Productivity and exports of Small and Medium Enterprises in Senegal: the Effects of Power Outages and formality

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Abstract

In this paper, we use a generalized linear model, a logit and Tobit models to analyze the effect of power outages, formality and other covariates on businesses' productivity and exports. From the results, power outages appear to have negative significant effects on technical and scale efficiency scores. On the other hand, formality helps businesses to be more efficient both in scale and technically, and to engage in export activities. Other important points stand out this analysis. It appears formality does not affect managerial efficiency, a difference is observed only on scale efficiency; further, while loan access has a significant effect on productivity, it seems like businesses used them more for operational activities than in investment. Both power outages and formality have significant effect on the propensity and the level of exports.

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1. Introduction

Small and medium enterprises (SMEs) haven't been in forefront of the fight against poverty in many countries so far in the developing world. That task has been devoted more to the agricultural sector, since most poor people are farmers. However, developing agriculture comes in the end with deepening capital in the sector, thus freeing a mass of workers. The latter would be in a precarious situation if employment is not available to harbor them, and thus threaten most results gained through other poverty reduction strategies. The development of SMEs, in providing employment and contributing to economic growth, is necessary and a complementary way in reducing poverty, especially when countries specificities are taken into account. SMEs are, however, still operating in difficult environment in the developing countries: inadequate enforcement of the rules of law, high cost of inputs, financial issues, and poor quality of other services such as electricity.

Senegal's economy has undergone a major crisis in the electricity sector during the past decade resulting in the daily occurrences of power outages. This environment has undoubtedly affected economic activities particularly industrial production, which relies heavily on electricity. The industrial sector contributes approximately 20 percent to GDP and employs around 12% of the labor force (YENIYF[2], 2009). SMEs, which consist of 95 percent of total businesses, are playing a greater economic role with a contribution to the industrial production going from 17 and 21 percent from 2003 to 2006 (World Bank, 2007).

Poor quality and power outages are the two main electrical disturbances businesses could suffer from (Lineweber and McNulty, 2001). The first refers to the fluctuations in voltage, which could result in severe damage to machinery and equipment, and a corresponding high cost of frequent repair and replacement. The second corresponds to a complete electric power loss of with a variable duration. Because of measurement and data collection issues, the present study considers only power outages, for which more reliable data can be collected. Electricity service quality is thus measured as the frequency, their duration of power outages, or as firms' self-assessment of the severity of the issue or the associated losses (Lineweber and McNulty, 2001; Jyoti and Ozbafli, 2006).

[2] YENIYF: The Youth Employment Network and the International Youth Foundation

Power outages can affect businesses activities through a variety of channels, which eventually lead to negative effects on productivity. First, efficiency will be challenged, because discontinuous power provision is synonymous with disruption in the production process, causing productive resources to lie idle, resulting in lower output level. The second issue is related to the costs associated with the replacement or repair of broken machines and equipment on the one hand, and the cost related to the spoilage of finished products or inventory on the other. Further, power shortages lead to extra cost to firms, because they often have to rely on alternative sources of energy, like rented or self-owned generators. Third, product quality could be at risk, it could be due to spoiled inventories, or malfunctioning machines. This means businesses have to produce more goods to replace the low-quality units, or discarded units. Consequently, production cost increases. At last, because businesses could not predict with any accuracy the occurrence of power outages, it brings about uncertainty in their activities. This situation translates into uncertainty in meeting deadlines, getting materials from suppliers on time, or profiting from new market opportunities. In the end, it could lead businesses to invest less and idle more capital, and hire fewer workers consequently.

The SMEs sector in Senegal is dominated by informal businesses. In fact, just 10 percent of them are formal. Nevertheless, the average sale of formal businesses is more than four times that of informal ones. Further, exporting businesses have an average sale nine times that of non-exporting ones. Crossing these two variables shows that formal exporting businesses tend to have higher sales and level of employment than other counterparts. These figures beg some questions, however. Are formal businesses more affected by power outages compare to informal ones? Did formal businesses react differently to informal ones to power outages?

The objective of this paper is to quantify and analyze the adverse effects of power outages and informality on the productivity and exports of SMEs in Senegal. We will, therefore, estimate SMEs' productivity and characterize them base on their formal and non-formal aspects. Further, we will model the determinants of SMEs' productivity as well as their exports as a function of power outages, and firms' characteristics (formality, size, age, owner's education and gender, exporting or non non-exporting business, loans, etc.) and industry characteristics (sectors, etc.);

SMEs appear to suffer from Power outages the most (Lee and Anas, 1992; Steel and Webster, 1991). Different analytical frameworks have been used to analyze these effects. Some of them consider a production function in which electricity is introduced as separate input alongside

labor and capital (see for instance Adenikinju, 2005). Others measured power outages based on businesses self-assessment of the electricity service quality they receive as determinants of businesses' productivity. However, many biases can plague the outcome, since firms may have the tendency to overestimate the incurred costs, hence, over-emphasize the constraint that electricity poses to their business activity (see Uchendu, 1993). And at last some studies used outage duration or frequency to capture the effect of power outages (Kaseke and Hosking, 2011; Siriprapa Panya et al., 2010).

Many criteria are used to characterize businesses' formality (Benjamen and Mbaye, 2012). Formal businesses in this paper are those located in industrial or exports free zones, or those holding regular accounting of their activities. Productivity is measured using data envelopment analysis (Coelli, 1996), while exports are represented by two variables, exports share in production and an export dummy variable.

Exporting decision may vary across different producers within industrial sectors. Some studies try to identify the differences in the characteristics of exporters and non-exporters, find that exporting businesses were more productive, use more labor and had a higher capital-worker ratio. The analyses include explaining the factors affecting firms' propensity to export as well as in the over-all the level of export (Bernard and Jensen, 2004. Factors considered in the many studies on the determinants of firms' export activities include size, age, labor productivity, type of ownership, access to finance, and constraints to registration and legal procedures (Jongwanich and Kohpaiboon, 2008; Amornkitvikai et al., 2012; Roberts and Tybout, 1997; Aldaba, 2012b; Tranh et al., 2010; Berman and Hericourt, 2008; Bernard and Jensen, 2004).

In this paper, we use a Generalized Linear Model, Logit and Tobit models to analyze the effect of power outages, formality and other covariates on businesses' productivity and exports. From the results, power outages appear to have negative significant effects on technical and scale efficiency scores. On the other hand, formality helps businesses to be more efficient both in scale and technically, and to engage in export activities. From other important points that stand out this analysis, it appears formality does not affect managerial efficiency, a difference is observed only on scale efficiency; further, while loan access has a significant effect on productivity, it seems like businesses used them more for operational activities than investment. Both power outages and formality have significant effect on the propensity and the level of exports.

