Impact of Petroleum Excise Tax Costs on Firm Productivity in Uganda

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Authors' contributions

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

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ABSTRACT

The aim of this paper is to investigate the effects of petroleum fuel excise tax costs on productivity of generator-reliant firms in Uganda. Most studies investigated the association between corporate tax and firm productivity, value added tax and firm productivity. This study contributes to the neglected area on the influence of petroleum excise tax costs on firm productivity. In this paper, we employ the ordinary least square (OLS) method for estimations. The results show a negative impact of petroleum fuel excise tax costs on the productivity of manufacturing firms, driven by the severe tax burden. In addition there is a negative significant association between tax cost and household welfare. Therefore tax policy actors should formulate policies that not only raise tax revenue but also boost business growth.

1. INTRODUCTION

In this paper we investigate the impact of petroleum fuel excise tax costs on productivity of generator-reliant manufacturing firms in Uganda. In the recent past, interest in the productivity of manufacturing firms has emerged as a critical engine for growth and employment creation [1].

This is because of increasing gaps in productivity levels among firms [1,2]. Particularly, excise tax imposed on petroleum fuels, adversely affects firm productivity and competitiveness [3,4]. This tax imposes direct financial, operating and efficiency costs on firm's profits [5]. The excessive burden involves tax-induced market distortions are operating costs to government of administering and collecting taxes or costs incurred by taxpayers as tax burden and costs of meeting tax laws [6].

Anecdotal studies providing snapshots of firm productivity have highlighted the need to determine the tax compliance costs on generator-reliant firms [7], which negatively impacts on productivity [8]. From the government revenue generation perspective, if tax burden harms firms' operations, then it harms government revenue generation too in three ways; (1) the ability to pay tax is dependent on firms' growth. Given that firms pay corporation tax as a percentage of their profits, it means that if tax burden reduces growth and profits of the firm, then the government revenue will also fall. (2) The value added tax revenue will fall due to the fact that the output by the firms has reduced by the tax burden. [3] Income tax by workers will also fall as a result of lower wages, which stems from lower output and profits [9]. In addition, studies investigating firm productivity show that the tax costs are substantial for Small and Medium firms [6] and affects productivity. They are mainly high in absolute terms and relative to the size of the business and appear not to reduce over time [10,11]. However, these studies largely focus on all the taxes and less is known on the impact of petroleum excise tax cost on firm productivity.

Prior study by [12] among taxpayers in Germany shows that outsourcing tax compliance activities results in cost reduction. Contrary, the study by [13], in Malaysia among larger firms suggests that relying on external tax professionals increases tax cost. Given this lacuna, scholars have raised calls for further study on tax burden [14,5]. Even study by [15] on fossil fuel subsidy reforms and their impacts on firm productivity have produced contradictory results, they show that cost increases both direct and indirect do not necessarily disclose competitiveness losses since firms can mitigate and pass on price shocks. Furthermore, majority of studies on impacts of tax costs on firm productivity have focused on corporation tax [16,17] value added tax [18,19] but less is known on the impact of

petroleum excise tax especially on generator reliant firms. Among the few studies that have explored energy prices, generator and the performance of manufacturing firm: evidence from Indonesia was by [3]. They found that generator-reliant firms reduce output and value added by around 0.6-0.8 in response to 10% fossil fuel price increase. Indonesia is an oil exporter, but imports gasoline as a result of insufficient refining capacity while Uganda is an oil importer whose fuels are exposed to excise tax. This finding may not be generalized in the context of Uganda. Moreover, studies on the impact of fuel taxes have focused on environmental regulations (see [20-26] and less on the impacts of fuel excise tax costs on firm productivity of generator-reliant firms.

Here we report the impact of petroleum fuel tax costs on firm productivity of generator-reliant firms using evidence from Uganda. We show that, petroleum fuel tax compliance costs have a negative impact on the productivity of generator-reliant firms (r =-0.02; *p*=0.000). These are largely driven through by the severe tax burden and requirements of meeting the tax laws imposed by the tax authorities in the quest of raising revenue. This requirements inflict pressure on the firm's profits, competeiveness and thus on its productivity. This implies that policy choices that seek to reduce tax burden on firms and create investment environment that allows productivity improvement should be formulated by the policy makers to break the growing trend [76][63] in Africa and Uganda in particular. This will not only allow firms to increase on their performance but also allows government to get sufficient revenue.

In order to achieve this, this study sets to establish the contribution of fuel excise tax costs on firm productivity using evidence from Uganda. Specifically to:

1. To examine the impact of petroleum fuel excise tax costs on productivity of generator-reliant manufacturing firms
2. To examine the association between petroleum fuel excise tax costs on household welfare.

This study makes the following contributions to the existing literature: As a distinction from the previous studies that largely focused on the impact of fuel excise tax on households [29-31]. This study contributes to economic sector and shows the impact of fuel excise tax costs on the

firm productivity of generator-reliant firms [3] in a single study using evidence from Uganda. And further provides empirical evidence on the role of fuel excise tax costs on firm productivity in the improvement of firm performance.

