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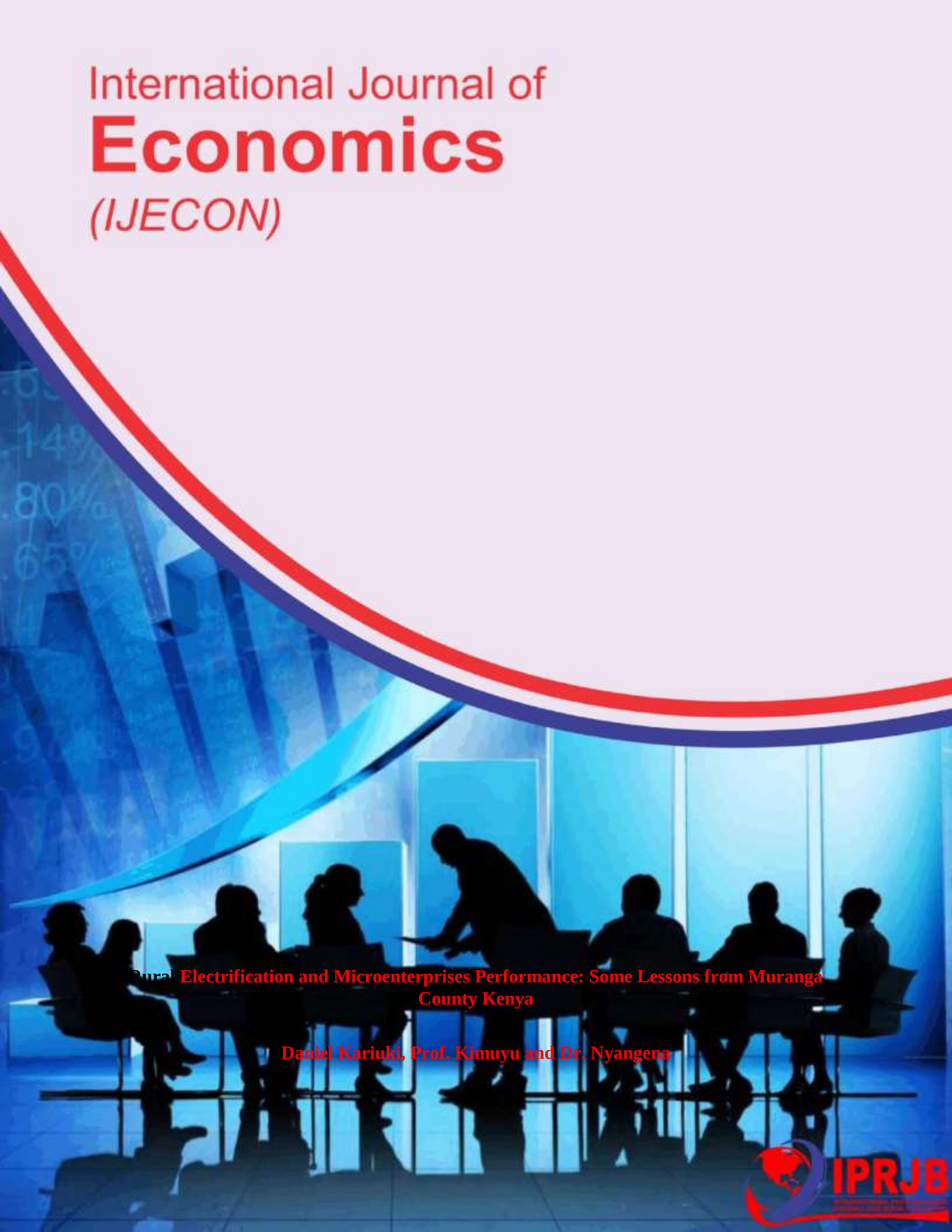

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Rural Electrification and Microenterprises Performance: Some Lessons from Muranga County Kenya

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Abstract

Purpose: The purpose of this study was to assess rural electrification adoption by microenterprises in Muranga County Kenya. The study was guided by two specific objectives which are; to establish the determinants of rural electrification adoption by Micro and Small enterprises in Murang'a County, Kenya and to determine the effect of adoption of rural electrification on the performance of rural micro and small enterprises in Murang'a County, Kenya.

