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Exports Promotion Policies for African Manufacturing Firms: Does electricity infrastructure matter more than exchange rate undervaluation?

Kabinet KABA*

Abstract

This paper studies the effects of power outages and exchange rate undervaluation on the allocation of manufacturing firms between the domestic and the exports market. I apply the instrumental variables approach to a sample of 12,062 manufacturing firms operating in 33 sub-Saharan African countries. The main results show that a 1% increase in the length of power outages reduces the share of exports in total sales by 0.939 percentage points. An undervaluation of 1% leads to an increase in the share of exports by 0.540 percentage points. The collateral damage effects show a negative impact of power outages and exchange rate undervaluation on the share of foreign inputs and a positive effect on the share of domestic inputs in the total purchase of inputs. Moreover, power outages and exchange rate undervaluation affect more the share of exports of firms in countries with low access to electricity, non-innovative firms, firms making less self-generation and firms operating in non-resource-rich countries. The robustness check indicates that the access to electricity and the exchange rate (undervaluation and depreciation) are substitutes. Indeed, a 1% improvement in electricity access per population reduces the positive impact of exchange rate undervaluation and depreciation on the share of exports by 0.172 and 0.583 percentage points, respectively.

Keywords: Power outages, Exchange rate, Manufacturing firms, Exports, Domestic sales, Africa.

JEL Classification : D22, F15, F40, H54, L1

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1 Introduction

The allocation of resources from the informal to the manufacturing sector is viewed as a natural path to economic development (Murphy et al., 1989b; Lewis, 1954). The inter-sectoral movement of resources to manufacturing firms increases total factor productivity. A rise of productivity causes wage growth and therefore an improvement in the standard of living (McMillan et al., 2014; McMillan & Headey, 2014). Nevertheless, this process of structural change has failed to occur in sub-Saharan Africa (SSA). In some cases, resources move from the manufacturing to the informal sector (McMillan et al., 2014). The intra-sectoral allocation of resources is also an important factor for economic growth and improves the standard of living. Indeed, a movement of manufacturing firms from the domestic to the export market is seen as source of income growth in small countries.¹ This is explained by the fact that, exporters are more productive than non-exporters, allowing them to have: an efficient production structure, more jobs, better jobs, better wages, and rapid growth (Bernard, 1995).² More precisely, entering the export market improves the productivity of new entrants (Fafchamps et al., 2007; Van Biesebroeck, 2005; Greenaway et al., 2002; Aw et al., 2000; Bigsten et al., 2000). Although exporting firms perform better than non-exporting firms, SSA is the worst performing region in the world in terms of manufacturing exports (Figure 1). Its manufacturing exports are 95 times less than Asia, 82 times less than Europe, 19 times less than North America, and 8 times less than Latin America.

Since manufacturing exports are important to improve the standard of living, some studies advocate real exchange rate undervaluation policies as a tool for exports expansion and economic growth in developing countries.³ According to Rodrik (2016) and Johnson et al. (2010), the undervaluation of exchange rate, as a substitute for industrial policy, could be the most effective tool to boost industrialization and thus growth in Africa. For Rodrik (2016), an undervaluation of 20% represents a 20% subsidy to industries allowing African manufacturing firms to compete with Chinese and Vietnamese exporters both in the domestic and exports markets. Moreover, Freund et al. (2012) show that, an undervaluation of real exchange rate by about 25% should give a large and immediate boost to manufacturing exporters in developing countries. In summary, the exchange rate undervaluation, by decreasing prices, would give a competitiveness advantage to manufacturing firms operating in small countries like those in SSA. The competitive gain for firms would be explained by the fact that undervaluation acts as a subsidy to manufacturing firms. Such a subsidy would reduce or eliminate the negative effects of some constraints related to the poor quality of the infrastructure service on manufacturing firms' activities.⁴ This would allow exporting firms to increase their foreign sales and new firms to enter the export market.

From the above analyses, three interesting questions arise. First, even if an undervalued ex-

¹The terms firms, enterprises and companies have the same sense in this paper, so they are used alternately.

²See also: Bernard & Jensen (1999) and Schank et al. (2007).

³For the sake of simplicity, we use in some cases the term "undervaluation" without accompanying it with "real exchange rate", but undervaluation clearly concerns the real exchange rate.

⁴See for example Rodrik (2016).

change rate could have a positive effect on the intra-sectoral allocation of firms, is this impact sufficient to eliminate the negative effect of the poor quality of infrastructure service? Second, would the ability of undervaluation to remove the negative effects of infrastructure on the movement of manufacturing firms to the export market depend on countries and/or firms' characteristics? Third, would exchange rate undervaluation also cause competitiveness losses by reducing imports of inputs, which are an important source of productivity in developing countries?⁵ This paper addresses these questions by conducting a comparative study between the effects of the quality of electricity infrastructure service and those of undervaluation on the intra-sectoral allocation of manufacturing firms. More specifically, it studies the effects of power outages (the measure of the quality of electricity service) and exchange rate undervaluation on the share of manufacturing exports in total sales and that of domestic sales. For this purpose, the country and industry fixed effects instrumental variables (IVFE) approach is applied on a sample of 12,062 manufacturing firms in 33 SSA countries between 2006-2019. There are many reasons for choosing to analyze the effects of exchange rate undervaluation/depreciation and electricity infrastructure. For exchange rate policies (devaluation, undervaluation, depreciation), they are part of the economic history of developing countries in general, and African countries in particular. The most illustrative case in terms of its magnitude (50% or 100% in national currency) is the devaluation of the CFA franc against the French franc in 1994 in the WAEMU countries.⁶ There have also been cases of devaluation in other African countries, with devaluations ranging from 15% to 70%.⁷ Although these exchange rate policies were implemented in the 1980s and 1990s, they continue to fuel the current economic debate through both their effects on firm competitiveness and their socio-economic impacts. These policies have also been implemented in Japan, South Korea, Taiwan and Singapore, but after, there was massive investments in infrastructure to boost the growth of manufacturing firms (Nayyar, 2019). The issue of electricity infrastructure is important in SSA for four main reasons. First, SSA is the region of the world with the lowest access to electricity per population (Figure 2).⁸ Second, it has the most unequal access to electricity between the rural and urban populations (Figure 3 & 4).⁹ Third, power outages are considered by manufacturing firms in SSA to be the most important barrier to their business (Figure 5). Fourth, the services of infrastructure like electricity enter in manufacturing production as inputs, therefore, as source of productivity. Thus, a poor quality of these services could cause a productivity loss, and then a competitiveness loss in manufacturing firms. I assume that the competition should be tougher in the export market than the domestic market in developing economies like those in SSA.¹⁰ Hence, the loss of competitiveness could lead some manufacturing companies to focus more on the domestic market at the expense of the export

⁵See: Goldberg et al. (2010).

⁶See: Devarajan (1997).

⁷See: Kimaro (1988).

⁸The term SSA refers to sub-Saharan Africa, but I sometimes use it to say SSA countries i.e., sub-Saharan African countries.

⁹For more explanation, see the next section.

¹⁰See the section about theoretical framework.

market. Therefore, in the context of exchange rate undervaluation, the policymakers have to ensure that the competitiveness losses due to the poor quality of electricity services is offset by the competitive gain due to the undervaluation. The effectiveness of exchange rate undervaluation should, therefore, depend on its ability to remove the negative effect of the poor quality of electricity service.

To the best of my knowledge, there is no article simultaneously studying the effects of power outages and exchange rate undervaluation on firms' allocation between the export and the domestic market. The existing literature focuses on the individual effects of these two variables. The first includes a number of articles examining the impact of power outages on business performance, such as productivity, sales, investment and employment. (Cole et al. 2018; Mensah, 2018; Allcott et al. 2016; Fisher-Vanden et al., 2015; Alam 2013; Steinbuks & Foster, 2010; Reinikka & Svensson, 2002). The second wave includes two sets of studies. The first concerns a number of papers investigating the role of exchange rate depreciation or undervaluation in exports and economic growth (Freund et al.; 2012; Eichengreen, 2007; Rodrik, 2007; Hausmann et al., 2005; Bernard & Jensen, 2004; Dooley et al., 2004; Sekkat & Varoudakis, 2000; Arslan & Van Wijnbergen, 1993; Bayoumi, 1999). The second focuses on the correlation between overvaluation and economic development (Acemoglu et al., 2003; Loayza et al., 2004; Benaroya & Janci, 1999; Razin & Collins, 1997; Dollar, 1992; Cottani et al., 1990). According to them, the more a currency is overvalued, the lower the GDP per capita.

The contribution of this article is twofold. First, I examine the effects of power outages and exchange rate undervaluation simultaneously on the intra-sectoral allocation of manufacturing firms. This enables a comparison between the effects of policies that promote manufacturing exports and the impacts of domestic constraints that discourage them. It also allows to understand if there is some interactions between the effects of the two variables. Second, the literature on the effects of exchange rate undervaluation focuses on aggregate exports, which may mask some heterogeneities across firms and industries. To avoid this issue, the empirical approach combines the country (undervaluation variable) and firm-level data (export variable). This approach also addresses the problem of non-exogeneity of instruments that could be due to a direct link between them and the performance of firms by using other macroeconomic variables as control.¹¹

The results on the overall sample suggest that power outages negatively affect the share of exports in total sales while the impact on the share of domestic sales is not significant. More specifically, a 1% increase in the length of power outages reduces the share of exports by 0.939 percentage points. For exchange rate undervaluation, it positively impacts the share of exports while its effect on the share of domestic sales is not significant. An undervaluation of 1% leads to an increase in the share of exports by 0.540 percentage points. The results on the overall sample show that the poor quality of electricity service discourages manufacturing firms from selling their products abroad while the undervaluation encourages them to export more. However, the positive effect of under-

¹¹See the discussion on instruments in the empirical strategy.

valuation is apparently offset by the negative effect of power outages. Indeed, the effect of power outages on the share of exports (-0.939) is approximately two times higher than that of exchange rate undervaluation (0.540). The collateral damage effects show a negative impact of power outages and undervaluation on the share of foreign inputs and a positive effect on the share of domestic input in the total purchase of inputs. A 1% increase in power outages and exchange rate undervaluation reduces the share of foreign inputs by 0.793 and 0.357 percentage points, respectively. However, it increases the share of domestic inputs by 0.638 and 0.332 percentage points, respectively. In addition to being unable to eliminate the negative effects of power outages, undervaluation is a barrier to foreign inputs utilization. The effect of power outages and that of undervaluation increase drastically in countries with poor access to electricity compared to those with better access to electricity. In addition, electricity shortages and undervaluation have a greater effect in non-innovative firms than innovative firms. For firms that rely heavily on self-generation, the effects of power outages and undervaluation are small compared to firms that do less self-generation. These results show that firms making efforts to introduce new production processes that could generate productivity gains and therefore competitive gains are less affected by power outages and exchange rate undervaluation. Also, firms that make efforts to reduce electricity shortages by producing a part of their electricity consumption are less affected by power outages and exchange rate undervaluation than those that do not make such efforts. Furthermore, manufacturing companies in non-resource-rich countries are more affected by power outages and undervaluation than those in resource-rich countries. The macroeconomic measure of electricity service quality confirms the previous results. Indeed, a 1% increase in the proportion of the population that has access to electricity increases the share of exports by 0.582 percentage points. Considering the interaction variable, a 1% improvement in electricity access per population reduces the impact of exchange rate undervaluation and depreciation on the share of exports by 0.172 and 0.583 percentage points, respectively. From the above results, it appears that when a country improves its access to electricity, the positive effect of undervaluation decreases. Undervaluation is therefore an effective subsidy for manufacturing firms only in the case of countries with low access to electricity. Countries with better access to electricity have less need for exchange rate undervaluation as a source of competitiveness to increase their export share. So, what really matters is improving the access to electricity rather than undervaluing the real exchange rate. Hence, the exchange rate policy and policies improving electricity access are substitutes.

The rest of the paper is organized as follows: Section ?? presents the issues of: exporters and non-exporters performance, electricity access and power outages in sub-Saharan Africa. Section 3 explains how power outages and exchange rate undervaluation theoretically affect the allocation of manufacturing firms between the export and the domestic market. Section 4 describes the variables and data used in the paper. Section 5 presents the specification approach. The main results are presented in Section 6. Section 7 and 8 concern the sensitivity tests and robustness, respectively.

Finally, Section 9 concludes.

2 Background: Exporters and non-exporters, access to electricity and power outages in sub-Saharan Africa

This section can be organized into two main parts. First, it focus on the issue of manufacturing exports in Africa. Second, it provides a statistical analysis of the availability and the quality of electricity service in SSA.

Table 1 presents a comparative analysis between exporting and non-exporting firms. Exporters in SSA perform better than non-exporters. In terms of sales, exporting firms sell about 8 times more than non-exporting firms. The average total sales of firms that export is about \$38.5 million while this amount is \$4.85 million for non-exporters. The average number of workers in exporting firms (248.43) is 4 times more than that in non-exporting firms (60.62). In terms of employment structure, both exporters and non-exporters employ more production workers than non-production employees. The average number of production workers in exporting firms is 208.85 while that of non-production employees is 44.22. Similarly, in non-exporting firms, the average number of production employees is 44.77 while that of non-production workers is 14.11. Nevertheless, the production and non-production workforce in exporting firms are 4 and 3 times higher than those in non-exporting firms, respectively. With 151.87 skilled workers on average, the exporters employ 5 times more skilled employees than non-exporters. The exporters also employ more unskilled workers and more women than non-exporters. Finally, the average number of workers that the firms would like to hire is about 8 times greater for exporters (47.11) than non-exporters (5.47). Although exporting firms perform better than non-exporting firms, SSA is the worst performing region in the world in terms of manufacturing export (Figure 1). Indeed, it exports 95 times less than Asia, 82 times less than Europe, 19 times less than North America, and 8 times less than Latin America.

In all regions of the world except SSA, more than 90% of the population has access to electricity (Figure 2). To be more exact, 100% of the population in North America, 99.99% in Europe and Central Asia... and 94.40% in South Asia have access to electricity. This proportion is only 46.75% in SSA making it the region where the population has limited access to electricity. For SSA, Figure 2 hides an unequal access to electricity between the rural and urban populations. Indeed, 77.86% of the urban population has access to electricity (Figure 3), compared to only 28.06% of the rural population (Figure 4). Such an inequality is not visible in the rest of the world. In other regions, more than 90% of the rural and urban populations have access to electricity (Figures 3 & 4). From the previous stylized facts, SSA is the most unequal region in terms of access to electricity between the urban and the rural populations. It is also the region with the lowest rate of electricity access per population. In addition to the lack and the inequality of electricity access, the poor quality

of electricity service is a severe constraint for manufacturing firms in SSA. Among the biggest obstacles to the operations of manufacturing firms in SSA, electricity is the most important (Figure 5).

3 Theoretical framework

Power outages and exchange rate undervaluation affect the allocation of firms through the intensive margin and the extensive margin. The intensive margin is defined as the expansion of existing firms in terms of sale in the export and the domestic market. For the extensive margin, it refers to the entry of firms in the two markets.

3.1 Power outages and the allocation of manufacturing firms between the export and the domestic market

As electricity is an input for manufacturing production, its services may contribute to productivity growth. The poor quality of these services, measuring by the length of power outages, could reduce firms' productivity.¹² The productivity loss due to power outages would decrease firms' sales and the possibility for new enterprises to enter in manufacturing sector. It may also be an incentive for firms to move from one market to another. Indeed, the decrease of productivity reduces the competitiveness of manufacturing firms both in the exports and the domestic market. However, for small economies like those in SSA, the extent of competitiveness in exports market should be more important than that in domestic market. Thus, the productivity loss due to power outages would make it more difficult to participate in export market than domestic market. Therefore, the companies that exist in the two markets would tend to sell more in domestic markets at the expense of export markets. In certain cases, some firms could exit the export market to stay or enter into the domestic market. For firms selling all of their products on the domestic market, power outages could prevent them from entering the exports market. Thus, even if a firm sells 100% of its products in the domestic market, power outages could be an incentive to stay there instead of exporting. Hence, the length of power outages should positively affect the share of domestic sales and negatively impact the share of exports in total sales.