1.1 Overview of Fuel Excise Tax in Uganda

In Uganda, petroleum products and other fuels in the energy sector is subjected to indirect taxes such as excise tax, according to income tax act 1997 [32] amended. According to [33], this is an indirect tax levied on petroleum fuels aimed at raising revenue, correction of environmental externalities, and capture of rents associated to natural resources that are used in energy production or consumption. It is paid by the petroleum oil distributing companies involved in the importation and sale of excisable fuel and paid at the time of importation [34,35]. While the fuel tax is meant to raise revenue, correction of environmental externalities and capture of rent associated with natural resources, its impact on firms has negatively affected productivity. On 1st July 2021, government of Uganda introduced a new fuel tax on petroleum fuels [36]. According to government, the new tax would help boost the stressed economy. However, this tax has become a burden especially on generator reliant manufacturing firms. Under the excise duty Amendment Bill, 2021, that was endorsed by parliament, motorist would pay a shs 100 tax increase per litre of petrol and diesel; this per unit tax affects the unit cost of production as compared to the advalorem tax [36]. Government argued that fuel tax would compensate for the earlier proposed annual road licence fee of shs 200,000 per motor vehicle and shs 50,000 per motorcycle that has since been dropped. And is expected to raise an additional shs 196 billion and would increase the tax on petrol to shs 1,450 per litre and shs 1,130 per litre of diesel. This has had an adverse effect and burden on the businesses amidst efforts to recover from the Covid-19 impact. The fuel prices in Kampala and other towns in the past increased, with the price of a litre of petrol jumping to shs 10,000 while diesel in some areas to shs 8,500 induced by excise tax. In addition, there are other costs related to the excise-duty such as implicit costs on time spent by the taxpayer visiting the tax officials, arranging meetings with tax officials, gifts to tax officials and time required to prepare and pay taxes translate to compliance costs and negatively affects firm competeness [37]. One of the elements of tax management that affects

the firms' productivity is the time to prepare and pay taxes which is reported by World Bank's Doing Business database. It measures the time in hours per year it takes to prepare, file and pay tax; Though the average number of visits, meetings with tax officials has reduced from 84.9% to 75.5% due to e-filing in Uganda, the number of hours required to prepare and pay taxes has stagnated from 2014 at 209h, 2015 at 209h and stagnated at 195h in 2016 to 2018 [37]. While this is an improvement, it is noted to be higher compared to the peers in the region such as Rwanda, Botswana and Mauritius among others with 144.4h, 147h and 158h respectively. This suggest that increase in time required to prepare and pay indirect taxes will lead to high costs which ultimately affects productivity of the firm. These costs reduce business resources without raising income to the government, resulting in a waste of economic assets [38].

Reducing tax costs could enhance the productivity and competitiveness of generator-reliant manufacturing firms and allows them to invest in essential activities and increase employment capacity [3,38]. Consequently, the impact of excessive tax costs increases the prices of goods or services and diverts incomes from business activities thus affect productivity and competitiveness [38,39,40]. Efficiency of a tax system, specifically in the emerging economies like Uganda, is critical not only to raise government revenue but also to promote investment in the economy, increase employment as well as long term growth [38]. Therefore the decision about the shape of the tax system and the incidence of the tax burden on the economic activities are critical in facilitating the attraction of foreign investment in the national economy [41].

2. REVIEW OF RELATED LITERATURE

Neoclassical economic growth theory [42] incorporated technological progress into the economic growth model, and proposed a production function Y = AF (KL), after deducting the contributions of inputs factor growth to output from a growth of total output. "Total factor productivity" as a way of increasing productivity and efficiency [43]. Productivity refers to efficiency in resource use [44]. Literature suggests that there is single factor productivity and a multi-factor or the total factor productivity. The single factor productivity refers to the ratio of output to factor inputs. For example labour and

capital productivity can be defined as Y/L and Y/K. According to the Solow model, the improvement of total factor productivity provides a sustainable development of a country's economy.

Theoretically, the view of academia is that productivity is the ratio of output to input factors and measures the efficiency in input resources used in production.

As an engine of economic growth, manufacturing firms play a fundamental role in employment creation and long term growth of an economy. By the end of 2019, the percentage share of jobs of manufacturing firms to the total formal jobs in Uganda, increased to 9.5% up from 8.7% in 2016 [45] contributing 15.5% of manufacturing value added as a proportion of GDP. And 21.62% to the total tax revenue collections [45]. The productivity of manufacturing firms is on the downward trend and the economic environment such as taxes and the related costs of compliance has made it difficult for firms to develop and create employment opportunities. In this setting, the adverse costs restricting enterprises growth should be fixed. On the other hands, policies that seek to reduce tax burden should be formulated.

