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Use of ICTs and the Economic Performance of SMEs in East Africa

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Abstract

This paper assesses the use of information and communication technologies (ICTs) and their impact on the economic performance of small- and medium-scale enterprises (SMEs) of three East African countries: Kenya, Tanzania and Uganda. Findings of the paper suggest that the diffusion of ICT among East African SMEs is both industry and country specific. The empirical findings suggest that investment in ICT has a negative impact on labour productivity and a positive impact on general market expansion. However, such investment does not have any significant impact on enterprises' return, nor does it determine enterprises exporter (non-exporter) status.

Keywords: information and communication technology, small and medium enterprises, firm performance, market expansion, East Africa

JEL classification: D2, D8, O3

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1   Introduction

In this paper we study the use of information and communication technologies (ICT) and their impact on the economic performance of small- and medium-scale enterprises (SME) of three East African countries: Kenya, Tanzania and Uganda. The SMEs in our study include enterprises from three sectors: food processing, textile and tourism, which as a whole make a sizeable contribution to the GDP of these countries. In evaluating the information and communication technology induced performance of small- and medium-scale enterprises, we consider three performance indicators: internal rate of return, labour productivity, and domestic and export market expansion.

East Africa is a marginalized region in terms of economic production and world trade. In the case of all three countries, the size of internal markets is relatively small in general and in particular for the manufacturing sector. These countries also share a relatively low gross domestic fixed investment, a poor export performance, and a relatively less diversified export portfolio. However, despite these similarities, there are noticeable differences in terms of both static and dynamic respects. As can be seen from Table A.1 in the appendix, Uganda and Kenya are at a higher stage of development compared to Tanzania in terms of static indicators, such as GDP per capita, share of industry in GDP and primary school enrolment ratio in 1999, the year of our survey. In Uganda and partly in Tanzania, dynamic indicators such as GDP growth, investment per GDP and export growth are relatively higher compared to the other two countries. In terms of labour productivity measured by average annual growth of real GDP per worker, Uganda and Tanzania are also well ahead of Kenya which has experienced a decline in labour productivity over the period 1980-90.

SMEs in East African countries contribute significantly to the economy especially in the manufacturing sector both in terms of employment and of value-added. In the case of all three countries, SMEs provide employment to more than 50 per cent of the employed labour force. In Kenya, 49 per cent of employment in 1969 was in enterprises with one to nine workers and an additional 10 per cent in enterprises with 10 to 49 workers. For Tanzania, the respective figures were 56 and 7 per cent.[1] SMEs also account for more than 50 per cent of manufacturing GDP. It is estimated that small enterprises in Kenya generate 12 to 14 per cent of the national income.[2]

The three sectors chosen for this paper bear different importance in these three countries. As can be seen from Appendix Table A.2, in Kenya food products account for the highest share in manufacturing value-added with 32 per cent in 1995. Textiles and wearing apparel play a minor role, while in Tanzania textiles constitute the largest manufacturing sector with 18 per cent of value-added. The tourism sector is currently the most important for Tanzania in terms of its contribution to GDP.

Despite their importance, one principal weakness of SMEs in general is their weak productive capacity, which manifests in low domestic and international market coverage. There are specific obstacles in economies of scale for SMEs in both domestic and export market expansion because of high fixed costs of marketing, particularly of export marketing. In fact, one of the important reasons that has led to the dominance of

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[1]   See Liedholm and Mead (1987).

[2]   See Daniels and Mead (1998).

SMEs in developing economies is due to poor physical and communication infrastructure. This results in relatively isolated markets with limited demand that can best be served by small-scale localized production.[3] But weak infrastructure also acts as a major obstacle for SMEs in any outward expansion.

In the 1990s, many SMEs in East Africa, albeit on a limited scale, have embraced information and communication technology. The increased use of ICT in enterprises can lead to a substitution of such equipment for other forms of capital and labour and may generate substantial returns for enterprises that invest in ICT. ICTs are often lauded as the catalyst for development not only for industrial countries but also for developing countries. Thus the question whether these technologies can help SMEs overcome their disadvantages and contribute to overall growth and export performance becomes important.

The empirical evidence of the impact of ICTs on enterprise performance is at best mixed. In fact in the industrial countries, the growth of total factor productivity that is associated with technical change has even declined in parallel to the increased use of ICTs in the past 10 to 20 years.[4] It is only in the 1990s that empirical evidence has shown ICTs to have a substantial effect on firms' productivity levels.[5] As there are hardly any studies that analyse the effect of ICTs on small enterprises in developing countries, particularly in the East African context, we use firm level data from East Africa to shed some light into this issue.

The paper proceeds as follows: section 2 describes the theoretical links between investment in ICT and performance of SMEs, section 3 describes the phase and use of ICTs by SMEs in East Africa, section 4 presents the econometric specification and estimates the impact of ICTs on firms' performance, and section 5 concludes.

2   ICTs and firm's performance

SMEs use ICTs both as input in the production process, and in the transaction process selling their products or acquiring inputs. ICTs can enhance enterprise performance through indirect cost savings such as labour costs and increased labour productivity, and direct cost reduction of firm's input such as information costs. On top of these short-run impacts of ICT adoption in the production process, the use of ICTs in the transaction process can foster input and output market expansion. However, in the long run, ICT may have an even bigger impact as it can completely restructure the production process and transaction methods, increase flexibility and improve outputs. Though ICTs can influence the performance of an enterprise in multifaceted ways, we limit ourselves only to ICT effects on enterprise return, labour productivity and market expansion.