The remainder of the paper is organized as follow: the next section presents some background information on the electricity sector; data and methodology are presented in section 3; and finally, section 4 presents the results.

2. Background

Like in many colonized developing countries, Senegal, also, tried to fill the gap created by decolonization. Because of the weak local private sector, the government got involved in the production of certain goods and services, particularly, sectors such as water and electricity have been nationalized.

Until 1960, the production of electricity was mostly private. In the late 1960 and early 1970, however, the nationalization process started; the first step covered the 1972-1983 period, with the signing of an "affermage" contract (EDS) and the creation of a public company, the Senegalese Electricity Company (SENELEC); the second step started in 1983 with the creation of a national company, SENELEC, holding the monopoly in the sector.

Until 1996, the sector went through many problems, and borne heavily on public finances, triggering pressure from most lenders (World Bank, and the IMF) toward the privatization of electricity in Senegal. In fact, below target investment realization, combined with poor maintenance on a dilapidated generation facilities led to a poor quality of service with an increasingly number of power outages leading many businesses that could afford it to settle their own power generation system.

The privatization process started effectively in December 1996, and in March 1999, 34 percent of the shares of SENELEC was sold to Hydro-Quebec International and Elyo jointly. This first privatization of the electricity sector in Senegal lasted only 18 months. A new elected government in Senegal, in 2000, bought the shares sold to Hydro-Quebec International and Elyo and launched a second privatization process in 2001 that weights less on the bidding price and more on the technical and investment issues, and the majority of the shares tendered. Negotiations have been unsuccessful so far.

As for 2010, 33 percent of the electricity delivered to SENELEC comes from Manantali hydroelectric Bridge plant, and the rest of the electricity used in Senegal is from a thermal production using liquid hydrocarbon. The company's own production went down by 10.4 percent between 2009 and 2010, which is in part compensated by the increase in the purchase of electricity from private suppliers by 22.1 percent; total production, in the end went up by 5.2 percent.

The deficit in electricity production led to deep decrease in the service quality, with the deficit in production increasing by 121 percent, mainly due to problems related to fuel supply, maintenance, investment, and the network (Commission for Regulation of the Electricity Sector (CRSE), 2011). With power outages frequently occurring at a daily rhythm, around 97 percent of all businesses surveyed in Senegal by the World Bank in 2007 have experienced electricity related problems, and almost all of them used generated electricity, and at last around 37 percent of own or share their generator against 63 percent not having generators at all. With projected investment realized only up to 16 percent (10.227 over 63.885 billion CFA Francs, it is very likely that the increasing demand from domestic usage, and professional will not be satisfied (WB, 2007; CRSE, 2011). Small and medium enterprises, and particularly the small ones that have problem generating their own power, will meet great deal of problems in their activities. Profitability will be at risk, leading to problems such as funding refusal from banks, or lack of own financial resources to develop or integrate new technologies in businesses.

3. Data and Methodology

3.1 Data

The data for this study is collected on businesses in 2013 in Senegal, with 2011 as the reference year. SMEs are defined according to the same criteria used in the World Bank surveys on industries in Senegal. Small enterprises are those having up to 19 employees; medium enterprises have from 20 to 99 employees. This definition contrasts with the definition of SMEs adopted in Senegal. However, it allows comparisons with the information in the Senegalese industry survey by the World Bank in 2006.

3.1.1 SMEs in Senegal's economy

Businesses in Senegal are distributed across two broad sectors: services and manufacturing. Most of the sample is in the former sector, which represents around 80 percent of the surveyed firms. They mainly operate in wholesale, retail, and other non-specified areas. The manufacturing businesses are mostly found in activities related to food processing, textiles and garments, chemicals, rubber and non-metallic minerals, and machinery and equipment; more details are shown in Table 1.

Table1: Distribution of sampled firms across sectors and size

	SMEs			Large	Total
	Small	Medium	Total		
			Percentages		
Agrifood	0.4	1.2	1.6	0.0	1.6
Textile and garments	2.4	0.2	2.6	0.0	2.6
Chemicals rubber and non metallic minerals	1.6	0.4	2.0	0.0	2.0
Machinery and equipment	2.4	1.6	4.0	0.2	4.2
ITC and electronic appliances	3.0	0.2	3.2	0.0	3.2
Construction	3.2	3.4	6.6	0.2	6.8
Wholesale and retail	32.5	1.2	33.7	0.2	33.9
Hotels et restaurants	3.8	1.6	5.4	0.0	5.4
Transportation	1.4	1.0	2.4	0.2	2.6
Other services	23.9	8.2	32.1	1.6	33.7
Other Manufacturing	3.0	0.8	3.8	0.0	3.8
Total	77.7	19.9	97.6	2.41	100.0
Count	387	99	486	12	498

Source: Enterprises Survey, 2013

Table 2 shows some of the general characteristics of the surveyed firms. The average age is around 16 years for SMEs, which more often are in the proprietorship legal status. Domestic ownership is predominant, and SMEs tend to depend heavily on one supplier with around 66 percent of material coming from their main supplier; the share of imported material is about 19 percent. More than 90 percent of production in sold domestically, with just 14.6 percent of SMEs exporting part or the total of their output. The managers' education level is 4 years, which places them mostly at the primary school level, even if they tend to be very experienced (19 years on average).

The share of main owners is as high as 86.7 percent on average for SMEs, which can be explain by the prevalence of proprietorships among them as mentioned earlier (Table 4). Among the many challenges usually faced businesses, the financial constraints are probably the most crucial. The lack of financial resources can impede not only the daily activities, but their development as well; because businesses will eventually need it to sustain end deepen their capital stock, and to integrate probably new technologies. On that point, only 17.2 percent of businesses applied for a loan, with one over two applications rejected on average. In the end 14.1 percent of businesses have a loan or a credit line, accounting for loans and

credit lines prior to the reference year. Average interest rates were 10 percent for loans and 9 for credit line, with respectively, durations of 41 and 29 months.