Firms pay more concern on productivity, [46] adopted a global Malmquist – Luenberger productivity index to examine the drifts of energy productivity growth in the Pearl River Delta Metropolitan region during 2005- 2015. Their results indicate that the greatest contributor of productivity is technological progress. [47], investigated whether indirect taxation matter for total factor productivity growth in India, evidence from ADRL bound testing approach; results indicate cointegrating relationship between indirect taxation and TFP growth. [48], investigated industry level analysis of productivity growth under market imperfections in India and found considerable disparities in productivity growth in terms of TFP.

In recent years, the issue of economic operating environment that restricts enterprise growth has come to the center stage in most academic conversation in a bid to improve productivity and efficiency. With this view[49] explored the impact of investment environment on manufacturing productivity in Nigeria, the results show that power outage, loss in transit due to breakage or spoilage and tax burden have a significant negative effect on total factor productivity of

manufacturing industries in Nigeria. Similarly [50] studied the efficiency of energy intensive industries across European countries based on Data envelopment analysis (DEA) combined with Malmquist productivity index (MPI) and found that the high electricity prices, energy taxes have a negative effect on industrial efficiency. According to [8] findings on tax compliance costs measurement in Czeck republic revealed that the factors affecting tax compliance costs were size of the business and vary with the scope.

2.1 Theoretical Framework

In this study, we use the rational choice theory pioneered by George Homan [51], the basic framework for exchange theory and later recorded by Becker [52] and the endogenous growth theory [53]. The rational choice theory is appropriate for this study as it is based on economic behavioral model of "homo economicus", which perceives human and human agency as naturally calculative, haggling and materially acquisitive acting to maximize their own success [54,55]. It is suitable for the understanding of specific goals, given the limitations imposed by the situation [56]. Given that this study uses actor's choices in formulating policies that enhances tax efficiency and minimizes tax burden as possible explanation for productivity improvement in manufacturing firms, and the fact that it points out the actors as a rational, independent being that have the responsibility perspectives in policy formulation, this theory remains core [57,58].

The essence of rational choice theory is that when faced with several courses of action, people usually do what they believe is likely to have the best overall outcome [59]. We argue consistent with [60] and Friedman [61] that the "rationality" in the rational choice theory basically means that an individual act by balancing the effects of cost against benefits to arrive at action that maximizes personal advantage and minimizes costs. The core of the theory is anchored on three assumptions: (i) individuals have personal bias and plan (ii) they capitalize on their own strength and gains, and (iii) they act in isolation based on full personal digression and available information.

In relation to petroleum excise tax costs, rational choice theory is adopted to show that the tax policy actors in parliament have a rational drive to the productivity growth in the manufacturing

firms [12]. There are certain significant steps which the rational choice actors and analyst should follow in making decisions. These includes a definition of the problem, identification of decision criteria, weighing the criteria, generation of valid alternatives, rating each of the alternative on each criterion and computation of optimal decision. These significant steps and other assumptions informed the rational choice of the people, individual actors and the state policy makers.

The tax policy makers are burdened with the effectiveness of the tax system not only to raise government revenue but also to promote investment environment, increase employment as well as long term growth [38] According to Stewart [58] and [57] policy formulators as rational actors have the task of ensuring that the best policies that seek to reduce the tax burden should be formulated. Selection of the right instrument by the policy actors and choosing the most efficient form of regulation which produces the desired results with the least deadweight costs should be considered. Such a policy according to [62] increases the productivity of firms.

Though the theory is criticized on the basis that the individual actor can be compromised and his actions may endanger the popular interests of the stakeholders. And that at what point can other people rate the actor's action as rational or irrational [57]. This weakness is addressed in such a way that, tax policy actors do not make decisions in isolation but in union with other actors to maintain a rational choice of the best policy for the entire tax system. And because productivity cannot only be explained by tax compliance costs alone but other factors such as infrastructure, technology, trade openness and ICT services are equally significant. This study therefore adopts endogenous growth theory [53] because of its capacity to explain the productivity level of workers in an organization [63].

The Endogenous growth theory [53] holds that economic growth is primarily the results of endogenous and not external forces. Endogenous growth theory holds that investment in human capital and knowledge are significant contributors to economic growth. The theory also focuses on positive externalities and spillover effects of a knowledge-based economy which will lead to economic development. It primarily holds that the long run growth rate of an economy depends on policy measures. For example

policies that encourages diffusion of knowledge (A) from high technology to low technology regions that enhances productivity growth in firms. Since the flow of knowledge from the technology leader makes the technology grow faster in the follower country or firm. In effect it assumes that output for firms could be attained through investment in $Y = F (R, K, H)$ homogeneous to degree one production function. In this case, investment in research (R), physical capital (K) and human capital (H) as inputs in the production system are likely to spur productivity growth in firms. This is often aggregated as R, K and H into a broad measure of capital X thus F(X). And that a constant fraction of output Y is saved and used to produce more of X and generate persistent productivity growth for firms. This is consistent with [48] who argue that for productivity growth to be realized there is need to consider change in technology.