Methodology: This study adopted two stage least squares incase of violation of endogeneity. The population of this research consists of the 650 small and medium enterprises in Murang'a. The study used primary data.

Results: Results revealed that, amount of capital invested, nature of business activity and distance from market significantly influenced the predicted probability of electricity adoption. Results also revealed that electricity adoption was positive and significantly related with business performance. The results also indicated that gender, capital invested and workforce were positively and significantly related to business performance.

Unique contribution to theory, practice and policy: It is recommended that Murang'a County should conduct business incubation programmes for businesses so as to boost the business performance/turnover as well as the capital invested. This will have a positive effect on electricity adoption since well performing businesses are likely to adopt electricity.

Keywords: *determinants of rural electrification, adoption of rural electrification, microenterprises*

1.0 INTRODUCTION

Rural electrification can be defined as the provision of electricity to areas of Low demand and highly dispersed potential consumers. Electricity can be supplied to such areas through smallscale auto generation, local independent grids, or a central regional or national grid (Cecelski and Glatt, 2009). Electricity is the backbone of socio-economic development of any country and is associated with provision of numerous services to people which directly enhances their quality of life. However, in today's world this situation becomes bit complex as not only continuous supply of electricity is important but it is equally essential to generate it in a green fashion. It is universally accepted that electrification enhances quality of life at household level and stimulates economy at a broader level. The immediate benefit of electrification comes through improved lighting, which promotes extended hours of study and in turn contributes to better educational achievements. Lighting can also benefit other household activities, such as sewing by women, social gatherings after dark, and so on. Electric gadgets such as radios and television improve the access to information by rural households and can provide entertainment to family members. In addition, economic activities of household, both inside and outside, improves as a result of use of electricity. For example, crop productivity can be increased by the application of electric irrigation pumps, businesses can be operated longer hours in the evening, electric tools and machinery can impart efficiency and productivity to industrial enterprises, and so on (Khandker, Barnes, and Samad 2009).

Lack of access to a reliable energy source is a major impediment to sustainable development in developing countries and to the harmonious progress of the global society. He believes that all nations on earth have a right and should have the means to pursue these benefits. This will become increasingly important in a world where opportunity is disproportionately divided between the industrialized countries of the northern hemisphere and the poorer nations farther south. Wider access to electricity in developing countries will be a key requirement for narrowing the north-south gap. He also states that if electricity is to truly promote human progress in developing countries, then the problem of rural electricity supply must be addressed (Khatib, 2006). Globally, Micro and small enterprises (MSEs) have been accepted as the means through which accelerated economic growth and rapid industrialization have been achieved (Harris & Gibson, 2006).In most developing countries, MSEs are generally regarded as the driving force of economic growth in job creation and poverty reduction. In Kenya, according to the Economic Survey (2006), the sector contributed over 50 percent of new jobs created in the year 2005 but despite the challenges of failure of at least three out five within the first few months of operation. (K N B S, 2007). Despite the challenge, the sector has generated income and provided a source of livelihood for the low income in the country accounting for 12-14 % of GDP (Ngugi & Muturi, 2012).

According to Boswell, (2003), Growth of micro and small scale enterprises depends on the changing industry patterns and management; Storey, (2004) states that the growth of an enterprise is influenced by the background and the strategic decisions taken by the owner/manager. Kibera (2000) reaffirms that micro and small scale enterprises are engaged in a number of business activities characterized by the economic and political environment existing in the country. McMohan (2001) feels that business growth and performance by human capital outcomes are correlated. Starting and operating a small business includes a possibility of success as well as

failure. Lack of planning, improper financing and poor human resources management has been suggested as the main causes of failure of small enterprises.

1.2 Problem Statement

Electricity service is one of the factors, which may have both a direct and indirect impact on small micro-enterprises development. Despite the importance, contributions and potential of Micro-enterprises in the Kenyan economy, there are several factors that hinder their establishment, growth, decline and closure. One of the factors, which may contribute to these problems is grid electricity services, because without available and reliable electricity services there is no possibility of utilizing modern electrical appliances, welding kits, and machinery which may pave the way to small and cottage industries. There also no convenient lighting in businesses such as bars and retail shops, which reduces the number of customers.

