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Effect of Power Outages on Export Performance of Manufacturing Firms in Kenya

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Unreliable electricity supply often results in increased cost of production and lower output which reduces the competitiveness of firms in international trade. Despite the existence of evidence on the connection between power outages and export performance of firms in developed countries, such evidence is non-existent in developing countries like Kenya where power interruptions are a common phenomenon. Therefore, the study investigated the effect of power outages on export performance of manufacturing firms in Kenya using 2018 World Bank Enterprise Survey data. By employing Heckman two step procedure, the study findings indicated that frequency of the power outages have a negative statistically significant effect on export propensity, although this effect was reversed with the introduction of an interaction term between frequency of power outages and capacity utilization. Besides, energy cost lowered both the export propensity and export intensity of firms. Further, labor productivity increased the chances of firms exporting and their export intensity. Therefore, the study concluded that power outages affect the export propensity rather than export intensity of Kenyan manufacturing firms. The government should address the frequency of power outages in the country as it is a hindrance to exporting decisions of the manufacturing firms. It should also address the rising energy costs as they lower both the export propensity and export intensity of the manufacturing firms.

Keywords: Power Outages, Export Propensity, Export Intensity, Manufacturing Firms

1. Introduction

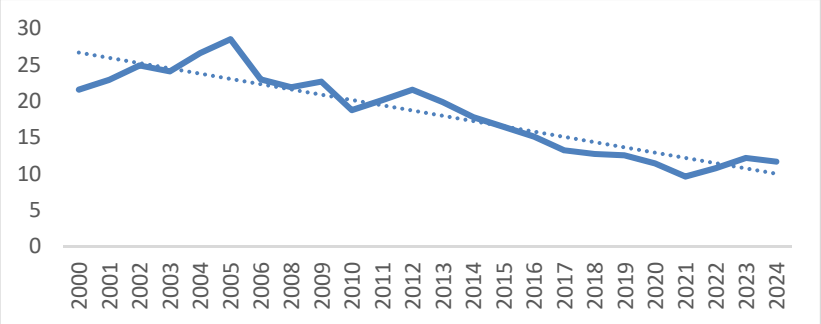
A favorable business environment has a significant role in the firm performance in terms of productivity, sales and profits. However, an unfavorable business environment characterized by obstacles dwindles the performance of the firms as it increases the cost of production making the firms less productive and competitive (Cissokho−Seck 2013). One such obstacle is power outage which is a huge problem in developing countries such as Sub-Saharan Africa. In fact, electricity shortages have been identified as the major obstacle or very severe obstacle to the business operations in Sub-Saharan Africa accounting for 45.9% against 41.2% in South Asia, ranking higher than access to finance and political instability (Asiedu et al. 2021).The leading causes of the power outages in developing countries have been recognized as inadequate installed generation capacity (Abdisa 2020), transmission and distribution losses, and extreme weather conditions such as climate change (Bao et al. 2024). A plethora of literature has investigated the relationship between power outages and firm performance nevertheless a dearth of literature is evident on the relationship between power outages and export performance particularly in developing countries such as Kenya.

1.1. Justification and Significance of the Study

Power outages refer to electricity supply interruption that makes the end users lose access to the national electrical grid for more than a minute (Mangat–Singh 2015). According to macroeconomic literature, the reliability of electricity is determined using three indices which include Customer Average Interruption Duration Index (CAIDI) measuring the duration taken to restore power supply, System Average Interruption Duration Index (SAIDI) referring to duration of the electricity interruption and System Average Frequency Index (SAIFI) denoting frequency the outages. Based on World Bank Enterprise Survey data, the average duration of power outages in Kenya was 5.3 hours in a typical month from 2007 to 2018. This trend has taken an upward trajectory as the Energy and Petroleum Regulatory Authority [EPRA] (2025) reported that the average duration of power outages was 9.2 hours per month between FY2022/23 and FY 2023/24, surpassing the set target of 5 hours per customer. Similarly, in the same period the average frequency of power outages averaged 3.9hours per customer, exceeding the regulatory authority's set limit of 2.15 interruptions per power customer.