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3   See Liedholm and Mead (1987), Tybout (2000).

4   See Jorgenson and Stiroh (1999).

5   See Brynjolfsson and Hitt (2000).

2.2   ICT and labour productivity

The potential of ICT as a cheap substitute, particularly with respect to labour, is well recognized in the literature.[6] As an input in the production process, ICTs can have both substitution and complementary effects; they can be a cheaper substitute for other inputs and they might have positive complementarities with other inputs through which ICTs can increase productivity of other inputs.

2.3   ICT and return on investment

An important characteristic of ICTs is that they are mostly scale neutral and available to small firms and poor countries as well, although access is restricted by poor infrastructure and high cost. The increased use of ICTs in enterprises[7] leads to a substitution of ICT equipment for other forms of capital and labour and may generate substantial returns for the enterprises that invest in ICTs and restructure their organization.

However, though ICTs have high return potentials, they may erode a firm's profitability by integrating markets and exposing SMEs to competition. Particularly, SMEs in rural areas serve the local market niche and are protected against competition from bigger enterprises because of high information and communication costs, they are expected to face more competition and hence a reduction in monopoly rents.

2.4   ICT and market expansion

ICTs can cause the costs of input and output market interactions for an enterprise to drop. As a result, the costs for inputs can decrease as ICTs reduce information and search costs, and the price of output can raise as ICTs increase the effective price of output by reducing the search and information costs of trade.

Both the input and output markets in developing countries are characterized by imperfect and asymmetric information. A seller looking for a buyer is unlikely to be fully informed about all the potential buyers. Negotiation costs are also large. ICTs have the potential to improve seller-buyer communications. As a result, ICTs—particularly Internet—can change the way that seller-buyer matches are made, and SMEs can integrate themselves with the global market. In other words, the demand for a particular product produced by a SME may become less dependent on local market conditions.[8]

In case of export market expansion, the process starts usually with a SME searching for a foreign buyer. The search process usually involves advertising, participation in international trade shows or dealing with brokers and other intermediaries. After a successful search process, the next step is to negotiate the product specifications and prices, and to draw up a contract. Once the contract is agreed upon, exporting the product still involves delivering, transporting, billing, and acceptance of payment. ICT,

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6   See Berndt and Morrison (1995).

7   Increased use of ICT over time can be observed in case of SMEs of our sample as well (see Figure 1).

8   See Autor (2001) in the case of labour market.

particularly use of Internet in the transaction process—known as electronic commerce—can reduce the costs of the export process before, during and after the export.[9]

Empirical evidence of the effects of ICTs on a firm's performance in the context of industrialized countries is, at best, mixed. However, some recent enterprise-level studies in the US have reported positive effects of ICTs on firm's performance.[10] In case of developing countries, the empirical evidence of the effects of ICTs on small enterprises is very limited partly due to data problems. Similar to the analyses on industrialized countries, some recent studies on SMEs in the manufacturing sector of India have reported a positive link between ICT-capital stock and productivity,[11] and between ICT adoptions and export performance.[12]

Given the discussion above, we can now formalize the problem. Following Stoneman and Kwon (1996), we assume that the performance of a firm can be decomposed into performance stemming from information and communication technology and performance resulting from other factors. More specifically, we decompose the performance of a firm i operating in industry k into gross performance and performance due to the adoption of ICT. It follows that we define y_i as the gross performance of firm i at time t, y_i^{ict} as the performance of the firm due to the adoption of ICT, and y_i^0 as the counter factual performance where no technology has been adopted.

It follows that:

$$y_i = y_i^0 + D_i y_i^{ict} \tag{1}$$

$$y_i^0 = y_i^0 [Z_i, Z_k] \tag{2}$$

$$y_i^{ict} = y_i^{ict} [Z_i, Z_k, I_i^{ict}] \tag{3}$$

Here D_i is a bivariate state, it is equal to 1, if firm i owns ICT, and 0 otherwise; Z_i and Z_k are the respective firm and industry characteristics; I_i^{ict} is an index representing the extent of ICTs that the firm i has adopted at time t. Summing up (2) and (3) into (1) gives us the basic estimating equation:

$$y_i = y_i^0 [Z_i, Z_k] + D_i y_i^0 [I_i^{ict}] \tag{4}$$

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9   See Lucking-Reiley and Spulber (2001) on business-to-business electronic commerce.

10 See Brynjolfsson and Hitt (2000) for the case of large US enterprises.

11 See Müller-Falke (forthcoming) for labour productivity and enterprise growth.

12 See Lal (1996) for export performance.

3   Phases and use of ICTs in East Africa

We start with the general availability and use of ICT in the East African countries. Table 1 depicts the physical infrastructure of ICT in East Africa. The portrayed nationwide diffusion of ICT is rather low by international standards, as is underscored by the comparison with South Africa. For instance, in Tanzania and Uganda, the intensity of telephone main lines and mobile phones is less than 4 per cent of the comparable intensity in South Africa. In Kenya the situation is only slightly better. However, the waiting time for a fixed phone in Kenya is by far the longest in East Africa and has even increased from 5.6 years in 1997 to 9.6 years in 1999. The increase in mobile phones has been most rapid in Uganda where it increased from 0.2 phones per 1,000 people in 1997 to 2.6 in 1999, but was also considerable in the other countries.

