Gender, Innovation and Labour Productivity in Ugandan manufacturing firms

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Abstract

In this paper, we analyzed the relationship between gender, innovation and labour productivity in Ugandan manufacturing firms. An augmented Cobb Douglas production function was estimated using pseudo panel data. Little was known about the relationship between gender, innovation and labour productivity in Ugandan manufacturing firms. The descriptive results showed that manufacturing firms that are innovative using ICT usage as proxy had on average high levels of labour productivity than their counterparts. In addition, firms owned by male entrepreneurs had higher levels of labour productivity compared firms owned by female entrepreneurs. The regression results did not find any significant differences in terms of labour productivity between firms owned by female and male entrepreneurs. ICT usage was shown to be positively correlated with labour productivity although the correlation was weak. The results show that gender is not complementary to ICT usage in improving labour productivity. These findings have vital policy implications on innovation and gender consideration asa development strategy.

Keywords: *ICT usage, gender, labour productivity, manufacturing firms*

Introduction

With increased globalization, developing countries are under pressure to promote competitiveness. In order for Ugandan manufacturing firms to achieve global competitiveness, they need to have an indication of the factors that influence their labor productivity. It is now evident in the literature that usage of information and communication technology (ICT) has a positive and significant impact on the labour productivity. An understanding of the relationship between ICT usage as a proxy for innovation and labor productivity is central in establishing competitive

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strength of Ugandan manufacturing firms in the global market. In developed countries the penetration rates of basic ICTs such as computers are already close to saturation levels and therefore computer presence is nearly used by all businesses (of more than 10 employees). However, in developing countries there is a lower share of businesses that use at least one computer. Uganda recognizes the important role of information and communication technologies as an enabler of economic and social development and for enhancing the competitiveness of domestic businesses.

Information and communication technologies (ICT) represent one major pillar in forming a knowledge based economy through facilitating effective communication, disseminating and processing of information. ICT usage can significantly contribute to economic growth basically through gains in total factor productivity and increased flows of information and knowledge which are translated in reducing uncertainty and transactions costs (Dina, 2009). In the theoretical setting, computers bring value to businesses both through their intrinsic characteristics such as processing and storage capacity and as necessary means for acquiring a superior complexity of ICT use such as Internet access and web presence. ICT usage can generate higher market shares either by reducing input costs and thus allowing firms to produce more of the same products, or by improving the quality of products or product packages, with, as a result, additional sales or higher-priced products.

Although the role of ICTs in promoting development is increasingly recognized, it is becoming clear that there is a digital gender divide (UNESCO, 2003, UNDP, 2005). Prevailing inequalities in the access to and use of ICT indicates that these technologies are not gender neutral. Regarding use, some studies have tried to test the hypothesis that issues of gender will disappear since the internet is a virtual environment. On the contrary, most studies confirmed that males have dominated internet use (Boafo, 2003). Lack of access and participation in the use of ICT could become a significant factor in marginalizing women from the economic, social and political mainstream of their countries and of the world (Hafkin and Taggart, 2001). There is a wide-spread notion that women in general and women entrepreneurs in particular are less likely to use ICT than their male counterparts. This is often associated with a weaker performance of women-led firms. Unless this gender digital divide is specifically addressed, there is a risk that ICT may exacerbate existing inequalities between women and men and create new

forms of inequality. Mitter (2006) underpinned, women entrepreneurs can benefit from better access to global information which would enhance their competitiveness in the market.

Persistent substantial differences in productivity across firms have been documented, and many empirical papers have provided a deeper understanding of the connection between productivity and observable characteristics of firms, such as size, ownership, technology, ICT usage, and so forth. However, less is known about the way firms' outcomes are related to gender of major shareholders and ICT usage and their complementarities.In this study, we focus on the impact of gender as one aspect of ownership of the firm and ICT usage on labour productivity. Research on the impact of gender and ICT on labour productivity at firm level is highly constrained by the lack of micro data classified by gender, and the scarcity of surveys that document all the uses women make of ICT in developing countries. Little or no detailed individual information on empirical studies on the impact of gender and ICT usage on productivity in Ugandan manufacturing firms is available. The lack of such information is an obstacle to reducing gender bias in labour productivity. An understanding of the impact of gender and ICT usage on labour productivity may go a long way in explaining factors facilitating labour productivity and competitiveness. We believe that comparisons between male- and female-owned firms, and ICT using and non-ICT using firms is key to explaining variations in labour productivity among manufacturing firms.