In addition to encouraging firms to stay or to move towards domestic market, power outages can have a collateral damage effect on exports. Indeed, electricity shortages impose transaction costs on businesses increasing the cost of production. In order to reduce high production costs, firms could turn to cheaper production factors such as unskilled labor and less technological inputs. Assuming that foreign inputs would be more technological and thus more expensive than domestic ones in developing countries like SSA, firms could replace the imports of foreign inputs with the purchases of domestic inputs. Hence, power outages may reduce the share of foreign inputs and increase

¹²See for example [Cole et al. \(2018\)](#).

that of domestic ones in the total purchase of inputs. It should be noted that, the intermediate inputs, especially those imported, are an important source of productivity for manufacturing firms (Grossman & Helpman, 1991; Markusen, 1989; Romer, 1987; Ethier, 1982; Halpern et al., 2015; Goldberg et al., 2010; Amiti & Konings; Amiti & Konings). According to Halpern et al. (2015), the imports of intermediate inputs accounted for 30% of total factor productivity growth in Hungary and about 50% of this effect was due to importers. Moreover, the reduction of trade tariffs has led to higher imports of new varieties of inputs in India, which in turn have accounted for 31% of new varieties of finished goods (Goldberg et al., 2010). So, if the imported inputs are used exclusively to produce the export products, then the decline in the import of inputs due to power outages will lead to productivity loss and then to competitiveness loss which would further reduce the share of exports.

3.2 Real exchange rate undervaluation and the allocation of manufacturing firms between the export and the domestic market

Theoretically, a depreciation, more strongly, an undervaluation of exchange rate positively impacts manufacturing firms because it improves their competitiveness through the reduction of prices (Rodrik, 2016; Freund et al., 2012; Rodrik, 2008; Hausmann et al., 2005). More precisely, undervaluation moves resources from the non-tradable to the tradable sectors. Thus, it would increase the amount of manufacturing sales in both domestic and export markets. In terms of proportion, Freund et al. (2012) argue that, an undervalued exchange rate shifts resources to the export sector. Therefore, when the exchange rate is undervalued, one can expect an increase in the share of exports in total sales relative to that of domestic sales. Furthermore, one might also expect that the undervaluation allows domestic manufacturing firms to enter export markets or allows entrepreneurs outside of markets to enter the export market. According to Freund et al. (2012) and Rodrik (2016), an undervaluation reduces or eliminates the effects of distortions and constraints - like power outages - reducing manufacturing firms' performance. However, to eliminate the effects of power outages, the positive influence of exchange rate undervaluation on the export share must be greater than or equal to the negative impact of power outages. Moreover, the ability of undervaluation to eliminate the negative effects of electricity shortages may depend on firms and countries characteristics. Indeed, firms that make efforts to increase their productivity and thus their competitiveness may have less need for undervaluation. Conversely, firms that do not make such efforts may use undervaluation to improve their competitiveness. Such efforts may be the introduction of a new production process (innovation) or the use of a generator to prevent power outages.

Yet, the undervaluation of the exchange rate could have collateral damage through lower input imports due to higher prices. As these inputs are used in the production process, their inaccessibility due to undervaluation could lead, in the long run, to significant productivity losses and thus competitiveness losses. Since these competitiveness losses are due to productivity losses, they

could be greater than the competitiveness gains from undervaluation, which is due to a simple price reduction. To summarize, the drop in inputs imported would negatively affect the production structure of firms, whereas the drop in prices that increases firms exports would be temporary. Indeed, the constraints related to the production process of firms are structural problems, while an exchange rate policy can, at best, be a short-term solution. According to [Rodrik \(2016\)](#), maintaining an undervalued exchange rate requires an appropriate monetary/fiscal policy framework. In most SSA countries, deep institutional reforms would be required to achieve such a macroeconomic framework. However, even if these economies were able to build the necessary institutions to maintain the undervalued exchange rate, this would not solve the infrastructure problems, which remain structural. Moreover, if all African countries implement an undervaluation policy, it would result in real exchange rate competition among them. This type of competition would, at best, ensure the success of a select number of countries.

4 Variables and data description

This paper focuses on both company and country specific data. The firm-level data are from the World Bank Enterprise Surveys (WBES). The macroeconomic variables are from Penn World Table 10.0, KOF globalization database and World Development Indicators (WDI).¹³ About, 12,062 manufacturing firms in 33 SSA countries are studied between 2006-2019. The WBES concern the issues related to the business environment in developing countries, they allow for identifying the determinants of firms' performance. The stratification is based on three dimensions: sector, size, and the geographical location of firms. The surveys are carried out with the cooperation of the statistical office in each country covered.

4.1 Variable description

The variables description is mainly organized in two parts: firm variables and macroeconomic variables.

4.1.1 Firm's variables

The present subsection exhibits the set of firm variables used in this paper.

- **Firms allocation between the domestic and the foreign market:** The movement of manufacturing firms between two markets is defined in this paper as the increase or decrease in sales of a firm in one market relative to another. Thus, the more a firm sells in one market relative to another, the more it moves to the first market. Based on this concept, the allocation of manufacturing firms between the domestic and export markets is measured by the increase

¹³For the contributions relating to the KOF trade globalization index see [Gygli et al. \(2019\)](#) and [Dreher \(2006\)](#).

or decrease in the share of exports in total sales relative to that of domestic sales. The exports refer to the sales of manufactured goods whose immediate recipients are located outside the borders of country. The domestic sales concern the sales of manufactured products whose recipients are inside the country's borders. Furthermore, the movement of manufacturing firms between the domestic market of inputs and the foreign market of inputs is measured by the increase or decrease in the share of foreign inputs in total input purchases relative to that of domestic inputs. Foreign inputs concern the purchase of inputs whose sellers are located outside the borders of country. Domestic inputs correspond to the purchase of inputs whose sellers are inside the borders of country.

- **The quality of electricity service:** It is measured by the length of power outages experienced in each firm. Initially, this variable was monthly, I convert it to annual because the dependent variables are annual. The length of power outages is considered as key measure of electricity service because it matters more than the number of outages. The extent of the impact of power outages on the manufacturing production depends on their duration not on its number. Indeed, an outage lasting a few minutes would have a negligible effect on manufacturing production compared to an outage lasting several hours.
- **Capital ownership:** This firm characteristic measures the distribution of the company's ownership among the economic agents. I consider in this paper the share of capital that is held by: domestic economic agents (share owned by nationals), foreigners (share owned by foreigners) and government/state (share owned by government/state). This group of variables controls for heterogeneities that might exist between firms that are mainly owned by foreigners, domestic economic agents or by the government. Such differences may affect the probability of whether a firm exports or not. Indeed, it could be argued that a firm that is largely owned by foreigners would be more oriented toward foreign markets and one that is domestically owned would be more oriented toward the domestic market.
- **Firms' size:** Three dimensions represent the size of companies, namely small, medium and large. Small-sized and medium-sized firms employ 1 to 19 and 20 to 99 employees, respectively. Large-sized firms are those with 100 or more employees. If the size is associated with productivity and competitiveness, differences in size can also affect the ability of a firm to export or not.
- **Firms' locality:** This variable shows the size of the city in which a firm is operating. It is a dummy variable taking 1 if one firm is operating in large city and 0 otherwise. This dummy allows for controlling the agglomeration effect.
- **Sales 3 years ago:** This variable represents the amount of firms' sales three years before the survey. It allows to control the phenomenon of persistence. Indeed, the increase in sales three years ago could be used to improve the competitiveness of companies to participate in

the export market. In contrast, the decline in sales of firms three years ago may affect their future competitiveness and thus fail to participate more in the export market.

4.1.2 Macroeconomics variables

This subsection presents the macroeconomic variables from Penn World 10.0 database, WDI and KOF Globalization Index database.

- **Exchange rate undervaluation:** The exchange rate undervaluation is the macroeconomic variable of interest. To determine this variable, I use the method of [Rajan & Subramanian \(2011\)](#), [Rodrik \(2008\)](#), [Johnson et al. \(2006\)](#), [Easterly & Levine \(2003\)](#), which is summarized in three steps.

First, I collect data on the variable “price level of output-side real GDP“ from the Penn World table 10.0 as the measure of real exchange rate. This variable is expressed as one unit of local currency against an amount of dollars, thus, its inverse, named RER, is used allowing to study the impact of the undervaluation rather than the overvaluation. An increase in RER indicates that local currency is more depreciated while a decrease in RER means that the value of national currency is more appreciated compared to what is recommended by the purchasing power parity.

Second, in order to take into account the Ballassa-Samuelson effect, I regress the RER on the level of economic development (GDP per capita), allowing to take into account the purchasing power parity.

$$RER_{i,t} = \beta GDP_{C_{i,t}} + \delta_c + \Delta_t + U_{i,t} \quad (1)$$

With: δ_c , Δ_t , $GDP_{C_{i,t}}$, $U_{i,t}$ corresponding to the country and year fixed effects, GDP per capita and the error term, respectively.

In the final step, I calculate the measure of exchange rate undervaluation as the difference between the RER and its estimated values obtained from equation 1 ($\hat{RER}_{i,t}$).

$$Undervaluation_{i,t} = RER_{i,t} - \hat{RER}_{i,t} \quad (2)$$

With: $Undervaluation_{i,t}$ corresponding to the undervaluation index of the real exchange rate.

When the undervaluation measure is greater than 1, it indicates that the exchange rate is such that goods produced in the country are relatively cheap in dollar terms. Otherwise, the currency is overvalued. An increase in the undervaluation variable shows a trend to undervaluation, otherwise, there is a trend to overvaluation. For robustness, the RER is used as variable of interest instead of the undervaluation measure.

- **Access to electricity (%):** This variable is the percentage of population with access to electricity. It represents the alternative macroeconomic measure of the electricity service quality used in the robustness model. A country where a large part of the population has access to electricity could mirror a situation where a large part of firms also have access to electricity.
- **Households and government consumption:** One of the main determinants of firms' sales is the domestic demand. If the increase in manufactured goods consumed by households and the government consists of domestic goods, domestic sales will increase. Hence, the shares of households consumption and the government consumption in GDP are used as control variables. These variables are all from Penn World 10.0 database.
- **Domestic investment:** The effect of domestic investment measured by the share of gross fixed capital formation in GDP is controlled. The investment in inputs by one firm is the final sale of other enterprises. So, I expect a positive impact of investment on manufacturing sales. However, the effect on the share of exports and that of domestic sales could be mitigated.
- **GDP per capita growth:** The growth of GDP per capita, from WDI, can measure both the growth of income per capita and that of market size. As with income per capita, the expansion of GDP per capita could lead to an increase in the demand for domestic manufacturing products. As with market size, its growth offers opportunities for new firms to enter in the manufacturing sector.
- **GDP growth rate:** This variable measures the effect of the dynamism of an economy. It also takes into account the effect of the instruments on the performance of the companies which does not pass by the power outages.
- **Trade openness:** The country's outward orientation is controlled. The assumption is: countries that are more outward-oriented allow firms to export and import more. The outward-orientation of countries is measured by the De facto KOF trade globalization indicator.
- **The quality of institutions:** According to [Azomahou et al. \(2021\)](#), the quality of domestic institutions is an important determinant for the intensive and extensive margins of exports. I try to control for this effect. The quality of institutions is measured by the rule of law variable from WDI. It ranges from -2.5 (low rule of law) to 2.5 (high rule of law).

4.2 Data description

This subsection presents summaries for industries and countries.

Table 9 shows the representation of industries in the overall sample. The non-manufacturing and manufacturing industries represent 45.17% and 54.83% of the overall sample, respectively. The industry of wholesale and retail trade and that of food are the most represented in the total sample. In the specific case of the manufacturing sector, the labor-intensive industries tend to be

more represented than capital-intensive industries. Indeed, the food industry is the largest with 2,957 firms, which accounts for 24.52% of manufacturing sample. Moreover, the wearing apparel and dressing industries represent 13.73% of manufacturing sample. The capital-intensive industry like manufacture of office and computing machinery is the least represented, accounting for 0.07% of the sample.

Table 11 shows the representation of countries in terms of firms surveyed. Two countries, namely Nigeria and Kenya are the most represented in the manufacturing sample. In total, 4,198 Nigerian firms are considered, this represents 16.98% of the manufacturing sample. The number of Kenyan firms is 2,220 manufacturing firms, representing 8.98% of the sample. The least represented countries are Gabon, Guinea-Bissau, and Togo with 0.56%, 0.63%, 0.93% of manufacturing firms, respectively.

Table 10, presents the aggregate statistics. It is organized into two parts namely enterprises and macroeconomic variables. On average, the enterprises in the sample tend to sell more in domestic country rather than foreign countries. Indeed, the average share of exports in total sales is 12.07% while that of domestic sales is 83.02%. The average annual length of power outages is 82.01 hours while the average number of power outages is 85.61. Firms tend to be, on average, domestic rather than foreign firms. The average share of capital held by nationals is 88.28% while that held by foreigners is 8.24%. The locality dummy is, on average, 0.38, showing that the firms tend to not be located in large cities. The undervaluation measure (-0.09), is on average, overvalued in SSA countries.

Table 12 presents the statistics of the dependent variables by couple (country, year). In all couples (country, year) except (Ethiopia, 2019), the share of domestic sales in total sales is considerably higher than that of exports (direct exports). Moreover, in most countries with at least two years of surveys, the export share tends to decline over time. For example, in Botswana, the share of direct exports declined by 233% from 2009 (26.89% of total sales) to 2017 (8.07% of total sales). For Madagascar, this reduction is 795% from 2009 (30.51% of total sales) to 2017 (3.41% of total sales). In the same time, the share of domestic sales in total sales has increased from 66.79% to 90.63% in Botswana and from 64.03% to 94.71% in Madagascar between 2009 and 2017.

Table 13 presents the summaries about the variables of interest by couple (country, year). Regarding the variables of power outages (in columns 1 & 2), there is heterogeneity between the couples (country, year). Some couples record a significant number of power outages while having a relatively short duration of outages (Cameroon2014; Liberia2013; Lesotho2013; Nigeria2013; Malawi2009; Namibia2009; Nigeria2009). Moreover, other couples have long length of outages with low number of outages (Mozambique2019; Senegal2019; Mauritania2015; Mali2015; Zimbabwe2015; Rwanda2012; Senegal2012; Angola2010; Kenya2010; Mauritius2010; Zambia2009; Ghana2008; Angola2006). With the exception of the couple (Togo, 2008), all couples (country, year) in the sample have strongly overvalued exchange rates. Indeed, the undervaluation indicator is

significantly lower than 1 in all of these couples.

