Exporting from manufacturing firms in Sub-Saharan Africa: Micro evidence for macro outcomes

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Exporting from manufacturing firms in Sub-Saharan Africa: Micro evidence for macro outcomes

Neil Rankin, Måns Söderbom and Francis Teal

Centre for the Study of African Economies
Department of Economics
University of Oxford

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Abstract

The poor performance of many African economies has been associated with low growth of exports in general and of manufacturing exports in particular. In this paper we draw on micro evidence of manufacturing firms in five African countries - Kenya, Ghana, Tanzania, South Africa and Nigeria - to investigate the causes of poor exporting performance. Micro empirical work on manufacturing firms has focused on the relationship between export participation and efficiency. The evidence for SSA shows that exporters tend to be larger, more capital intensive and produce more output per unit of labour than non exporters. We show that firm size is a robust determinant of the decision to export. It is not a proxy for efficiency, for capital intensity, for sector, for time-invariant unobservables or for the fixed cost of entry into exporting. The implication of these findings is that large firms are necessary for exporting. However larger firms are more capital intensive. Small firms may create jobs, they will not be able to export. We also find that efficiency only impacts on the decision to export regionally, defined as within Africa, not internationally. The implications of these findings are discussed.

1. Introduction

Two key facts underlie the problems faced by sub-Saharan African (SSA) economies over the 1990s. The first, which is shown by Table 1, is that while on average across the continent economic growth moved from negative in the 1980s to positive in the 1990s, the rate of growth was still less than 0.2 per cent per annum. Low SSA growth has now been the norm since the

Table 1. Decadal Growth Rates (per cent per annum) by Region: Real GDP per capita in US$ (PPP)

	1960s	1970s	1980s	1990s	Average
Australasia	2.95	1.32	1.49	2.27	1.98
East Asia	6.29	2.92	5.23	7.28	5.33
Industrial	4.57	2.61	2.44	1.81	2.77
Latin America	3.21	3.39	-0.68	1.63	1.67
Middle-East	5.54	0.84	1.09	3.28	2.24
South Asia	2.28	0.69	3.61	3.51	2.70
South-East Asia	2.34	4.80	3.27	2.50	3.21
Sub-Saharan Africa	1.67	0.27	-0.37	0.18	0.27
Average	3.23	2.27	3.06	3.76	3.12

Source: PENN World Tables 6.1. Countries are weighted by population.

1960s with the result that on average over this four decade period SSA growth has averaged 0.3 per cent per annum, one tenth of the world average.

The second key fact is that the rate of capital investment in Africa in the 1990s has been lower than the rate of population growth. Comparative regional figures are given in Table 2 and show that there was a decline in the capital stock per capita for SSA of nearly 1 per cent per annum over the 1990s. The implications of such macro figures are stark. Without rapidly falling real wages employment demand will stagnate.

Where are those coming onto the labor market to find jobs if wages do not adjust? What are the implications for those increasing number of young people who now have secondary education? What are the implications of falling wages, if they do occur, for household consumption and poverty? All these questions have been central to the policy debate in South Africa. There is evidence for South Africa, Casale, Muller and Posel (this conference) that real wages have fallen and that the rise in employment has been far below the rate of growth of the labour force, rising unemployment has been the outcome. Reversing those outcomes is crucial to

the success of the South African economy. We approach this employment issue indirectly in this paper.