Maleko (2005) conducted a study on the impact of electricity services on microenterprise in rural areas in Tanzania and found out that there is a possibility of rapid emergence and development of MEs in rural areas of the same characteristics as Kilimanjaro region if the electricity services supplied should be available, reliable and affordable to most of rural poor. Abdullaha and Markandyab (2009) investigated the major issue impeding the rural electrification programs in rural Kenya (high connection payments) and found out that the government needs to reform the energy subsidies, increase market ownership and performance of private suppliers, establish financial schemes and create markets that vary according to social-economic and demographic groups. Ahlborg and Hammar (2011) conducted a study seeking to establish the specific drivers and barriers for rural electrification and off-grid solutions in Tanzania and Mozambique and found out that there existed country-specific institutional, financial and poverty-related drivers and barriers to grid and off-grid electrification. However none of the study focused on the determinants of rural electrification adoption by microenterprises in Muranga County Kenya. This is the research gap that this study wishes to address.

1.3 Research Objective

i. To establish the determinants of rural electrification adoption by Micro and Small enterprises in Muranga County, Kenya.

ii. To determine the effect of adoption of rural electrification on the performance of rural micro and small enterprises in Muranga county, Kenya.

2.0 LITERATURE REVIEW

2.1 Theoretical Review

Diffusion of Innovation (DOI) Theory

Diffusion of Innovation (DOI) Theory, developed by E.M. Rogers in 1962, is one of the oldest social science theories. It originated in communication to explain how, over time, an idea or product gains momentum and diffuses (or spreads) through a specific population or social system.

The end result of this diffusion is that people, as part of a social system, adopt a new idea, behavior, or product. Adoption means that a person does something differently than what they had previously (i.e., purchase or use a new product, acquire and perform a new behavior, etc.). The key to adoption is that the person must perceive the idea, behavior, or product as new or innovative. It is through this that diffusion is possible. New information technologies represent innovations for potential adopters: "an idea, practice, or object that is perceived as new by an individual or other unit of adoption."(Rogers, 1995).

One popular and enduring conceptualization of innovation adoption behavior is Rogers' theory of the diffusion of innovations. Although the overall theory is rich and complex, its essence views the innovation adoption process as one of information gathering and uncertainty reduction. Information about the existence of an innovation, as well as its characteristics and features, flows through the social system within which adopters are situated. Potential adopters engage in information seeking behaviors to learn about the expected consequences of using the innovation. An assessment and evaluation of this information manifests itself in the form of beliefs about the innovation, and is then a proximal antecedent of adoption behavior. The theory also contains predictions regarding the spread of an innovation through a social system, i.e., the diffusion process, which is postulated to follow S-shaped curve. The S-shaped curve of cumulative adopters gives rise to a bell-shaped distribution of adopters. Rogers utilizes this distribution to distinguish between five categories of adopters – ranging from "innovators" to "laggards" – derived from their time of adoption of the innovation. Based on a meta-analysis of findings from a wide range of studies in several innovation domains, he also offers several generalizations regarding early adopters versus the rest related to the socioeconomic status of adopters, personality characteristics, and communication behaviors (Burkhardt and Brass, 1990). This theory is relevant to this study as it is related to adoption of electricity by micro enterprises.

Adam Smith Theory of economic Growth

Adam Smith (1723) defined economics as follows: "Economics is the science of wealth". He was the author of the famous book "Wealth of Nations" (1776). Adam smith was of the view that economics was concerned with the problems arising from wealth-getting and wealth-using activities of people. He was interested mainly in studying the ways by which the wealth of all nations could be increased. The relevance of Adams smith writings was in advocating for large investments of capital and use of large scale machinery in a bid to produce wealth on a large scale.This theory is relevant to this study as it shows how wealth could be increased by SMEs. It is through large investment of capital and use of large scale machinery. Rural electrification requires large investment of capital. Once rural electrification is adopted, it is expected to facilitate use of large scale machinery to produce wealth.