5 Empirical specification

I estimate the effect of power outages and exchange rate undervaluation on the allocation of manufacturing firms between the export and the domestic market. The basic econometric model is:

$$Y_{fict} = \alpha + \beta P_{fict} + \sigma E_{ct} + \mu F_{fict} + \gamma X_{ct} + \delta_c + \theta_i + \epsilon_{fict} \quad (3)$$

Where Y_{fict} represents either the share of exports in total sales (log) or the share of domestic sales in total sales (log) for firm f in industry i operating in country c at time t . Y_{fict} can also be the share of foreign inputs or that of domestic inputs in overall input purchases for firm f in industry i operating in country c at time t . P_{fict} and E_{ct} are the variables of interest. P_{fict} represents the enterprise variable of interest: the logarithm of the length of power outages in firm f located in industry i and operating in country c at time t . E_{ct} is the macroeconomic variable of interest corresponding to the logarithm of real exchange rate undervaluation or the logarithm of real exchange rate depreciation in country c at time t . F_{fict} is the vector of firm control variables for company f in industry i , country c at time t . X_{ct} is the vector of macroeconomic control variables for country c at time t . δ_c and θ_i are the country and industry fixed effects, respectively. ϵ_{fict} is an idiosyncratic error term. The ordinary least squares (OLS) approach with country and industry fixed effects is applied on equation 3. However, a major concern emerges from the previous specification. Indeed, the OLS with country and industry fixed effects do not take into account a possible endogeneity bias in the variables of interest. Thus, the challenge is to deal this issue in the firm-level variable of interest and in the macroeconomic variable of interest.

Concerning the endogeneity in the undervaluation measure, it could be explained by the existence of the reverse causality. I assume in equation 3 that, the real exchange rate undervaluation in time t makes manufacturing firms in SSA more competitive in time t . This would increase the share of exports in total sales relative to the share of domestic sales. However, one may argue that, the rise of manufacturing export in country c at year t could lead to an overvaluation or appreciation of the real exchange rate at the same year. Specifically, the more manufacturing firms in a country sell abroad, the more foreign currency will flow into that country affecting the value of the local currency. To deal with this, I use the one-period lag of the undervaluation measure. I assume that the performance of firms in terms of exports and domestic sales in country c at time t does not impact the real exchange rate in $t-1$.

There are two main reasons that may explain the endogeneity of the firm-level variable of interest. First, the length of power outages is self-reported by firms, so it could possibly be biased toward over- or under-estimation. Second, there may be a reverse causality between the length of power outages and the dependent variables. Indeed, I assume in equation 3 that an increase in the length

of power outages causes a productivity losses and then a competitiveness losses in manufacturing firms. These losses would encourage manufacturing enterprises to turn more toward the domestic market at the expense of the export market. However, one can argue that the good performance of firms in terms of both exports and domestic sales provide incentive for states to improve the quality of electricity service reducing the length of power outages. To address this type of endogeneity, I apply the IVFE approach by using two instruments namely: temperature shock and precipitation shock. The instruments may affect the length of power outages in two main ways. First, a rise of temperature should increase the demand of households for electricity (Eskeland & Mideksa, 2009; De Cian et al. 2007; Scott & Huang, 2007; Pardo et al. 2002; Li & Sailor, 1995; Al-Zayer & Al-Ibrahim, 1996; Ayyash et al. 1985; Bolzern et al. 1982). The increase in electricity demand passes through the use of household appliances such as air conditioners, fans, freezers, refrigerators... Since the supply of electricity is limited in the short term, the rise of the demand should increase the occurrence of power outages. For example, an additional 1 degree Celsius of temperature increases the demand for electricity by 2 kWh per year and per capita (Eskeland & Mideksa, 2009). Second, in countries with hydro-electric dams, the dry season which is characterized by low precipitation - a rainfall decrease - leads to a reduction in the water flow of the river that feeds the hydro-electric dam (Cole et al. 2018; Mideksa & Kallbekken, 2010; Bye, 2008; Demers & Roy, 2006; Beldring et al. 2006). The reduction in water flow, by decreasing electrical production will lead to power outages if the demand for electricity does not decrease.

I therefore expect that the shock of temperature positively affects the length of power outages while the shock of precipitation negatively affects it. These instruments, being shock variables, are exogenous by nature. Moreover, it could be argued that they might not satisfy the exclusion restriction condition if their effects on the dependent variables pass through other channels. For example, a flood or earthquake shock may affect the aggregate level of economic activity, thus inhibiting the output of firms. They could also have sectoral effect. Indeed, in agrarian countries like those in SSA, a flood shock can reduce the agricultural production and therefore decrease the production of the food industry because of the lack of raw materials. Hence, the challenge is to take into account these weather effects on the performance of firms that do not pass through power outages. To do so, I introduce macroeconomic measures of firm performance (GDP growth and GDP per capita growth) among the control variables in the two step of instrumentation. The value added is one of the most relevant measures of firm performance as it shows how a firm contributes to the economic activity. Moreover, an important component of GDP is the sum of the value added of all firms regardless their industries and sectors. Putting GDP growth as well as GDP per capita growth among the explanatory variables prevents the instruments from being correlated with the error term through the firm performance channel. The weather effects that pass through other macroeconomic variables like household consumption and government consumption are also controlled. The combination of the company and country dimensions allows me to make this kind

of control. The temperature or precipitation shocks for each couple (country, year) are determined as the deviation of the annual temperature or the annual precipitation from the historical average:

$$Shock_Temperature_{c,t} = \frac{T_{c,t} - \bar{T}_{c,t}}{T_c^{SD}} \quad (4)$$

$$Shock_Precipitation_{c,t} = \frac{Pr_{c,t} - \bar{Pr}_{c,t}}{Pr_c^{SD}} \quad (5)$$

$T_{c,t}$ and $Pr_{c,t}$ represent the annual temperature and the annual precipitation for country c at year t , respectively. $\bar{T}_{c,t}$ and $\bar{Pr}_{c,t}$ are the historical annual averages of temperature and precipitation in country c at year t (1961 is the historical year), respectively. Finally, T_c^{SD} and Pr_c^{SD} are the standard deviations of temperature and precipitation from 1961 to 2019 in county c . Thus, the IVFE is used. In the first step, the impacts of temperature and precipitation shocks on the length of power outages are estimated.

$$P_{fict} = \alpha + \beta Shock_Temperature_{ct} + \Gamma Shock_Precipitation_{ct} + \zeta E_{ct-1} + \eta F_{fict} + \rho X_{ct} + \delta_c + \theta i + \nu_{fict} \quad (6)$$

Where P_{fict} represents the endogenous firm-level variable in country c and time t (the logarithm of the length of power outages). E_{ct-1} is the lag (1) of the real exchange rate undervaluation or depreciation (log). Figures 6 show the relationship between the instruments and the variables of interest. As expected, the graphs reveal a positive correlation between the temperature shock and the length of power outages. However, the precipitation shock is negatively correlated to the length of power outages. The equation of the second step is :

$$Y_{fict} = \alpha + \Psi \hat{P}_{fict} + \tau E_{ct-1} + \chi F_{fict} + \phi X_{ct} + \delta_c + \theta i + \omega_{fict} \quad (7)$$

Where \hat{P}_{fict} is the fitted values of the length of power outages from the first stage. As expected, the length of power outages is negatively correlated to the share of exports in total sales and positively correlated to that of domestic sales (Figures 7). However, the exchange rate undervaluation is positively correlated to the share of exports and negatively correlated to that of domestic sales in total sales (Figures 8). Moreover, the length of power outages is negatively correlated to the share of foreign inputs and positively correlated to the share of domestic inputs in total purchase of inputs (Figures 9). Concerning the exchange rate undervaluation, it is negatively correlated to the share of foreign inputs and positively correlated to the share of domestic inputs in total purchase of inputs (Figures 10). Note that all the above correlations are statistically significant. The IVFE method is accompanied by two tests of validity for the instruments, namely the under-identification and weak identification tests. The first test determines whether the instruments are correlated with the variable suspected to be endogenous. The under-identification test is a Chi-square test based on the

null hypothesis of no correlation between the endogenous variable and the instruments. Therefore, the instruments will be relevant if the null hypothesis is rejected by the Kleibergen-Paap rk LM statistic. The weak identification test allows to understand whether the instruments are weakly correlated with the potentially endogenous variable. Thus, the instruments used will be valid if the Kleibergen-Paap rk Wald F statistic is greater than all the critical values of Stock-Yogo.

6 Results

The main results regarding the effects of power outages and exchange rate undervaluation on the allocation of firms between the domestic and foreign markets are reported in Table 2 and Table 3. Table 2 presents the impacts of power outages and exchange rate undervaluation on the share of exports and that of domestic sales in total sales. The results of the OLS method are included in the two first columns. This method shows that the measure of undervaluation has a positive and statistically significant effect on the share of exports in total sales and a negative impact on that of domestic sales. An undervaluation of 1% leads to an increase of 0.454 (column 1) and a decrease of 0.504 (column 2) percentage points in the share of exports and the share of domestic sales in total sales, respectively. For power outages, they have no statistically significant effect on the allocation of firms between the domestic and export markets (column 1 & 2). Since these results are subject to a potential endogeneity bias, the IVFE method and the one-period lagged exchange rate undervaluation measure are used to account for this issue. From column 3 to 6, I begin by presenting the results related to the effects of power outages and then I examine the impacts of exchange rate undervaluation. The columns 3 and 4 concern the IVFE model in which the length of power outages is endogenous and affects the share of exports in total sales. The first stage equation of this model is reported in column 3. As expected, the shock of temperature has a positive and statistically significant effect on the length of power outages while the shock of precipitation negatively impacts it (column 3). In addition, the shock of temperature and precipitation are relevant as instruments because they pass the under-identification and weak identification tests (column 4). Indeed, the P-value of the under-identification test (Kleibergen-Paap rk LM statistic) rejects the null hypothesis of no correlation between instruments and the length of power outages. Simultaneously, the Kleibergen-Paap rk Wald F statistics for the weak identification test is higher than all the critical values of Stock-Yogo (19.93; 11.59; 8.75; 7.25). In column 4, the length of power outages has a positive and statistically significant effect on the share of exports in total sales. More precisely, an increase in the length of power outages by 1% causes a decline in the share of exports by 0.939 percentage points. The columns 5 and 6 show the results of the model in which the length of power outages is endogenous and affects the share of domestic sales in total sales. The first stage equation of this model is reported in column 5. The annual shock of temperature positively and significantly impacts the length of power outages while the annual shock of precipitation negatively affects it

(column 5). Also, the instruments pass the validity tests (column 6). In column 6, although the sign of power outages' effect is positive, its impact on the share of domestic sales is not significant. For undervaluation, it positively and significantly impacts the share of exports (column 4) while it has no significant impact on the share of domestic sales (column 5). An undervaluation of 1% leads to an increase in the share of exports by 0.540 percentage points. Table 2 indicates that the poor quality of electricity service discourages manufacturing firms from selling their products abroad while the undervaluation encourages them to export more. However, the positive effect of undervaluation is apparently offset by the negative impact of power outages. Indeed, the effect of power outages on the share of exports (-0.939 percentage points) is approximately two times higher than that of exchange rate undervaluation (0.540 percentage points).

Table 3 presents the collateral damage effects of power outages and exchange rate undervaluation. The OLS method states that neither power outages nor undervaluation have a statistically significant effect on the purchase of foreign and domestic inputs (columns 1 & 2). To address the endogeneity bias, the IVFE method is applied in columns 3-6. As earlier, the instruments remain valid in the first stages of the estimate (columns 3 & 5). The length of power outages and exchange rate undervaluation negatively affect the share of foreign inputs and positively impact the share of domestic inputs in the total purchase of inputs. A 1% increase in power outages and exchange rate undervaluation reduces the share of foreign inputs by 0.793 and 0.357 percentage points, respectively (column 3) while it increases the share of domestic inputs by 0.638 and 0.332 percentage points, respectively. In addition to being unable to eliminate the negative effects of power outages, undervaluation is a barrier to foreign inputs utilization. As these inputs are an important source of productivity for manufacturing firms, their reduction due to undervaluation could lead, in the long run, to significant productivity losses and thus competitiveness losses. Since these competitiveness losses are due to productivity losses, they could be greater than the competitiveness gain from undervaluation, which is due to a simple price reduction. To summarize, the drop in input imports would negatively affect the production structure of firms, whereas the drop in prices would be temporary.

The above results highlight three interesting findings. First, power outages in SSA represent an obstacle to the movement of manufacturing firms from the domestic to the export market. Since manufacturing exports allow for the improvement of living standards through the creation of better jobs and the payment of better wages, improving the quality of electricity service becomes crucial for the development of SSA countries. Second, the undervaluation of real exchange rate seems to act as an instrument for promoting manufacturing exports thus as a source of the intra-sectoral structural change. Nevertheless, exchange rate undervaluation is unable to completely eliminate the negative effects of electricity shortages. Third, undervaluation also has a collateral damage as it reduces the imports of inputs which are an important source of productivity, therefore, an important source of competitiveness for manufacturing firms.

7 Sensitivity tests

The section examines four sensitivity tests related to access to electricity, innovation, business use of generators, and natural resource availability.

7.1 Countries with poor access to electricity vs countries with better access to electricity

The role of exchange rate undervaluation is to make firms more competitive by reducing or eliminating barriers/constraints related to their activities. Hence, if these obstacles - poor quality of electricity services - are less deep, the undervaluation of exchange rate could fail to achieve this goal. According to [Freund et al. \(2012\)](#), exchange rate depreciation allows to alleviate the distortions experienced by firms. The authors argue that exchange rate depreciation would be effective in developing countries with high distortions contrary to developed countries. This hypothesis is tested by applying the estimates to both the sample of countries with better access to electricity per capita and the sample of countries with poor access to electricity per population. The sample of countries with better access to electricity is made up of the 50% of countries with a high value of the variable: access to electricity by population. Likewise, the sample of countries with poor access to electricity is made up of the 50% of countries with a low value of the same variable. Obviously, the effects of undervaluation and power outages should be more important and statistically significant in countries with poor access to electricity than countries with better access to electricity. Table 4 reports the results of the present sensitivity test. Indeed, an undervaluation of 1% increases the share of exports by 1.311 percentage points (column 2) and reduces that of domestic sales by 0.513 percentage points in countries with poor access to electricity (column 3). In countries with better access to electricity, a 1% undervaluation increases the share of exports by 0.312 percentage points (column 6) and reduces the share of domestic sales by 0.398 percentage points (column 8). For electricity shortages, a 1% increase in the length of power outages reduces the share of exports by 1.664 percentage points (column 2) while it raises the share of domestic sales by 1.186 percentage points (column 4) in countries with poor access to electricity. However, an augmentation of the length of power outages by 1% reduces the share of exports by 0.453 percentage points (column 6) while it increases the share of domestic sales by 0.311 percentage points (column 8) in countries with better access to electricity. From the previous sensitivity test, it appears that the effects of power outages and the undervaluation on the share of exports are three times higher in countries with poor access to electricity than countries with better access to electricity.

7.2 Innovative firms vs non-innovative firms

According to [Van Beveren & Vandebussche \(2010\)](#), innovation increases the probability for firms to be exporters. Hence, there could be a correlation between innovation and the share of exports

and that of domestic sales. If I define innovation as the introduction of new production processes, it can play a role in reducing the effect of power outages if the new technique leads to productivity and competitiveness gains. So, the negative impact of power outages on the share of exports should be lower and less significant in innovative firms compared to non-innovative firms. From the WBES, I define innovation as all firms that claim to introduce a new process of production. This definition highlights the fact that some firms are making efforts to introduce new production processes that could generate productivity gains and therefore competitive gains. For this category of firms, one might expect undervaluation to play a minor or insignificant role in increasing competitiveness. In contrast, firms that do not make these efforts may benefit from the competitive gains of undervaluation. To some extent, non-innovative firms could use the competitiveness gain due to undervaluation as a substitute for innovation. Hence, undervaluation would appear to be a double-edged sword.