Empirical evidence on the impact of ICT usage and gender on labour productivity is scarce and inconclusive. However, little is known about the impact of ICT usage and gender on labour productivity in Ugandan manufacturing firms. This study therefore attempted to fill this research gap by providing answers to the following questions: (i) Do gendered patterns in labour productivity exist in manufacturing firms? (ii)Do ICT using manufacturing firms produce more value added output per worker than non-ICT using manufacturing firms? and (iii) Do ICT usage act to mediateobserved gendered disparities in productivity? These questions are especially important in Uganda situation with low levels of labour productivity. Specifically, the objective of the study is to establish the impact of gender and ICT usage on labour productivity in Ugandan manufacturing firms and how the combined use of ICT and gender can account for variations in productivity gains

between firms.Ignoring the complementarities between gender and ICT usage may lead to over estimating the effect of ICT usage on labour productivity.

Evidence from this study can provide policymakers with additional information for fine-tuning ICT policy and gender master plans. Our descriptive results show that manufacturing firms that use ICT had on average high levels of labour productivity than their counterparts.In addition, male owned firms had labour productivity levels higher for the two periods compared to female owned firms. The regression results showed a positive correlation between ICT usage and labour productivity, although the correlation is weak. The results also showed no significant differences in terms of labour productivity between firms owned by female and male entrepreneurs after accounting for other factors. Gender was also shown not to be complementary to ICT usage in improving labour productivity. Our major contribution to the literature is demonstrating that labour productivity and the usage of ICT in improving labour productivity is gender neutral. The rest of the paper is organized as follows. The next section reviews the existing literature. The third section describes the methodology. The fourth section discusses the results and the last section concludes.

Literature Review

There is a limited empirical research that examines the impact of gender on labour productivity, at the micro level of the firm.However, literature on the impact of ICT usage on labour productivity at firm level is emerging. The earliest studies on the link between ICT and productivity at the macro level were mainly aimed at understanding the so-called Solow Paradox, i.e. the fact that "computers were visible everywhere except in the productivity statistics" (Solow, 1985).Much of the early literature on ICT, theoretically justified the advantages of information technologies, but they obtained contradictory empirical evidence, especially weak or with no link between ICT and firm performance (Brynjolfsson, 1993; Kettinger et al., 1994; Weill, 1992). This empirical evidence led to the so-called Productivity Paradox. However, there is growing new evidence that ICT generates large positive returns that are even in excess of the returns from other types of investments (Dewan and Min, 1997). There is now wide consensus that ICT does have positive effects on labour productivity and total factor productivity (Pilat 2005, van Ark 2002 and Khayyat et al. 2014)). Authors such as Lichtenberg

(1995) and Brynjolfsson and Hitt (1996) also offer empirical evidence of the positive impact of ICT on a variety of measures of firm performance.

The most recent empirical evidence confirms the positive effect of ICT on firm performance not only in terms of productivity, profitability, market value, and market share, but also in intermediate performance measures, such as process efficiency, service quality, cost savings, organizational and process flexibility, and customer satisfaction (Brynjolfsson and Yang, 1996; Adeya, 2003; and Lal, 2007). Even if based on different indicators, the relationship between ICT and productivity at the firm level is generally positive (Black and Lynch (2001) and Bresnahan et al.(2002) for the US, Greenan et al.(2001) for France, Bugamelli and Pagano (2004) and, more recently, Castiglione (2009) on Italy), but ICT alone is not enough to affect productivity. In fact, Black and Lynch (2001) and Bresnahan (2002) focus on the interaction between ICT, human capital and organizational innovation. Ignoring these complementarities may lead to overestimating the effect of ICT on productivity.