In Sub-Saharan Africa in general, the average use of Internet is still very low due to high connection fees. Internet contact is mostly by people outside the continent. Most users are NGOs, universities or private companies, and the users are mainly well-educated males. E-mail is used for correspondence, document exchange, technical advice, managing projects, arranging meetings, and exchanging research ideas, but is still limited for accessing formal information resources. There are both substitution and income effects; 25 per cent of e-mail communications are replacing fax messages, 10 per cent replace phone calls and 65 per cent constitutive communication which would not have been made without an e-mail-system. Although still an under-utilized resource, users report that Internet has increased efficiency and reduced information costs.[13]

Table 1
State and costs of selected ICTs in East Africa, 1997-99

Indicators	Tanzania	Kenya	Uganda	RSA
Telephone main lines (per 1,000 persons) 1999	4.5	10.3	2.6	125
Waiting list (thousands) 1999	29	121	9	116[a]
Waiting time (years) 1999	1.6	9.6	3.0	0
Average cost of a 3 minute local call (US $) 1999	0.1	0.1	0.2	0.1
Average cost of a 3 minute call to the US (US $) 1997	3.7	11.2*	8.6	–
Mobile phones (per 1,000 persons) 1999	1.6	0.8	2.6	120
Fax machines (per 1,000 persons) 1997	0.1	0.1	0.1[b]	3.6
Personal computers (per 1,000 persons) 1999	2.4	4.2	2.5	54
Internet hosts (total number) 1999	158	560	125	140,470
Internet hosts (per 10,000 persons) 1999	0.04	0.2	0.1	33
Dialup Internet costs (20 hrs/month in US $) 1998	–	123	109	40
Radios (per 1,000 persons) 1997	279.3	104.1	127.5	332.5
TV sets (per 1,000 persons) 1998	20.9	22.1	27.6	129

Notes: RSA is Republic of South Africa;
[a] Data available for 1997 only;
[b] Data available for 1996 only;
– not available.

Source: World Bank (2001a), and African Internet Connectivity web page.

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[13] See Jensen (2000) survey on the African Internet status reports.

Figure 1
Diffusion of ICT, % of SMEs using different ICTs
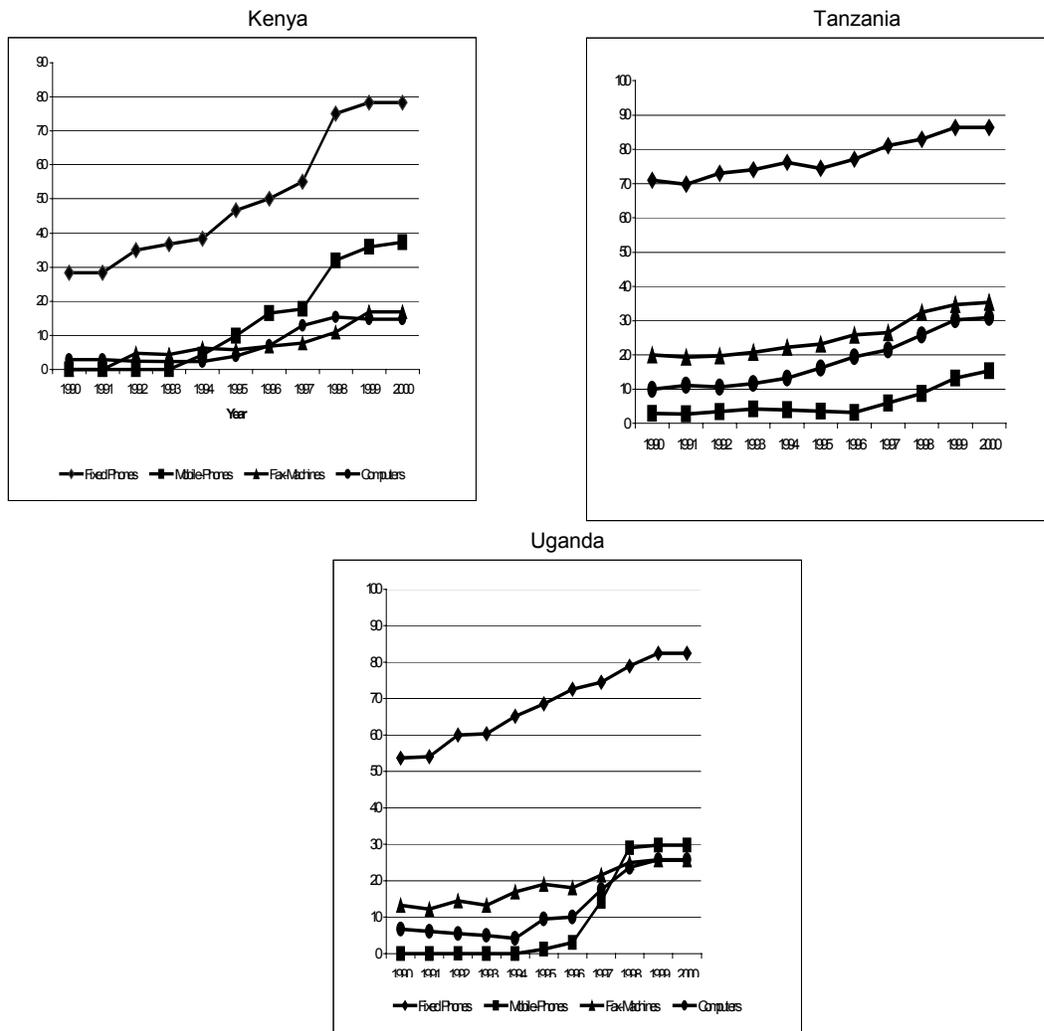
Source: Own calculations from SME survey.