Table 5 reports this sensitivity test and shows that an augmentation of power outages by 1% reduces the share of exports by 0.587 percentage points in innovative firms (column 2) while this effect is -1.455 percentage points in non-innovative firms (column 5). Table 5 also indicates that exchange rate undervaluation has a positive impact on the export share of non-innovative firms, whereas this effect is not significant for innovative firms. An undervaluation of 1% increases the export share by 0.779 percentage points in non-innovative firms (column 5). The previous results show that the obstacles like power outages affect more non-innovative firms than innovative firms. They also exhibit that undervaluation would be an effective subsidy to enhance exports of non-innovative firms by eliminating internal distortions in these enterprises contrary to innovative firms. Therefore, undervaluation, as an export promotion tool, appears to be ineffective in the case of firms that make efforts to innovate.

7.3 The share of self-generation in firms

Faced with power outages, an alternative solution that manufacturing firms often apply is self-generation of electricity. It allows to replace partially or totally the electricity coming from the public networks. According to [Fisher-Vanden et al. \(2015\)](#), in the long term, companies produce their own electricity by adopting a generator. In the specific case of Nigeria, 20-30% of firms' initial investment is allocated to improve the electricity supply's reliability. Thus, one could argue that the more a firm makes self-generation the less it will be affected by power outages therefore, it will experience little loss of productivity and competitiveness. As in the case of firms that innovate, one might expect undervaluation to play a minor or insignificant role in increasing competitiveness of firms that make efforts to remedy power outages through their own means. Firms that do little or no self-generation could also use undervaluation as a way to protect themselves from competitiveness losses due to power outages without investing in improving the quality of electricity service which should protect them against productivity losses due to power outages. I measure self-generation by

the share of electricity that comes from a generator. In the overall sample, on average, the share of firms' electricity that comes from a generator is 60% (in country level). Thus, firms in which this share is less than 30% are considered to be more dependent on public electricity than those in which this share is greater than 30%.

Table 6 reports the results for the sample of firms that rely heavily on public electricity and for the sample of firms that rely on it less. In the sample of firms with small self-generation, a 1% increase in power outages leads to a 1.664 percentage points decrease in the share of exports (column 2) and a 1.186 percentage points rise in the share of domestic sales (column 4). However, the reduction in the export share caused by a 1% increase in power outages is 0.453 percentage points (column 6) while the increase in domestic sales is 0.311 percentage points (column 8) in the sample of firms with high self-generation. Regarding real exchange rate, an undervaluation of 1% leads to an increase in the share of exports by 1.311 percentage points (column 2) and a decrease in the share of domestic sales by 0.513 percentage points (column 4) in the sample of firms with little self-generation. For firms that rely heavily on self-generation, an undervaluation of 1% implies an increase in the export share of 0.312 percentage points (column 6) and a decrease in the domestic sales share of 0.398 percentage points (column 8). As mentioned earlier, the above results show that firms that make efforts to reduce power outages by important self-generation are less affected by electricity shortages and exchange rate undervaluation than those that do not make such efforts.

7.4 Excluding resources-rich countries

According to the model of [Corden \(1984\)](#), the main characteristic of the Dutch disease phenomenon is exchange rate appreciation. In such a context, an undervaluation may fail to rise the competitiveness of manufacturing firms. I expect that the undervaluation should be more significant with high elasticities in non-resources-rich countries contrary to resource-rich countries. Furthermore, in resource-rich countries, the industrial base being weak, a depreciation or undervaluation of the exchange rate would act more as a policy to promote exports of raw materials in contrast to non-resource-rich countries. Following the criteria of the World Bank, I consider as resource-rich all countries whose rents from the exploitation of natural resources are higher than 10% of GDP.

Table 7 sets out the results of the estimates in the sample of resource-rich and non-resource-rich countries. For non-resource-rich countries, an undervaluation of 1% increases the export share by 0.705 percentage points (column 2) while this impact is 0.480 percentage points in resource-rich countries (column 6). The negative effect of power outages on the export share is statistically significant in non-resource-rich countries while it is not in resource-rich ones. This could be explained by the fact that non-resource-rich countries would be much more dependent on manufacturing exports than resource-rich economies. It is important to note that in non resources-rich countries, the coefficients of undervaluation are approximately the same to those of power outages (-0.702 for exports share and 0.365 for the share of domestic sales). Thus, the undervaluation of exchange rate would

allow to offset the negative impact of power outages on the share of exports in non resources-rich countries.

8 Robustness check

The present robustness check examines the effects of alternative measures of electricity service quality and exchange rate on the dependent variables. I use a macroeconomic measure of the electricity service quality, which is the percentage of the population that has access to electricity and its interaction with real exchange rate variables. The OLS method with country and industry fixed effects is applied with the lag of the electricity access variable. The purpose of this second estimation technique is to ensure that the results of the IVFE method are valid even when using other measure of electricity service quality and correcting for endogeneity bias by another method. The estimation also allows to study the effects of interactions between the access to electricity and exchange rate variables. The interaction variables will allow to understand the extent to which the effects of the exchange rate undervaluation and depreciation are affected by those of electricity shortages. The model is written as follows:

$$Y_{fict} = a + bA_{ct-1} + cE_{ct-1} + dF_{fict} + eX_{ct} + \delta_c + \theta_i + \epsilon_{fict} \quad (8)$$

With A_{ct-1} , the lag (1) of the percentage of the population that has access to electricity.

Table 8 presents the results when the measure of electricity access (lag 1) and those of real exchange rate (lag 1) are the variables of interest as well as their interactions. The effects of electricity access and undervaluation as well as their interaction are reported in columns 1-4, those of electricity access and exchange rate depreciation are in columns 5-8 with their interaction. For the same dependent variable, the first column corresponds to the model without the interacting variable while the second column takes it into account. In column 1, a 1 percentage point increase in the proportion of the population with access to electricity increases the export share by 0.582 percentage points, while the effect of undervaluation is not significant. When controlling for the interaction variable, the impact of electricity access increases and the effect of undervaluation becomes significant (column 2). Furthermore, the interaction variable negatively affects the exports share, showing a substitutability between the improvement of the electricity service quality and undervaluation. In column 2, a 1 percentage point improvement in the electricity access per population reduces the impact of undervaluation on the share of exports by 0.17 percentage points. Columns 3 and 4 correspond to the models in which the share of domestic sales in total sales is the dependent variable, the same conclusions as above can be drawn but in the opposite direction. In column 5, the access to electricity positively impacts the exports share while the effect of exchange rate depreciation is not significant. Controlling for the interaction variable, the impact of electricity access increases drastically, the effect of exchange rate depreciation becomes statistically

significant. As before, the effect of the interaction variable is negative; an increase in the proportion of people with access to electricity of 1 percentage point leads to a decrease in the effect of exchange rate depreciation of 0.583 percentage points on the share of exports. The same conclusions can be drawn in the last two columns, but in the opposite direction.

From the above findings, it appears that when a country improves its access to electricity, the positive effect of undervaluation decreases. Undervaluation is therefore an effective subsidy for manufacturing firms in the case of countries with low access to electricity. Countries with better access to electricity have less need for exchange rate undervaluation as a source of competitiveness to increase their export share. So, what really matters is to improve access to electricity rather than undervalue the real exchange rate. Therefore, exchange rate and electricity access policies are substitutes.

9 Concluding remarks

The movement of manufacturing firms from the domestic to the export market is seen as a way to improve the standard of living. Indeed, exporting firms appear to create better jobs and pay better wages than non-exporting firms. In the same vein, a number of studies advocate real exchange rate undervaluation policies as a means to promote manufacturing exports. Meanwhile, manufacturing firms in sub-Saharan Africa report that the poor quality of electricity service is the most important obstacle to their operations. From the above, a number of questions arise. How do exchange rate undervaluation and power outages affect the movement of firms into the export market? Are there interactions between the effects of these two variables? These are the questions that the paper aims to answer. More specifically, I study the allocation of 12,062 manufacturing firms between the domestic and exports markets in 33 sub-Saharan African countries. The effects of power outages and exchange rate undervaluation are examined on the share of exports and that of domestic sales in total sales.

The results on the overall sample suggest that power outages negatively affect the share of exports in total sales while the impact on the share of domestic sales is not significant. More specifically, a 1% increase in the length of power outages reduces the share of exports by 0.939 percentage points. For exchange rate undervaluation, it positively impacts the share of exports while its effect on the share of domestic sales is not significant. An undervaluation of 1% leads to an increase in the share of exports by 0.540 percentage points. The results on the overall sample show that the poor quality of electricity service discourages manufacturing firms from selling their products abroad while the undervaluation encourages them to export more. However, the positive effect of undervaluation is apparently offset by the negative effect of power outages. Indeed, the effect of power outages on the share of exports (-0.939) is approximately two times higher than that of exchange rate undervaluation (0.540). The collateral damage effects show a negative impact of power out-

ages and undervaluation on the share of foreign inputs and a positive effect on the share of domestic input in the total purchase of inputs. A 1% increase in power outages and exchange rate undervaluation reduces the share of foreign inputs by 0.793 and 0.357 percentage points, respectively while it increases the share of domestic inputs by 0.638 and 0.332 percentage points, respectively. In addition to being unable to eliminate the negative effects of power outages, undervaluation is a barrier to foreign inputs utilization. The effect of power outages and that of undervaluation increase drastically in countries with poor access to electricity compared to those with better access to electricity. In addition, electricity shortages and undervaluation have a greater effect on non-innovative firms than innovative firms. For firms that rely heavily on self-generation, the effects of power outages and undervaluation are small compared to firms that do less self-generation. These results show that firms making efforts to introduce new production processes that could generate productivity gains and therefore competitive gains are less affected by power outages. Also, firms that make efforts to reduce electricity shortages by producing a part of their electricity consumption are less affected by power outages and exchange rate undervaluation than those that do not make such efforts. Furthermore, manufacturing companies in non-resource-rich countries are more affected by power outages and undervaluation than those in resource-rich countries. The macroeconomic measure of electricity service quality confirms the previous results. Indeed, a 1% increase in the proportion of the population that has access to electricity increases the share of exports by 0.582 percentage points. Considering the interaction variable, a 1% improvement in electricity access per population reduces the impact of exchange rate undervaluation and depreciation on the share of exports by 0.172 and 0.583 percentage points, respectively. From the above results, it appears that when a country improves its access to electricity, the positive effect of undervaluation decreases. Undervaluation is therefore an effective subsidy for manufacturing firms only in the case of countries with low access to electricity. Countries with better access to electricity have less need for exchange rate undervaluation as a source of competitiveness to increase their export share. So, what really matters is improving the access to electricity rather than undervaluing the real exchange rate. Hence, the exchange rate policy and policies improving electricity access are substitutes.

In summary, I find that the issue of electricity infrastructure must be considered in the exports promotion policies for manufacturing firms in sub-Saharan Africa. Since the effect of exchange rate undervaluation is important for firms in countries with poor access to electricity, non-innovative firms, less self-generation firms, and for firms in non-resources rich countries, it could be recommended for them. Nevertheless, it is important to note that undervaluation can be a double-edged sword for the aforementioned companies as it can discourage them from making innovation and self-generation efforts. Overall, the priority in sub-Saharan African countries should be the improvement of electricity infrastructure rather than exchange rate undervaluation. Indeed, undervaluation is a short-term solution because of the exchange rate competition that it could fuel. Also, given its collateral damage effects and its difficulty to be maintained in the long term, it can be sub-

stituted by policies improving the quality of electricity service, which is a more sustainable solution for firms' performance.

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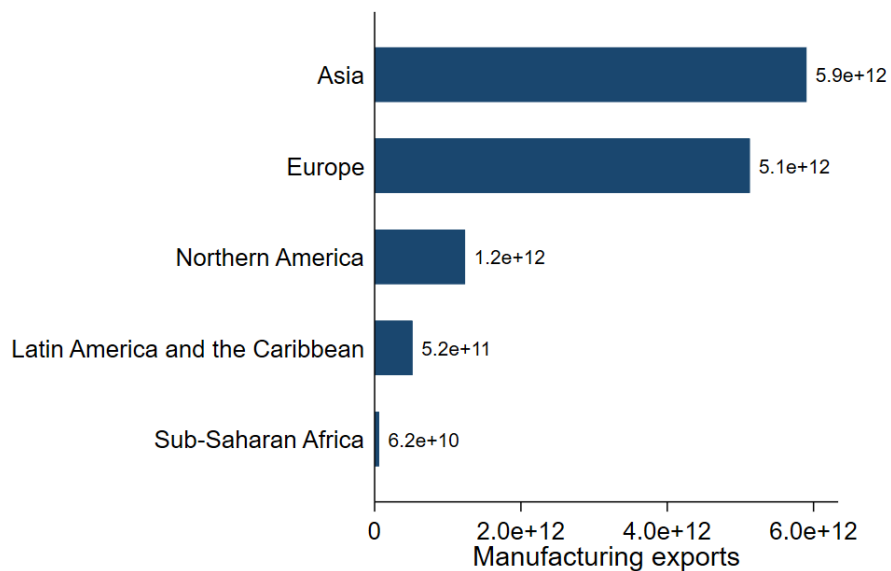
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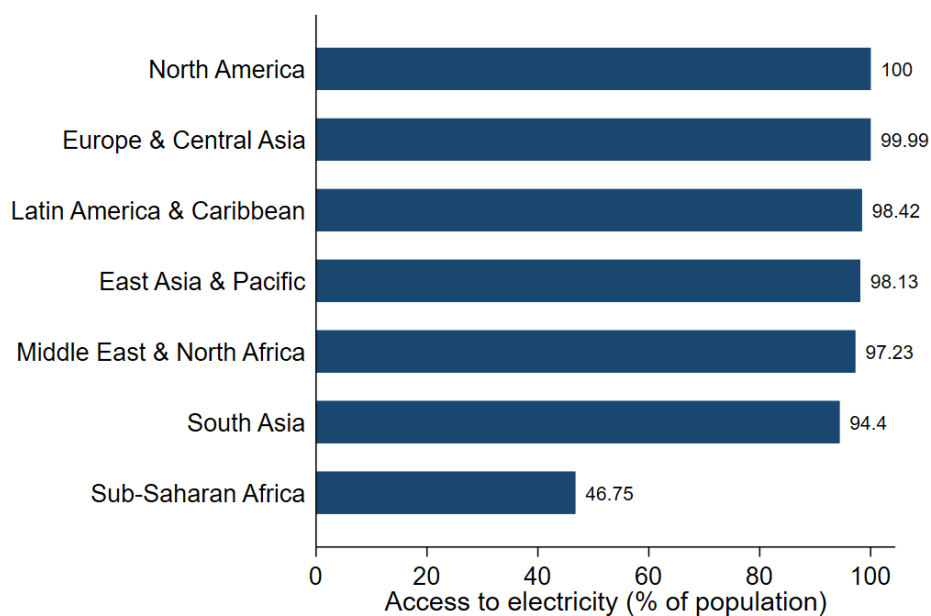
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Figure 1: Manufacturing exports by United Nations Conference on Trade and Development regions classification



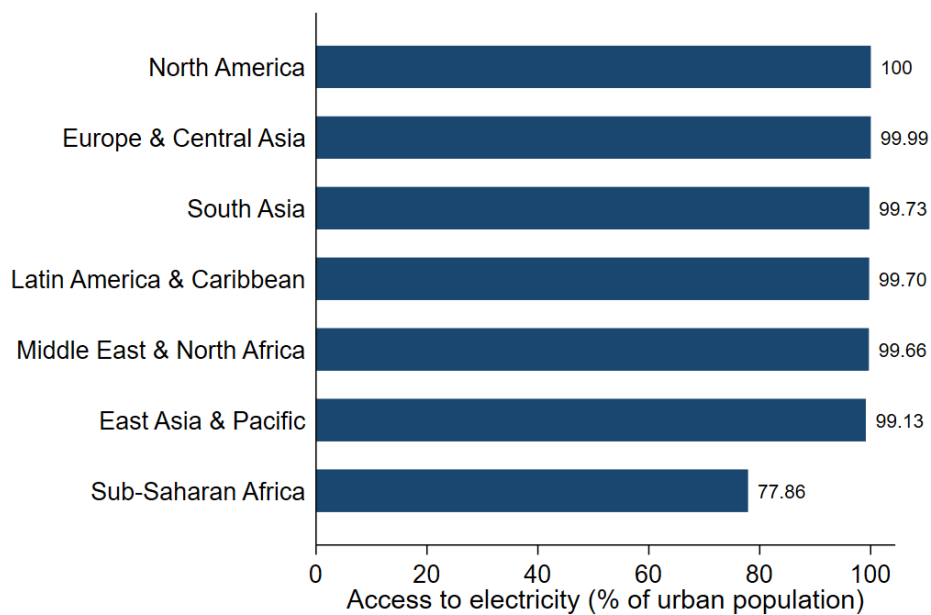
Author's construction. Source: UNCTAD.