According to the export-led growth hypothesis, an improvement in export performance, particularly of the manufacturing sector, is a key contributor to economic growth. Therefore, as part of the Structural Adjustment Programmes (SAPs) from World Bank and International Monetary Fund (IMF), Kenya enacted the Sessional Paper No. 1 of 1986 on Economic Management for Renewed Growth which abolished the import substitution industrialization and adopted export promotion industrialization. This paved the way for trade liberalization which introduced export promotion measures such as manufacturing under bond, green channel of customs clearance, export exchange rate regime, Export Processing Zones (EPZs) and export compensation schemes (Kenya Association of Manufacturers [KAM] 2025). In addition, Kenya's efforts to promote international trade has been evident as the country is a member of several trade arrangements namely World Trade Organization (WTO), East African Community (EAC), Common Market for East and Southern Africa (COMESA), African Growth and Opportunity Act (AGOA) among others. Despite these policies and trade agreements in place, the country's exports of goods and services as a percent of Gross Domestic Product (GDP) have taken a downward trend, decreasing from 21.55% in 2012 to 11.67% in 2024 as shown in Figure 1.

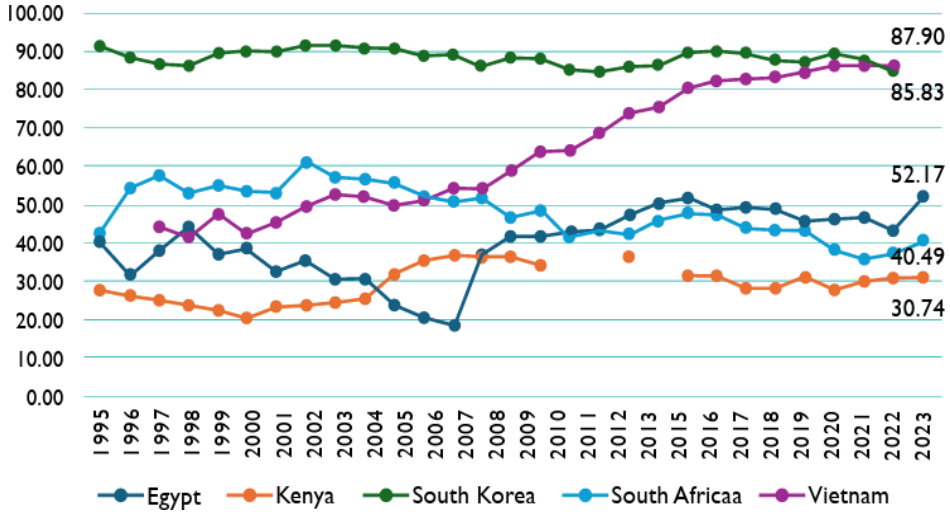
Figure 1. Export of goods and services as a percent of GDP, 2000–2024



Source: own calculation using world development indicators data

Further, despite adopting an export-led industrialization, the country's manufacturing exports as a percent of merchandise exports have not been that stable. From Figure 2, manufacturing exports as a percent of merchandise exports averaged 30% between 1995 and 2023, a value below the set target of 60% by the National Exports Development and Promotion Strategy (NEDPS) (Republic of Kenya 2017). Even though, based on Africa industrialization index 2022, Kenya is among the top leading manufacturing countries in Africa along with Egypt, Nigeria, Senegal and South Africa among others (African Development Bank 2022), the country's manufacturing exports continue to face stiff competition from South Africa and Egypt as they accounted for 40.49% and 52.17% respectively from 2019 to 2023 (KAM 2025).

Figure 2. Manufacture export (% of merchandise exports) between 1995 and 2023



Source: Kenya Association of Manufacturers (2025)

The existing empirical literature has documented a lot of evidence on the negative effects of power outages on firm performance, specifically productivity (Guo et al. 2023, Moyo 2013). However, the evidence between power outages and export performance exists in the developed countries as conducted by (Bao et al. 2024, Gupta–Singh 2021). This evidence is lacking in developing countries such as Kenya, a country with over 80% of its electricity generated from renewable energy but one with frequent power outages. Therefore, the study's research question entailed how power outages affect export performance of manufacturing firms in Kenya. With the aim of improving competitiveness of the firms in global markets, the study investigated the effect of power outages on export performance in Kenyan manufacturing firms using 2018 World Bank Enterprise Survey data and employed Heckman two step estimation technique.