Table 2. Decadal Growth Rates (per cent per annum) by Region: Real Capital per Capita (1996 US$)

	1970s	1980s	1990s	Average
Australasia	2.41	1.64	1.98	1.99
East Asia	5.00	6.12	7.78	6.40
Industrial|	4.80	3.37	3.08	3.71
Latin America	4.29	1.20	1.61	2.20
Middle-East	6.15	2.36	1.24	2.86
South Asia	2.44	2.80	3.72	3.07
South-East Asia	6.23	5.98	5.14	5.72
Sub-Saharan Africa	2.24	0.13	-0.80	0.33
Average	4.20	3.73	4.24	4.06

Source: PENN World Tables 6.1. Countries are weighted by population. The figures for Real Capital per Capita are imputed from the investment data by the method due to

In the next section we present the macro data which shows the performance of the South African economy in comparative perspective. We show there the strong relationship that appears to exist between export performance and long run growth. That the implicit correlation is causal has been argued in a range of papers - for example Dollar (1992), Sachs and Warner (1995), Edwards (1998), Frankel and Romer (1999), Irwin and Terviö (2002), Greenaway et al. (2002) and Söderbom and Teal (2003). Our intent here is not to add to this macro evidence but to investigate, using comparative firm-level data, why export performance in SSA has been so poor in an area which has proved the engine of growth for many economies - manufactures.

We begin to do that in section 3 where we present the data we have collated for five SSA countries - Ghana, Kenya, Tanzania, Nigeria and South Africa. As the length of time over which we observe the firms differs across the five countries we will not be able to use than all for all the issues we investigate. However we have enough observations to highlight the differences and similarities across these countries. In section 4 we present the modeling framework we will use for the export participation decision. The first set of empirical results of the paper are given in section 5 where we report the estimation of a series of models which progressively relax the assumptions made in a basic probit specification of the export decision. In section 6 we move beyond simply whether the firm exports and ask if the factors determining export destination