Table 1: General characteristics of businesses

	SMEs			Large	Total
	Small	Medium	Total	**Enterprises**	**general**
Age (average year)	15.2	18.4	15.8	18.2	15.9
Limited Liability Corporation (% of firms)	26.4	12.9	39.2	2.0	41.3
Proprietorship	44.1	6.0	50.1	0.0	50.1
Domestically Owned shares firms (%)	88.2	80.5	84.9	65.9	84.4
Part of main supplier in total supply	68.0	61.8	66.4	49.7	66.0
Part of imported materials in total supply	18.6	21.8	19.4	29.5	19.7
Exporting businesses (%)	12.7	22.2	14.6	25.0	14.9
Output sold in domestic markets (%)	94.2	91.1	93.4	83.8	93.2
Years of education of the main manager	3.9	4.1	3.9	4.0	3.9
Years of experience of the main manager	18.1	20.4	18.7	24.1	18.8

Source: Enterprises Survey, 2013

Tableau 3: SMEs financial issues

	SMEs			Large	Total
	Small	Medium	Total	**Enterprises**	**general**
Share of the main owner in the capital (%)	88.1	82.1	86.7	67.2	86.2
Businesses that applied for a loan (%)	14.0	29.6	17.2	25.0	17.3
Average number of applications	2.0	1.9	2.0	1.7	2.0
Application rejected (average)	1.3	0.9	1.1	0.6	1.1
Establishment with a credit line/loan (%)	8.3	36.4	14.1	33.3	14.6
Average interest rates on loans	9.8	9.7	9.8	10.7	9.9
Average interest rates on lines of credit	9.1	8.6	8.8	-	8.8
Average duration of loans	44.7	33.9	41.0	108.0	47.5
Average duration of lines of credit	27.0	29.1	28.5	-	28.5
Average amount for loans	9.1e+06	9.8e+07	3.9e+07	5.2e+08	8.9e+07
Average amount for on lines of credit	2.4e+07	1.1e+08	8.8e+07	-	8.8e+07

Source: Enterprises Survey, 2013

The energy sector in Senegal, electricity especially, is dominated by one big public firm, SENELEC. Ninety nine percent of enterprises reported SENELEC as their main provider of electricity. It is therefore clear that the crises undergone by this company will challenge almost all businesses.

Table 4 summarizes data on electricity and electricity-related issues. The year 2011 will remain among the periods most affected by power outages. Fifty seven percent of total businesses reported electricity as a major concern; considering size, 57.4 and 66.7 percent of SMEs and large businesses, respectively, were affected. In a typical month, power outages occurred 26 times on average for the SMEs, and 15 times for the larger businesses, with an outage lasting more than 2 hours on average. Consequently, businesses faced a certain number of challenges, leading to some adjustment or coping costs. For instance, 41 percent of SMEs and 50 percent of large businesses reported that production stopped during power outages. Businesses that continued operating during outages had their capacity reduced to around 80.5 percent for SMEs and 90.5 for larger businesses. The immediate consequence following this problem was related to whether or not wages for idled worker were paid. Ninety-nine percent of SMEs, among those for which activities stopped during power outages and all of their larger counterparts reported paying wages for workers in electric outage time. That was probably because most workers were, and still are, paid on a monthly instead of an hourly basis in Senegal. Nonetheless, it could be a major source of inefficiency since more output could have been reached for the same cost. For businesses in Agri-food, the losses could take other forms such as losing stocked outputs that are heavily electricity-dependent, dairy products for instance. Respectively, 27.4 and 16.7 percent of SMEs and large enterprises reported their product quality being affected by power outages. In the end, SMEs reported losing around 34 million FCFA on average, which amount to a total loss of 51.4 billion overall; the average loss was 349 million for large businesses, amounting to 44.2 billion in total. In relative terms, these figures, respectively, turn around 5 and 8.3 percent of their total sales in 2011.

Besides the costs mentioned above, power outages could cause many other inconveniences that trigger uncertainty in business activities. Considering the backward linkages and the forward linkages, any constraint on a supplier, especially one affecting production directly as is the case with electric power outages, could translate into a constraint for a business and further to its customers.

In the one hand, 47.4 percent of SMEs and 50 percent of large enterprises have experienced delivery delays from their suppliers; and in the other hand, 56 and 62.5 percent of SMEs and large businesses reported to have experienced delivery delays to their customers. These inconveniences are very rarely isolated. They often lead to some more unfavorable situations such as facing penalties, and/or losing customers or some other market opportunities. As a

matter of fact, 5 percent of SMEs, and 12.5 percent of large enterprises, for example, have faced some penalties because of delivery delays. Further, 4.2 and 12.5 percent of SMEs and of large businesses, respectively, reported having lost market opportunities due to power outages. The uncertainty created by these issues could have some ramifications directly related to the dynamics of the businesses in terms of investing more in capital or hiring more workers. For instance, 25 and 33.4 percent of SMEs reported that their hiring and investment decisions, respectively, are affected by power outages. For large enterprises, the figures are, respectively, 15 and 31 percent. One would expect, therefore, scale efficiency to be adversely affected by power cuts if most businesses are operating on a decreasing return to scale.

Table 4 compares some energy related statistics of businesses in Senegal to those of Sub-Saharan Africa (SSA) and the world. Enterprises in Senegal appeared to face more electricity constraints compared to their foreign counterparts. To begin with, 57.5 percent of businesses identified electricity as a major constraint to their activities, which was above the average for SSA and in the world, but less than in Nigeria (around 76 percent). In a typical month, businesses faced power outages 26 times on average, which is above the double of the frequency observed in SSA, and three times the world average. Nigeria, however, had the same frequency. A typical power outage lasted 2.3 hours on average, which was less than the duration in the regions retained for comparison.

The proportion of firms that own generators is much larger in Senegal than elsewhere, with the alternative source of electricity accounting for 31 percent of total electricity used. In SSA, the figure are 44 percent of businesses owning or sharing a generator, for 13.8 percent of electricity used generated, lower than in Nigeria (44% of businesses, 48% of electricity) and in the world at large (32% of firms and 7% of electricity generated). The proportion of firms that owned a generator was greater in our sample than that revealed by the World Bank Enterprises Survey for Senegal in 2007, which was 49 percent. That could be explained by a worsening of the crisis in the electricity sector in Senegal, with no apparent solution expected in short time run. This strategy appears to having helped avoid much of the negative impact of power outages; indeed the average losses due to power outages amounted to 5 percent of total sales, which was lower than the SSA (6.7% of sales) and Nigeria (8.9% of sales).