The study contributes to the body of knowledge in literature in several ways. Firstly, it will add new evidence on how obstacles in the business environment such as electricity shortages affect export performance of

manufacturing firms in developing countries, particularly Kenya. Secondly, the findings will inform the appropriate energy policy to undertake to lower frequent power outages among manufacturing firms in Kenya.

The study was structured as follows; the foregoing section I: Introduction, justification and significance of the study, section II: Literature review, Section III: Methodology, Section IV: Results, discussion and Section V: Conclusion.

2. Theoretical Review

The classical theory of international trade by Ricardo in the nineteenth century and neoclassical theory of international trade by Heckscher-Ohlin in the twentieth century were both centered on the concept of comparative advantage. According to Ricardo's model, trade is beneficial between two countries if every country exports goods that it has comparative advantage, implying the goods it has lower relative opportunity cost in their production. On the other hand, H-O model developed further the ideas of Ricardo by arguing that given that countries have different resources endowments, that is, capital and labour, then countries endowed with capital should specialize in the production of capital-intensive products while countries with abundant labour should specialize in producing labor-intensive products. However, these models focused exclusively on inter-industry trade and failed to explain intra- industry trade, that is, trade between countries with homogenous resource endowment and similar industrial sectors. This laid the foundation for the 'new' new trade theory.

2.1. 'New' New Trade Theory

Melitz (2003) further developed Krugman's new trade theory by incorporating heterogeneous firms in analyzing the intra-industry trade, a dimension ignored in the traditional trade theory. Just like Krugman's theory, Melitz model was anchored on imperfect competition and increasing returns to scale assumptions. Further, the theory argues that exposure to international trade induces only productive firms to enter the export market whereas the least productive firms continue to produce for the domestic market eventually forcing them to exit this market. Further, the model argues that entry into the export market is expensive and productive firms are able to generate enough profits to cover fixed costs of entering international markets. As a result, this leads to self-selection bias, determining which firms become exporters. More importantly, the model posits that the firm's exporting decisions take place after it has gained enough knowledge of its productivity.

2.2 Empirical Review

The existing literature on power outages, firms' performance and export performance can be categorized in three strands of literature. One strand investigates determinants of export performance, another one the effects of power outages on firm productivity and the final one on the effects of power outages on export performance.

The first strand of literature is focused on determinants of export performance

in firms. For instance, Charoenrat and Amornkitvikai (2024) used the World Bank's Enterprise Survey in China to investigate the determinants of export intensity in manufacturing firms. The authors adopted the Tobit regression model and maximum likelihood estimation technique and established that foreign direct investment, chief executive officer's gender, research and development, innovation and foreign imported technologies have a positive significant effect on export intensity of Chinese manufacturing firms. Further, the authors found that the age of the firm and skilled labour had an insignificant effect on export intensity of manufacturing firms in China. In another study, Fonchamnyo (2014) used the World Bank Investment Climate Survey to examine the determinants of export performance of manufacturing firms in Cameroon. The study used logit model and Tobit model to investigate the determinants of firms' export decisions and export intensity respectively. The author established that firm size, human capital, firm age, and turnover had a significant positive increase on the likelihood of firm's exporting decisions and export intensity of firms in Cameroon. However, power outages, insecurity and capital intensity had a significant negative effect on export intensity of the Cameroonian firms. Similarly, Sebolao et al. (2019) used WBES firm level data to investigate the determinants of export performance in Botswana. The authors used 87 manufacturing firms and employed Probit and Tobit models for analysis. From the Probit model, the authors found that firm size, human capital and access to finance increase the chances of firms engaging in exporting while from Tobit model the findings revealed that firm size, human capital and location affect the level of export volumes in manufacturing firms in Botswana. One notable limitation of these three studies is that they all used Tobit model implying that the authors did not handle the sample selection bias since firms self-select themselves into exporting. In another study, Reis–Forte (2014) analyzed the determinants of export intensity of 1,425 Portuguese firms spanning from 2008 to 2010. By using fixed effects model, the authors established that industry characteristics namely labour productivity, export orientation, concentration and firm characteristics such as labour productivity and firm size were significant determinants of export intensity of Portuguese firms. Moreover, the empirical results indicated that labor productivity both at firm and industry level positively affected export intensity of the firms.