differ by whether the firm exports regionally (by which we mean within Africa) or internationally (that is outside of Africa). We find that there are very significant differences. In particular we find that the firm's efficiency level affects it probability of exporting regionally but not internationally. Section 7 concludes the paper by asking why this might be the case and how these micro findings link to the two macro issues with which we began namely the underlying reasons for the poor performance of manufacturing exports in Africa and its link to job creation.

2. An Overview of Macro Performance

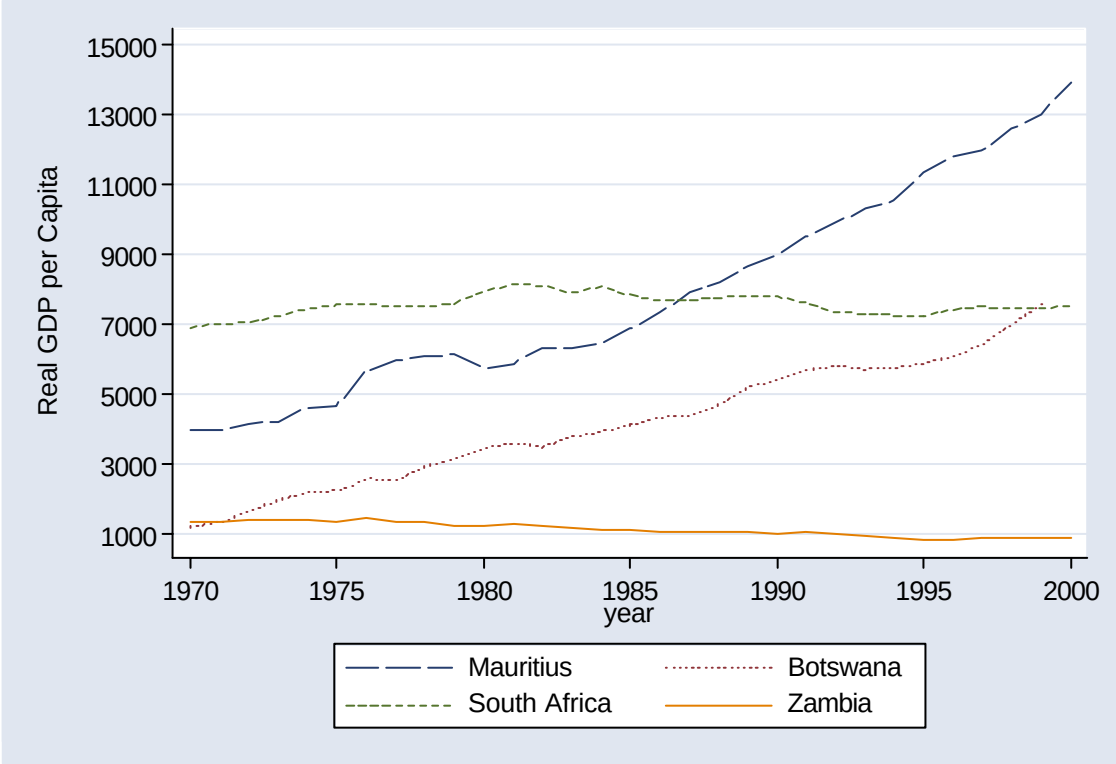
In this section we show the performance of the South African economy in its SSA context. Figure 1 shows the growth since 1970 in purchasing power parity (PPP) US$ for countries which cover the range of outcomes for SSA. The top part of Figure 1 shows the outcomes for four economies whose per capita incomes ranged from 1,000-7,000 US$ in 1970 - Mauritius, Zambia, Botswana and South Africa. By the end of the 1990s Botswana's income had risen from US$ 1,000 to 7,000 while South Africa's income had stagnated for the whole thirty years. In contrast Zambia which at the beginning of the period had an identical income to that of Botswana had seen a steady decline in income with only the most modest of recoveries in the 1990s. The spectacular success over this period was the performance of the Mauritian economy whose per capita income quadrupled in 30 years. In 1970 Mauritius had half the income of South Africa, by the end of the 1990s it had twice its income.