Figure 1 shows the diffusion of ICTs in the three countries under review. Our sample shows that the use of ICTs by SMEs in Kenya as well as in Tanzania and Uganda has been increasing over time.[14] The use of fixed phone lines has nearly reached the saturation point but is still lower in Tanzania and Uganda than in Kenya. The percentage of firms using mobile phones has been increasing much faster than other technologies in all three countries. In Tanzania and Uganda, despite its late start in 1995 and 1994 respectively, mobile phones have already exceeded the use of fax machines. This picture corresponds with the expectation that within the next three to five years mobile phones will outnumber fixed phones in many African countries, as they have already done in Uganda by 2000. This is perhaps an example how the use of advanced technology can help to leapfrog some stages of technology adoption. As computers are still a relatively expensive investment for most SMEs, their use, which is slightly higher in Kenya than in Tanzania and still very low in Uganda, has been increasing, albeit slowly but steadily.

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14 Müller Falcke (forthcoming) observes a similar pattern in India.

As Table 2 shows, the various forms of ICT usage differ not only by country, which could to some extent be a reflection of differences in costs and availability of services, but also by sector. This might be the result of different cost benefit analyses of entrepreneurs due to different production and marketing structures in the three sectors. The most advanced ICT is used in the tourism sector of Tanzania and Kenya, where SMEs are mainly tour operators organizing safaris. Flexibility and rapid coordination are especially important in this sector. Mobile phones are used to stay in contact with the drivers. At the same time, this is also the sector that is mostly oriented towards foreign customers. Some tour operators have even set up their own web pages to attract customers directly. The food sector, on the other hand, does not differ markedly from the textiles sector with respect to exporting. However in the use of more advanced ICT, the food sector outperforms the textiles sector in Uganda, as well as in the other two countries.

Table 2
Use of ICTs by country and sector

% of enterprises that:	Tanzania			Kenya			Uganda	
	Food	Textiles	Tourism	Food	Textiles	Tourism	Food	Textiles
Do not have any ICT	22.4	31.9	2.6	18.4	52.8	0.0	17.4	29.4
Have phones (fixed + mobile)	76.3	64.0	97.4	81.6	45.3	100.0	80.4	68.6
Have faxes	13.6	2.0	74.4	30.6	11.5	66.0	23.9	13.7
Have computers	3.4	4.0	35.9	2.0	1.9	10.0	2.2	2.0
Mean of ICT index	12.5	6.9	40.8	14.7	5.5	29.0	19.1	13.9

Source: Own calculations from SME survey.

4   Impact of ICTs on performance

4.1   Empirical specification

The framework adopted here for empirical analysis relates the composition of capital and the intensity of capital to relative and absolute measures of economic performance of firms. We relate the absolute performance of a firm with the composition of capital stock and the relative firm performance with the intensity of capital. The basic assumption is that as a profit maximizer, a firm allocates its investment in ICT and non-ICT capital stocks and achieves a capital composition such that it ensures the highest return.

More specifically, to assess the impact of ICT on the economic performance of firms, we employ the following three traditional indicators of performance:

   i)   Internal rate of return;

   ii)   Labour intensity and labour productivity; and

   iii)   Market expansion (domestic and foreign).

We use the analytical framework developed in section 2. For tractability, we discuss each of the indicators and their empirical formulations separately.

4.1.1 Internal rate of return

Internal rate of return, henceforth IRR, is defined here as the logarithm of revenue minus variable costs divided by the aggregate capital stock. IRR is an *ex post* measure of a firm's profitability and is a flow measure of performance by construction.

For accounting the impact of ICT capital on IRR, we divide the whole capital stock of firm i denoted by K_i into ICT-capital, and non-ICT capital denoted by ICT_i, and EQ_i respectively. We regress IRR on constant term, aggregate capital intensity (K_i / Y_i), the ratio of ICT-capital to total capital (ICT_i / K_i), and the ratio of non-ICT capital to total capital (EQ_i / K_i):[15]

$$IRR = \ln A + \ln(K / Y) + \ln(ICT / K) + \ln(EQ / K) \tag{5}$$

4.1.2 Labour intensity and labour productivity

To measure the impact of ICTs on labour productivity, a similar relationship can be derived. We start with a Cobb-Douglas production function given by (6):

$$\ln Y = \ln A + \beta_1 \ln L + \beta_2 \ln K^* \tag{6}$$

Here, L stands for labour and K^* stands for quality-adjusted stock of aggregate capital defined as:

$$K^* = K(ICT / K)^\delta (EQ / K)^\gamma \tag{7}$$

Which in logarithmic form can be written as:

$$\ln K^* = \ln K + \delta \ln(ICT / K) + \gamma \ln(EQ / K) \tag{8}$$

Combining (8) into (6), assuming constant returns to scale, and solving for $\ln(L / Y)$, we get:[16]

$$\ln(L / Y) = \alpha_1 + \alpha_2 \ln(K / Y) + \alpha_3 \ln(ICT / K) + \alpha_4 \ln(EQ / K) \tag{9}$$

Where $\alpha_1 \equiv -\ln A / \beta_1$, $\alpha_2 \equiv (1 - \beta_1) / \beta_1$, $\alpha_3 \equiv -\delta(1 - \beta_1) / \beta_1$, $\alpha_4 \equiv -\gamma(1 - \beta_1) / \beta_1$.