Likewise, Kimolo et al. (2024) investigated the determinants of export performance of Kenyan manufacturing firms using 2007, 2013 and 2018 World bank Enterprise survey datasets. The authors adopted Heckman Two-Stage estimation technique and established that the Total Factor Productivity (TFP), human capital, cost of raw materials, electricity cost, foreign ownership and the size of the firms had significant positive effect on manufacturing firms' export decisions. However, the age of the firm, capital intensity and research and development had insignificant effect on exporting decisions of the manufacturing firms in Kenya. Further, the results indicated that TFP, foreign ownership, firm size, age of the firm, human capital and R&D had positive effect on export intensity of the Kenyan manufacturing firms. Labour productivity had negative effect on both export propensity and export intensity of the firms in Kenya. At the same time the cost of energy had weak significance effect on export intensity while cost of raw material had insignificant effect.

From the second strand of literature, Guo et al. (2023) analyzed the effect of electricity blackouts on firm performance by constructing a power shortage index in China using text analysis method. The study found that power shortage reduces the probability, quantity, and quality of R&D investment and also it has a negative impact on firm productivity, although it has a lower negative impact on the total factor productivity of large- and medium-sized firms, export-oriented firms, and state-owned firms. By employing random effects in a lineal panel model, Cissokho (2019) estimated the effect of power outages on the productivity of SMEs in Senegal. The study results revealed that electricity disruptions have negative and significant effects on the productivity of SMS in Senegal. Further, the author also established that power outages resulted in 11.6 percent loss of productivity in 2011, with small firms greatly affected more than medium sized firms. The results also indicated that generator ownership mitigated the negative effects of power outages for firms owning generators and that access to credit made firms more productive relative to firms without access to credit. Besides, the author also found that the larger the firm the more its productivity firms. While using World Bank's Investment Climate Surveys on manufacturing sectors in SSA countries from South Africa, Zambia, Uganda, Mauritius and Tanzania between 2002 and 2005, Moyo (2013) conducted firm level analysis between quality of power infrastructure and manufacturing productivity and estimated TFP using Cobb–Douglass production function. By employing OLS the author established the existence of a negative and significant effect between power infrastructure quality and firms' productivity. Moreover, the results indicated generator ownership reduces the impact of unstable power supply in Uganda, Tanzania and Mauritius. Whereas labour, capital and foreign ownership had positive and significant effects, the age of the firm had insignificant effects.

The third strand of literature is centered on investigating the trade effects of electricity shortages on export performance of firms. While employing World Bank Enterprise Survey data running from 2012 to 2019, Gupta and Singh (2021) investigated the effect of power outages on firms' export decisions and export intensity of manufacturing and service sector firms operating in 106 countries. The study measured power outages and export decisions using a dummy variable while export intensity was measured as a proportion of the sum of direct and indirect exports in sales. The control variables used by the authors were firms' productivity, firm size, firm age, foreign ownership, access to finance, foreign technology, foreign input, and Research & Development. While using the instrumental variable Probit model and Heckman model, the study established that power outages had a negative significant impact on the export decisions of the firms and that firms facing electricity disruptions had a 9 to 13 percent lower probability of exporting. Further the study findings showed that firms experiencing power outages had significantly lower export intensity ranging from 3 to 4 percentage points. Further, the findings indicated that large firms had the highest chances of exporting and also the export intensity compared to medium sized and small firms, although power outages lowered the chances of getting into export and export propensity for all firm sizes.

Similarly, Bao et al. (2024) investigated the effects of power outages on export propensity of Chinese manufacturing firms using data from 2006 to 2014.