Table 4: Power Outages and related issues in Senegal

	SMEs			Large Enterprises	Total
	Small	Medium	Total		
Supplied by SENELEC (%)	99.0	100.0	99.2	100.0	99.6
Average electricity consumption electricity month (kWh)	1295.9	6662.5	2590.5	6222.1	2678.7
Average price per kWh (CFAF)	173.0	172.6	172.9	198.2	173.5
Electricity is a major concern (%)	55.8	63.3	57.4	66.7	57.6
Number of electrical outages in a typical month	25.5	26.9	25.8	15.0	25.5
Duration of a typical electrical outage (hours)	2.2	2.4	2.3	1.6	2.3
Does production stop in case of a power outage? (% of yes)	38.5	49.5	40.8	50.0	41.0
Are wages paid in case of a power outage? (% of yes)	96.1	96.0	96.1	100.0	96.2
Is product quality affected by power outages (% of yes)	25.6	34.3	27.4	16.7	27.1
Losses due to electrical outages (% of annual sales)	5.0	4.4	4.9	8.3	4.9
Average capacity utilization because of power outages	80.9	79.2	80.5	90.5	80.8
Do power cuts affect hiring decisions (% of yes)	22.5	34.7	25.0	16.7	24.8
Do power cuts affect investment decisions (% of yes)	30.5	45.9	33.6	33.3	33.6
Delivery delays from suppliers due to power cuts (% of yes)	46.1	52.5	47.4	50.0	47.5
Delivery delays to customers due of power outages (% of yes)	52.82	68.75	56.2	62.50	56.30
Associated penalties (% of total sales)	4.32	6.25	4.7	12.50	4.88
Loss of customers	23.92	8.75	20.7	0.00	20.31
Loss of market opportunities	3.65	6.25	4.2	12.50	4.37

Source: Enterprises Survey, 2013

Table 5: Power Outages in Senegal, in Sub-Saharan Africa, and in the world

Indicator	Senegal* (2011)	Nigeria	SSA	World
Number of electrical outages in a typical month	25.8	26.3	10.,7	8.6
Duration of a typical electrical outage (hours)	2.3	8.2	6.6	4.0
Losses due to electrical outages (% of annual sales)	5.1	8.9	6,7	4,8
Percent of firms owning or sharing a generator	90.7	85.7	43.6	31.6
Proportion of electricity from a generator (%)	30.8	47.5	13.8	7.1
Percent of firms identifying electricity as a major constraint	57.5	75.9	50.3	39.2

*Sources: Adenikinju, 2005; * from Enterprises Survey, 2013; SSA: Sub-Saharan Africa*

3.1.1 Measuring Productivity

The productivity of businesses is measured using three types of productivity indices: total technical efficiency, pure technical efficiency, and scale efficiency scores. Pure technical efficiency (PTE) is a measure of technical efficiency controlling for scale efficiency. It captures the managerial ability to organize inputs in the production process. Scale efficiency (SE), in the other hand, reveals whether the optimal size is chosen to produce the expected output level. It considers the fact that a bigger or smaller size in producing a given output level could induce some inefficiency in a business. If the firm is using a too big size for its output level, it is said to be on a decreasing return to scale (DRS), if however, the size is too small or the expected output level, it is said to be on an increasing return do scale (IRS). And finally, total technical efficiency (TTE) combines the above-mentioned 2 efficiency measures (Coelli, 1996).

The efficiency scores are estimated using data envelopment analysis (DEA), which uses the concept of relative efficiency (Farel, 1957; Charnes et al., 1978; Farel et al., 1994). A business is deemed technically efficient, given the available information, if compared with other businesses in the sample, its output cannot be improved with the level of input it uses, or if, given its level of output, its input usage cannot be improved. Scale efficiency refers to a business's ability to choose the optimal scale of production to generate a given level of output.

The efficiency scores are measured by sector first, which leads to more meaningful matching, and then stacked together to allow for further analysis. Overall, the average efficiency scores were 22, 42, and 48 percent for the total technical, pure technical and scale efficiencies (Table

5). SMEs appear less technically efficient compared to the large businesses, however, as for scale efficiency, the average scores are about the same for both groups.

Formal enterprises are shown to be more technically efficient overall compared to large ones, 34 against 22 percent. That difference, however, seems to come from their difference in scale efficiency, with formal businesses scoring 70 percent against 50 percent for SMEs. This reveals that in terms of managerial skills, there is not a significant difference between formal and informal businesses; this result is quite understandable if we consider the relative proximity of the average years of education and experience of the two groups of businesses (Table 6).

Table 5: Efficiency scores across business size

	Small	Medium	SMEs	Large	Informal	Formal	Total
Total Technical efficiency	0.19	0.32	0.22	0.53	0.22	0.34	0.23
Pure Technical efficiency	0.41	0.35	0.40	0.97	0.41	0.42	0.41
Scale efficiency	0.41	0.82	0.51	0.53	0.50	0.70	0.51

Source: Enterprises Survey, 2013

Table 6: Years of experience of managers

	Percentage of businesses		Average years of experience	
years of experience	Informal	Formal	Informal	Formal
0 - 10	21.4	14.0	7.3	7.6
11 - 20	42.2	46.0	16.0	16.6
21 - 30	23.4	26.0	26.2	25.7
31 - more	12.9	14.0	38.5	38.5
Total	100.0	100.0	18.5	21.0

Source: Enterprises Survey, 2013

3.2 Econometric Analysis

The econometric Analysis is twofold. The first part uses alternatively each measure of efficiency (technical and scale) and tries to understand what might drive differences in firms' performance, in a regression analysis. We regress the efficiency scores on two sets of explanatory variables E and X, as shown in Equation (1).

$$Y_{1i} = \alpha_0 + E_i\gamma_1 + F_i\delta_1 + X_i\beta + \varepsilon_{1i} \qquad (1)$$

Where Y_{2i} is the efficiency score of firm i.

The second part models firms' exports as a function of the same regressors as in equation (1). Y_{2i}, however, is a measure of firms' output share exported or a dummy variable taking on the value of 1 if the firm exports and 0 if not.

$$Y_{2i} = \eta_0 + E_i\gamma_2 + F_i\delta_2 + X_i\theta + \varepsilon_{2i} \qquad (2)$$

E_i a set of regressors related to electrical power outages, F_i a variable that takes on the value of 1 if the business is formal and 0 if not, and X_i a vector of characteristics associated with businesses and their environment. α_0, η_0, γ_1, γ_2, δ_1, δ_2, β and θ are models' parameters to be estimated, and ε_{1i} and ε_{2i} error terms.

In the model presented in equation (1) above, the dependent variables are the efficiency scores, which are proportions since each firm's performance is given relative to the best-practicing peer on the frontier. The dependent variables are therefore bounded between zero and one, with the possibilities of some observations taking the values zero or one. OLS estimates of such variables could lead to some nonsensical predictions with values outside the boundaries. Models to handle these types of data were developed by Papke and Wooldridge (1996), and implemented in Stata using a generalized linear model (GLM) (Baum, 2008).

GLM method will be used in the case of the second model, as well when the dependent variable is the exported share output. However, when we consider a dummy variable probabilistic model, probit or logit will be used.