2.2 Empirical Review

Muhoro (2010) conducted a study seeking to identify the factor that affect rural electrification in rural western Uganda. The study used both quantitative and qualitative methods, including informal surveys, intra-business energy allocation studies and historical analysis, to analyze offgrid electricity access among micro-enterprises. Data was obtained from 56 micro-enterprises located in 11 village-towns within 3 districts in Uganda. Findings showed that Micro-enterprises in rural Uganda created income for the poor; they acted as resources for poverty reduction. Further

findings indicated that without subsidies, credit-based sales and better financing options, it is unlikely that access to electricity will increase beyond the levels established in the existing cash market.

Maleko (2005) carried out a study in Tanzania and sought to find out the effect of adoption of electricity on the performance of microenterprises. Result revealed that the growth rate of microenterprises were noticeably higher in areas with electricity services than in areas without electricity services, but the proportion was low compared to micro-enterprises growth rate and time of electricity introduction. Fifteen micro enterprises owners (15) out of forty-three (43) interviewed said they had added at least one permanent employee since its establishment because there are enough activities and long working hours, which needed assistance from these permanent staff. In addition, the establishments of new branches/expansion of micro-enterprises within and outside the studied areas were observed. For instance, in Foo village, Hai district small Kiosk was selling salt and kerosene but the business grew into many branches within the village and now there grain-milling machines, sunflower oil extraction machines and wood workshop, all these used electricity services for production.

Chaieb and Ounali (2011) conducted a study seeking to identify whether community perceptions affects rural electrification in parts of Tunisia. The study was conducted using participatory rural appraisals (community interviews and investigations) to discover the perceived benefits of introduced access to electricity in Tunisian communities. Linkages were discovered between rural electrification and the areas of education, basic health, family planning, and women's reproductive health. Many families had purchased (and now consistently watch) televisions, which prompted intellectual expansion, expose women to political happenings, and introduce families to messages concerning personal hygiene and health. Findings revealed that communities' perception increased economic opportunities for women, who were choosing to sew or open hair-salons at home rather than travel to urban areas in search of work.

Hisaya and Yuko (2011) explored intra-state disparity in access to electricity and examined the determinants of electrification at the village level in Bihar, one of the underdeveloped states in India. Data was collected through field survey of 80 villages in 5 districts conducted in 2008–09. The econometric analyses demonstrated that location is the most important determinant of a village's electricity connection. Results showed that 48 villages (60%) were electrified. Further finding revealed that rapid progress of rural electrification under the recent government program and the tendency to connect the villages that are easily accessible, the collective bargaining power of the village, which used to significantly affect the process of electrification, had lost influence. This adversely affected remote villages. The researcher recommended that the government needs to consider other options for sustainable electricity supply, such as decentralized distribution of electricity rather than the conventional connection through the national/local grids so as to extend electricity supplies to remote and geographically disadvantaged villages.

Nanka (2010) conducted an analytical study of the socio-economic factors which have a significant impact on rural electrification development in sub-Saharan Africa. The study employed cross-sectional data for 24 of the 47 countries in the sub-Saharan region. Findings revealed that there existed several factors which include the Human Development Index, wealth distribution, institutional development and urban population size of a country to have a significant impact on rural electrification development. A detailed policy survey of four countries from the sample; two

countries categorized as over-performing (Nigeria and Madagascar) and two as under-performing (Tanzania and Chad), highlighted that collaboration with international partners, integration of national policies and strategies and the use of renewable energy sources enhanced the development of rural electrification in sub-Saharan Africa.

3.0 RESEARCH METHODOLOGY

Probit regression was used for the first model while OLS was used for the second model. The choice of probit regression is justified by the observation that the independent variable is categorical in nature and hence suitable for probit analysis. The population of the study was 650 registered SMEs operating in Murang'a County. The sampling frame was a list of registered MEs operating provided by Murang'a Council. The sample size was 384 respondents. Diagnostic tests was done to check on normality and heteroscedasticity and endogeneity. After correcting for heteroscedasticity and endogeneity, probit regression was run for the first model. After correcting for heteroscedasticity and endogeneity bias, OLS regression was run for the second model.