Figure 2: Access to electricity (% of population) by World Bank regions classification



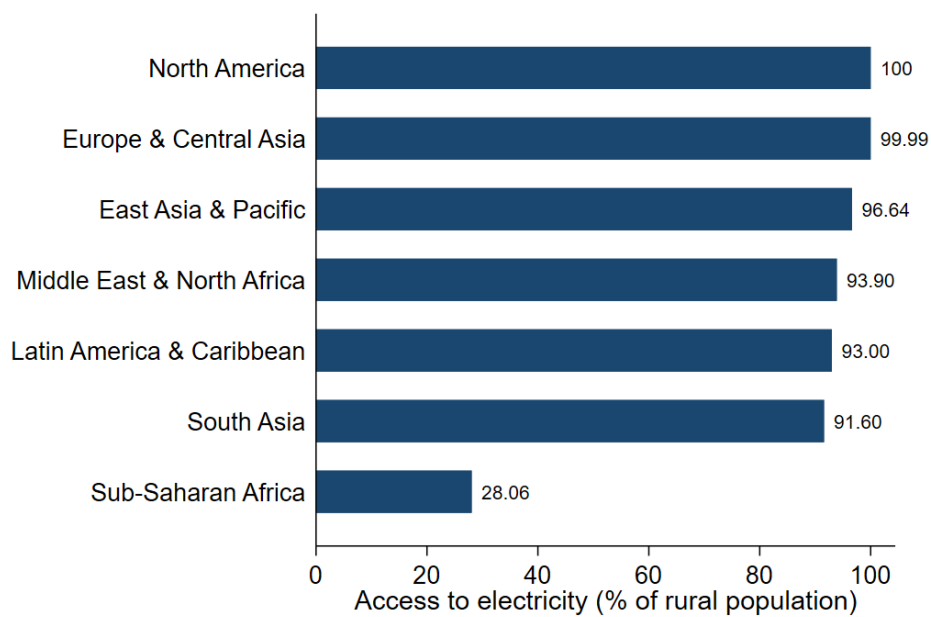
Author's construction. Source: World Development Indicators.

Figure 3: Access to electricity (% of urban population) by World Bank regions classification



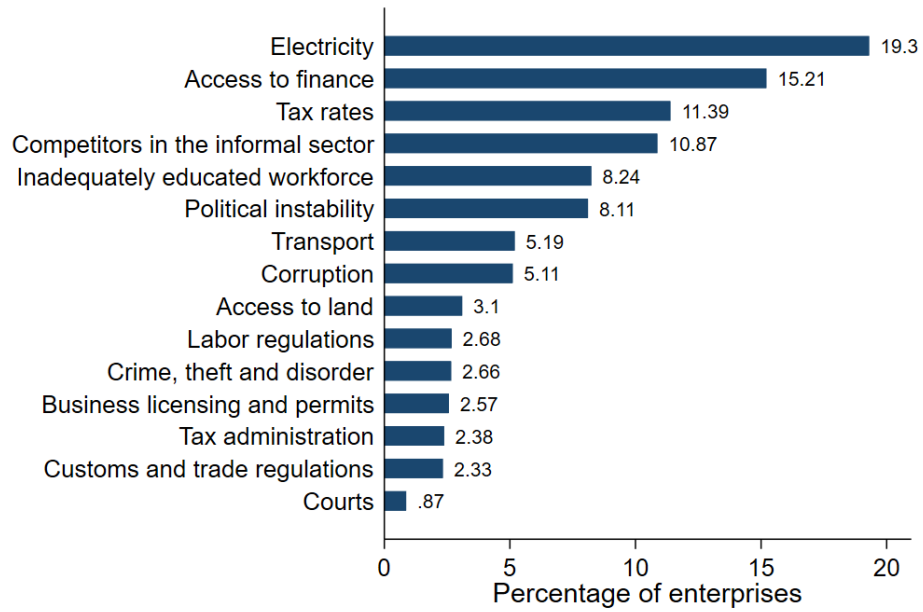
Author's construction. Source: World Development Indicators.

Figure 4: Access to electricity (% of rural population) by World Bank regions classification



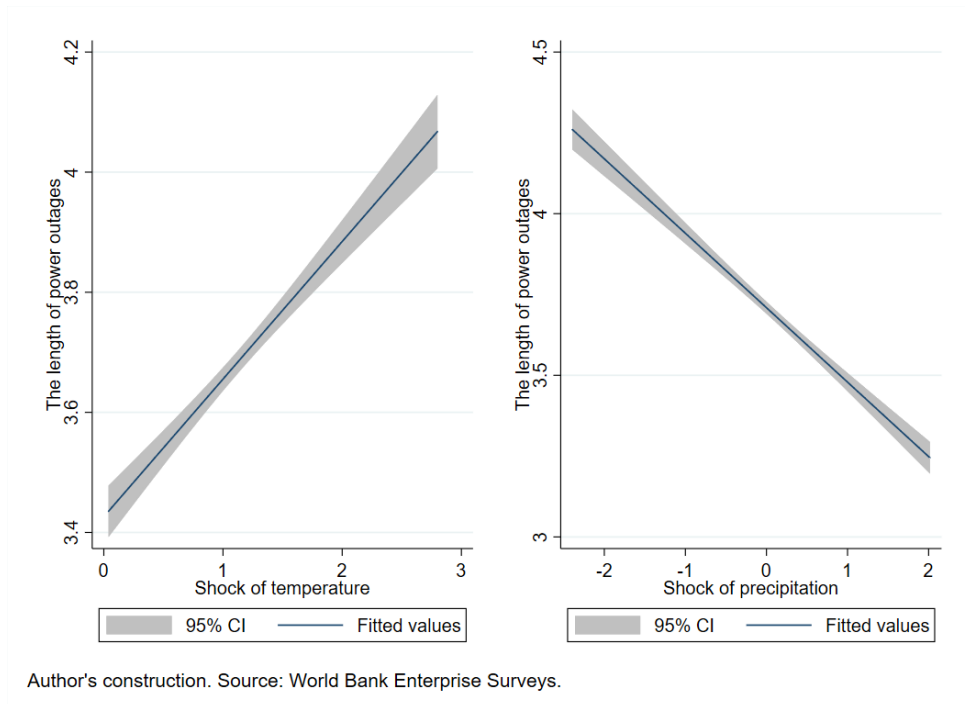
Author's construction. Source: World Development Indicators.

Figure 5: Biggest obstacle affecting the operations of firms



Author's construction. Source: World Bank Enterprise Surveys.

Figure 6: Correlation between the shocks of temperature/precipitation and the length of power outages in sub-saharan African manufacturing firms



Author's construction. Source: World Bank Enterprise Surveys.

Figure 7: Correlation between the length of power outages and the allocation of manufacturing firms between the exports and the domestic market

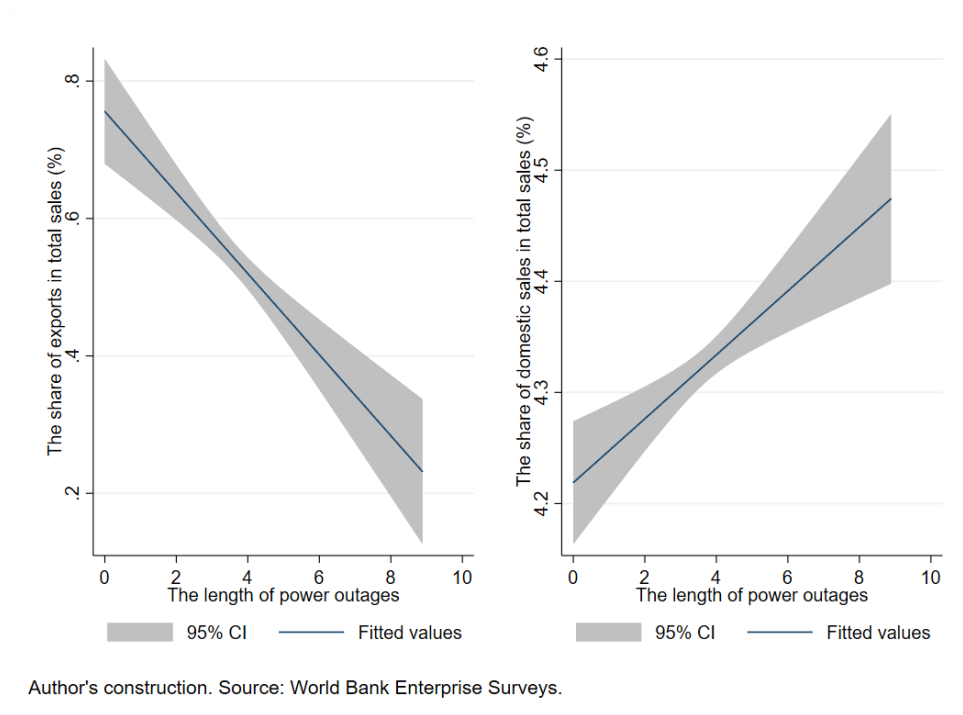


Figure 8: Correlation between the exchange rate undervaluation and the allocation of manufacturing firms between the exports and the domestic market

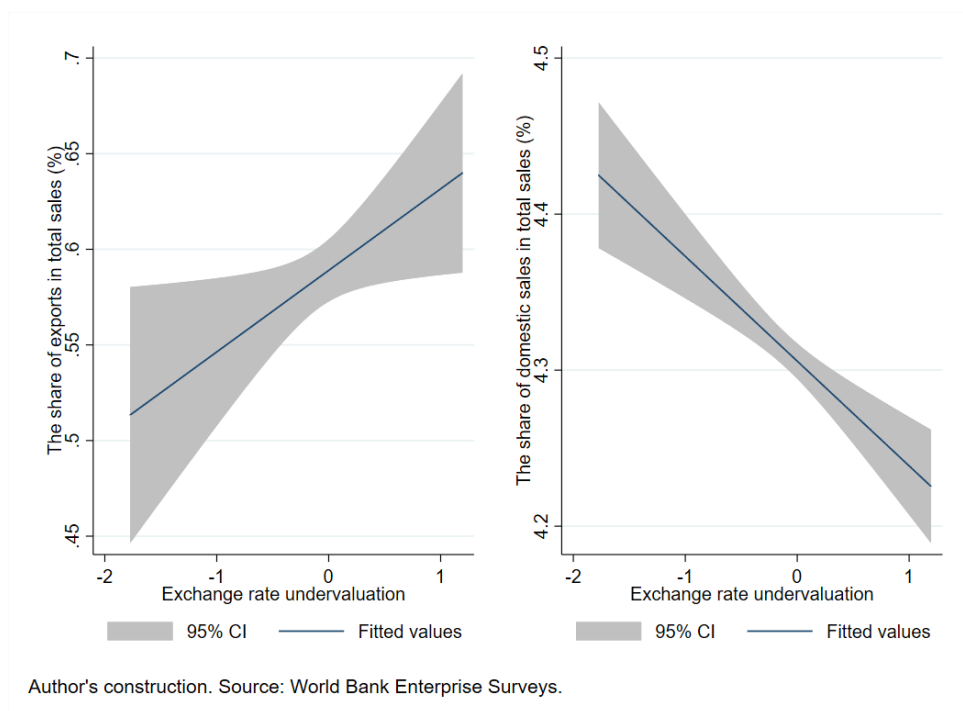


Figure 9: Correlation between the length of power outages and the allocation of manufacturing firms between the imports and the domestic market

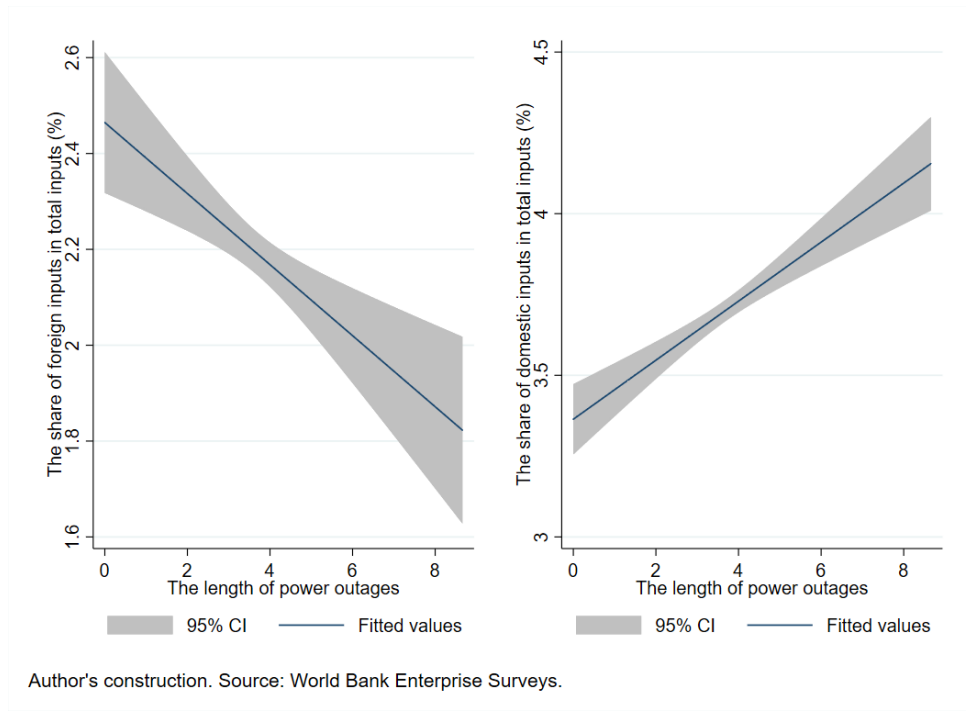


Figure 10: Correlation between the exchange rate undervaluation and the allocation of manufacturing firms between the imports and the domestic market