A study by UNCTAD (2008) shows that computer use, Internet access and web presence are associated with significantly higher sales per employee. The groups which seem to benefit from a stronger ICT -labour productivity relationship are the larger and medium-sized firms. Maliranta and Rouvinen (2003) estimate that young manufacturing firms in Finland, unlike older ones, have 3 per cent higher productivity gains from the use of computers. Farooqui (2005) runs four different growth models on young and older British firms in manufacturing and services taken separately. Results show that ICT indicators such as investment in IT hardware and software and the share of ICT-equipped employment have a more pronounced impact on young manufacturing firms as compared with older ones.

Bloom, Sadun and van Reenen (2005) estimated that in their large sample of UK firms from all business sectors, US-owned establishments had significantly higher productivity gains from IT capital than other foreign-owned firms or domestically owned firms. Atrostic and Nguyen (2005) estimated that computer networks brought a 5 per cent positive net effect to firm labour productivity in the United States after accounting for the contribution of computer capital. Research in the 1980s (e.g. Bailey and Gordon, 1988 and Alma and Elina, 2014) found little impact of computers on trends in aggregate productivity growth, although more recent work by

Oliner and Sichel (1994) argues that this is to be expected given that they represent such a small percentage of the capital stock. The empirical evidence reviewed above suggest that usage of ICT has a positive impact on labour productivity at firm level. However, there is limited literature on the impact of gender and ICT usage on labour productivity in Ugandan manufacturing firms. This study fills this literature gap by investigating the impact of ICT usage and gender on labour productivity in Ugandan manufacturing firms.

Methodology

Data used: This study utilized pseudo panel data covering 2000, 2001 and 2002 period. The data set was obtained from RPED data set that was collected in 2003 by the World Bank on 300 manufacturing firms in Uganda. The standard questionnaire administered in these surveys has a number of sections covering firm characteristics. The survey was stratified according to location, sector and size. Data was gathered through face-to-face interviews conducted with senior managers or owners and accountants.

The model: We base our empirical analysis of the impact of ICT and gender on labour productivity on an augmented Cobb Douglas production function containing value added per employee, labor, capital, human capital, gender and ICT usage. We test the restriction implied by constant returns to scale and find that for our data this restriction is always accepted. The basic framework of equation (1) relies on a modified Cobb-Douglas production function whose residual includes the effect of ICT usage and gender. We estimate the following standard Cobb Douglas production function that is augmented by gender and ICT usage;

$$LnY_{it}/L_{it} = \alpha_o + \alpha_1 ln\, K_{i,t-1}/L_{i,t-1} + \alpha_2 ln\, L_{i,t-1} + \alpha_3\, ln\, aveduc_{i,t-1} + \alpha_4 ICTusage_{it} + \alpha_5 gender_{it} + \alpha_6\, gender*ICT\ usage_{it} + v_i + u_{it} \quad (1)$$

Where $Y_{i,t}/L_{i,t}$ represents labor productivity, measured as a ratio of gross value added to labor. Value added is measured as the total sales of the firm less cost of intermediate inputs. Intermediate inputsinclude; costs for raw materials, solid and liquid fuel, electricity and water. $K_{i,t-1}/L_{it-1}$ represents capital-labor ratio, defined as a ratio of the replacement value of the machinery and equipment adjusted for capacity utilization to labor. Since values of machinery were available only for one year, an annual depreciation of the

capital stock of 4.5 percent that is commonly used in empirical literature was assumed (see Chappelle and Plane, 2005). This percentage corresponds to a mean machinery life of 22 years.$L_{i,t-1}$ represents labor, proxied by the total number of employees, being the average number of permanent workers and temporary workers employed. *Aveduc* represents the weighted average education where weights are average schooling years(see Jones,2001). Human capital is measured by the average educational attainments of workers. *gender* represents a dummy variable that equals one for firms whose principal owner is a male entrepreneur and zero for firms whose principal owner is female entrepreneur. *ICT usage* as a proxy for innovation is measured by the percentage of total workers using computers. *Gender*ICT usage* interaction term was obtained by multiplying the ICT usage variable by the gender variable. We have opted to interact ICT usage and gender to see if there are interaction effects beyond the own effect of ICT usage and gender. All continuous variables are in logarithms.