The main independent variable was the degree of power shortages which was measured using city level power outage index. The control variables used by the study at firm level were firm size, labour productivity and capital-labour ratio while the control variables adopted at city level were GDP per capita and the share of the manufacturing industry in GDP. Further, the authors used instrumental variable approach and Heckman's two-step approach for estimation of the specified model. The study established that power outages have a significant negative effect on export propensity of manufacturing firms in China. Further, from the transmission mechanism analysis, the results indicated that electricity shortages lower the exports of the manufacturing firms by depleting inventory levels and constraining innovation activities. Moreover, the heterogeneity analysis indicated that non-state-owned enterprises, coastal regions firms, and firms in low energy-consuming industries were more severely affected by electricity outages. Conclusively, the authors found that electricity shortages affected the intensive margins of exports rather than extensive margins.

Moreover, Nguyen et al. (2025) examined the connection between power constraints and participation in the Global Value Chains (GVCs) of manufacturing firms in 119 countries spanning from 2005 to 2022. The authors found that firms with high exposure to electricity constraints had lower chances of participating in GVCs as a result of reduced productivity, increased energy costs and decreased capital investment in machinery. The results demonstrated heterogeneity across years, sizes of firm, sectors and geographic regions. In another study, Yu et al. (2023) employed two stage least squares to explore the effect of power outages on carbon dioxide emissions intensity in Chinese manufacturing firms running from 2008 to 2015. The authors used city level power shortage index to measure power outages and established that electricity shortages have a positive significant effect on CO_2 emissions intensity of manufacturing firms in China. From the indirect effect of power outages on CO_2 emissions through technological innovation, energy intensity and productivity channels, the authors found that power shortages increase firms' CO_2 emissions intensity mainly through reducing firms' R&D investments, increasing firms' energy consumption, and curbing firms' productivity.

3. Methodology

3.1. Data Sources

The study utilized data from the latest 2018 World Bank Enterprise Survey in Kenya. The survey data is usually collected by conducting interviews with business managers or the owners of the firms. Stratified sampling technique is used in the WBES which stratifies firms based on region, firm size and sector. The firm size stratification usually has small firms to comprise 5–19 employees, medium firms have 20–99 employees and 100 or more employees form large firms. The total number of manufacturing firms was 520 in 2018 WBES.

Table 1. Variables and measurement

Variable	Description and measurement	Source of variables and data
Dependent variables		
Export intensity	The sum of direct and indirect exports as a % of total sales	Bao et al. (2024), Gupta–Singh (2021),WBES
Export decisions	1 if a firm engaged in direct and indirect exports, 0 if national sales only.	Kimolo et al. (2024), Gupta–Singh (2021),WBES
Independent variables		
Power outages	Number of power outages experienced in a typical month (frequency)	Fonchamnyo (2014), WBES
Control variables		
Capacity utilization	Capacity utilization of the firms in percentage	WBES
Total factor productivity	Estimated total factor productivity using Cobb Douglas production function using KLEM	Kimolo et al. (2024), Gupta–Singh (2021),WBES
Labour productivity	Ratio of total sales divided by total workers in logarithm	Bao et al.(2024), Kimolo et al. (2024), WBES
R&D spending	Dummy variable, 1 if a firm spend on R& D and 0 if otherwise	Charoenrat–Amornkitvikai (2024), Gupta–Singh (2021)
Energy cost	Logarithm of total annual cost of electricity	Kimolo et al. (2024),WBES
Managerial experience	Number of years working experience as a top manager in logarithm	Fonchamnyo (2014),WBES
Firm size	Dummy variable, 1 if the firm small and 0 otherwise; 1 if firm is medium and 0 otherwise and 1 if firm is large and 0 otherwise	Gupta–Singh (2021), Bao et al. (2024),WBES
Ownership	Dummy variable, 1 if the firm is foreign, 0 the firm is domestic.	Kimolo et al. (2024), Gupta–Singh (2021), WBES
Self-generation	Dummy variable, 1 if a firm shared or owned a generator. 0 if otherwise	WBES
Access to finance	1 if a firm borrowed from financial institutions, 0 if otherwise.	Gupta–Singh (2021), WBES
Foreign inputs	Percentage of material inputs and supplies of foreign origin	Gupta–Singh (2021), WBES
Foreign technology adoption	1 if the firm uses technology licensed from foreign-owned companies, 0 if otherwise.	Gupta–Singh (2021), WBES
ISO certification	1 if the firm is ISO certified and 0 otherwise	WBES
Capital intensity	Capital to labour ratio in logarithm	Bao et al.(2024), Kimolo et al. (2024), WBES
Exclusion restriction variables		
Firm age	Number of years of operating in logarithm since the firm was starteduntil the survey year	Bao et al.(2024), WBES,
Region	1 if urban /city and 0 if rural	WBES