4.0 RESULTS AND DISCUSSIONS

4.1 Descriptive statistics

Descriptive were run and presented in tale 1. Descriptive results indicated that only 37% of small businesses located in Murang'a County are connected to the electricity grid. This implies that the majority of businesses in Murang'a County are not connected to the electricity grid. The findings agree with those of Fraser (2013) who found out that only 25 percent of people in Kenya have access to electricity. He also indicated that in rural areas the number drops to 5 percent. This further implies that the electricity access in Murang'a County is significantly higher than other areas.

On average, those with electricity connection paid Kshs 252 monthly. This implies that the electricity rates are subsidized in the rural areas. It can also imply that businesses in Murang'a County are not heavy consumers of electricity.

In relation to education level of the respondents, half (50%) had primary education as the highest level of education, 28% had secondary education as the highest level of education while 22% had college education as the highest level of education. This implies that majority of the respondents were poorly educated.

Descriptive results indicated that only 41% of the respondents were male implying that the majority (59%) of the respondents were female. The significant absence of men could be explained by rural-urban migration as most men travel to Nairobi to look for greener pastures and better employment.

On average, the small business monthly turnover was Kshs 89,498 while the average capital invested was Kshs 156,176. This implies a potential capital output ratio of 1.7. This is an indicator of poor capital productivity.

Descriptive results revealed that 65% of the small businesses had a work force of less than 10 employees. This implies that SMEs in Murang'a County are still struggling to create employment though they are far from solving the unemployment problem in the area.

In relation to main activity, the descriptive results indicated that 24% of the SMEs were retailers,

19% of the SMEs were wholesalers, 25% of the SMEs were both retailers and wholesalers while 32% of the SMEs practiced services oriented activities such as M-pesas, barber shops, salons, tailors and shoe shiners.

The average distance of the SMEs from the market was 2.45 KM and 2.70 KM from the transformer. This may have an implication on the adoption rate because distance may act as a disincentive to adoption of electricity as the associated cost is higher for longer distances.

Table 1: Demographics

Variable	Characteristic	Obs	Mean	Std. Dev.	Min	Max
Electricity adoption and usage	electricity connection	160	0.37	0.48	0	1
	last electricity bill	160	252.39	359.12	0	1087
Education	primary education	160	0.50	0.50	0	1
	secondary education	160	0.28	0.45	0	1
	college education	160	0.23	0.42	0	1
Gender	gender	160	0.41	0.49	0	1
Business Characteristics	last month turnover	160	89498.57	37838.94	26947	173337
	capital invested	160	156176.10	86445.44	35783	354770
Work force	None	160	0.29	0.45	0	1
	1 to 10 employees	160	0.36	0.48	0	1
	11 to 50 employees	160	0.35	0.48	0	1
Main activity	retailing	160	0.24	0.43	0	1
	wholesaling Both	160	0.19	0.40	0	1
	retailing and wholesaling	160	0.25	0.43	0	1

	other	160	0.32	0.47	0	1
Geographic characteristics	distance to market	160	2.45	1.23	0.2	8
Variable	**Characteristic**	**Obs**	**Mean**	**Std. Dev.**	**Min**	**Max**
	distance to transformer	160	2.70	1.28	0	5

4.2 Determinants of adoption of Electricity in Muranga County

The first objective of the study was to establish the determinants of electricity adoption in Murang'a County.

4.2.1 Coefficients

A probit regression was conducted to establish the determinants of electricity adoption in Muranga County. The coefficients were presented below. However, they were not interpreted as errors from probit regression are highly dependent on assumptions. The first assumption is that the errors are normally distribution with a mean zero and variance 1. The assumptions are made necessary because the dependent variable is a latent variable whose distribution is not known and can only be assumed. These assumptions make it impossible to interpret the regression coefficients. Results are shown in table 2.

The likelihood ratio of -10.61929 is the value that maximizes the likelihood that the observations are drawn from a normal distribution. The likelihood chi-square of 189.41 implies that the overall model is significant and this is also supported by a p value of 0.000. The Pseudo R squared of 0.8992 implies that 89.92% of the variations in the dependent variable are explained by the independent variables.