The bottom part of Figure 1 shows the path of GDP for five economies which embarked on major reforms in the 1980s. Reviewing African policy regimes in the mid 1990s, the World Bank (1994) identified Tanzania, Ghana and Kenya as countries where policy progress had been made and argued that these changes had led to improvements in income. Of these countries only Ghana has been viewed as a country which has sustained its reforms since their inception in the early 1980s. Uganda, the final country shown in the bottom part of Figure1, reformed later than Ghana but has grown more rapidly. It is clear from the figure that the two success stories among the economies presented are Ghana and Uganda. The qualified nature of the success is also apparent from the Figure. While Uganda's income has doubled since 1970 it remains much below that of Ghana whose income has still not returned to its level of the early 1970s.

Why have Mauritius and Botswana been so much more successful than all the other SSA countries we have reviewed? A key part of their success had been their ability to ensure exports grew and grew rapidly. Figure 2 shows for all the countries figures for exports per capita in US$ using 1995 prices. From US$ 500 per capita in 1970 Mauritius' exports by the end of the 1990s

Figure 1. GDP per Capita (in 1996 US$ PPP)

Source: PENN World Tables 6.1



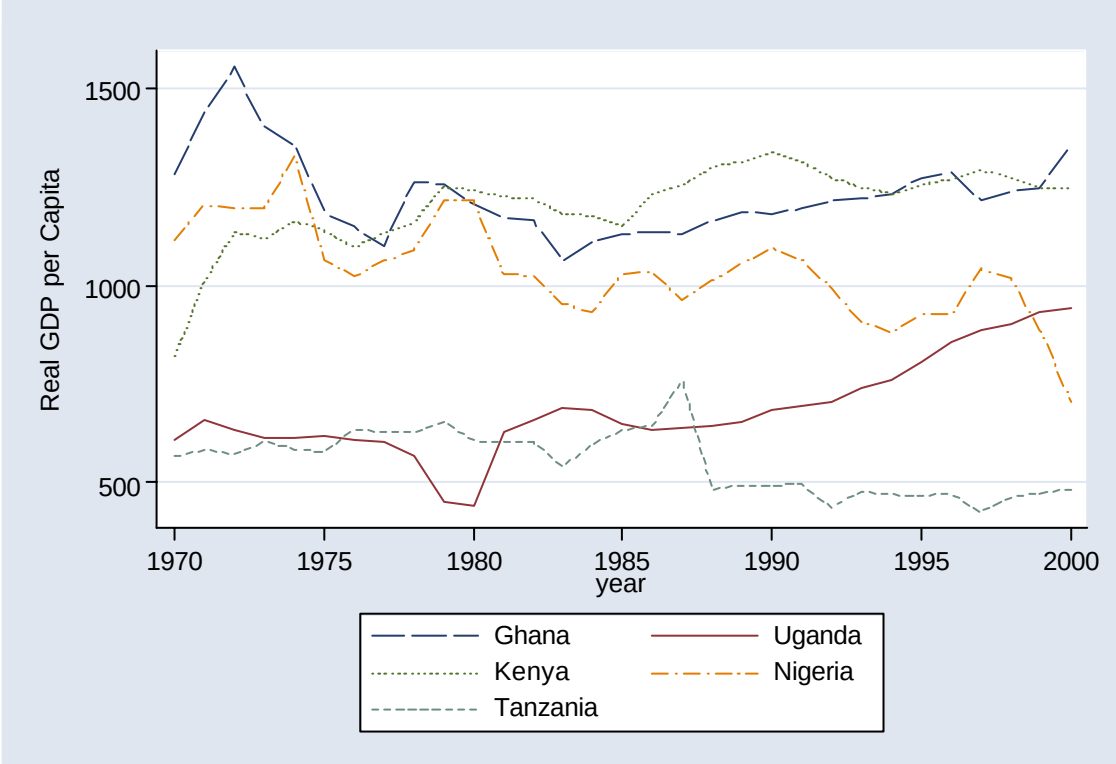
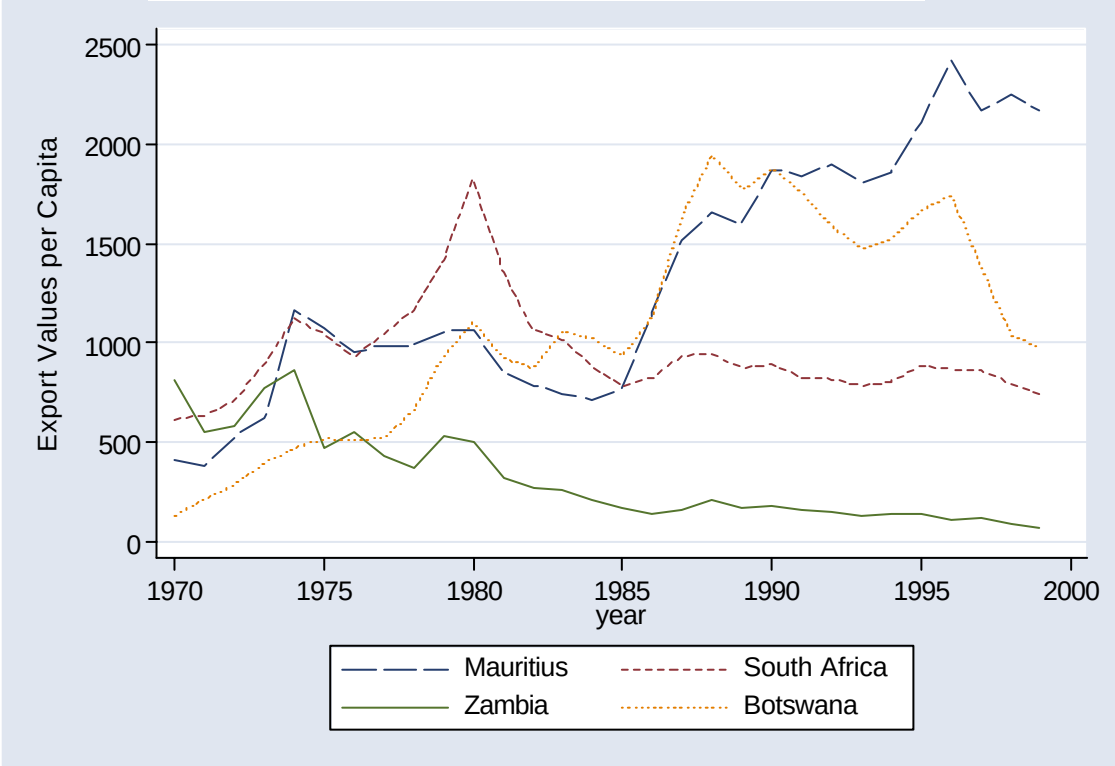
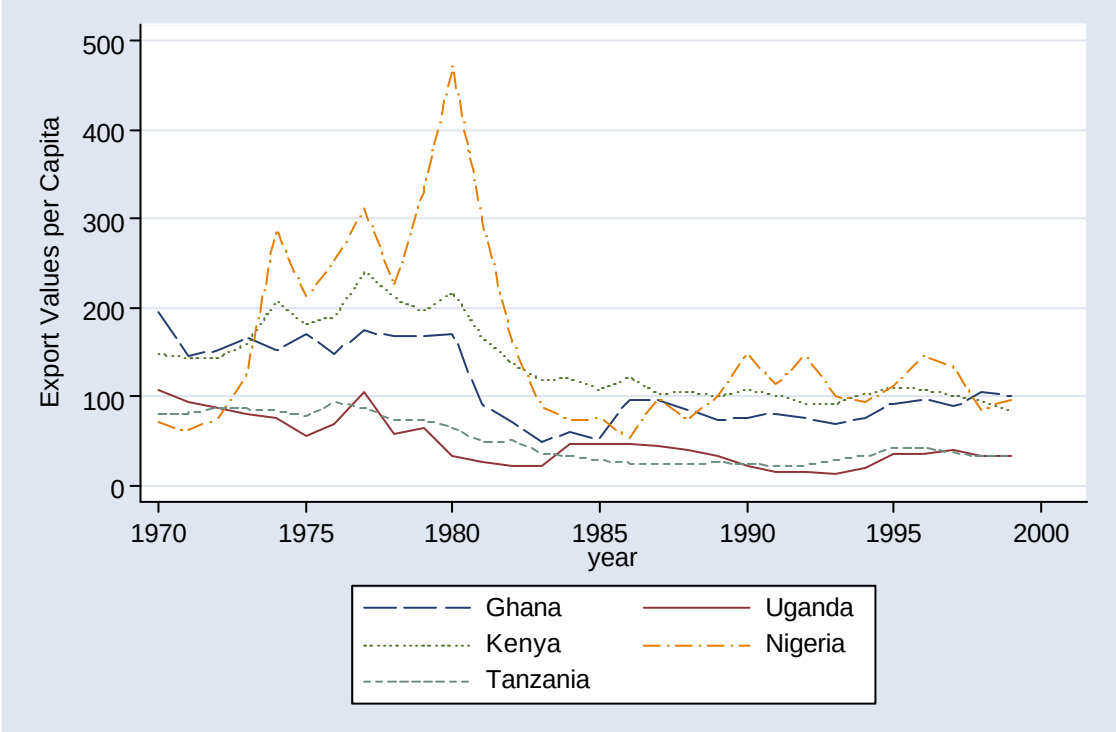