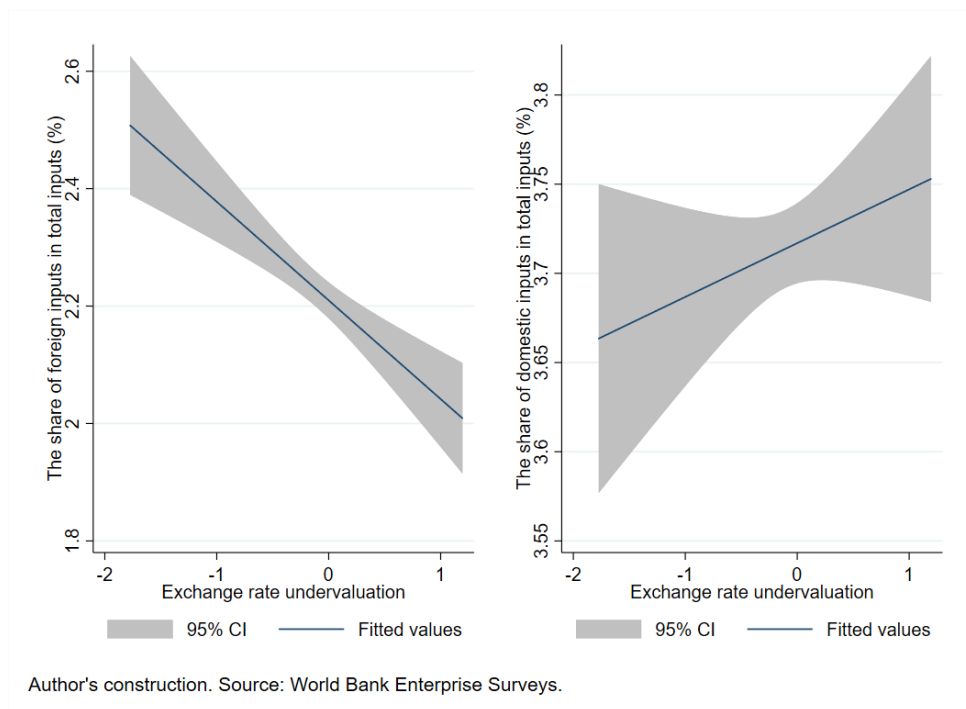


Table 1: The performance of exporters and non-exporters

Performance	Exporters	Non-exporters
Total sales	3.85e+07	4855553
Total employment	248.433	60.617
Number of Production workers	208.845	44.771
Number of Non-Production workers	44.228	14.110
Number of skilled workers	151.874	28.907
Number of unskilled workers	65.543	13.594
Number of female workers	35.13	10.87
Number of workers that the firm would have hired	47.11	5.47

Table 2: The effects of power outages (length of outages) and real exchange rate undervaluation on the allocation of manufacturing firms between the export and the domestic market

	Dependent variable: Share of sales exported and domestically sold by firms (log)					
	Linear fixed-effects model		Instrumental variables for panel-data models			
	Sales exported	Domestic sales	Sales exported		Domestic sales	
	(1) Model 1	(2) Model 2	(3) First Stage	(4) Model 3	(5) First Stage	(6) Model 4
Length of power outages (log)	0.005 (0.018)	-0.015 (0.014)		-0.939*** (0.203)		0.165 (0.135)
Undervaluation (log)	0.454*** (0.163)	-0.504*** (0.133)				
I.Undervaluation (log)			0.359*** (0.063)	0.540*** (0.146)	0.359*** (0.063)	-0.031 (0.095)
Nationals share of capital (log)	-0.011 (0.028)	0.090*** (0.020)	-0.026 (0.018)	-0.035 (0.033)	-0.026 (0.018)	0.095*** (0.021)
Foreign share of capital (log)	0.155*** (0.026)	-0.037** (0.018)	-0.031* (0.016)	0.128*** (0.031)	-0.031* (0.016)	-0.033* (0.019)
Government of capital (log)	0.056 (0.049)	0.017 (0.033)	0.004 (0.034)	0.064 (0.060)	0.004 (0.034)	0.013 (0.034)
Medium size	0.344*** (0.038)	-0.148*** (0.027)	0.011 (0.029)	0.349*** (0.046)	0.008 (0.029)	-0.153*** (0.028)
Large size	1.255*** (0.063)	-0.706*** (0.050)	0.029 (0.040)	1.276*** (0.074)	0.026 (0.040)	-0.711*** (0.051)
Location (= large city)	-0.175*** (0.050)	0.076** (0.037)	0.024 (0.037)	-0.122* (0.063)	0.026 (0.037)	0.048 (0.039)
Households consumption share (log)	0.949*** (0.208)	-0.733*** (0.161)	-1.648*** (0.191)	-0.011 (0.360)	-1.657*** (0.191)	-0.613*** (0.238)
Government consumption share (log)	-0.430** (0.216)	0.293* (0.159)	-0.903*** (0.167)	-1.401*** (0.348)	-0.909*** (0.167)	0.323 (0.215)
Investment	-0.003 (0.006)	-0.004 (0.004)	-0.016** (0.006)	-0.018* (0.009)	-0.015** (0.006)	0.001 (0.006)
Sales 3 years ago (log)	0.030*** (0.006)	-0.004 (0.005)	-0.022*** (0.004)	0.011 (0.008)	-0.022*** (0.004)	-0.001 (0.006)
Trade openness (log)	0.087 (0.260)	0.092 (0.182)	-0.590** (0.248)	-0.881** (0.433)	-0.591** (0.248)	0.010 (0.272)
GDP per capita growth	0.041 (0.200)	-0.078 (0.124)	-0.234 (0.163)	-0.178 (0.264)	-0.228 (0.163)	0.096 (0.137)
GDP growth	-0.027 (0.197)	0.071 (0.123)	0.207 (0.160)	0.188 (0.260)	0.200 (0.160)	-0.099 (0.135)
Rule of Law	-0.148 (0.257)	-0.400* (0.212)	-0.120 (0.279)	-1.164*** (0.414)	-0.123 (0.279)	-0.149 (0.282)
Instruments						
Shock Temperature			0.270*** (0.050)		0.271*** (0.050)	
Shock Precipitation			-0.254*** (0.048)		-0.251*** (0.047)	
Observation	6089.000	6085.000	6089.000	6089.000	6085.000	6085.000
F-stats	59.333	28.402		41.590		26.466
Kleibergen-Paap rk LM statistic				62.438		61.937
Chi-sq(2) P-value				0.000		0.000
Kleibergen-Paap rk Wald F statistic				32.205		31.935
Country fixed effect	Yes	Yes	Yes	Yes	Yes	Yes
Industry fixed effect	Yes	Yes	Yes	Yes	Yes	Yes

Notes: robust standard errors are in parentheses *** p < 0.01, ** p < 0.05, * p < 0.1.

Table 3: The effects of power outages (length of outages) and real exchange rate undervaluation on the purchase of foreign and domestic inputs

	Dependent variable: Share of sales exported and domestically sold by firms (log)					
	Linear fixed-effects model		Instrumental variables for panel-data models			
	Foreign Inputs	Domestic inputs	Foreign Inputs		Domestic inputs	
	(1) Model 1	(2) Model 2	(3) First Stage	(4) Model 3	(5) First Stage	(6) Model 4
Length of power outages (log)	0.034 (0.024)	0.040** (0.020)		-0.793*** (0.276)		0.638*** (0.239)
Undervaluation (log)	0.003 (0.192)	0.124 (0.167)				
I.Undervaluation (log)			0.331*** (0.063)	-0.357** (0.178)	0.332*** (0.063)	0.332** (0.156)
Nationals share of capital (log)	0.065** (0.030)	0.054** (0.026)	-0.023 (0.019)	0.043 (0.035)	-0.024 (0.019)	0.070** (0.028)
Foreign share of capital (log)	0.235*** (0.027)	-0.100*** (0.023)	-0.030* (0.017)	0.207*** (0.032)	-0.030* (0.017)	-0.079*** (0.026)
Government of capital (log)	-0.073 (0.053)	0.162*** (0.031)	0.002 (0.036)	-0.069 (0.060)	0.002 (0.036)	0.160*** (0.037)
Medium size	0.334*** (0.057)	-0.146*** (0.042)	-0.001 (0.029)	0.321*** (0.061)	-0.001 (0.029)	-0.134*** (0.045)
Large size	0.963*** (0.074)	-0.321*** (0.057)	0.018 (0.041)	0.946*** (0.081)	0.018 (0.041)	-0.306*** (0.062)
Location (= large city)	0.216*** (0.065)	-0.096* (0.050)	0.023 (0.038)	0.252*** (0.072)	0.023 (0.038)	-0.117** (0.056)
Households consumption share (log)	1.971*** (0.307)	-0.639*** (0.229)	-1.732*** (0.195)	0.036 (0.513)	-1.729*** (0.195)	0.875** (0.419)
Government consumption share (log)	0.571* (0.327)	-1.127*** (0.296)	-0.880*** (0.174)	-0.104 (0.447)	-0.880*** (0.174)	-0.619 (0.393)
Investment	0.005 (0.010)	0.005 (0.007)	-0.018*** (0.006)	-0.038*** (0.012)	-0.017*** (0.006)	0.038*** (0.010)
Sales 3 years ago (log)	0.014* (0.008)	-0.005 (0.007)	-0.019*** (0.005)	0.004 (0.010)	-0.019*** (0.005)	0.002 (0.008)
Trade openness (log)	-1.318*** (0.364)	0.108 (0.327)	-0.432* (0.253)	-0.869* (0.516)	-0.433* (0.253)	-0.291 (0.455)
GDP per capita growth	2.137*** (0.285)	-0.928*** (0.242)	-0.223 (0.167)	1.392*** (0.335)	-0.221 (0.167)	-0.353 (0.290)
GDP growth	-2.023*** (0.280)	0.870*** (0.237)	0.193 (0.163)	-1.302*** (0.329)	0.192 (0.163)	0.313 (0.284)
Rule of Law	-2.068*** (0.325)	1.114*** (0.272)	-0.060 (0.284)	-1.383*** (0.454)	-0.063 (0.284)	0.439 (0.394)
Instruments						
Shock Temperature			0.272*** (0.051)		0.272*** (0.051)	
Shock Precipitation			-0.206*** (0.048)		-0.206*** (0.048)	
Observation	5794.000	5793.000	5794.000	5794.000	5793.000	5793.000
F-stats	48.375	20.824		41.919		20.494
Kleibergen-Paap rk LM statistic				51.211		51.053
Chi-sq(2) P-value				0.000		0.000
Kleibergen-Paap rk Wald F statistic				26.102		26.021
Country fixed effect	Yes	Yes	Yes	Yes	Yes	Yes
Industry fixed effect	Yes	Yes	Yes	Yes	Yes	Yes

Notes: robust standard errors are in parentheses *** p < 0.01, ** p < 0.05, * p < 0.1.

Table 4: The effects of power outages (length of outages) and real exchange rate undervaluation on the allocation of manufacturing firms between the export and the domestic market: country with poor access to electricity vs country with better access to electricity

Dependent variable: Share of sales exported and domestically sold by firms (log)								
Ordinary least square instrumental method with country and industry fixed effects								
Poor access to electricity				Better access to electricity				
Sales exported		Domestic sales		Sales exported		Domestic sales		
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	
First Stage	Model 1	First Stage	Model 2	First Stage	Model 3	First Stage	Model 4	
Length of power outages (log)		-1.664** (0.697)		1.186** (0.475)		-0.453*** (0.107)		0.311*** (0.071)
I.Undervaluation (log)	0.031 (0.178)	1.311*** (0.400)	0.031 (0.178)	-0.513** (0.254)	-0.060 (0.145)	0.312* (0.173)	-0.060 (0.145)	-0.398*** (0.117)
Nationals share of capital (log)	-0.012 (0.028)	0.003 (0.062)	-0.012 (0.028)	0.099** (0.044)	-0.045** (0.022)	-0.058 (0.037)	-0.046** (0.022)	0.106*** (0.030)
Foreign share of capital (log)	-0.011 (0.025)	0.123*** (0.055)	-0.011 (0.025)	-0.027 (0.037)	-0.052** (0.021)	0.157*** (0.037)	-0.051** (0.021)	-0.023 (0.028)
Government share of capital (log)	0.001 (0.047)	-0.032 (0.107)	0.001 (0.047)	0.052 (0.073)	-0.028 (0.049)	0.107 (0.071)	-0.027 (0.049)	-0.014 (0.056)
Medium size	0.036 (0.044)	0.535*** (0.100)	0.035 (0.044)	-0.228*** (0.069)	0.020 (0.039)	0.198*** (0.048)	0.016 (0.038)	-0.084** (0.037)
Large size	0.037 (0.053)	1.417*** (0.123)	0.037 (0.053)	-0.677*** (0.090)	0.051 (0.059)	1.045*** (0.100)	0.047 (0.059)	-0.743*** (0.083)
Location (= large city)	0.056 (0.058)	-0.220 (0.139)	0.054 (0.058)	0.094 (0.100)	-0.003 (0.052)	-0.019 (0.066)	0.003 (0.052)	0.047 (0.054)
Households consumption (log)	-0.563 (0.854)	3.479* (1.979)	-0.576 (0.856)	-0.376 (1.430)	-3.221*** (0.294)	0.507 (0.402)	-3.220*** (0.294)	-0.867*** (0.294)
Government consumption (log)	-0.296 (0.433)	-0.800 (0.724)	-0.302 (0.433)	1.135** (0.560)	-1.924*** (0.227)	-0.924*** (0.338)	-1.919*** (0.227)	0.258 (0.234)
Investment	0.016 (0.022)	0.102** (0.041)	0.016 (0.022)	-0.015 (0.028)	-0.090*** (0.013)	0.011 (0.014)	-0.089*** (0.013)	-0.034*** (0.011)
Sales 3 years ago (log)	-0.010 (0.007)	0.048*** (0.016)	-0.010 (0.007)	-0.009 (0.011)	-0.024*** (0.006)	0.007 (0.008)	-0.023*** (0.006)	0.008 (0.007)
Trade openness (log)	-0.944* (0.545)	-2.866** (1.440)	-0.947* (0.545)	0.512 (1.091)	1.157* (0.610)	-1.462** (0.672)	1.148* (0.609)	1.904*** (0.430)
GDP per capita growth	-0.135 (0.256)	0.699 (0.556)	-0.132 (0.256)	0.204 (0.349)	-0.914** (0.460)	-2.037*** (0.621)	-0.917** (0.460)	1.550*** (0.462)
GDP growth	0.127 (0.253)	-0.545 (0.543)	0.123 (0.253)	-0.243 (0.347)	0.915** (0.450)	2.059*** (0.609)	0.917** (0.450)	-1.569*** (0.451)
Rule of Law	-1.569** (0.716)	-6.698*** (1.336)	-1.566** (0.716)	2.182** (0.922)	2.937*** (0.790)	-0.514 (0.714)	2.928*** (0.789)	0.956* (0.506)
Instruments								
Shock Temperature	0.294** (0.117)		0.293** (0.117)		0.929*** (0.090)		0.927*** (0.090)	
Shock Precipitation	-0.190 (0.144)		-0.190 (0.144)		-0.446*** (0.065)		-0.439*** (0.064)	
Observation	2728.000	2728.000	2725.000	2725.000	3344.000	3344.000	3343.000	3343.000
Kleibergen-Paap rk LM statistic		12.753		12.735		84.151		83.663
Chi-sq(2) P-value		0.002		0.002		0.000		0.000
Kleibergen-Paap rk Wald F statistic		6.767		6.756		68.038		67.530
Country fixed effect	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Industry fixed effect	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Notes: robust standard errors are in parentheses *** p < 0.01, ** p < 0.05, * p < 0.1.