Electrical power outages are measured by their frequency, duration, and severity, which is a self assessment of the business of the sternness of the power outage it faces. Variables related to a firm's characteristics include its age, ownership, manager profile, capital per worker, human capital, and whether it possesses alternative sources of electricity... The variable that captures the business environment is whether the firm is located in a free-trade zone, which makes them eligible for some fiscal advantages on their purchases of inputs and on profit.

4. Results

In this section we present and discuss the results of the regressions. We start first with the productivity model. The three measures of productivity are individually run on each measure of power outage (i.e. Power outages number, duration or severity), on a variable describing formality (formal) and on a set of regressors including business and business environment characteristics. We then present the exports model for which a similar work is done. The determinants of exports are analyzed using export shares in output first as dependent variable,

and second using a dummy variable that takes on the value of 1 if a business exports and 0 if not. The variables' names and definitions can be found in the annex.

4.1. Productivity

Tables 7-9 present the results of the GLM estimates of the different productivity as explained above; Table 10 contains the average marginal effects. Overall power outages have negative significant effects on productivity, while being formal has positive significant effects.

Beginning with pure technical efficiency, the duration of power outages and businesses' assessment on its severity on their activities (severity) have negative effects; the number of power outage, however, does not show significant effects. All three measures of power outages have negative significant effects on scale efficiency, as well as on total technical efficiency. Businesses, therefore, suffered from power outages in their activities, as it appears in the 57.6 percent of businesses that identified electricity as a major concern.

One would expect that an environment characterized by a poor electricity service would lead to capacity under utilization; as indicated average capacity utilization is around 80 percent, which could sometime hinder the motivation of firms to grow. In fact, 24.2 and 33.7 percent of SMEs indicated that their hiring and investing decisions, respectively, are affected by power outages. Therefore, it makes sense that the ability of businesses to reach their optimal scale of production be constrained in some ways by the power outages. The negative effects of these factors would extent to pure technical efficiency as well. The uncertainty about the timing and length of power outages will translate into uncertainty about the operational decision-making process. As a consequence total technical efficiency receives some adverse effects.

When we consider total technical and scale efficiency, formality appears to have a positive significant effect on productivity, which confirms the results of recent studies on the productivity-informality relation in West Africa (Benjamin and Mbaye, 2012). This result can also be foreseen in Table 5 depicting the productivity scores of the formal as opposed to informal units. Moreover, the decomposition of total technical efficiency in pure technical and scale efficiencies allows the results in this paper to give further insight. In fact we found that formality of businesses has no significant effect on pure technical efficiency. In other words, managerial skills tend to be the same on average across formal and informal businesses. Tables 6 and 8 show, respectively, the distribution of experience and education across levels and across formal and informal firms; as it appears the differences are not very important.

What really seems to drive productivity differences between formal and informal unit of production overall is scale efficiency. Formal firms manage better their size as compared to informal ones, which hint at other issues probably constraining informal units to adjusting their size in an optimal way.

Table 8: Level of education of managers

	Informal	Formal	Total
None	2.46	0.00	2.22
Primary	7.61	10.20	7.86
Secondary	16.78	18.37	16.94
Higher education	56.38	38.78	54.64
Professional education	10.96	24.49	12.30
Others (non specified)	5.82	8.16	6.05
Total	100.00	100.00	100.00

To avoid the negative effects of power outages on their activities, many firms developed coping strategies that consisted of generating their own electricity by means of owning, sharing, or renting a generator, or else by getting electricity from a self-producer. The variable solution is introduced to capture the effects on the productivity of businesses that developed such strategies, and appears to have a positive significant effect on all measures of efficiency. Naturally, at times of power shortage, businesses without a solution would have no choice but idle all or part of their capital and consequently, some of their workers as well; and as explained above, it could interfere with the investment decisions. Having a solution at hand to that problem allows enterprises to use more of their capacity than otherwise, and makes the investment decisions relatively easier to make. As a result, they were able to produce more than otherwise, which would explain the positive significant effect on efficiency scores.

Loans and credit lines come with a cost for businesses, since they have to face the payments of capital and interest. However, if used to finance investment, they could affect productivity, and allow full repayment and profitability. In fact, access to a loan or a credit line has shown a positive significant effect on total and pure technical efficiencies. The effect on scale efficiency, even if positive and significant, is smaller than the effect on pure technical efficiency, which lead to another important idea to be outlined. It hints to the fact that probably businesses that benefitted from loans or credit lines used it more in operational activities rather than in financing new capital, which is surprising since most production units are found to be experiencing increasing return to scale. A consequence of such behavior

would be less innovation or less technology adoption since most technologies are incorporated in capital.

The level of capital per worker has negative and significant on total and pure technical efficiencies. In fact, for a given level of product, more capital per worker means less productive capital, and therefore, technical efficiency would be adversely affected. Further, since the proportion of informal businesses in the economy is very high, a high capital-worker ratio will burden managerial operations, and thus affect their efficiency negatively. This result contrasts with the effect on scale efficiency, which is positive and significant, as expected. The positive effect on scale efficiency comes from the fact that most businesses are operating on the economies of scale part of their production function, using less capital than the long-run cost-minimizing level. In such case, more capital per worker leads businesses to gain in efficiency, as they get closer to their optimal scale.

The proportion of skilled labor in the work force (human capital) seems more crucial than the level of education of the manager when we consider their effect on technical efficiency. In fact, the former has positive significant effect technical efficiency scores, while the latter has shown no significant effect. Managerial efficiency seems, therefore, to draw more from the proportion of skilled workers in the work force than from the level of education of the manager itself. Most surprisingly, human capital affects negatively scale efficiency.

The older the businesses, the more technically efficient and the less scale efficient they are. The productivity of older businesses depends more on managerial than the scale efficiency. The shares of the main owner in businesses have negative significant effects on productivity. Therefore, single owned establishments meet more challenge in growing compared to other businesses. Female ownership has a negative impact on technical efficiency scores, while it seems to have no effect on scale efficiency. Limited liability corporation (LLC) businesses did better in technical efficiency, but are disadvantaged in scale efficiency. SMEs appeared to suffer more from management skills and do better in terms of scale efficiency. In fact, SMEs are expected to be more flexible in implementing size adjustments compared to larger businesses. Nevertheless, overall total technical efficiency is affected negatively, meaning that SMEs' inefficiency in management outreaches their efficiency gain in size management. As expected exporting businesses tend to be more efficient that non exporting ones. Further, businesses with foreign ownership have no advantage over entirely owned domestic ones regarding technical efficiency; however, they tend to be more scale efficient.