It was revealed by results that a unit increase in capital invested significantly increases the predicted probability of electricity adoption by 3.3407, holding all other factors constant. The implication is that capital invested may be associated with higher rates of electricity adoption. Hence, increase in the level of capital invested can be associated with higher high ability to pay for electricity. The findings agree with those in Abdullaha and Markandyab (2009) who investigated the major issue impeding the rural electrification programs in rural Kenya (high connection payments) and found out that the government needs to reform the energy subsidies, increase market ownership and performance of private suppliers, establish financial schemes and create markets that vary according to social-economic and demographic groups.

The predicted probability of electricity adoption was significantly higher for those businesses whose main activity was 'other' (service oriented activities) as compared with the businesses whose main activity was retailing, by 5.0265 holding other factors constant. The reason for this

higher adoption of electricity by the service oriented activities, which include welding, tailoring, salons and barber shops, is that they need electricity for them to be in operation.

Further, the results also revealed that a unit increase in distance from market significantly decreased the predicted probability of electricity adoption by 0.8460, holding all other factors constant. The implication is that the cost of connecting to the grid electricity increases as the distance from the market increases. The findings agree with those in Ahlborg and Hammar (2011) who conducted a study seeking to establish the specific drivers and barriers for rural electrification and off-grid solutions in Tanzania and Mozambique and found out that there existed country-specific institutional, financial and poverty-related drivers and barriers to grid and off-grid electrification.

Table 2: Determinants of Electricity Adoption/Connection

	Electricity Connection
Education level (1. Primary education = ref)	.
2.Secondary education level	0.7515
	(0.8971)
3.College education level	1.554
	(1.292)
Age	0.1147
	(0.0619)
Gender (Female = ref)	.
1.Male	-1.005
	(1.2037)
Ln last month turnover	4.744
	(2.6949)
Lncapital invested	3.3407*
	(1.4405)
Workforce (1.none=ref)	.
2.1-10 employees	4.045
	(2.2735)

3.11-50 employees	4.529
	(2.6794)
Main Activity (1.retailing = ref)	.
2.Wholesaling	3.1764
	(1.9208)
3.Both retailing and Wholesaling	2.2762
	(1.8446)
Electricity Connection	
4.Other	5.0265*
	(2.3663)
Distance to Market	-2.4822*
	(1.094)
Distance to Transformer	-0.8460
	(0.5921)
_cons	-97.710*
	(1.108)
N	160

Log likelihood	-10.61929
Likelihood Chi square	189.41
Pseudo R square	0.8992

Standard errors in parentheses
* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

4.3 Effects of Electricity adoption on Business performance

A two stage least squares regression was conducted as the error term of the model was assumed to be correlated with the x matrix. The situation of endogeneity was corrected by first running the electricity adoption against all instrumental variables. The instrumental variables in this case were "Distance to market" and "Distance to the transformer". To control for heteroscedasticity the robust option was used. Table 3 indicated that the model goodness of fit was satisfactory as revealed by coefficient of determination (R squared) of 0.4908. The Wald Chi square statistic of 157.32 indicated that the overall model was significant. This was supported by a p value less than 0.05.

Results indicate that electricity adoption was positive and significantly related with business performance. This is supported by a beta coefficient of 0.708. Those with electricity connection had higher business performance 0.708 compared to those who had not been connected to the electricity grid. The findings imply that the electricity adoption may have a positive role to play in small business performance. The findings agree with those of Bose, Uddin, and Mondal (2013) who detected favorable changes on the production costs, profit margin, development and modernization of business, women empowerment, quality of life, and human development due to the electrification. The findings disagree with those of Peters, Vance and Harsdorf (2013) who found out that beneficial impact are found from firm creation after electrification, firms that existed before showed an inferior performance compared to their matched counterparts from a non-electrified region. However, the performance gap was insignificant.

Results indicate that gender was positively and significantly related to business performance. Businesses owned by men out performed those owned by women by a factor of 0.114. This may have been brought about by gendered social structures such as where men own assets and access credit more quickly than women. Results also revealed that capital invested was positive and significantly related to business performance. This was supported by a coefficient of 0.204. This implies that an increase in capital invested by one unit will result to an increase in business performance by 0.204 units.