Figure 2. Export Values per Capita in US$ (1995) prices

Source: World Bank Development Indicators





were over US$ 2000. Until the early 1990s Botswana was equally successful, however since then it has fallen sharply. While the Botswana economy has remained reliant on natural resources, primarily diamonds, Mauritius has diversified its export base initially into manufactures but more recently into services such as tourism. This was associated with large increases in the demand for labor, much of it female, and substantial rises in real wages, Milner and Wright (1998) and Durbarry (2001). In contrast even the sustained reformers like Ghana and Uganda have had only very modest success with their exports. On a per capita basis for all the countries exports remain at, or below, the level of the early 1970s.

While South Africa had, and retains, one of the highest levels of income per capita in SSA in terms of its long run per capita growth rate it is close to the continental average, ie zero. This long run growth performance is closely mirrored in its exports. The question posed in this paper is what can be learnt from micro data as to the factors underlying this outcome. In the next section we briefly summarise the data that we have collated. In the following sections we will modeling framework we will apply to firm-level data from Ghana, Kenya, Tanzania, Nigeria and South Africa.

3. Export participation and the characteristics of exporting firms

As Table 3 below shows overall one quarter of the observations in the sample are of exporting firms. South Africa has the highest export propensity (71 percent) and Kenya the next highest (36 percent). Nigeria has the lowest export propensity with only 9 percent of observations being of exporting firms. Export participation differs greatly within sectors and within countries. In Ghana 80 percent of observations in the wood sector are exporting firms. In comparison the highest export propensity in this sector in other countries is 18 percent for Tanzania. Within Ghana the sector with the next highest export propensity rate is the textiles sector. 42 percent of observations in this sector are exporting firms. There are similar variations in export propensity in Kenya. 83 percent of observations in the Kenyan textiles sector are exporting firms. The next highest export propensity within Kenya is in the metal products and machinery sector where 47 percent of observations are export firms. The variation in export propensities within the other countries is lower than in Ghana and Kenya.

The firms in the sample are heterogeneous and export behaviour varies by country and sector, but can we identify certain characteristics that are common to exporting firms? Table 4 presents mean values for a number of variables broken down by country and export participation. Across all countries the results show clear similarities – exporters have higher levels of labour

productivity are larger, more capital intensive, tend to be older and more likely to be foreign owned. Although these results indicate that in terms of labour productivity exporters are more productive than non-exporters, they do not control for factor inputs, nor other characteristics of the firms. We know from other work with this data that exporting firms have higher levels of total factor productivity.

Table 3. Export propensity: by country and sector

	Ghana	Kenya	Tanzania	Nigeria	South Africa	Total
Wood						
Mean	0.80	0.14	0.18	0.00	.	0.46
n	79	42	44	2	0	167
Furniture						
Mean	0.11	0.27	0.02	0.00	0.63	0.14
n	168	77	103	12	19	379
Foods						
Mean	0.09	0.43	0.34	0.17	0.63	0.24
n	203	95	106	12	8	424
Metal & machinery						
Mean	0.14	0.47	0.10	0.02	0.72	0.29
n	196	122	143	48	112	621
Textiles (except SA)						
Mean	0.42	0.83	0.28	0.11	.	0.40
n	26	35	46	36	0	143
Garments (except SA)						
Mean	0.06	0.14	0.15	0.17	.	0.11
n	164	91	46	35	0	336
Textiles & Garments (SA)						
Mean	.	.	.	.	0.75	0.75
n	0	0	0	0	8	8
Total						
Mean	**0.18**	**0.36**	**0.17**	**0.09**	**0.71**	**0.25**
n	836	462	488	145	147	2078

Notes: Observations are for firms over time and thus firms may be counted more than once.