2.2 Fuel Excise Tax Costs and Productivity of Manufacturing Firms

Regulations impose burden on firms' productivity growth, particularly through their effects on new firm formation, competition, and investment [63]. This burden may be taxes themselves either on profits, products or employees, efficiency costs and the tax operating costs, the costs to the government of administering and collecting the taxes and costs incurred by taxpayers in complying with tax obligation usually represented as compliance costs [6]. This study will focus on the tax operating costs incurred by fuel importing taxpayers in complying with the tax obligations. Compliance costs cover a wide range of monetary and non- monetary costs. They include the cost of; the tax itself, the cost of tax, preparing and paying tax, acquiring the relevant knowledge on tax matters, compiling records, acquiring and maintaining the tax accounting system and completing tax return forms, evaluating and learning the tax rules [9,64]. These tax compliance costs divert resources from productive activities and increase input costs without creating additional output for enterprises and revenue to government [38].

There is an extensive body of literature on the effects of tax compliance costs on enterprises evaluating the compliance costs of all taxes on business taxpayers using large scale sample [3]. The results are rather inconclusive, but the overall conclusion of these studies appears to be that the effects of these costs are significantly larger than previously estimated [64]. The

majority of the studies are on corporate tax compliance costs [13]. This study focuses on the neglected area of fuel excise tax compliance costs. However, numerous researchers' results indicate that there is association between tax compliance costs and firm productivity [65,66,63,64]. Findings by [65] indicate that better tax operating system improves the productivity gaps of small and new firms relative to large firms. This means that firms can gain growth and productivity dividends from enhancement in tax operating system and lowers the compliance costs. Also [66] found that a one percentage point increase in overall firm specific tax rate causes 0.15 percentage decrease in return on assets in Romanian listed companies. Furthermore, [63] find that the tax operating burden for enterprises has a negative effect on firm output. We hypothesize that:

H₁: Fuel excise tax costs negatively influences productivity of generator-reliant manufacturing firms.

2.3 Fuel Excise Tax Compliance Costs and Household Welfare

The operation of fuel excise tax in emerging economies with many levels of income earners has stimulated arguments among taxpayers' particularly low income earners regarding the welfare loss of tax compliance costs [67]. This is because the tax compliance costs increases input costs without creating additional output for enterprises and revenue to government [38]. Petroleum excise tax introduced by government in Uganda in a bid to increase tax revenue; in contrast increased the tax incidence of the households thereby affecting both the households' disposable income and government revenue. It is a consumption based tax imposed on the sale of petroleum fuels. There is a consensus both on the household level and government that tax compliance costs harm household welfare and government revenue [9]. If household's income is affected by tax, it means the other indirect taxes associated with consumption will fall, thereby affecting government tax revenue. The tax system that balances growth, government revenue and equity in an economy is better. [68] evaluated the value added tax in South Africa in the context of distortions in the economy by computing the marginal cost of funds effects of raising government revenue by increasing the indirect tax rate on household welfare using a computable general equilibrium (CGE) and found

that it imposes a heavy burden on household welfare. Similarly, the results of the study of impact of the tax on retail prices, product availability, purchases, child and adult consumption of taxed beverages in Okland by [69] indicate that roughly 60% of the tax was passed on to customers in the form of higher prices, suggesting that the decreased volume of purchases per shopping trip of households. We therefore hypothesize that:

H₂. There is a negative relationship between the fuel excise tax costs and household welfare.

3. METHODOLOGY

3.1 Model Specification and Data

Our simple estimation model has the following specification, commonly used in previous studies [9,70]. It is grounded on the augmented Cobb-Douglas production function and following studies on firm-level performance. The first equation for estimating the effect of tax compliance costs on firms' productivity is as follows:

$$P_{ijl} = \beta + \phi Tcc_{ijl} + \delta X_{ijl} + \varepsilon_{ijl} \tag{1}$$

Where P_{ijl} is the measure of firms' productivity (proxied by labour productivity, annual sales/value added both in logs). Subscripts i,j,l represent individual firm, industry of the firm and year of survey of the firm respectively. TCC_{ijl} is the measure of tax compliance costs; X_{ijl} is the vector of labour and capital input ε_{ijl} is the error term. However, there are other factors that affect firms' productivity according to the theory. Thus in order not to suffer from misspecification bias, Equation (1) is augmented to include factors such as infrastructure, technology, international trade, ICT investment. Infrastructure affects the firms cost of production. When faced with frequent power outages and insufficient physical infrastructure, unfavorable investment climate, productivity can be slowed down [71].