Further, result revealed that the workforce had a positive and significant relationship with business performance. Those with a workforce of 1-10 employees had a higher business performance by a factor 0.156 compared to those who had no employees (business was run by owner). Those with a

workforce of 11-50 employees had a higher business performance by a factor 0.186 compared to those who had no employees (business was run by owner).

Table 3: Effects of Electricity Adoption on Business Performance

	Lnlast month turnover
Electricity connection (Yes=1, No=0)	0.708*
	(0.329)
1b.educ_level(Primary education=ref)	.
2.Secondary education level	0.0278
	(0.0643)
3.College education level	-0.0837
	(0.0732)
Age	0.00177
	(0.00282)
Gender (0.Female= ref)	.
1.Male	0.114*
	(0.0571)
Lncapital invested	0.204*
	(0.0958)
Workforce (1.none = ref)	.

Lnlast month turnover	
2.1-10 employees	0.156*
	(0.0690)
3.11-50 employees	0.186*
	(0.0790)
Main Activity (1.retailing= ref)	.
2.Wholesaling	-0.0849
	(0.0863)
3.Both retailing and Wholesaling	-0.140
	(0.0769)
4.Other	-0.0918
	(0.0779)
Last electricity bill	-0.000345
	(0.000304)
_cons	8.927***
	(1.108)
N	160
R squared	0.4908
Wald Chi square	157.32
Prob (chi square)	0.000

Standard errors in parentheses
* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

5.0 DISCUSSION CONCLUSIONS AND RECOMMENDATIONS

5.1 Findings

The study sought to establish the determinants of rural electrification adoption by small and micro enterprises in Muranga County Kenya. The results revealed that the amount of capital invested in a business influenced electricity adoption. The implication is that capital invested may be associated with higher rates of electricity adoption. Hence, increase in the level of capital invested can be associated with higher high ability to pay for electricity. Similarly, predicted probability of electricity adoption for those businesses whose main activity was 'other' (service oriented activities) was higher compared with the businesses whose main activity was retailing.

Further, the results also revealed that distance from market influenced electricity adoption. This may have an implication on the adoption rate because distance may act as a disincentive to adoption of electricity as the associated cost is higher for longer distances. Results indicate that electricity adoption was positive and significantly related with business performance.

The results also indicated that gender, capital invested and workforce were positively and significantly related to business performance. This implies that male business owners were more likely to report higher business performance compared to women. This may further imply a gender bias on resources necessary for supporting businesses. Higher capital invested implied that the business could exploit more business opportunities and hence higher turnover. Higher workforce implied economies of scale and this may have led to improved turnover/sales.

5.2 Conclusions

Research findings concluded that the amount of capital invested in a business influenced electricity adoption; distance from market influenced electricity adoption while gender, capital invested and workforce were positively and significantly related to business performance.

5.3 Recommendations

In a bid to increase electricity connection/adoption, Murang'a county government and electricity providers such as Kenya Power should target business owners who are mature and who have more business experience since they are more likely to warm up the idea of electricity adoption in their businesses. It is recommended that Murang'a county should conduct business incubation programmes for businesses so as to boost the business performance/turnover as well as the capital invested. This will have a positive effect on electricity adoption since well performing businesses are likely to adopt electricity. They should also assist the businesses to get funds from youth fund and women enterprise fund and this will increase the capital.

The Murang'a county government should encourage businesses to grow and hire more workforce as this may lead to high electricity adoption. Similarly, the Kenya Power company should lower the cost of connection which is associated with electricity poles and length of electricity cables all of which are dependent on the distance from the market. The study also recommends that Murang'a County and electricity providers should encourage electricity adoption through conducting awareness campaigns that would sensitize small business owners on the value brought about by electricity adoption.

5.4 Areas of Further Study

A comparative study should be done between various counties to compare and contrast the findings as far as determinants of electricity adoption are concerned. Other studies should focus on the determinants of adoption of solar energy as well as bio gas energy. Furthermore, future studies should focus on determinants of joint adoption of electricity, solar energy and bio gas energy. Future studies should focus on the effect of electricity adoption on education, health and fertility.

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