by one standard deviation to 17.1% raises relative output to 44% and relative TFP to 74% 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 41%, relative TFP to 69% and capital to output ratio to 31%. However, if we make a simultaneous one standard deviation improvement of the tax and financial development, output for Africa will increase to 48% and productivity to 77% of the US level. This is a 25% increase in income per worker and 16% increase in TFP from the baseline. While the experiments shows large effects of the average tax and low level financial development, we should keep in mind that this is not representative of any particular country as all firms are taxed at the same high rate. In reality taxes vary across firms.
5.3 Simulation for thirty African countries

After showing how homogenous taxes and poor financial development affect output and TFP in the previous sub-section, here we use firm-level taxes and country-level financial development to simulate the model for the thirty Sub-Saharan African countries in our sample. For a given country, we total taxes for each firm by ignoring missing values and obtain a tax distribution. The effect of this distribution on output and TFP depends on its correlation with productivity. Restuccia and Rogerson [2008] found that the quantitative effects of correlated distortions are much larger than those of uncorrelated distortions. For instance, higher taxes on the most productive firms will have larger effects than higher taxes on the least productive firms. This arises because heterogeneous taxes lead to misallocation of resources across firms. This can amplify or reduce the misallocation resulting from low financial development. It is then important that samples of taxes used in the simulation of the model preserve the correlation structure with productivity for the entire population of firms in the survey for each country.

The ES dataset does not contain information on capital necessary to compute TFP for each firm. Instead, we use sales per employee as a proxy for productivity. We approximate the joint distribution of the logarithm of productivity and the tax by a copula. The idea of a copula is as follows: consider a random vector \((X_1, X_2)\) with continuous cumulative distribution functions (CDF), i.e: \(F_i(x) = P[X_i \leq x]\) are continuous. The random vector \((U_1, U_2) = (F_1(X_1), F_2(X_2))\) obtained by applying the probability integral transformation is a random vector. The copula of \((X_1, X_2)\) is then defined as the joint cumulative distribution function of \((U_1, U_2)\). Using the inverse of the copula, we can generate pseudo-random samples that maintains the correlation structure of \((X_1, X_2)\). Given that our data comes from a sample representing the population of firms, the constructed copula, called empirical copula, is an approximation of the true copula. We use the approximate maximum likelihood method from Matlab to generate our copula.

The simulation procedure can be summarized as follows: For each country, use an empirical copula to construct the joint distribution of taxes and productivity. Use the inverse of the copula to draw a sample of 100 tax rates corresponding to the 100 grid
points for managerial skill. Simulate the model using the sample of taxes and the financial development at the country level. Repeat this procedure 20 times and report the average results.

Table 6 shows the results of the simulation for each country. Again, the values are relative to the US. The first two columns show that relative GDP per worker vary between 42% for the Democratic Republic of Congo, which has very low level of intermediated capital and high tax rates, and 80% for South Africa while relative TFP vary between 71% and 93%. The drop in output per worker is due to the decline in TFP, the sharp decline in the use of capital as shown by the drop in capital to output ratio, and employment per firm. With low level of capital and TFP, the wage declines which lowers the cut-off value for managerial talent to become a manager \(Z_{\text{cut}}\). Many more workers become managers including less productive ones which lowers the average managerial talent for producing firms \(Z_{\text{avge}}\). This creates a misallocation of resources. The mass of producers vary between 1.5 and 6 times the US level and the average managerial talent vary between 68% in Congo to 92% in South Africa. We also observe a big decline in the output per establishment which is less than 10% for most countries.

The misallocation of resources results from an interaction of the low financial development and heterogenous tax. To show this, we simulate the model with zero taxes for all firms in each country and compare the cut-off values and averages for managerial talent with the previous results. As has been shown in table 5 a constant tax rate does not cause misallocation; therefore there is no change in the distribution of managerial talent for operating firms. By setting the tax rate to zero, all misallocation is caused by the low financial development. We find that the ratios of \(Z_{\text{cut}}\) and \(Z_{\text{avge}}\) for the economies with no tax to those with heterogenous taxes are not one. The ratios of \(Z_{\text{avge}}\) vary between 1 and 1.07 for 28 countries and 0.97 for Benin and 0.99 for Burkina Faso. This means that the misallocations from taxes and financial development are reinforcing each other, leading to bigger decline in TFP, for 28 countries while they are offsetting each other for two countries.