Table 7: Determinants of Total Technical Efficiency

	(1)	(2)	(3)
Outage duration	-0.0002**		
	(0.0000)		
Outages number		0.0003	
		(0.0002)	
Severity			-0.1669**
			(0.0216)
Formal	0.1564**	0.1605**	0.2092**
	(0.0163)	(0.0228)	(0.0099)
Solution	0.4704**	0.4599**	0.4814**
	(0.0694)	(0.0704)	(0.0659)
Exports	0.5548**	0.5731**	0.5871**
	(0.0362)	(0.0336)	(0.0413)
Loan/credit	0.2874**	0.2418**	0.2660**
	(0.0754)	(0.0825)	(0.0770)
Age	0.0093**	0.0097**	0.0078**
	(0.0008)	(0.0004)	(0.0008)
Log(capital/worker)	-0.0039	-0.0104**	-0.0049*
	(0.0033)	(0.0034)	(0.0026)
Higher education	-0.0246	0.0257	-0.0083
	(0.0551)	(0.0711)	(0.0603)
Legal status	0.1924**	0.2334**	0.2098**
	(0.0191)	(0.0087)	(0.0201)
Female owner	-0.3467**	-0.3727**	-0.3178**
	(0.0011)	(0.0053)	(0.0008)
Foreign owner	0.0002	-0.0001	-0.0004
	(0.0004)	(0.0003)	(0.0003)
Main owner share	-0.0062**	-0.0068**	-0.0059**
	(0.0004)	(0.0005)	(0.0003)
Human capital	0.0626**	0.1381**	0.1267**
	(0.0269)	(0.0657)	(0.0427)
SME	-1.6952**	-1.7751**	-1.7839**
	(0.1007)	(0.1336)	(0.1105)
_cons	0.5027**	0.4224**	0.4705**
	(0.0949)	(0.0746)	(0.0957)
N	361	361	364
R2	0.4315	0.4321	0.4320
Dev	1743.5435	1751.3833	1753.5395
pval	0.0000	0.0000	0.0000

Standard errors in parentheses; * $p < 0.1$, ** $p < 0.05$

Table 8: Determinants of Pure Technical Efficiency

	(1)	(2)	(3)
Outage duration	-0.0001**		
	(0.0000)		
Outages number		0.0004	
		(0.0003)	
Severity			-0.2459**
			(0.0339)
Formal	-0.0020	-0.0144	0.0680
	(0.0434)	(0.0611)	(0.0455)
Solution	0.2140**	0.2005**	0.2423**
	(0.0801)	(0.0800)	(0.0695)
Exports	0.4267**	0.4469**	0.4670**
	(0.0237)	(0.0217)	(0.0290)
Loan/credit	0.3083**	0.2741**	0.3024**
	(0.0863)	(0.0926)	(0.0854)
Age	0.0095**	0.0103**	0.0078**
	(0.0011)	(0.0003)	(0.0008)
Log(capital/worker)	-0.0153**	-0.0209**	-0.0108**
	(0.0030)	(0.0039)	(0.0025)
Higher education	0.0724	0.1180	0.0624
	(0.0670)	(0.0869)	(0.0683)
Legal status	0.2247**	0.2701**	0.2367**
	(0.0226)	(0.0078)	(0.0228)
Female owner	-0.3265**	-0.3434**	-0.2721**
	(0.0475)	(0.0533)	(0.0489)
Foreign owner	-0.0008	-0.0009	-0.0013
	(0.0009)	(0.0008)	(0.0009)
Main owner share	-0.0060**	-0.0066**	-0.0053**
	(0.0008)	(0.0010)	(0.0007)
Human capital	0.1594**	0.2216**	0.1856**
	(0.0561)	(0.1091)	(0.0703)
SME	-17.0177**	-17.3451**	-18.3350**
	(1.2154)	(1.2419)	(1.2113)
_cons	16.2005**	16.3600**	17.4232**
	(1.1939)	(1.1523)	(1.1778)
N	361	361	364
R2	0.3183	0.3198	0.3192
Dev	2121.8874	2116.1544	2119.7924
pval	0.0000	0.0000	0.0000

Standard errors in parentheses; * $p < 0.1$, ** $p < 0.05$

Table 9: Determinants of Scale Efficiency

	(1)	(2)	(3)
Outage duration	-0.0003**		
	(0.0001)		
Outages number		-0.0001**	
		(0.0000)	
Severity			-0.0541**
			(0.0220)
Formal	0.3307**	0.2961**	0.1569*
	(0.1224)	(0.1055)	(0.0906)
Solution	0.4533**	0.4500**	0.4236**
	(0.0123)	(0.0108)	(0.0152)
Exports	0.5583**	0.5594**	0.3089**
	(0.0623)	(0.0606)	(0.0536)
Loan/credit	0.0665	0.0709*	0.0285
	(0.0408)	(0.0385)	(0.0284)
Age	-0.0018**	-0.0008	-0.0100**
	(0.0007)	(0.0009)	(0.0001)
Log(capital/worker)	0.0269**	0.0258**	0.0480**
	(0.0020)	(0.0019)	(0.0033)
Higher education	0.2269**	0.2054**	0.1573**
	(0.0241)	(0.0262)	(0.0338)
Legal status	-0.2103**	-0.2017**	-0.1715**
	(0.0206)	(0.0145)	(0.0113)
Female owner	-0.0323	-0.0223	0.0719
	(0.0570)	(0.0544)	(0.0649)
Foreign owner	0.0882**	0.1145**	0.0443
	(0.0427)	(0.0458)	(0.0302)
Main owner share	-0.0018**	-0.0017**	
	(0.0006)	(0.0005)	
Human capital	-0.2325**	-0.2419**	-0.2882**
	(0.0488)	(0.0537)	(0.0569)
SME	1.1298**	1.1346**	
	(0.0450)	(0.0591)	
_cons	0.3427**	0.3373**	1.1802**
	(0.0988)	(0.1104)	(0.1220)
N	361	361	409
R2	0.8136	0.8137	0.9313
Dev	970.5956	968.9740	1144.3522
pval	0.0000	0.0000	0.0000