Moreover inadequate infrastructure is a key determinant of low productivity growth in the manufacturing firms. Outlay in human capital, infrastructure and research and development, technology improves productivity in firm operations [44,71]. Technologies like website, emails makes communication and visibility of the firms' products faster thereby increasing the overall labour productivity. In addition, openness of firms to international environment allows them

to acquire recent technology that spurs productivity [72]. Furthermore, investment in service input and ICT intensity can significantly influence positively productivity of the manufacturing operations.

Therefore, the second equation for estimating the effect of tax compliance costs on firm productivity is as follows:

$$P_{ijl} = \beta + \phi TCC_{ijl} + \delta X_{ijl} + \varphi i_{jl} + \acute{\omega} i_{ll} + \gamma ijl_f + \varepsilon_{ijl} \qquad (2)$$

Where X is now augmented to include the set of control variables such as labour (number of employee), capital, infrastructure, technology, ICT services and as well as international trade, this study did not look at firm features such as age, experience of managers and overseas own. Φj, $\acute{\omega}$l, and γf represent industry, year of survey and fixed effects, respectively while ε is the error term. It is eminent that the main parameter of interest is ϕ, which measures the impact of tax compliance costs on firm productivity. All regression results are based on Huber-White robust standard errors.

Furthermore, in finding out how tax compliance costs affect the productivity of small and large firms, the equation three is estimated consistent with [65].

$$P_{ijl} = \beta + \phi TCC_{ijl} + \mu SMALL_{ijl} + \theta LARGE_{ijl} + \delta Xijl + \varphi_j + \acute{\omega}_{l} + \gamma_f + \varepsilon_{ijl} \qquad (3)$$

Where SMALL and LARGE are dummy variables that represent the firm size ("1" if the firm has less than 20 employees). The parameters of interest here are μ and θ which echoes the impact of tax compliance costs on small and large firms respectively.

3.2 Identification and Estimation Approach

The paper employs the ordinary least square (OLS) method for estimations. Two issues could arise in using OLS to estimate the linear models in Equation (2) and (3) are heteroskedasticity and endogeneity. Heteroskedasticity poses a challenge because the data type is made up of firms of different industry and data gathered at different years. Endogeneity may result in the inability to assess true causal impact of the explanatory variable (tax compliance costs) on the dependent variable. This apart from the model specification in Equation (2) and (3) by design, control for time invariant covariates. Again results are estimated using Huber-White

robust standard errors while controlling for industry time fixed effect. As a result, it is unlikely to suffer from heteroskedasticity. Moreover, the results to be estimated are unlikely to be affected by endogeneity since the tax management policies are planned by government and are seen as exogenous to the individual firm. In absence of the previous problems and given that the models for estimations are linear; this paper uses the OLS method of estimation. This is because it has unbiased estimator with minimum variance among the class of linear unbiased estimators [73].

3.3 Data and Descriptive Statistics

3.3.1 Data

The main data source for this paper is the survey of firms across countries in the Sub-Saharan Africa conducted by the World Bank [74]. Countries covered in this study are shown in appendix 3. The survey provides information on a wide range of firm characteristics and firm performance measures including tax management. For instance firms were asked on a scale of 1= low to 6= high on business regulation how much time, severity of the tax compliance costs poses hindrance to their operations. This is a measure of tax burden on business operation. This indicator can help policy makers understand the business environment in the country and on this score the emphasis is how severe the tax compliance costs imposes pain (costs) on firms' operations. Therefore, tax compliance costs are recorded as dummy "1" (if response is major and severe impediment) and "0" (if otherwise).

In addition, the survey has information on sales (manufacturing value added) made by firms. This is used as a proxy for firm productivity since there is no direct information on actual productivity. The justification is that, given prices, higher sales imply higher output and productivity. Thus this proxy is more of revenue productivity. The other proxy used for productivity is the labour productivity. It should be noted that the survey is designed to be a representative of medium size and large business at the firm level and contain a mixture of manufacturing and service sector. However, for this study the service sector was not considered since our main focus was on generator-reliant manufacturing firms of small and large. As a limitation firms with 100 percent government/state ownership were not eligible to participate in the survey. Also agricultural sector was left out in this study.

Table 1. Definitions of variables used in the study

Variables	Definitions	Variables	Definitions
Petroleum Excise tax	Is an indirect tax levied on petroleum fuels aimed at raising revenue, correction of environmental externalities, and capture of rents associated to natural resources that are used in energy production or consumption	**Infrastructure**	Refers to auxiliaries that facilitates trade, they include infrastructure and infrastructural services that supports trade and how the quality and cost of infrastructure are related to trade.
Productivity	Productivity refers to efficiency in resource use	**International trade**	Exchange of capital goods, goods and services across international boundaries
Labour productivity	Labour productivity can be defined as the ratio of output to labour in put (Y/L).	**ICT**	Is a broad term for information technology which refers to all communication technologies, including the internet, wireless networks, cell phone and computers, email among others
Tax compliance costs	Is the excessive burden involving tax-induced market distortions that are either operating costs to government of administering and collecting the taxes or costs incurred by taxpayers as tax burden or costs of complying with tax obligation		

4. RESULTS AND DISCUSSIONS

4.1 Basic Descriptive Statistics of the Model Variables

To appreciate the data features, the paper creates the basic descriptive statistics on the model variables as provided in Table 2. The specific data that were used is as follows: productivity, labour, tax compliance costs, infrastructure, international trade, ICT and technology at levels. And the sensitivity analysis and robustness check were carried, Fig. 1(normality test), Fig. 2 linearity (q-q plot), White's test for homoscedasticity, and the Multicolinearity, were done to check for robustness.