Another experiment we conducted to highlight the total effect of the tax is to fix the
financial development at the US level for each country but use the heterogenous taxes as explained earlier. This give us both the level and misallocation effects of the taxes. We find that output per worker now vary between 84% and 94% of the US. The effect on TFP is a little bit smaller, leading to declines between 5% and 12%. There is very little effect on capital to output ratio, even though capital declines. There is also a sizable decline in the average size of firms, up to 26%. As indicated with the previous experiment, there is a change in the distribution of productivity for producing firms. There are small declines of the cut-off values and averages of managerial talent, at most 6% for each statistic.

While the model used here 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 \cite{ 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 54% of dispersion of income per worker. We also regressed GDP per worker from the model on GDP per worker from the data and found a significant coefficient of 0.53. As a robustness check we compared the outcome of the model with GDP per worker for the non-agriculture sector. The measure of dispersion drops to 53% and the coefficient in the regression drops to 0.52 while maintaining its significance at 1%. Dropping large mineral and oil producing countries (Angola, Botswana, Congo, Gabon and Nigeria) reduces the dispersion measure to 52% while the regression coefficient increase to 1.1 for both the whole economy and the non-agriculture sector. With only financial development in their model, \cite{ Amaral and Quintin 2009} was able to explain a third of the income variation in their sample which included only middle and high income countries. Including the other dimensions of the business environment increases the explanatory power of the model.

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 capital, hence a predominance of small firms and low total factor productivity.

While some improvements of the business environment are costly and will take a 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 incentivises 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 Africa’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 impor-
tant 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 their long term development objectives, the African countries need to make changes to make the business environment friendly for business creation and growth.
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nomic Review.

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opment Bank Economic Brief, 1.

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Appendix: Tables and Figures

Figure 1: Share of Industry in Sample vs Share of Industry Value Added

Figure 2: Shares of Non-Agriculture in Value Added
<table>
<thead>
<tr>
<th></th>
<th>OECD</th>
<th>SSA</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Corruption</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Percent of firms expected to give gifts to public officials “to get things done”</td>
<td>12.1</td>
<td>34.9</td>
</tr>
<tr>
<td>Bribery index (% of gift or informal payment requests during public transactions)</td>
<td>3.1</td>
<td>19.2</td>
</tr>
<tr>
<td>Percent of firms identifying corruption as a major constraint</td>
<td>13.9</td>
<td>37.9</td>
</tr>
<tr>
<td><strong>Crime</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Losses due to theft and vandalism (% of annual sales) + Products shipped that were lost due to theft (% of product values)</td>
<td>0.3</td>
<td>2.7</td>
</tr>
<tr>
<td>Security costs (% of annual sales)</td>
<td>0.8</td>
<td>2.0</td>
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<tr>
<td>Percent of firms identifying crime, theft and disorder as a major constraint</td>
<td>9.6</td>
<td>28.5</td>
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<tr>
<td><strong>Infrastructure</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Losses due to electrical outages (% of annual sales) + Proportion of products lost during shipping (%)</td>
<td>1.3</td>
<td>8.2</td>
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<td>Percent of firms identifying electricity as a major constraint</td>
<td>16.4</td>
<td>50.3</td>
</tr>
<tr>
<td>Percent of firms identifying transportation as a major constraint</td>
<td>11.3</td>
<td>27.8</td>
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<tr>
<td><strong>Regulation</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Senior management time spent dealing with the requirements of government regulation (%)</td>
<td>4.2</td>
<td>7.7</td>
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<td>Percent of firms identifying business licensing and permits as a major constraint</td>
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<td>16.5</td>
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<td>Percent of firms identifying tax administration as a major constraint</td>
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<td>27.5</td>
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<td><strong>Access to Finance</strong></td>
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<tr>
<td>Percent of firms with a bank loan/line of credit</td>
<td>44.0</td>
<td>22.5</td>
</tr>
<tr>
<td>Proportion of investments financed by banks (%)</td>
<td>21.1</td>
<td>10.0</td>
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<td>Percent of firms identifying access to finance as a major constraint</td>
<td>14.6</td>
<td>45.6</td>
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Figure 3: Distribution of establishments by employment levels-Model vs. Data