Standard errors in parentheses; * $p < 0.1$, ** $p < 0.05$

Table 10: Marginal effects on efficiency measures

	Scale efficiency			Pure technical efficiency			Total technical efficiency		
	(1)	(2)	(3)	(1)	(2)	(3)	(1)	(2)	(3)
Outage duration	-0.0000**			-0.0000**			-0.0000**		
	(0.0000)			(0.0000)			(0.0000)		
Outages number		-0.0000**			0.0000			0.0000	
		(0.0000)			(0.0000)			(0.0000)	
Severity			-0.0161**			-0.0205*			-0.0281**
			(0.0007)			(0.0121)			(0.0037)
Formal	0.0359**	0.0399**	0.0366**	-0.0184	-0.0195	-0.0109	0.0264**	0.0271**	0.0353**
	(0.0131)	(0.0151)	(0.0139)	(0.0191)	(0.0217)	(0.0212)	(0.0028)	(0.0039)	(0.0017)
Solution	0.0539**	0.0543**	0.0490**	-0.0733**	-0.0753**	-0.0692**	0.0793**	0.0776**	0.0812**
	(0.0013)	(0.0015)	(0.0017)	(0.0148)	(0.0140)	(0.0129)	(0.0116)	(0.0117)	(0.0110)
Exports	0.0686**	0.0685**	0.0698**	0.0696**	0.0718**	0.0745**	0.0935**	0.0968**	0.0990**
	(0.0076)	(0.0078)	(0.0074)	(0.0022)	(0.0027)	(0.0020)	(0.0062)	(0.0059)	(0.0071)
Loan/credit	0.0086*	0.0080	0.0061	0.0304**	0.0276**	0.0309**	0.0484**	0.0408**	0.0448**
	(0.0048)	(0.0051)	(0.0047)	(0.0122)	(0.0125)	(0.0120)	(0.0127)	(0.0140)	(0.0130)
Age	-0.0001	-0.0002**	-0.0001	0.0006**	0.0006**	0.0003**	0.0016**	0.0016**	0.0013**
	(0.0001)	(0.0001)	(0.0001)	(0.0002)	(0.0002)	(0.0002)	(0.0001)	(0.0001)	(0.0001)
Log(capital/worker)	0.0031**	0.0032**	0.0027**	-0.0165**	-0.0169**	-0.0162**	-0.0007	-0.0018**	-0.0008*
	(0.0002)	(0.0002)	(0.0002)	(0.0007)	(0.0010)	(0.0009)	(0.0005)	(0.0006)	(0.0004)
Higher education	0.0248**	0.0273**	0.0308**	-0.0093	-0.0044	-0.0112	-0.0041	0.0043	-0.0014
	(0.0033)	(0.0030)	(0.0044)	(0.0128)	(0.0147)	(0.0140)	(0.0093)	(0.0120)	(0.0102)
Legal status	-0.0240**	-0.0252**	-0.0240**	-0.0307**	-0.0265**	-0.0285**	0.0324**	0.0394**	0.0354**
	(0.0017)	(0.0024)	(0.0021)	(0.0093)	(0.0071)	(0.0104)	(0.0032)	(0.0016)	(0.0034)
Female owner	-0.0027	-0.0038	-0.0040	-0.0491**	-0.0505**	-0.0452**	-0.0584**	-0.0629**	-0.0536**
	(0.0064)	(0.0067)	(0.0065)	(0.0043)	(0.0046)	(0.0060)	(0.0001)	(0.0007)	(0.0002)
Foreign owner	0.0001	0.0000	0.0000	-0.0004**	-0.0005**	-0.0005**	0.0000	-0.0000	-0.0001
	(0.0001)	(0.0001)	(0.0001)	(0.0001)	(0.0001)	(0.0001)	(0.0001)	(0.0000)	(0.0001)
Main owner share	-0.0002**	-0.0002**	-0.0002**	-0.0006**	-0.0006**	-0.0005**	-0.0011**	-0.0012**	-0.0010**
	(0.0000)	(0.0001)	(0.0001)	(0.0001)	(0.0001)	(0.0001)	(0.0001)	(0.0001)	(0.0000)
Human capital	-0.0282**	-0.0271**	-0.0182**	0.0519**	0.0580**	0.0559**	0.0105**	0.0233**	0.0214**
	(0.0065)	(0.0059)	(0.0080)	(0.0087)	(0.0141)	(0.0120)	(0.0045)	(0.0110)	(0.0072)
SME	0.1350**	0.1346**	0.1314**	-4.1238**	-4.1312**	-4.1243**	-0.2857**	-0.2997**	-0.3008**
	(0.0069)	(0.0053)	(0.0064)	(0.2887)	(0.2890)	(0.2897)	(0.0168)	(0.0219)	(0.0183)
N	361	361	364	361	361	364	361	361	364

Standard errors in parentheses; * $p < 0.1$, ** $p < 0.05$

4.2. Exports

The results of the exports models are stored in Tables 11 to 13. Let us first consider Tables 11 and 12, which present the effects of the determinants of the probability to exports and of the exported share of output. The probability to export and exports shares are adversely affected by power outages. Formal production units are more likely to, and export more of their production than informal units, as well as businesses able to access to alternative electricity supply at times of power outages. However, surprisingly businesses that have a credit line or a bank loan are less likely to export and when they do, they export less compared to other businesses.

The government policy with the free zones seems to have well promoted exports. In fact, the variable free zone has a positive significant effect both on the probability to exports and on the exported share of production. The age of businesses, the level of education of the manager, the capital share on the main owner, and the proportion of skilled workers in the labor force have all negative significant effects on the probability to exports and the level of exports. On the other hand, the capital worker ratio, LLC and female and foreign ownership come out with positive significant effects on both the likelihood to export and the production share exported.

Exports in general give a higher price compared to local markets. Therefore, when possible, businesses do export, especially, when they are competitive. One could rightly think of the zero exports share units as below a certain level of competiveness or exports potential. The dependent variable will be, therefore, left-censored, as formalized below.

$$Y_{2i} = \begin{cases} 0 \text{ if } y_i^* \leq 0 \\ y_i^* \text{ if } y_i^* > 0, \end{cases}$$

Where y_i^* is a latent variable that can be potential competiveness or exports as stated above. In this case, a Tobit model (Tobin, 1958) is more appropriate to analyze the exported shares of production. The results of the Tobit regression are in Table 13.

The magnitudes of the coefficients have decreased, otherwise, most of the results reached with the GLM regression are found in the Tobit estimates; the only difference is that human capital seems to have no significant effect. Summing up, power outages have affected adversely, not only the likelihood to export, but also the quantity of their product they could devote to foreign markets. Further, informality seems to damper export activities.