Source: own compilation

3.2. Estimation of Total Factor Productivity

The TFP was estimated using Cobb-Douglas Production, where it was estimated as the residual of this production function. The output was proxied by total sales whereas labour was measured using total labor cost which included wages, salaries and bonuses, raw materials was assessed using total cost of raw materials and intermediate goods used in production, the energy was measured using the total annual electricity cost and capital was assessed using cost for establishment to repurchase all its machinery. The production function took the following form

$$Q_i = AK_iL_iM_iE_i\varepsilon^{v_i} \quad (1)$$

Where Q is output, K= capital, L = labour, M =raw materials and E = energy cost.
By taking logarithm

$$\ln Q_i = LnA + \beta_1 lnK_i + \beta_2 lnL_i + \beta_3 lnM_i + \beta_4 lnE_i + v_i \quad (2)$$

After the regression the TFP residual were generated and thereafter antilogarithm was run so as to obtain the TFP in level form.

3.3. Specification of the Estimation Model

The study used Heckman two step procedure to jointly estimate the export propensity and export intensity models as follows;

$$\textit{Export propensity} = \beta_0 + \beta_1 \textit{frequency of power outages} + \beta_2 \textit{capacity\_utilization} + (\beta_3 \textit{frequency of power outages\#\#capacity utilization}) + \beta_4 \textit{firm size} + \beta_5 \textit{R\&D spending} + \beta_6 \textit{capital\_intensity} + \beta_7 \textit{energy cost} + \beta_8 \textit{labor\_productivity} + \beta_9 \textit{total factor productivity} + \beta_{10} \textit{managerial experience} + \beta_{11} \textit{foreign ownership} + \beta_{12} \textit{access to finance} + \beta_{13} \textit{self\_generation} + \beta_{14} \textit{ISO certification} + \beta_{15} \textit{foreign technology} + \beta_{16} \textit{foreign inputs} + \beta_{17} \textit{firm age} + \beta_{18} \textit{region} \quad (3)$$

$$\textit{Export intensity} = \beta_0 + \beta_1 \textit{frequency of power outages} + \beta_2 \textit{capacity\_utilization} + (\beta_3 \textit{frequency of power outages\#\#capacity utilization}) + \beta_4 \textit{firm size} + \beta_5 \textit{R\&D spending} + \beta_6 \textit{capital\_intensity} + \beta_7 \textit{energy cost} + \beta_8 \textit{labor\_productivity} + \beta_9 \textit{total factor productivity} + \beta_{10} \textit{managerial experience} + \beta_{11} \textit{foreign ownership} + \beta_{12} \textit{access to finance} + \beta_{13} \textit{self\_generation} + \beta_{14} \textit{ISO certification} + \beta_{15} \textit{foreign technology} + \beta_{16} \textit{foreign inputs} \quad (4)$$

Notably, the difference between the export propensity or selection equation and export intensity or outcome equation lies in the exclusion restriction variables, that is firm age as used by (Bao et al. 2024) and region.