Equation (9) provides the basic relationship between labour intensity and ICT-capital intensity. If $\alpha_3 < 0$, ICT-capital has a positive impact on labour productivity as labour intensity decreases. However, if $\alpha_3 = 0$, the effect of ICT-capital is not different from non-ICT capital.

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[15] This equation has been adopted from Berndt and Morrison (1995). They have estimated a similar relationship in the case of US manufacturing industry. Their measure includes a time trend. Note that we avoid the subscript i in writing the equations.

[16] See Berndt and Morrison (1995) for details.

4.1.3 Market expansion

To examine the extent of ICT-driven market expansion, we have adopted two sub-indicators: (a) output market expansion and (b) export market expansion.

(a) Output market expansion

Output market expansion includes market expansion in general. To capture this, we have constructed a market expansion index and we have ranked the SMEs based on their local, regional and export market participation, named as market expansion rank. We start with the market expansion index. It is a weighted index where weights are based on the proportion of output sold locally, regionally (within the country but outside the locality) and internationally (export). The index is normalized to 100.

The market expansion rank varies from 0 to 5. It is based on market expansion index and defined as 0 for SMEs that sell their production only locally, 1 for SMEs that sell both locally and regionally but regional sales do not exceed 40 per cent of their total production, 2 for SMEs that sell more than 40 per cent of their production to the regional market but not for export, 3 for SMEs that export, but exports do not exceed 40 per cent of their total production, 4 for SMEs that export more than 40 per cent but less than 80 per cent of their total production, and 5 for SMEs that export 80 per cent or more of their production.

Though it is possible to see the market expansion in a continuum, our choice of ranking is motivated by the fact that in such cases, we can see how each phase of performance, e.g., local, regional and export, is affected, *ceteris paribus,* by the level of ICT investment. However, as we have only cross-sectional data,[17] it is not possible to examine the transition from one phase of performance to another, e.g., from local to regional or regional to export and vice versa.

Econometrically it follows that we rank the performance of the firms where ranks are ordinal and rank 0< rank 1 …<rank 5, and follow a latent regression model:[18]

$$y^* = \beta'x + \varepsilon \qquad (10)$$

Where y^* is performance which is unobserved. What we observe is:

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\begin{aligned}
y &= 0 \ \text{ if } \ y^* \leq 0 \\
&= 1 \text{ if } \ 0 < y^* \leq \mu_1 \\
&= 2 \text{ if } \ \mu_1 < y^* \leq \mu_2 \\
&= 3 \text{ if } \ \mu_2 < y^* \leq \mu_3 \\
&= 4 \text{ if } \ \mu_3 < y^* \leq \mu_4 \\
&= 5 \text{ if } \ \mu_4 \leq y^*
\end{aligned} \qquad (11)
$$

where μ are unknown parameters to be estimated with β, and x are observable firm characteristics that include ICT-capital and non-ICT capital in line with the basic estimating framework given by equation (4). In addition, x include country, sector and

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[17] For a description, see section 4.2.

[18] See Greene (2000: 875-7).

regional dummies, as well as size and education of firm management. Here, ε are unobservable factors. Assuming that ε is normally distributed with mean 0 and variance 1, we estimate the probabilities and corresponding marginal effects utilizing the ordered logit method.

(b) Export market expansion

Export market expansion examines the impact of ICTs on export market participation where SMEs are categorized as exporters and non-exporters. Econometrically, the specification problem is very similar to (10), and follows a latent regression model:

$$y^* = \beta'x + \varepsilon \tag{11}$$

Where y^* is the unobserved latent variable. What we observe is a dummy variable y defined by

$$y = 1 \text{ if } y^* > 0$$
$$y = 0 \text{ otherwise} \tag{12}$$

We use probit method to estimate this equation. Here x include similar observable characteristics described for general market expansion.

4.2   Data and summary statistics

We use data from an enterprise survey conducted in East Africa, namely Kenya and Tanzania. The survey was carried out from November 1999 to May 2000 and includes enterprises from three sectors: food processing, textiles and tourism. The entire sample includes 300 enterprises. The distribution is 150 enterprises from Kenya and Tanzania each, distributed equally among the three sectors. In the selection of enterprises, the survey followed a simple random sampling procedure where the sample enterprises are randomly selected from major commercial corridors in the countries. The two key considerations in the determination of the sample regions are their economic significance, and their ability to proxy fairly for the SME sector. The selected commercial corridors are the Lake Zone, the Coastal Zone, and the Arusha Region in Tanzania and the Coastal Zone and Lake Zone in Kenya.

Table 3 provides summary statistics pertaining to the performance of SMEs and Table 4 provides summary statistics pertaining to regressors. The internal rate of return (IRR) and labour intensity (L_Y) are measured in nominal scale, and the market expansion index (MKT_IND) is measured in logarithmic scale. The two other measures of market expansion, market expansion rank (MKT_RANK) and export market expansion (EXP) are ordered (0 to 5) and binary variables (0,1) respectively.