Figure 4: Distribution of employment-Model vs. Data
Table 2: Correlation Coefficients

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<tr>
<th></th>
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<th>crime</th>
<th>infrastructure</th>
<th>corruption</th>
<th>finance</th>
<th>logGDP</th>
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<td>corruption</td>
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<td>finance</td>
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Table 3: Parameter Values

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<th>$\mu$</th>
<th>$r$</th>
<th>$\eta_{US}$</th>
<th>$g_{mean}$</th>
<th>$g_{std}$</th>
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<td>0.2833</td>
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Table 4: Business Environment Statistics for Africa

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<th>Country</th>
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<th>regul</th>
<th>corrup</th>
<th>crime</th>
<th>infras</th>
<th>&quot;tax&quot;</th>
<th>Fin./US(%)</th>
<th>ln (Prod)</th>
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<td>5.8</td>
<td>4.6</td>
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<td>22.2</td>
<td>5.99</td>
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<td>4.3</td>
<td>20.4</td>
<td>9.50</td>
<td>13.82</td>
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<td>6.12</td>
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<td>7.6</td>
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<td>17.19</td>
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<td>33.8</td>
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<td>18.24</td>
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<td>MUS</td>
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<td>34.0</td>
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<td>5.0</td>
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<td>18.22</td>
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</tbody>
</table>

Mean: 444.3  5.5  3.5  9.7  7.1  25.6  9.2  16.0  
Stddev: 429.6  2.3  2.5  4.0  3.4  8.5  12.6  2.9

Note: The table shows the overall averages of regulation, corruption, crime, infrastructure and their total for each country. The last two columns show the debt to GDP ratio relative to the US and logarithm of average sales per employee.
Table 5: Benchmark Experiments

<table>
<thead>
<tr>
<th>Taxes</th>
<th>GDP worker</th>
<th>TFP</th>
<th>K/Y</th>
<th>Size</th>
<th>Z_{cut}</th>
<th>Z_{avg}</th>
<th>Share of managers</th>
<th>Output per est.</th>
</tr>
</thead>
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<td>10%</td>
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<td>0.90</td>
<td>1.00</td>
<td>1.00</td>
<td>1.00</td>
<td>1.00</td>
<td>1.00</td>
<td>0.86</td>
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<tr>
<td>20%</td>
<td>0.73</td>
<td>0.80</td>
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<table>
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<tr>
<th>Finance Relative to the benchmark</th>
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<tr>
<td>Mean finance and tax</td>
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<tr>
<td>Decrease tax 1 std. dev.</td>
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<tr>
<td>Increase finance 1 std. dev.</td>
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<td>Improve both</td>
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Note: In the first panel, financial development is fixed to the US level. In the second panel, the tax is set to zero. For the last panel, the mean tax is 25.6% and mean finance is 9.2% of the US.
<table>
<thead>
<tr>
<th>Country</th>
<th>GDP worker</th>
<th>TFP</th>
<th>K/Y</th>
<th>Firm size</th>
<th>Z_cut</th>
<th>Z_avg</th>
<th>Share of managers</th>
<th>Output per est.</th>
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</table>

Note: The values in the table are relative to the US. For each country, a sample of 100 tax rates and the value of $\eta$ corresponding to the country debt to GDP ratio are used to simulate the model 20 times and the averaged results are shown.