4. Results and Discussion

Table 2. Descriptive statistics of categorical variables

Variable	Total	Category	Sub-total	Percent.	Cum.
Firm size	520	Small	173	33.27	33.27
		Medium	198	38.08	71.35
		Large	149	28.65	100.00
Self generation	519	Yes	354	68.21	68.21
		No	165	31.79	100.00
Exporting decision	517	No	295	57.06	57.06
		Yes	222	42.94	100.00
R&D spending	517	Yes	116	22.44	22.44
		No	401	77.56	100.00
Access to finance	508	Yes	203	39.96	39.96
		No	305	60.04	100.00
ISO certification	507	Yes	140	27.61	27.61
		No	367	72.39	100.00
Region	520	Rural	247	47.50	47.50
		Urban	273	52.50	100.00
Ownership	520	Foreign	87	16.73	16.73
		Domestic	433	83.27	100.00
Foreign Technology	438	Yes	76	17.35	17.35
		No	362	82.65	100.00

Source: own computation

From the results in Table 2, 71% of the manufacturing firms used in the WBES were SMEs. Further, 68.21% of the firms engaged in self generation while 31.79 did not have backup generators. Only 42. 94% of the firms engaged in exporting whereas 57.06 of the firms did not export. Moreover, 16.74% of the firms were foreign owned while 83.27% were domestically owned.

Table 3. Descriptive statistics from the continuous variables

Variable	Obs	Mean	Std. Dev	Min	Max
Total factor productivity	275	4.01	22.04	0.024	278.098
Labour productivity	468	14.4597	1.6889	8.8049	20.7839
Firm age	517	26	18.583	0	103
Managerial experience	513	18.35	12.43	1	65
Export intensity	517	19.72	34.24	0	100
Capital intensity	327	14.23	2.33	6.57	23.38
Frequency of power outages	456	7.0811	15.7048	0	240
Capacity utilization	418	74.7560	20.5498	10	100
Energy cost	479	13.6595	2.5782	0	21.9760
Foreign inputs	517	28.6634	35.7628	0	100

Source: own computation

The results in Table 3 reveal that the average age of manufacturing firms is 26 years with the oldest firms being 103 years. In addition, the average experience of the

managers was 18 years. Further, the average frequency of power outages was 7 hours per month for the manufacturing firms. Moreover, the export intensity averaged 19.7% and the capital utilization averaged 74.76%. The average foreign inputs used by the firms constituted 28.66%.

The study estimated Heckman model using a two-step estimation procedure. The results are presented in the following Table 4.

Table 4. Heckman two step marginal effects of export intensity and export propensity

		Export Intensity			Export Propensity		
		Coef.	Std. Err.	P>|z|	Coef.	Std. Err.	P>|z|
Frequency of power outages		1.1525	1.1058	0.297	-0.06743	0.02987	0.024
Capacity utilization		0.5635	0.1913	0.003	0.002909	0.005849	0.619
Frequency of power outages##capacity utilization		-0.01376	0.01391	0.323	0.001103	0.000481	0.022
Firm size	Small–Ref.						
	Medium	-10.0389	8.3503	0.229	-0.01881	0.2712	0.945
	Large	-0.76457	11.208	0.946	0.5348	0.3289	0.104
R&D spending	No- Ref						
	Yes	9.357	7.1316	0.19	0.2225	0.2511	0.376
Capital intensity		-2.3089	1.6639	0.165	0.008659	0.05278	0.87
Energy cost		-6.7787	2.1794	0.002	-0.1723	0.05972	0.004
Labor productivity		7.0164	2.9292	0.017	0.1928	0.07448	0.01
Total factor productivity		-0.1375	0.1095	0.209	0.03103	0.04069	0.446
Foreign inputs		-0.4015	0.1011	0.000	0.005727	0.0032	0.074
Ownership	Domestic -Ref						
	Foreign	4.7026	8.884	0.597	0.7159	0.2935	0.015
Access to finance	Yes -Ref_						
	No	-3.434	6.9331	0.62	-0.1734	0.2189	0.428
Self generation	No-Ref						
	Yes	15.6276	8.2851	0.059	0.06227	0.2524	0.805
ISO certification	Yes-Ref						
	No	-34.3771	12.2472	0.005	-1.2633	0.2477	0.000
Foreign technology	Yes-Ref						
	No	4.246	7.6903	0.581	-0.3782	0.2842	0.183
Constant		32.607	45.5863	0.474	-1.3232	1.2358	0.284
Firm age		.3226	.1317	0.014			
Region	Rural-Ref				0.04881	0.2701	0.857
	Urban				-1.3232	1.2358	0.284
Millis lambda					30.0839	14.9392	0.044
rho					0.9049		
sigma					33.2473		
Wald chi2(16)					101.6		
Prob > chi2					0.000		