The variables under the study, demonstrate some interesting mean pattern to the productivity of the manufacturing firms, international trade contributes 27.58 % times higher to the productivity on average, which could be due to technology transfer followed by ICT at 17.3% and technology and labour at 16 times to the

productivity on average. The tax compliance cost on the other hand contributes less to the productivity by 5.7% times lower on average; implying that if tax burden and severity are improved, productivity of the manufacturing firms will increase.

4.2 Sensitivity Analysis and Robustness Check

In order to avoid spurious regressions results, we tested for a possible degree of multicolinearity among the regressors by running a correlation matrix of the variables (results are shown in appendix A1 and A2). The highest simple correlation coefficient among the regressors is 9.20 (namely infrastructure and labour). This posed a problem since it is above the threshold of 0.8 or 0.9 which is usually associated with variable inflation factors (VIFs) of between 6 and 10 [75]. However, labour variable was drop since it formed the multicolinearity between the predictor variables after testing for both exogenous and endogenous variables. So VIF in appendix A2 is 4.41. It means there was no

collinearity in the model after dropping labour. The correlation matrix further shows that the correlation coefficients between firm productivity and the explanatory variables (tax compliance costs, infrastructure, international trade, ICT and high technology) are statistically significant. This offers a good foundation for multivariate analysis.

For robustness checks and also to address possible normality and the linearity issues and White's test for homoscedasticity were carried out. The normality test was carried to check whether data was normally distributed. Fig 1 shows the results of the test.

From using kernel density estimates (KDE) algorithm which takes a parameter as *bandwidth*, which affects how "smooth" the resulting curve is. Therefore, KDE shows that data is normally distributed and smooth with the *bandwidth= 0.0250 which is less than 0.05.* In addition, q-q

plot generated for the test for linearity, the results in Fig. 2 shows that data was linear.

Test in Fig. 2 for linearity show that the data was linearly distributed.

Further, the white test for homoscedasticity was carried out to check for heteroskedasticity, results are shown in Table 3.

Ho: homoskedasticity, Ha: unrestricted heteroskedasticity
White's test for homoscedasticity show that *chi2* = 20.00 and df=19 therefore, the heteroskedasticity was not a problem and it was not a multiplicative function of the predicted values.

4.2 Ordinary Least Square Regression

Table 4: show our Ordinary least square estimation of productivity and explanatory variables.

Table 2. Showing Descriptive statistics

Variable	Obs.	Mean	Std. Dev.	Min	Max
Productivity	490	29.3569	0.6009	28.5403	30.1797
Labour	490	16.2301	0.2128	15.9072	16.5944
Tax compliance cost	490	5.7228	0.1224	5.4790	5.8266
Infrastructure	490	11.9633	0.7491	10.9277	13.0501
International trade	490	27.5758	1.1028	24.0207	28.7549
ICT	490	17.3267	0.8350	15.7470	18.4417
High technology	490	16.4591	0.9608	15.1068	18.9939