Table 5: The effects of power outages (length of outages) and real exchange rate undervaluation on the allocation of manufacturing firms between the export and the domestic market: Innovative firms vs non-innovative firms

Dependent variable: Share of sales exported and domestically sold by firms (log)								
Ordinary least square instrumental method with country and industry fixed effects								
	Innovative firms				Non-innovative firms			
	Sales exported		Domestic sales		Sales exported		Domestic sales	
	(1) First Stage	(2) Model 1	(3) First Stage	(4) Model 2	(5) First Stage	(6) Model 3	(7) First Stage	(8) Model 4
Length of power outages (log)		-0.587** (0.283)		0.315* (0.181)		-1.455*** (0.380)		0.240 (0.217)
I.Undervaluation (log)	0.054 (0.200)	0.351 (0.345)	0.056 (0.200)	-0.230 (0.249)	0.330*** (0.084)	0.779*** (0.232)	0.327*** (0.084)	-0.011 (0.128)
Nationals share of capital (log)	-0.040 (0.027)	-0.066 (0.051)	-0.040 (0.027)	0.137*** (0.043)	-0.002 (0.024)	-0.004 (0.047)	-0.002 (0.024)	0.074*** (0.022)
Foreign share of capital (log)	-0.053** (0.026)	0.122** (0.052)	-0.052* (0.027)	0.011 (0.040)	-0.007 (0.020)	0.142*** (0.042)	-0.007 (0.021)	-0.050*** (0.019)
Government share of capital (log)	-0.004 (0.042)	0.243*** (0.087)	-0.004 (0.042)	-0.042 (0.064)	0.001 (0.048)	-0.057 (0.088)	0.001 (0.048)	0.048 (0.042)
Medium size	0.082 (0.064)	0.439*** (0.099)	0.079 (0.064)	-0.057 (0.075)	-0.001 (0.032)	0.293*** (0.063)	-0.006 (0.032)	-0.171*** (0.029)
Large size	0.089 (0.080)	1.236*** (0.134)	0.089 (0.080)	-0.582*** (0.105)	-0.009 (0.046)	1.201*** (0.100)	-0.013 (0.046)	-0.738*** (0.058)
Location (= large city)	0.017 (0.075)	-0.110 (0.103)	0.016 (0.075)	0.266*** (0.080)	0.048 (0.045)	-0.054 (0.092)	0.052 (0.045)	-0.051 (0.049)
Households consumption (log)	-1.516** (0.758)	-1.931 (1.342)	-1.512** (0.759)	-1.369 (0.861)	-1.766*** (0.224)	-1.090 (0.687)	-1.796*** (0.223)	-0.305 (0.386)
Government consumption (log)	-2.908*** (0.524)	-2.074* (1.182)	-2.902*** (0.524)	0.138 (0.754)	-0.733*** (0.186)	-1.658*** (0.479)	-0.739*** (0.186)	0.525** (0.248)
Investment	-0.116*** (0.030)	-0.036 (0.030)	-0.115*** (0.030)	-0.019 (0.019)	-0.009 (0.007)	-0.012 (0.013)	-0.009 (0.007)	-0.003 (0.007)
Sales 3 years ago (log)	-0.032*** (0.009)	0.007 (0.017)	-0.032*** (0.009)	0.017 (0.012)	-0.015*** (0.005)	0.018 (0.011)	-0.014*** (0.005)	-0.006 (0.006)
Trade openness (log)	0.538 (0.670)	-2.349** (0.912)	0.537 (0.671)	0.661 (0.498)	-0.953*** (0.296)	-2.055*** (0.753)	-0.945*** (0.295)	0.355 (0.440)
GDP per capita growth	-1.103 (1.026)	-3.607*** (1.337)	-1.096 (1.026)	1.406* (0.793)	-0.103 (0.179)	-0.040 (0.340)	-0.094 (0.179)	0.082 (0.139)
GDP growth	1.118 (1.018)	3.664*** (1.322)	1.111 (1.018)	-1.351* (0.780)	0.086 (0.176)	0.063 (0.335)	0.076 (0.176)	-0.102 (0.137)
Rule of Law	1.756** (0.705)	-0.025 (0.972)	1.751** (0.705)	0.608 (0.610)	-0.653* (0.337)	-2.170*** (0.746)	-0.651* (0.337)	-0.167 (0.447)
Instruments								
Shock Temperature	0.778*** (0.180)		0.779*** (0.180)		0.224*** (0.060)		0.229*** (0.059)	
Shock Precipitation	-0.155 (0.109)		-0.157 (0.109)		-0.169*** (0.062)		-0.160*** (0.061)	
Observation	1476.000	1476.000	1473.000	1473.000	4610.000	4610.000	4609.000	4609.000
Kleibergen-Paap rk LM statistic		20.760		20.821		24.868		24.641
Chi-sq(2) P-value		0.000		0.000		0.000		0.000
Kleibergen-Paap rk Wald F statistic		11.442		11.481		12.723		12.591
Country fixed effect	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Industry fixed effect	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Notes: robust standard errors are in parentheses *** p < 0.01, ** p < 0.05, * p < 0.1.

Table 6: The effects of power outages (length of outages) and real exchange rate undervaluation on the allocation of manufacturing firms between the export and the domestic market: Self-generation share

Dependent variable: Share of sales exported and domestically sold by firms (log)								
Ordinary least square instrumental method with country and industry fixed effects								
Self-generation<=30%				Self-generation>30%				
Sales exported		Domestic sales		Sales exported		Domestic sales		
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	
First Stage	Model 1	First Stage	Model 2	First Stage	Model 3	First Stage	Model 4	
Length of power outages (log)		-1.422*** (0.395)		0.684*** (0.257)		-0.530*** (0.140)		0.146 (0.093)
I.Undervaluation (log)	0.102 (0.103)	0.489** (0.210)	0.104 (0.104)	-0.149 (0.139)	0.110 (0.139)	0.536** (0.236)	0.110 (0.139)	-0.146 (0.160)
Nationals share of capital (log)	-0.006 (0.024)	-0.028 (0.049)	-0.006 (0.024)	0.098*** (0.029)	-0.054** (0.022)	-0.043 (0.049)	-0.055** (0.022)	0.102*** (0.038)
Foreign share of capital (log)	-0.005 (0.021)	0.111** (0.043)	-0.005 (0.021)	-0.021 (0.025)	-0.075*** (0.022)	0.172*** (0.051)	-0.075*** (0.023)	-0.047 (0.036)
Government share of capital (log)	0.001 (0.040)	-0.087 (0.083)	0.001 (0.040)	0.025 (0.055)	-0.010 (0.066)	0.359*** (0.082)	-0.007 (0.065)	0.012 (0.042)
Medium size	0.093** (0.040)	0.517*** (0.082)	0.092** (0.040)	-0.240*** (0.053)	-0.094** (0.041)	0.194*** (0.060)	-0.100** (0.040)	-0.044 (0.036)
Large size	0.059 (0.049)	1.417*** (0.104)	0.059 (0.049)	-0.751*** (0.071)	-0.007 (0.066)	0.930*** (0.134)	-0.010 (0.066)	-0.509*** (0.091)
Location (= large city)	0.105** (0.046)	0.028 (0.099)	0.104** (0.046)	-0.026 (0.064)	-0.096 (0.064)	-0.358*** (0.100)	-0.082 (0.063)	0.239*** (0.067)
Households consumption (log)	-0.495 (0.472)	-0.840 (0.947)	-0.500 (0.472)	1.603*** (0.608)	-2.544*** (0.350)	2.192*** (0.618)	-2.557*** (0.350)	-1.794*** (0.435)
Government consumption (log)	-0.628** (0.260)	-1.763*** (0.602)	-0.633** (0.261)	0.874** (0.383)	-1.855*** (0.313)	-2.107*** (0.507)	-1.840*** (0.312)	0.885** (0.373)
Investment	-0.015 (0.009)	-0.011 (0.016)	-0.015 (0.009)	-0.004 (0.010)	-0.035** (0.016)	0.017 (0.018)	-0.034** (0.016)	-0.008 (0.012)
Sales 3 years ago (log)	-0.020*** (0.006)	0.019 (0.014)	-0.020*** (0.006)	0.004 (0.009)	-0.016*** (0.006)	0.004 (0.010)	-0.015*** (0.006)	0.003 (0.006)
Trade openness (log)	-1.123*** (0.325)	-2.580*** (0.824)	-1.127*** (0.325)	0.505 (0.528)	1.555*** (0.459)	2.167*** (0.692)	1.526*** (0.457)	-1.015** (0.499)
GDP per capita growth	-0.347* (0.192)	0.068 (0.378)	-0.344* (0.192)	-0.143 (0.212)	-4.604*** (0.564)	-1.438 (1.490)	-4.568*** (0.564)	-1.449 (1.159)
GDP growth	0.330* (0.188)	-0.047 (0.374)	0.327* (0.189)	0.138 (0.211)	4.439*** (0.549)	1.413 (1.446)	4.403*** (0.548)	1.385 (1.125)
Rule of Law	-0.833*** (0.310)	-2.840*** (0.733)	-0.836*** (0.310)	0.493 (0.507)	1.644** (0.718)	0.083 (0.898)	1.617** (0.717)	-0.974* (0.591)
Instruments								
Shock Temperature	0.264*** (0.074)		0.262*** (0.075)		0.764*** (0.094)		0.761*** (0.093)	
Shock Precipitation	-0.150* (0.088)		-0.151* (0.088)		-0.590*** (0.071)		-0.586*** (0.071)	
Observation	3838.000	3838.000	3835.000	3835.000	2251.000	2251.000	2250.000	2250.000
Kleibergen-Paap rk LM statistic		23.421		23.223		84.395		83.961
Chi-sq(2) P-value		0.000		0.000		0.000		0.000
Kleibergen-Paap rk Wald F statistic		11.964		11.860		69.139		68.446
Country fixed effect	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Industry fixed effect	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Notes: robust standard errors are in parentheses *** p < 0.01, ** p < 0.05, * p < 0.1.

Table 7: The effects of power outages (length of outages) and real exchange rate undervaluation on the allocation of manufacturing firms between the export and the domestic market (intensive margins): Resource-rich countries vs non-resource-rich countries

Dependent variable: Share of sales exported and domestically sold by firms (log)								
Ordinary least square instrumental method with country and industry fixed effects								
	Non-resource-rich countries				Resource-rich countries			
	Sales exported		Domestic sales		Sales exported		Domestic sales	
	(1) First Stage	(2) Model 1	(3) First Stage	(4) Model 2	(5) First Stage	(6) Model 3	(7) First Stage	(8) Model 4
Length of power outages (log)		-0.705*** (0.242)		0.376** (0.162)		-0.331 (0.229)		0.421** (0.185)
I.Undervaluation (log)	-0.370 (0.235)	0.702*** (0.266)	-0.370 (0.235)	-0.365** (0.172)	-0.152 (0.130)	0.480** (0.187)	-0.150 (0.131)	-0.366** (0.142)
Nationals share of capital (log)	-0.053* (0.030)	-0.049 (0.050)	-0.053* (0.030)	0.113*** (0.035)	-0.020 (0.021)	-0.027 (0.035)	-0.021 (0.021)	0.100*** (0.029)
Foreign share of capital (log)	-0.053** (0.027)	0.086* (0.046)	-0.053*** (0.027)	0.007 (0.032)	-0.021 (0.020)	0.166*** (0.034)	-0.020 (0.020)	-0.055** (0.025)
Government of capital (log)	-0.059 (0.046)	-0.073 (0.081)	-0.059 (0.046)	-0.009 (0.067)	0.040 (0.048)	0.124* (0.065)	0.042 (0.048)	0.048 (0.036)
Medium size	0.101* (0.052)	0.521*** (0.075)	0.101* (0.052)	-0.216*** (0.053)	-0.039 (0.034)	0.236*** (0.049)	-0.045 (0.034)	-0.098*** (0.036)
Large size	0.065 (0.060)	1.469*** (0.103)	0.065 (0.060)	-0.817*** (0.079)	-0.009 (0.050)	1.051*** (0.088)	-0.014 (0.050)	-0.589*** (0.069)
Location (= large city)	0.090 (0.058)	-0.048 (0.084)	0.090 (0.058)	-0.016 (0.058)	0.053 (0.050)	-0.267*** (0.082)	0.058 (0.050)	0.163** (0.067)
Households consumption share (log)	-2.027* (1.129)	0.617 (1.729)	-2.027* (1.129)	-0.264 (1.183)	-2.311*** (0.325)	1.014** (0.457)	-2.325*** (0.324)	-0.823** (0.367)
Government consumption share (log)	-1.584 (0.983)	-3.727*** (1.022)	-1.584 (0.983)	-0.167 (0.704)	-1.786*** (0.300)	-0.911* (0.523)	-1.793*** (0.300)	1.180*** (0.418)
Sales 3 years ago (log)	-0.022*** (0.007)	0.023* (0.012)	-0.022*** (0.007)	0.005 (0.009)	-0.012** (0.005)	0.025*** (0.009)	-0.011** (0.005)	0.001 (0.006)
Investment	-0.056*** (0.017)	0.023 (0.025)	-0.056*** (0.017)	-0.033* (0.017)	-0.040*** (0.013)	-0.027* (0.014)	-0.039*** (0.013)	0.002 (0.010)
Trade openness (log)	0.263 (0.434)	-1.553*** (0.620)	0.263 (0.434)	0.438 (0.319)	-2.007*** (0.388)	1.081 (0.833)	-1.981*** (0.388)	0.042 (0.705)
GDP per capita growth	-0.597 (0.558)	0.807 (0.638)	-0.597 (0.558)	0.522 (0.393)	-9.378*** (1.352)	0.286 (2.029)	-9.344*** (1.353)	1.579 (1.534)
GDP growth	0.611 (0.544)	-0.750 (0.621)	0.611 (0.544)	-0.496 (0.380)	9.068*** (1.320)	-0.303 (1.986)	9.035*** (1.320)	-1.552 (1.499)
Rule of Law	1.420** (0.605)	-0.071 (0.609)	1.420** (0.605)	0.037 (0.390)	2.565*** (0.655)	-1.836*** (0.575)	2.547*** (0.656)	0.604 (0.470)
Instruments								
Shock Temperature	0.579*** (0.112)		0.579*** (0.112)		0.627*** (0.088)		0.628*** (0.088)	
Shock Precipitation	-0.243** (0.116)		-0.243** (0.116)		-0.002 (0.096)		-0.000 (0.096)	
Observation	2443.000	2443.000	2443.000	2443.000	3644.000	3644.000	3640.000	3640.000
F-stats		27.932		13.508		27.910		13.352
Kleibergen-Paap rk LM statistic		28.997		28.997		45.131		45.259
Chi-sq(2) P-value		0.000		0.000		0.000		0.000
Kleibergen-Paap rk Wald F statistic		16.380		16.380		26.445		26.543
Country fixed effect	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Industry fixed effect	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Notes: robust standard errors are in parentheses *** p < 0.01, ** p < 0.05, * p < 0.1.