Source: own computation

From export intensity results in Table 4, capacity utilization marginal effect was 0.5635 with a p-value of 0.003 < 0.05. This implies that other factors constant, manufacturing firms that utilize a higher proportion of their production capacity have a higher export intensity of 0.56 percentage points. Labour productivity had positive effect of 7.016 with a p-value of 0.017 < 0.05. This means that holding other factors constant, an increase in labor productivity increases export intensity by 7.016 percentage points, therefore agreeing with Reis–Forte (2014) but then contrasting

(Kimolo et al. 2024) who established negative effect between labor productivity and export intensity. Further, the results indicate that an increase in the energy cost lowers the export intensity by 6.78 percentage points and it is statistically significant as p-value 0.002 < 0.05. Manufacturing firms using foreign inputs have lower export intensity of 0.4015 percentage points with a p value 0.000 < 0.05. Furthermore, firms engaging in self generation have a higher export intensity than firms not engaging in self generation with a p-value of 0.059. In addition, firms without ISO certification have a lower export intensity compared to ISO certified firms with a p- value 0.005 < 0.05. The rest of the variables were not statistically significant.

From the export propensity model in Table 4, the more frequent the power outages the lower the probability of firms engaging in exporting with a p-value of 0.024 < 0.05.This empirical finding agree with Bao et al. (2024) whose study findings showed a negative and statistically significant effect between power outages and export propensity of Chinese manufacturing firms. Further, the interaction term between frequency of power outages and capacity utilization is 0.0011027 and statistically significant with p-value 0.022. This implies that the negative effect of the frequency of power outages on export propensity is mitigated as a firm's capacity utilization increases. Further, the older the firms the higher the chances of engaging in exporting with 0.32 percentage points and statistically significant as the 0.014 < 0.05. Other things remaining the same, an increase in labour productivity increases the probability of firms engaging in exporting with 0.1928 percentage points and it is statistically significant with p-value 0.010 < 0.05, supporting 'new' new trade theory which argues that more productive firms are likely to engage in export.

In addition, an increase in the energy cost lowers the export propensity of firms with 0.17 percentage points and it is statistically significant at 5% significance levels (p-value 0.004 < 0.05), thereby contrasting Kimolo et al. (2024) who established a positive effect between energy cost and exporting decisions of firms in Kenya. Foreign owned firms have a higher export propensity compared to domestically owned firms with a p-value 0. 015 < 0.05. Moreover, firms using foreign inputs have higher probability of engaging in exporting though it has a weakly significant coefficient with a p-value 0.074 <0.10. Further, manufacturing firms without ISO certification have a lower export propensity relative to the firms with ISO certification and it is statistically significant with a p-value 0.000 < 0.05. Despite the other variables having the expected sign they were statistically insignificant.

More importantly, the Millis ratio lambda had a p-value of 0.044 < 0.05, justifying the use of the Heckman model. Moreover, the model was well specified as prob > chi2 =0.000 <0.05.

4. Conclusion

The study sought to investigate the effect of power outages on export performance of manufacturing firms in Kenya. From the Heckman two step estimation procedure, the study concludes that power outages affect the export propensity as opposed to export intensity of the firms. Further, although the frequency of the power outages has negative statistically significant effect on export propensity, this effect is reversed with the introduction of interaction term between frequency of power outages and capacity

utilization. Energy cost lowers both the export propensity and export intensity of manufacturing firms in Kenya. Labor productivity increases the probability of firms exporting and their export intensity. Firms without ISO certification have lower export propensity and export intensity compared to ISO certified firms. In addition, self-generating firms have higher export intensity than non-self-generating firms. Foreign owned firms have a higher likelihood of engaging in exporting than domestically owned firms. The older the firm the higher the export propensity. Interestingly, foreign inputs increase the export propensity but lowers the export intensity of the firms.

Based on these findings, the government of Kenya should address the frequency of power outages in the country as it is an obstacle to exporting decisions of the manufacturing firms. It should also address the rising energy costs as they lower both the export propensity and export intensity of the manufacturing firms.

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