Source: Generated by the author from raw Data
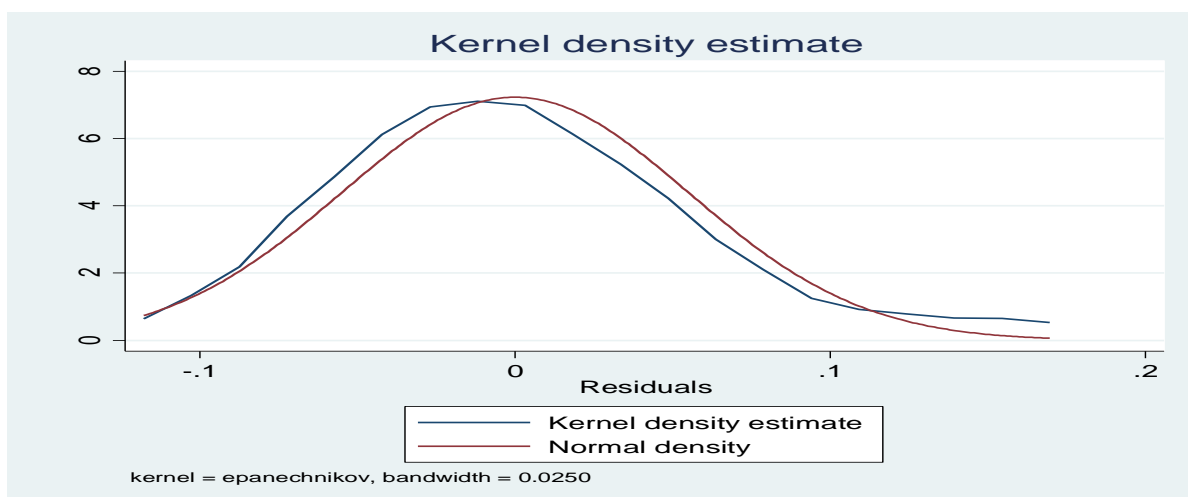
Fig. 1. Testing the normality
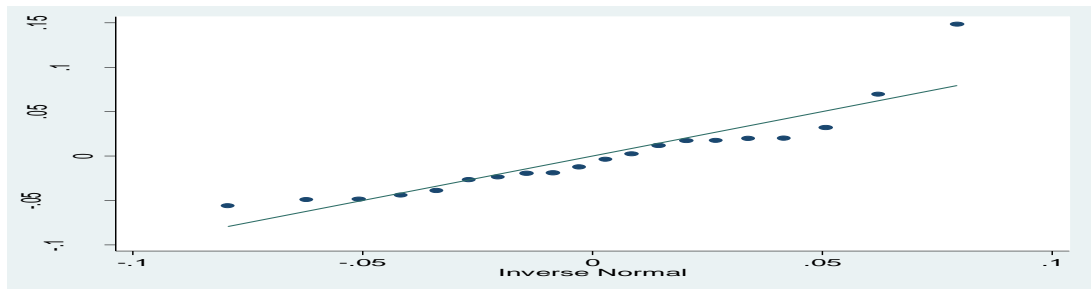
Fig. 2. Testing for linearity (q-q plot)

Table 3. Showing a test for White's test for homoscedasticity

Source	Chi2	df	*p*
Heteroskedasticity	20.00	19	0.3946
Skewness	7.09	5	0.2143
Kurtosis	0.55	1	0.4587
Total	27.63	25	0.3249

chi2(19) = 20.00: Prob > chi2 =   0.3946

Table 4. Showing, Ordinary least square estimation of productivity and explanatory variables

Productivity	Coefficient	Std. Err	*p*-values	(95% Conf. Interval)
Labour	0.05402	0.00623	0.000	0.04181- 0.06623
Tax compliance cost	-0.02082	0.00725	0.004	-0.03503 - -0.00662
Infrastructure	0.00939	0.00153	0.000	0.00641 - 0.01239
International trade	0.00249	0.00074	0.001	0.00104 - 0.00394
ICT	0.00269	0.00124	0.030	0.00026 - 0.00512
High technology	0.00306	0.00052	0.000	0.00204 - 0.00408

R-squared= 0.3938; Prob > F =   0.0000, Obs = 490

Table 5. Showing Ordinary least square estimation of tax compliance and welfare

Tax compliance cost	Coefficient	Std. Err	*p*-values	(95% Conf. Interval)
Welfare household	-0.16734	0.04243	**0.000**	-0.25050 **-** -0.08417
Productivity	0.13215	0.04086	**0.001**	0.05205 - 0.21224

R-squared= 0.77314; Prob > F= 0.0000

Productivity = 0.0030 high Tec + 0.0026 ICT + 0.00249 INTT + 0.0093 Infrast - 0.0208 Tax compl + 0.05402 labour + error term

Our results of a negative impact of tax compliance costs on the productivity of generator-reliant manufacturing firms, may be driven by the severe tax burden imposed by the tax authorities and the requirement to comply with the tax obligations(r = -0.02; *p*=0.000). This means that policy choices that seek to reduce tax burden on firms and foster investment environment that allows productivity improvement are needed to break the growing trend in Africa and Uganda in particular [76][63]. This will subsequently lead to more tax revenue collection from firms. This finds support in the study by [77] who explored the link between energy based taxes and economic growth. The

finding revealed that energy based taxes have a negative effect on economic growth rate.

Furthermore, findings demonstrate that there is a positive and significant association between labour and productivity. Implying that any unit standard deviation in skilled labourforce may leads to a unit standard deviation in the productivity of firms (r=0.05; *p*=0.000). This is in line with Corvers[78] who found that both intermediate and highly skilled labour have a positive effect on labour productivity and contributes to firms output. This suggests that these firms could improve on their effectiveness position by raising the employment shares of intermediate and highly skilled labour force. And that highly skilled labour has a significant positive effect on the growth of enterprise and labour productivity. Which is consistent with [79]-[81]

who finds that the cost of training by the firm, the level of educational attainment and R&D investment are significant and influences labour productivity in Malaysian on manufacturing firms.