Table 11: Determinants of Businesses' Exports using Logit

	(1)	(2)
Outage number	-0.0011**	
	(0.0001)	
Outage duration		-0.0002**
		(0.0001)
Formal	0.7281**	0.4851**
	(0.2943)	(0.2376)
Solution	0.9158**	0.8947**
	(0.0584)	(0.0520)
Loan/credit	-0.9301**	-0.9316**
	(0.1278)	(0.1363)
Age	0.0015	0.0036**
	(0.0012)	(0.0013)
Log(capital/worker)	0.1316**	0.1288**
	(0.0154)	(0.0146)
Higher education	-0.1059**	-0.1279**
	(0.0532)	(0.0569)
Legal status	1.0267**	1.0621**
	(0.0431)	(0.0381)
Female owner	0.3282**	0.3271**
	(0.0808)	(0.0774)
Foreign owner	0.0121**	0.0125**
	(0.0003)	(0.0003)
Main owner share	-0.0043**	-0.0050**
	(0.0008)	(0.0007)
Human capital	-0.3226**	-0.2466*
	(0.1423)	(0.1306)
Free zone	0.3159	0.4794**
	(0.2590)	(0.1980)
_cons	-4.0122**	-4.1538**
	(0.2525)	(0.2506)
N	374	374
pseudo R^2	0.155	0.152
ll	-1769.6378	-1777.6335

Standard errors in parentheses; * $p < 0.1$, ** $p < 0.05$

Table 12: Determinants of Businesses' Exports using GLM

	(1)	(2)
Outage number	-0.0020**	
	(0.0000)	
Outage duration		-0.0004**
		(0.0000)
Formal	0.7247**	0.3730*
	(0.3542)	(0.2244)
Solution	0.4760**	0.4284**
	(0.0604)	(0.0507)
Loan/credit	-0.6130**	-0.6293**
	(0.0946)	(0.1091)
Age	-0.0176**	-0.0139**
	(0.0011)	(0.0007)
Log(capital/worker)	0.0713**	0.0718**
	(0.0103)	(0.0092)
Higher education	-0.3434**	-0.3657**
	(0.0268)	(0.0313)
Legal status	0.6985**	0.7354**
	(0.0323)	(0.0260)
Female owner	0.9993**	0.9727**
	(0.0866)	(0.0789)
Foreign owner	0.0103**	0.0108**
	(0.0003)	(0.0003)
Main owner share	-0.0057**	-0.0066**
	(0.0010)	(0.0008)
Human capital	-0.5427**	-0.3896**
	(0.1553)	(0.1445)
Free zone	0.9451**	1.1469**
	(0.3227)	(0.2032)
_cons	-3.2759**	-3.5850**
	(0.0753)	(0.0743)
N	374	374
R2	0.2266	0.2171
Dev	1102.4274	1120.0689
pval	0.0000	0.0000

Standard errors in parentheses; * $p < 0.1$, ** $p < 0.05$

Table 13: Determinants of Businesses' Exports using Tobit

	(1)	(2)
Outage number	-0.0003**	
	(0.0001)	
Outage duration		-0.0001**
		(0.0000)
Formal	0.1828*	0.0995
	(0.1042)	(0.0874)
Solution	0.2296**	0.2259**
	(0.0194)	(0.0180)
Loan/credit	-0.1919**	-0.1923**
	(0.0382)	(0.0402)
Age	-0.0015**	-0.0010**
	(0.0003)	(0.0004)
Log(capital/worker)	0.0338**	0.0348**
	(0.0034)	(0.0033)
Higher education	-0.0799**	-0.0860**
	(0.0208)	(0.0224)
Legal status	0.3085**	0.3179**
	(0.0092)	(0.0073)
Female owner	0.1685**	0.1742**
	(0.0237)	(0.0230)
Foreign owner	0.0034**	0.0036**
	(0.0001)	(0.0001)
Main owner share	-0.0020**	-0.0022**
	(0.0002)	(0.0002)
Human capital	-0.0642	-0.0630
	(0.0439)	(0.0451)
Free zone	0.1966**	0.2581**
	(0.0972)	(0.0796)
_cons	-1.0808**	-1.1223**
	(0.0560)	(0.0545)
sigma		
_cons	0.5757**	0.5778**
	(0.0101)	(0.0102)
N	374	374
pseudo R^2	0.160	0.158
ll	-1754.0395	-1758.6902

Standard errors in parentheses; * $p < 0.1$, ** $p < 0.05$

5. Conclusion

In this paper we investigate how productivity and exports are affected by power outages and the formality of businesses, using cross-sectional data on industries in 2013, in Senegal. Power outages have negative significant effects on technical and scale efficiency, as well as on business export activities. Formal businesses, in the other hand are more productive, are more likely to exports and when they do, they export more. Further, access to loans and credit lines had significant positive effects on productivity. SMEs appear to do worse in managerial efficiency, while doing better in scale efficiency. The free zones policies have promoted export activities.

These results are important in terms of policy recommendations. They suggest that reforms should be undertaken, first to resolve the electricity problem in durable way. That in fact, will allow businesses to be close to their full potential in productivity, and thus, allow to some less efficient businesses to stay in activity and perhaps become more cost efficient. The results of the analysis on scale efficiency are in agreement with some the businesses' responses that their hiring and investment decisions are affected by power outage problems. A better electricity supply will promote, therefore, their growth, and provide more source of employment. Further, solving the electricity outage problems would allow businesses to save on the efforts and resources diverted to coping strategies, and thus gain more on technical efficiency if resources are reallocated to improve production management. Solving the electricity problem will improve on businesses' export activities, not only by improving productivity, but especially by reducing the uncertainty in production activities.

Second, measures to facilitate the formalization of informal businesses are in order. This will help businesses to grow, not only by improving productivity, but also by giving them more chance to get bank loans or credit lines, which affect technical efficiency.

Further, the results plead for the development of relevant support policies for SMEs, especially in an environment of deficient electricity supply. SMEs appeared to do better in scale efficient mainly because of the flexibility relative to their size. However, they still lag when it comes to cost and technical efficiency. And at last, free zones appear to be very important for productivity, with establishments in free zones being more technically efficient. The preferences given to businesses in these zones appear to be very important for their development.

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Annex

Table A 1: Definitions of the Variables

Variables	Definitions
Technical efficiency	Technical efficiency
Scale efficiency	Scale efficiency
Age	Age of enterprises
Share of main owner	Capital share of the main owner
Credit/loan	Does the business benefit from a loan or a credit line
Outage number	Number of electrical outages the year
Outage duration	Duration of a typical electrical outage (hours)
Higher education	Level of education of the principal manager
Experience	Number of years of experience of manager in the sector
Human capital	Share of skilled labor in total employment
Log of capital per worker	log of capital labor ratio
Major concern	Severity of power outages
Nationally owned share	Proportion of the capital of the business of private national ownership
SME	Is the business an SME or not
Solution	Does the business have a solution to its power outage problem (generator ownership, sharing or renting, or getting supply from someone else at time of power outage)
Free-zone	Location in a free zone

Source: Enterprises Survey, 2013