Turning to the regressors and their measurement scales, total stock of capital (K), ICT-capital (ICT), and non-ICT capital (EQ) are measured in US dollars. The average years of schooling of management (SIM) is measured in years and expressed in logarithmic scale. The size of enterprise (L) is the total number of employees expressed in logarithmic scale. Total capital-output ratio (K/Y), ICT-capital to total capital stock (ICT/K) and non-ICT capital to total capital stock (EQ/K) are expressed in logarithmic scale. The ICT index (ICT_IND) is based on the intensity of the use of different information and communication technologies namely number of fixed phone lines,

number of mobile phones, number of faxes, use of email and Internet. These intensities are weighed with the average investment that is necessary to purchase the devices and the index is normalized to 100. Similar to ICT_IND, we have constructed an index for non-ICT capital (EQ_IND) based on the value of non-ICT capital stock and normalized to 100. In Table-4, both indices are expressed in logarithmic scale.

As can be seen from the summary statistics, the SMEs in the different sectors differ markedly with respect to performance indicators as well as with respect to enterprise characteristics. IRR and labour intensity are the lowest in the tourism sector but market expansion is highest for all three indicators. In the tourist sector, management also has the highest education and the absolute stock of ICT capital is highest. As it is a services sector, the capital output ratio is the lowest in tourism. The differences between two manufacturing sectors are not as markedly, however, as all performance indicators are higher for the textiles sector. The similar size of enterprises across the three sectors and the low variance are due to the fact that the selection criterion for an SME to be included in the sample was a company size with up to 50 employees. Finally, the dummy for location controls whether the enterprise is located in the capital.

Table 3
Summary statistics of performance of SMEs (Mean and standard deviation)

Performance indicators	Performance indicators	Food		Textile		Tourism	
Internal rate of return	IRR	13.39	(35.01)	23.91	(74.76)	6.56	(19.26)
Labour intensity in log	L_Y	0.033	(0.075)	0.037	(0.106)	0.025	(0.057)
Market expansion index [a]	MKT_INDEX	1.44	(2.13)	1.74	(1.90)	3.70	(1.23)
Market expansion rank	MKT_RANK	2.39	(1.54)	2.42	(1.25)	4.65	(1.40)
Export market expansion	EXP	0.24	(0.43)	0.25	(0.43)	0.84	(0.37)

Note: [a]   Expressed in logarithmic scale.
Source: Own calculations from SME survey.

Table 4
Summary statistics of regressors
(Mean and standard deviation)

Regressors	Name	Food		Textiles		Tourism	
Stock of capital (in US$)	K	124804.31	(567281.27)	19591.18	(52271.54)	63100.31	(119589.27)
Stock of non-ICT capital (in US$)	EQ	127138.24	(574708.62)	18936.75	(51219.52)	61325.76	(120162.31)
Stock of ICT capital (in US$)	ICT	2027.98	(6661.04)	1544.58	(8602.38)	5741.76	(16213.61)
Schooling intensity of mgt [a]	SIM	2.466	(0.240)	2.476	(0.185)	2.613	(0.206)
Size of enterprise [a]	L	2.703	(0.835)	2.290	(0.632)	2.572	(0.686)
Capital-output ratio [a]	K/Y	2.07	(1.60)	2.64	(1.40)	0.92	(1.48)
ICT capital to total capital [a]	ICT/K	-3.82	(2.25)	-3.43	(1.99)	-2.67	(2.27)
Non-ICT capital to total capital [a]	EQ/K	-0.081	(0.139)	-0.130	(0.398)	-0.211	(0.349)
ICT index [a]	ICT_IND	2.633	(0.838)	2.509	(0.584)	2.833	(0.490)
Non-ICT index [a]	EQ_IND	-0.736	(2.150)	-1.966	(2.020)	0.085	(1.583)

Note: [a]   Expressed in logarithmic scale.
Source: Own calculations from SME survey.

4.3 Estimation and results

We have estimated equation (5) that measures IRR and equation (9) that measures labour productivity with the ordinary least square (OLS) method. For equation (4) and its variants given by (10) that measure market expansion, we have utilized both OLS, ordered logit and binary probit. Tables 5 to 9 describe the estimation results. In order to be more tractable, we discuss the results for the three categories of performance indicators.

4.3.1 Impact of ICT on IRR

The second column in Table 5 provides the estimation results of equation (5), and the third column provides a variant of equation (5) that controls for industry and other characteristics. The estimated coefficients are stable across both equations. The internal rate of return is mostly determined by the capital output ratio with a coefficient close to 1 in both cases. As can be seen in Table 5, the impact of ICT-capital as a proportion of total capital on IRR is not significant. Furthermore, IRR is influenced by industry characteristics and is positively affected if an enterprise represents the tourist sector. As both capital-output ratio and labour intensity are relatively low in the tourist sector, IRR is mainly determined by the costs for other inputs.

Table 5
Dependent variable: internal rate of return
(method: OLS)

Regressors	Coefficients	
$\ln(K/Y)$	1.0073 (0.0640)**	1.0840 (0.0721)**
$\ln(ICT/K)$	0.0235 (0.0528)	0.0257 (0.0597)
$\ln(EQ/K)$	-0.2111 (0.3027)	-0.1332 (0.3034)
Dummy for textile sector		-0.2528 (0.2449)
Dummy for tourism sector		0.5664 (0.2843)*
Dummy for Kenya		-0.0123 (0.1040)
Dummy for location		-0.0572 (0.2628)
Constant	-1.2458 (0.2651)**	-1.3989 (0.4182)**
Observations	163	163
R-squared	0.615	0.634
F		
D-W	2.104	1.917

Notes: * Significant at 5% level; ** significant at 1% level.