Discussion of Results

Descriptive results: Table 1 presents the distribution of labour productivity of firms in the sample according to ICT usage and gender. The labour productivity of firms using ICT is consistently higher for the two periods compared to firms that were not using ICT at all (Table 1). In addition, male owned firms had labour productivity levels higher for the two periods compared to female owned firms. These descriptive statistics are consistent with what has been found for manufacturing firms in other countries. We proceed next by analyzing these mechanisms using econometric methods.

Table 1: Descriptive Statistics

Variable	Average labour productivity of firms(in Uganda shillings) in 2001	Average labour productivity (in Uganda shillings)of firms in 2002
Computer usage	63,810,963(108)	74,100,343(108)
No computer usage	9,516,274(131)	19,522,910(131)
Male owned firms	34,451,914(234)	51,705,516(187)
Female owned firms	16,222,857(7)	11,418,171(7)

Figures in the bracket are the number of firms.

Regression Results: Table 2 present random effect regression results of variables that determine labour productivity among Ugandan manufacturing firms. The model is correctly specified, as indicated by the p-values. ICT usage as measured by percentage of workers using computers was shown to be positively correlated with labour productivity. However the positive correlation between ICT usage and labour productivity is weak and correlation disappears in different model specifications. This finding is consistent with earlier findings by Brynjolfsson(1993), Kettinger et al. (1994), and Weill(1992). In addition, male owned firms were also shown not to be significantly different in terms of labour productivity from female owned firms.

Table 2: Determinants of Labor Productivity: Random Effects Estimates
Dependent variable: Ln(Value Added Labor Ratio)

Variable	Coefficient(Z-statistics)	Coefficient(Z-statistics)
Constant	7.466(6.08)***	7.549(4.89)***
Ln(capital/labor ratio)$_{t-1}$	.251(5.34)***	.250(5.31)***
Ln(size)$_{t-1}$	-2.276(-3.88)***	-.277(-3.85)***
Ln(average education)$_{t-1}$	2.114(4.16)***	2.113(4.15)***
ICT usage	0.015(1.65)*	.007(.07)
Gender	-.081(-.037)	-.158(-.17)
ICT usage * gender		.008(.09)
R^2: Within	.177	.177
R^2: Between	.296	.296
R^2: Overall	.300	.299
Number of observations	352	352
Chi2	108.27	107.89
Prob>Chi2	.000	.000

*Note: ***,** and * indicate statistical significance at the 1 percent, 5 percent, and 10 percent levels, respectively. Values in brackets are robust Z-statistics.*

Average education was shown to be positively associated with labor productivity. This result is consistent with the fundamental assumption of human capital theory that education raises productivity. Moreover, numerous

studies have revealed a significant relationship between the accumulation of human capital and per capita growth rates, particularly in developing countries (see World Bank, 1993 and Jorgenson, 1987). This evidence of the importance of average education supports efforts to provide incentives to increasing investments in human capital in general. As expected, manufacturing firms with high capital labor ratio revealed high values of value added per worker.

The most important policy recommendation to emerge from this study is that human capital is important for workers if they are to be productive. The study also shows thatfirms owned by female entrepreneurs should receive more support both in terms of facilitating their access to ICTs and in terms of information campaigns on how ICTs can help to increase productivity, improve the quality of products and better respond to demand.

Conclusion

The main objective of the study was to establish the impact of gender and innovation on labour productivity in Ugandan manufacturing firms and how the combined use of ICT as a proxy for innovation and gender can account for variations in productivity gains between firms. The study utilized an augmented Cobb Douglas production function. The descriptive results showed that manufacturing firms that use ICT had on average high levels of labour productivity than their counterparts. In addition, firms owned by male entrepreneurs had labour productivity levels higher for the two periods compared to firms owned by female entrepreneurs. The regression results however did not find any significant differences in terms of labour productivity between female owned and male owned firms. ICT usage was shown to be positively correlated with labour productivity although the correlation was weak. The results show that gender is not complementary to ICT usage in improving labour productivity. The results also show that human capital is important for workers if they are to be productive. The policy implication from these findings is that policies that promote usage of ICT and labour productivity should be gender neutral.

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