Table 8: The effects of electricity access and real exchange rate undervaluation on the allocation of manufacturing firms between the export and domestic market

Dependent variable: Share of sales exported and domestically sold by firms (log)								
Ordinary least square with country and industry fixed effects								
	Sales exported		Domestic sales		Sales exported		Domestic sales	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6	Model 7	Model 8
1.Electricity access (log)	0.582***	0.609***	-0.414***	-0.442***	0.567***	1.242***	-0.254**	-0.990***
	(0.137)	(0.137)	(0.106)	(0.106)	(0.151)	(0.370)	(0.117)	(0.282)
1.Exchange rate undervaluation (log)	0.058	0.647**	-0.040	-0.665***				
	(0.056)	(0.287)	(0.042)	(0.232)				
Nationals share of capital (log)	-0.005	-0.005	0.080***	0.080***	-0.005	-0.005	0.082***	0.082***
	(0.018)	(0.018)	(0.014)	(0.014)	(0.018)	(0.018)	(0.014)	(0.014)
Foreign share of capital (log)	0.181***	0.180***	-0.071***	-0.070***	0.181***	0.180***	-0.070***	-0.069***
	(0.017)	(0.017)	(0.012)	(0.012)	(0.017)	(0.017)	(0.012)	(0.012)
Government of capital (log)	0.075**	0.074**	0.020	0.021	0.075**	0.074**	0.022	0.022
	(0.034)	(0.034)	(0.020)	(0.020)	(0.034)	(0.034)	(0.020)	(0.020)
Medium size	0.411***	0.411***	-0.183***	-0.183***	0.411***	0.409***	-0.181***	-0.178***
	(0.027)	(0.027)	(0.020)	(0.020)	(0.027)	(0.027)	(0.020)	(0.020)
Large size	1.190***	1.189***	-0.615***	-0.614***	1.189***	1.185***	-0.610***	-0.606***
	(0.042)	(0.042)	(0.033)	(0.033)	(0.042)	(0.042)	(0.033)	(0.033)
Location (= large city)	-0.099***	-0.101***	0.021	0.024	-0.098***	-0.106***	0.022	0.031
	(0.032)	(0.032)	(0.023)	(0.023)	(0.032)	(0.032)	(0.023)	(0.023)
Households consumption share (log)	1.071***	1.064***	-0.731***	-0.724***	1.004***	0.796***	-0.227	0.001
	(0.149)	(0.149)	(0.116)	(0.117)	(0.225)	(0.246)	(0.170)	(0.184)
Government consumption share (log)	-0.495***	-0.465***	0.269**	0.238**	-0.474***	-0.693***	0.328***	0.567***
	(0.160)	(0.160)	(0.120)	(0.120)	(0.162)	(0.186)	(0.121)	(0.128)
Investment	0.010**	0.009*	-0.014***	-0.013***	0.008	0.006	-0.007*	-0.005
	(0.005)	(0.005)	(0.004)	(0.004)	(0.005)	(0.005)	(0.004)	(0.004)
Sales 3 years ago (log)	0.023***	0.023***	-0.003	-0.003	0.023***	0.023***	-0.003	-0.004
	(0.004)	(0.004)	(0.003)	(0.003)	(0.004)	(0.004)	(0.003)	(0.003)
Trade openness (log)	-0.318	-0.273	0.132	0.084	-0.223	-0.089	0.053	-0.093
	(0.218)	(0.219)	(0.152)	(0.151)	(0.194)	(0.207)	(0.138)	(0.144)
GDP per capita growth (log)	-0.748***	-0.814***	0.389***	0.459***	-0.780***	-0.672***	0.351**	0.233
	(0.200)	(0.203)	(0.148)	(0.151)	(0.198)	(0.202)	(0.149)	(0.151)
GDP growth (log)	0.766***	0.830***	-0.395***	-0.463***	0.797***	0.691***	-0.358**	-0.243
	(0.198)	(0.201)	(0.146)	(0.149)	(0.196)	(0.200)	(0.147)	(0.149)
Rule of Law	-0.576***	-0.539***	0.053	0.014	-0.509***	-0.476***	0.071	0.034
	(0.187)	(0.188)	(0.143)	(0.145)	(0.160)	(0.161)	(0.124)	(0.125)
1.Electricity access per population*1.Undervaluation		-0.172**		0.183***				
		(0.080)		(0.064)				
1.Depreciation (log)					-0.027	1.965*	0.529***	-1.646**
					(0.185)	(1.029)	(0.143)	(0.820)
1.Electricity access per population*1.Depreciation						-0.583**		0.636***
						(0.289)		(0.228)
Observation	12454.000	12454.000	12452.000	12452.000	12454.000	12454.000	12452.000	12452.000
F-stats	122.420	116.068	57.057	55.232	122.466	115.457	57.579	55.218
R ²	0.285	0.286	0.222	0.223	0.285	0.286	0.223	0.224
Country fixed effect	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Industry fixed effect	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Notes: robust standard errors are in parentheses *** p < 0.01, ** p < 0.05, * p < 0.1.

Table 9: Number of firms and the share of each industry in the total sample of its sector

Industries	ISIC Code	Number of firms	Percent
Manufacturing sector		12062	100.00
Manufacture of food products and beverages	15	2,957	24.52
Manufacture of tobacco products	16	40	0.33
Manufacture of textiles	17	625	5.18
Manufacture of wearing apparel; dressing and dyeing of fur	18	1,656	13.73
Tanning and dressing of leather; manufacture of luggage, handbags, saddlery, harness and footwear	19	195	1.62
Manufacture of wood and of products of wood and cork, except furniture	20	524	4.34
Manufacture of paper and paper products	21	151	1.25
Publishing, printing and reproduction of recorded media	22	538	4.46
Manufacture of coke, refined petroleum products and nuclear fuel	23	31	0.26
Manufacture of chemicals and chemical products	24	630	5.22
Manufacture of rubber and plastics products	25	513	4.25
Manufacture of basic metals	26	1,015	8.41
Manufacture of other non-metallic mineral products	27	231	1.92
Manufacture of fabricated metal products, except machinery and equipment	28	1,074	8.90
Manufacture of machinery and equipment n.e.c.	29	539	4.47
Manufacture of office, accounting and computing machinery	30	8	0.07
Manufacture of electrical machinery and apparatus n.e.c.	31	239	1.98
Manufacture of radio, television and communication equipment and apparatus	32	40	0.33
Manufacture of medical, precision and optical instruments, watches and clocks	33	66	0.55
Manufacture of motor vehicles, trailers and semi-trailers	34	97	0.80
Manufacture of other transport equipment	35	45	0.37
Manufacture of furniture; manufacturing n.e.c	36	817	6.77
Recycling	37	31	0.26
Non-manufacturing sector		9936	100.00
Other Industries	4	243	2.45
Mining and quarrying	10	2	0.02
Collection, purification and distribution of water	40	3	0.03
Construction	45	1,221	12.29
Wholesale and retail trade; repair of motor vehicles, motorcycles and personal and household goods	50	6,255	62.95
Hotels and restaurants	55	1,179	11.87
Transport, storage and communications	60	766	7.71
Real estate, renting and business activities	70	265	2.67
Health	85	1	0.01
Other community, social and personal service activities	90	1	0.01

Table 11: Number of manufacturing firms and share of each country in the total sample

Countries	Number of firms	Percent
Angola	681	2.76
Benin	269	1.09
Botswana	573	2.32
Burkina Faso	362	1.46
Burundi	366	1.48
Cameroon	698	2.82
Chad	284	1.15
Ethiopia	1,265	5.12
Gabon	138	0.56
Ghana	1,106	4.47
Guinea	364	1.47
Guinea-Bissau	156	0.63
Kenya	2,22	8.98
Lesotho	242	0.98
Liberia	257	1.04
Madagascar	779	3.15
Malawi	470	1.90
Mali	824	3.33
Mauritania	317	1.28
Mauritius	283	1.14
Mozambique	838	3.39
Namibia	863	3.49
Niger	272	1.10
Nigeria	4,198	16.98
Rwanda	734	2.97
Senegal	929	3.76
Sierra Leone	279	1.13
South Africa	729	2.95
Sudan	273	1.10
Togo	230	0.93
Uganda	1,199	4.85
Zambia	1,566	6.34
Zimbabwe	953	3.86

Table 12: Summary of the dependent variables (percentage of total sales) by country

Country	Direct Exports	Indirect Exports	Domestic Sales	Exporters Dummy	Domestic Sellers Dummy
Angola2006	.023	.23	99.74	.00	1.00
Angola2010	0	.71	99.29	0	1
Burundi2013	21.88	5.73	72.38	.40	.58
Burundi2019	20.32	7.96	71.72	.39	.60
Botswana2009	26.89	6.32	66.79	.54	.44
Botswana2017	8.07	1.30	90.63	.18	.82
BurkinaFaso2007	24.55	4.55	70.91	.32	.64
BurkinaFaso2009	20.36	3.75	75.89	.39	.61
BurkinaFaso2013	10.35	9.35	80.30	.22	.74
Benin2013	30	0	70	.67	.33
Benin2018	21.19	6.42	72.38	.51	.49
Cameroon2006	.49	1.03	98.48	.02	.97
Cameroon2009	2.48	10.62	86.90	.1	.90
Cameroon2013
Cameroon2014	6.75	10.27	82.98	.18	.78
Chad2016	11.73	11.05	77.23	.13	.76
Ethiopia2006	25.70	1.30	73	.36	.64
Ethiopia2009	34.79	6.55	58.66	.58	.43
Ethiopia2011	10.50	2.30	87.20	.23	.77
Ethiopia2013	36.38	14.71	48.92	.63	.33
Ethiopia2016	8.13	6.58	85.30	.35	.65
Ethiopia2019	53.08	9.13	37.80	.84	.16
Gabon2011	1.72	4.74	93.53	.02	.97
Ghana2008	17.22	.88	81.89	.26	.74
Ghana2013	5.79	1.60	92.60	.13	.87
Ghana2018	2.73	2.58	94.70	.09	.91
Ghana2019	19.46	2.84	77.71	.30	.70
Guinea2006	10.24	4.489	85.28	.33	.66
Guinea-Bissau2006	9.90	3.59	86.51	.26	.74
Guinea-Bissau2010	10.19	4.60	85.21	.32	.67
Kenya2007	11.59	2.10	86.31	.37	.63
Kenya2013	12.18	11.96	75.86	.35	.57
Kenya2010	1.99	1.26	96.75	.08	.92
Lesotho2013	10	0	90	.67	.33
Lesotho2019	42	9.52	48.48	.66	.33
Liberia2013	21.14	3.82	75.05	.47	.53
Madagascar2009	30.51	5.46	64.03	.55	.44
Madagascar2013	29.21	6.62	64.17	.59	.41
Madagascar2016	14.17	2.22	83.61	.25	.75
Madagascar2017	3.41	1.88	94.71	.10	.88
Malawi2009	28.47	8.60	62.93	.33	.60
Malawi2013	9.33	8.92	81.75	.25	.67
Malawi2019	38.68	9.2	52.12	.63	.37
Mali2009	3.85	2	94.15	.15	.85
Mali2014	4.09	1.86	94.05	.17	.83
Mali2015	17.89	9.40	72.72	.48	.5
Mauritania2007	2.19	2.84	94.96	.07	.93
Mauritania2015	16.07	6.28	77.66	.45	.55
Mauritius2007	4.05	2.28	93.67	.09	.91
Mauritius2010	0	0	100	0.1	
Mozambique2013	22.52	6.24	71.25	.33	.66
Mozambique2019	19.67	10.18	70.15	.35	.64
Namibia2014	16.31	2.71	80.98	.17	.81
Namibia2018	5.89	4.08	90.03	.15	.84
Nigeria2006	4.96	2.72	92.32	.12	.88
Nigeria2007	.63	.29	99.08	.02	.98
Nigeria2009	3.62	2.40	93.98	.20	.80
Nigeria2010	8.19	4.01	87.80	.17	.82
Nigeria2013	2.65	.10	97.24	.08	.92
Nigeria2014	6.91	9.09	84.27	.21	.77
Nigeria2016	8.86	6.09	85.05	.17	.79
Nigeria2017	.48	2.26	97.26	.06	.94
Rwanda2012	2.34	.92	96.75	.11	.89
Senegal2012	1.33	3.48	95.18	.12	.88
Senegal2019	2.16	5.33	92.51	.10	.90
Sierra Leone2007	4.49	.43	95.09	.15	.85
Sierra Leone2009	6.95	4.76	88.29	.29	.71
Sierra Leone2019	8.39	7.06	84.56	.33	.61
South Africa2009	30.93	3.79	65.28	.55	.45
South Africa2013	21.66	7.04	71.30	.53	.47
South Africa2017	1.04	1.39	97.57	.05	.95
South Africa2019	13.06	9.37	77.57	.31	.69
Togo2008	5.10	1.98	92.92	.1	.90
Togo2013	13.14	0	86.86	.14	.86
Uganda2008	18.56	8.88	72.56	.46	.53
Uganda2013	17.74	13.92	68.35	.43	.51
Zambia2009	22.25	8.46	69.33	.36	.60
Zambia2010	1.57	.12	98.31	.13	.87
Zambia2015	16.32	8.70	74.98	.25	.72
Zimbabwe2013	16.49	1.65	81.86	.34	.66
Zimbabwe2015	16.26	7.72	76.03	.27	.71
Zimbabwe2019	21.74	.56	77.69	.38	.62

Table 13: Summary of power outages and exchange rate variables by country

Country	Length of Outages	Number of Outages	Undervaluation
Angola2006	328.53	82.70	-.06
Angola2010	141.00	75.43	-.16
Burundi2013	26.90	18.31	-.26
Burundi2019	16.73	7.32	-.83
Botswana2009	42.32	34.76	.11
Botswana2017	24.40	13.40	.07
BurkinaFaso2007	20.73	12.55	.22
BurkinaFaso2009	16.73	18.14	.15
BurkinaFaso2013	34	7.83	-.24
Benin2013	.	0	-.05
Benin2018	40.39	3.42	.13
Cameroon2006	130.57	112.24	-.42
Cameroon2009	37.89	84	-.11
Cameroon2013	.	.	.
Cameroon2014	60.81	233.36	.20
Chad2016	17.14	36.22	-.12
Ethiopia2006	23.34	26.78	.83
Ethiopia2009	31.68	6.45	.31
Ethiopia2011	100.80	82.64	-.32
Ethiopia2013	18.24	6.17	.53
Ethiopia2016	55.16	39.60	-.12
Ethiopia2019	15.24	4.78	-.58
Gabon2011	60.91	76.34	-.18
Ghana2008	145.64	9.12	-.36
Ghana2013	39.82	12.11	-.13
Ghana2018	81.52	197.45	-.13
Ghana2019	48.00	30.73	-.12
Guinea2006	38.53	23.29	-.44
Guinea-Bissau2006	21.6	21.54	.35
Guinea-Bissau2010	34.71	26.95	-.14
Kenya2007	58.56	65.18	.18
Kenya2013	70.32	90.35	.31
Kenya2010	65.06	6.52	-.12
Lesotho2013	48	600	-.60
Lesotho2019	19.04	4.58	-.13
Liberia2013	66.30	742.79	-.36
Madagascar2009	34.29	6.73	-.29
Madagascar2013	25.85	10.48	.1
Madagascar2016	63.78	9.67	-.02
Madagascar2017	118.04	177.39	.15
Malawi2009	25.29	195.20	.91
Malawi2013	40	5	-.82
Malawi2019	58.17	6.60	.00
Mali2009	42	10.15	-.15
Mali2014	50.14	85.92	.02
Mali2015	168.37	3.81	.05
Mauritania2007	35.96	53.47	.25
Mauritania2015	166.43	6.79	-.08
Mauritius2007	53.04	59.43	-.10
Mauritius2010	204	68	.08
Mozambique2013	30.55	14.40	-.22
Mozambique2019	173.33	4.81	.48
Namibia2014	28.67	151.22	.02
Namibia2018	73.71	17.92	.40
Nigeria2006	49.64	78.43	-.76
Nigeria2007	110.31	322.04	.00
Nigeria2009	19.59	295.68	-.05
Nigeria2010	51.62	75.79	-.10
Nigeria2013	48	118.78	.13
Nigeria2014	168.87	453.22	-.02
Nigeria2016	54.47	36.57	-.12
Nigeria2017	66.78	186.58	-.09
Rwanda2012	76.29	4.26	-.15
Senegal2012	36	3.27	.11
Senegal2019	22.30	3.58	.05
Sierra Leone2007	73.35	140.70	-.17
Sierra Leone2009	70	58.29	-.32
Sierra Leone2019	10.34	24	.30
South Africa2009	19.43	6.09	-.09
South Africa2013	23.57	9.29	-.16
South Africa2017	160.87	94.29	.28
South Africa2019	13.86	6.86	.14
Togo2008	140.86	57.68	2.30
Togo2013	52	89.14	-.22
Uganda2008	39.05	32.96	.14
Uganda2013	35.22	20.97	.36
Zambia2009	105.34	16.49	-.04
Zambia2010	28.17	27.18	-.11
Zambia2015	93.82	4.84	-.01
Zimbabwe2013	69.88	113.74	.15
Zimbabwe2015	242.43	4.93	.00
Zimbabwe2019	108.59	283.69	-.18