4.3.2 Impact of ICT on labour intensity and labour productivity

The first column of Table 4 provides the estimation results of equation (9), and the second column provides a variant that controls for industry and other characteristics that we have included in estimating IRR. Here the stock of ICT-capital as a proportion of total capital has a significant positive impact on labour intensity. This implies that the stock of ICT-capital has a negative impact on labour productivity, as the respective coefficient δ is negative. However, once we control for industry and other

characteristics, the negative impact of ICT on average labour productivity becomes significant only at 10 per cent level. The negative coefficient for the tourism sector corresponds with our expectation that the relatively high capital intensity of this sector has a positive impact on labour productivity.

Table 6
Labour intensity and productivity, dependent variable: ln(L/Y)
(method: OLS)

Regressors	Coefficients	
$\ln(K/Y)$	-0.5864	-0.3945
	(0.1170)**	(0.0576)**
$\ln(ICT/K)$	0.2743	0.0814
	(0.0948)**	(0.0470)~
$\ln(EQ/K)$	1.1413	0.2276
	(0.5534)*	(0.2416)
Dummy for textile sector		0.4852
		(0.1955)*
Dummy for tourism sector		-0.9244
		(0.2252)**
Dummy for Kenya		19.203
		(0.0822)**
Dummy for location		0.2821
		(0.2099)
Constant	-4.8946	-7.2067
	(0.4811)**	(0.3333)**
Observations	165	165
R-squared	0.192	0.854
Adjusted R-squared	0.177	0.8477

Notes: ~ Significant at 10% level; * significant at 5% level; ** significant at 1% level.

4.3.3. Impact of ICT on market expansion

We start with the general form of market expansion. For this we have estimated the basic estimating equation (4) by OLS where the dependent variable market expansion, MKT_IND, is measured in a continuum. Table 7 reports the estimated coefficients along with their standard errors and level of significance. As can be seen in the table, the firms' relative stock of ICT-capital has a positive impact on market expansion. Other factors that also have a positive impact are the relative stock of non-ICT capital, and industry characteristics. As the tourism sector is much more oriented towards foreign customers, the coefficient for the tourism dummy is relatively high. It is somewhat surprising that the size of the enterprise expressed in number of employees is not significant, contrary to other findings that conclude that bigger African enterprises are more likely to export (Söderbom and Teal 2000). To some extent, this might be due to the limited size range of our sample but it could also give a hint that the use of ICTs could somehow reduce the advantage of bigger size. The fact that the educational attainment of the management is also not significant here might also be due to the ICT effect as the usage of more advanced ICTs is already linked with higher education.

Table 7
Market expansion, dependent variable: MKT_IND
(method: OLS)

Regressors	Coefficients	
ln(ICT_IND) [a	0.5627	(0.2412)*
ln(EQ_IND) [a	0.2802	(0.0746)**
Dummy for Kenya	0.0380	(0.0944)
Dummy for textile sector	10.665	(0.3096)**
Dummy for tourism sector	23.675	(0.3090)**
Dummy for location	0.0407	(0.2481)
ln(L)	0.3306	(0.2207)
ln(SIM)	0.0055	(0.6621)
Constant	0.9899	-16.000
Observations	187	
R-squared	0.502	
Adjusted R-squared	0.479	
D-W	1.984	

Notes: [a Instrumentalized to correct for possible endogeneity bias.
* Significant at 5% level; ** significant at 1% level.

Table 8A
Market expansion, dependent variable: MKT_RANK
(method: ordered logit)

Regressors	Coefficients	
ln(ICT_IND) [a	1.1262	(0.3758)**
ln(EQ_IND) [a	0.3657	(0.0960)**
Dummy for Kenya	-0.2713	(0.1132)*
Dummy for textile sector	1.0175	(0.3803)**
Dummy for tourism sector	2.9698	(0.4297)**
Dummy for location	0.0457	(0.3038)
ln(L)	-0.0004	(0.2715)
ln(SIM)	0.0453	(0.8741)
Observations	188	
Chi-squared	139.67	
Significance level	0.0000	
Pseudo R^2	0.2180	

Notes: [a Instrumentalized to correct for possible endogeneity bias.
* Significant at 5% level; ** significant at 1% level.

To see the discrete change in market expansion performance, we have estimated equation (10) with ordered logit. Table 8A reports the estimated coefficients along with other statistics and Table 8B reports the marginal effects. Similar to MKT_IND, MKT_RANK is also influenced by the firms' relative stock of ICT-capital. A firm with a higher stock of ICT-capital is more likely to have a higher rank. With the exception of the country dummy, which was not significant in OLS regression, the significance of other factors has remained unchanged in the ordered logit method.

14

Table 8B
Marginal effects for ordered logit

Variable	MKT_RANK=0	MKT_RANK=1	MKT_RANK=2	MKT_RANK=3	MKT_RANK=4	MKT_RANK=5
ln(ICT_IND) [a	-0.2192805	0.1003429	0.0494821	0.0504306	0.0134987	0.0055262
	(0.07318)**	0.03349)**	0.01651)**	0.01683)**	0.0045)**	0.00184)**
ln(EQ_IND) [a	-0.0712096	0.0325856	0.0160689	0.0163769	0.0043836	0.0017946
	(0.01869)**	0.00855)**	0.00422)**	0.0043)**	0.00115)**	0.00047)**
KENYA	0.0528307	-0.0241754	-0.0119216	-0.0121501	-0.0032522	-0.0013314
	(0.02203)~	0.01008)~	0.00497)~	0.00507)*	0.00136)~	0.00056)*
ln(L)	0.000087	-0.0000398	-0.0000196	-0.00002	-5.36e-06	-2.19e-06
	(0.05286)	0.02419)**	0.01193)	0.01216)	0.00325)	0.00133
ln(SIM)	-0.0088117	0.0040323	0.0019884	0.0020265	0.0005424	0.0002221
	(0.17019)	0.07788)*	0.0384)	0.03914)	0.01048)	0.00429

Notes: Textile, tourism and regional dummies do not have any effect and have been excluded as a result;
[a   Instrumentalized to correct for possible endogeneity bias;
~ Significant at 10% level; * significant at 5% level; ** significant at 1% level.