Infrastructure has demonstrated that there is positive and significant relationship with firm productivity (r = 0.009; p=0.000). Suggesting that any unit increase in infrastructure may lead to a unit increase in firm productivity, this is consistent with [82]-[83] who investigated the direct and indirect effects of infrastructure on firm productivity in China, and found that all the three kinds of infrastructure both roads, telecommunication servers and cables promotes firm productivity.

A high increase in international trade can boost the productivity therefore there is a significant and positive relationship between international trade and productivity (r =0.002: p=0.001). This is in line with [84] who investigated productivity and trade openness in Ecuador's manufacturing industries and found a positive and significant effect of trade openness on productivity.

Information and communication technology (ICT) has greatly contributed to productivity as ICT improvement leads to an increase in the productivity which is exhibited with a significant and positive relationship between ICT and productivity hence (r =0.003 p=0.030). This is consistent with [86] who investigated internet connectivity and firm productivity and found that broadband adoption boost firm's productivity by 7%- 10%. In addition, high technology has proved to be positive and significantly association with productivity. A unit increase in high technology can lead to a unit increase in high productivity hence this present a positive and a significant correlation between high technology and productivity (r = 0.003; p=0.000) which is less than 0.05.

Overall, the ordinary least squares regression model has a reasonably high explanatory power. The adjusted R-square measure is 0.39 and the F-statistics is significant beyond the 1% level.

H_2: There is a negative relationship between the fuel excise tax costs and household welfare.

There is a negative significant association between fuel excise tax costs and welfare p<0.05 (see table 5). The increase in tax costs will lead

to the increase in the final selling price hence reduction in the household welfare. This is consistent with [87] who investigated the incidence of federal and state gasoline taxes that the specific gasoline tax falls on consumers and wholesalers, whereas the state specific taxes falls entirely on consumers. Deducing that, any unit increase in the excise fuel tax has a negative effect on household welfare. This is supported by the study of [88] who examined the distributional consequences of gasoline taxation in the United Kingdom and found that when all households are considered, middle-income households suffer most of the tax burden. This resonates with [89]-[90] who incorporates household price responsiveness that differs across income groups into a consumer surplus measure of tax burden, and found that Carbon taxation is regressive before revenue recycling of the tax revenue see Table 5.

5. CONCLUSION

This study sets out to empirically establish the contribution of fuel excise tax costs on firm productivity using evidence from Uganda. Specifically to: To examine the impact of petroleum fuel excise tax costs on productivity of generator-reliant manufacturing firms. To examine the association between petroleum fuel excise tax costs on household welfare. The study employs the ordinary least square (OLS) method for estimations. The key finding confirms that fuel excise tax cost negatively affects the productivity of generator-reliant firm. The study further establishes a negative association between fuel tax costs on household welfare. Thus tax policies that seek to balance the government revenue and business growth are essential to boost not only government revenue but also encourage business growth in emerging economies like Uganda.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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Appendix A1. Pairwise correlation Matrix

Variable	1	2	3	4	5	6	
Productivity	1.000						
Labour	0.983	1.000					
Tax compliance cost	-0.816	-0.841	1.000				
Infrastructure	0.910	0.854	-0.679	1.000			
International trade	-0.487	-0.379	0.216	-0.729	1.000		
ICT	0.759	0.723	-0.451	0.838	-0.674	1.000	
High technology	0.061	-0.033	0.243	0.075	-0.418	-0.038	1.000

**. Correlation is significant at the 0.01 level (2-tailed).
*. Correlation is significant at the 0.05 level (2-tailed).

Appendix A2.Showing test for Multicolinearity

Variable	VIF	1/VIF
Infrastructure	9.20	0.1087
ICT	4.29	0.2331
International trade	3.82	0.2619
Tax compliance cost	3.05	0.3281
High Technology	1.68	0.5959
Mean VIF	**4.41**	

Appendix 3. The number of countries covered in the survey

S/N	Country	S/N	Country
1	Angola	27	Equatorial Guinea
2	Azerbaijan	28	Kenya
3	Burundi	29	Libya
4	Burkina Faso	30	Lesotho
5	Central African Republic	31	Morocco
6	Côte D'voire	32	Madagascar
7	Cameroon	33	Mali
8	Dem. Rep. Congo	34	Mozambique
9	Congo	35	Rwanda
10	Djibouti	36	Sudan
11	Algeria	37	Senegal
12	Egypt	38	Sierra leone
13	Eritrea	39	Somalia
14	Mauritania	40	South Sudan
15	Mauritius	41	Sao Tome
16	Malawi	42	Seychelles
17	Namibia	43	Chad
18	Niger	44	Tunisia
19	Nigeria	45	Tanzania
20	Papa New Guinea	46	Uganda
21	Ethiopia	47	South Africa
22	Gabon	48	Zambia
23	Ghana	49	Zimbabwe
24	Guinea		
25	The Gambia		
26	Guinea Bissau		