Table 9
Export performance; Dependent variable: EXP
(method: binary bivariate probit)

Regressors•	Coefficients	Marginal effects
ln(ICT_IND) [a	0.4285	0.1683
	(0.2827)	(0.1108)
ln(EQ_IND) [a	0.1311	0.0515
	(0.0738)~	(0.0290)~
Dummy for Kenya	-0.1033	-0.0406
	(0.0917)	(0.0360)
Dummy for textile	0.3569	0.1406
	(0.2936)	(0.0865)
Dummy for tourism	1.7715	0.6129
	(0.3129)**	(.)
Dummy for location	0.1466	0.0576
	(0.2449)	(0.0509)
ln(L)	0.2857	0.1122
	(0.2202)	(0.0865)
ln(SIM)	0.0600	0.0236
	(0.6966)	(0.2736)
Constant	-2.5371	
	-1.6817	
Observations	188	188
Prob>chi^2	0.0000	0.0000
Pseudo R^2	0.3398	0.3398
Observed probability		0.4361702
Predicted probability		0.4300391

Notes: ~Significant at 10% level; * significant at 5% level; ** significant at 1% level;
[a Instrumentalized to correct for possible endogeneity bias.

15

Table 9 reports the coefficients related to export market performance where SMEs are classified either as exporter or not. As can be seen in the table, the relative stock of ICTs does not have any significant impact on the export performance indicator. Though weak, it is rather the non-ICT stock of capital that has a positive impact on export performance. Other factors that have a significant impact include industry characteristics and the country dummy.

5   Concluding remarks

Our descriptive and quantitative analysis of the data on SMEs in Kenya and Tanzania shows that investment in ICT is an important determinant of market expansion. For market expansion, it is not only the relative stock of ICT-capital that matters, it is also the relative stock of other capital that brings competitive advantages and hence market expansion. In the case of market expansion, it seems that the benefits resulting from better access to information through more use of ICT are relatively easy to reap.

However, investment in ICTs in our study does not have any significant impact on enterprise return and export performance and has even a negative impact on labour productivity. One explanation of the share of ICT capital not seemingly having a role for the internal rate of return is that a certain threshold of ICT investment may be needed to make it effective, and that this threshold might not have been reached in SMEs in the case of East Africa. On the other hand, if investment in different types of capital is allocated efficiently, it should be expected that the composition of capital should not affect performance. The negative impact of ICT investment on labour productivity could be interpreted as over-investment in ICT. This could be partly due to the relatively high costs of ICTs in East Africa and the non-divisibility of equipment in case of small enterprises. It could also because of the fact that in the initial phase, substantial learning on how to deal with the new technology is needed and therefore the labour intensity increases first. In case of export, there are many complementary factors such as infrastructure, and functioning of the banking system that are crucial for an increase in exports, and investment in ICTs is perhaps not the sufficient condition, at least in the short run.

One factor that limits the above analysis is that there may be a substantial time lag between ICT investments and their effects. Especially the learning effect has to be taken into account. Thus it is possible that the lack of an ICT effect may simply reflect the time lag before investments in these technologies begin to payoff. Additionally, the approach with a sole focus on productivity may be too narrow. Information and communication technologies may exert their influence through product-quality improvements, improved services and especially through improved networks, which also might have external effects. Further investigations are needed to reveal the complementary factors that impact on the links between ICTs and SME performance and may provide additional impetus for investments.

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Appendix

Appendix Table A1
Selected economic and social indicators of East African countries

Basic Indicators	Tanzania	Kenya	Uganda
Population (million)	32.9	29.4	21.5
Population growth (annual %)	2.4	2.3	2.7
GDP per capita, PPP (US$)	480	1,001	1,139
GDP growth (annual %)	4.3	1.6	7.80
Gross domestic fixed investment (% of GDP)	17.86	15.0	17.24
Industry, value-added (% of GDP)	14.34	16.8	17.90
Exports of goods and services (% of GDP)	19.8	24.7	11.4
Exports of goods and services (annual % growth)	4.7	-5.2	33.0
Av. annual growth of real GDP per worker (% 1980-90)	2.3	-1.4	3.5
Primary school enrolment (% gross, 1998)	66.8	84.9	74.3

Note: Data are for 1999 if not otherwise stated.
Source: World Bank (2001a and 2001b).

Appendix Table A2
The food, textiles and tourism sector in East Africa

Value-added	Kenya	Tanzania	Uganda
Manufacturing, value-added (% of GDP, 1999)	10.7	7.4	8.7
Food products (% of value-added in manufacturing, 1995)	32.0	11.0	–
Textiles and wearing (% of value-added in manufacturing, 1995)	7.0	18.0	–
Tourism receipts (% of GDP, 1999)	2.7	8.2	2.3 [a]

Note: [a]   1998 figure.
Source: UN (1997) and World Bank (2001a).