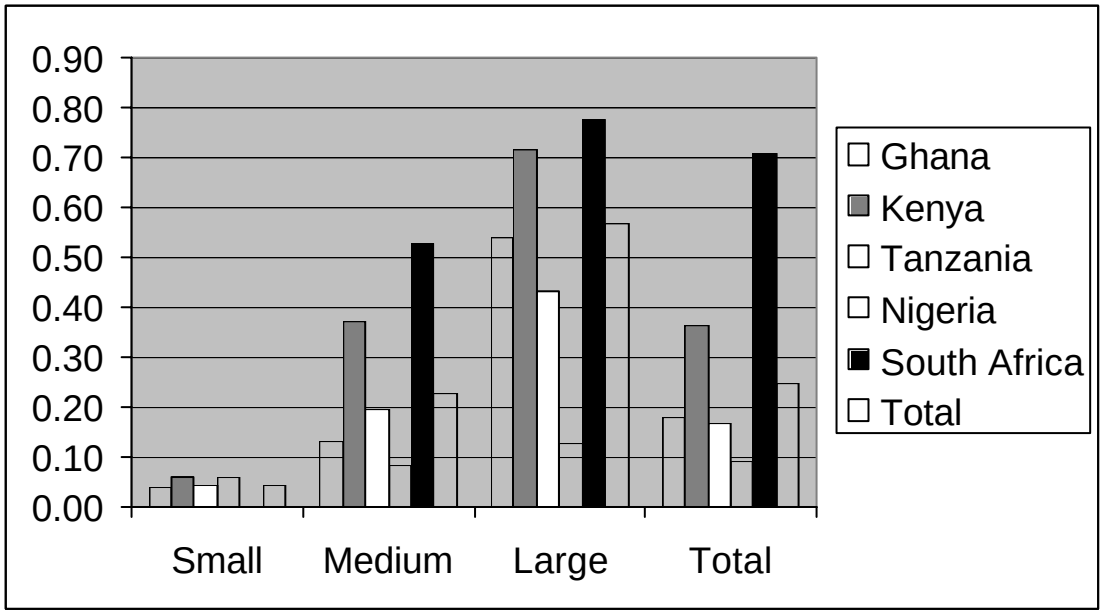
Table 4. The characteristics of non-exporting and exporting firms

	Output per employee		Value added per employee		Employment		Capital per employee		Age		Foreign ownership	
	Non exporter	Exporter	Non exporter	Exporter	Non exporter	Exporter	Non exporter	Exporter	Non exporter	Exporter	Non exporter	Exporter
Ghana												
Mean	7.99	8.69	6.90	7.59	2.90	4.76	6.79	8.62	17.77	20.58	0.15	0.47
Std Dev.	1.28	0.99	1.35	1.20	1.27	1.23	1.96	1.42	12.01	12.25		
N	688	148	636	141	688	148	688	148	688	148	688	148
Kenya												
Mean	8.57	9.55	7.41	8.35	2.76	4.72	8.13	9.67	21.37	21.32	0.11	0.35
Std Dev.	1.21	1.19	1.35	1.21	1.39	1.20	1.61	1.07	14.65	10.96		
N	295	167	269	160	295	167	295	167	295	167	295	167
Tanzania												
Mean	7.98	9.13	6.81	7.88	2.81	4.45	7.45	9.00	16.54	21.05	0.16	0.36
Std Dev.	1.30	1.27	1.22	1.25	1.31	1.42	1.74	1.67	11.88	15.70		
N	407	81	403	81	407	81	407	81	407	81	407	81
Nigeria												
Mean	8.53	9.36	7.02	8.02	3.57	4.87	8.50	8.68	20.21	25.46	0.27	0.38
Std Dev.	1.47	1.03	1.33	0.88	1.82	2.52	2.06	1.72	9.80	13.49		
N	132	13	130	13	132	13	132	13	132	13	132	13
South Africa												
Mean	10.28	10.70	9.44	9.76	4.51	5.05	9.57	9.75	17.35	22.78	0.14	0.29
Std Dev.	0.56	0.65	0.69	0.79	0.75	0.85	1.16	1.22	16.13	17.61		
N	43	104	42	102	43	104	43	104	43	104	43	104
Total												
Mean	**8.20**	**9.46**	**7.05**	**8.34**	**2.95**	**4.76**	**7.43**	**9.25**	**18.32**	**21.46**	**0.16**	**0.37**
Std Dev.	1.34	1.27	1.38	1.37	1.39	1.24	1.96	1.41	12.58	13.72		
N	1565	513	1480	497	1565	513	1565	513	1565	513	1565	513

Notes: The values for gross output per employee, value added per employee, employment and capital per employee are given in natural logarithms, firm age is in years, and foreign ownership is the proportion of observations of firms that have some foreign ownership. There is a smaller number of observations for value added per employee because taking the natural logarithm eliminates observations with negative value added.

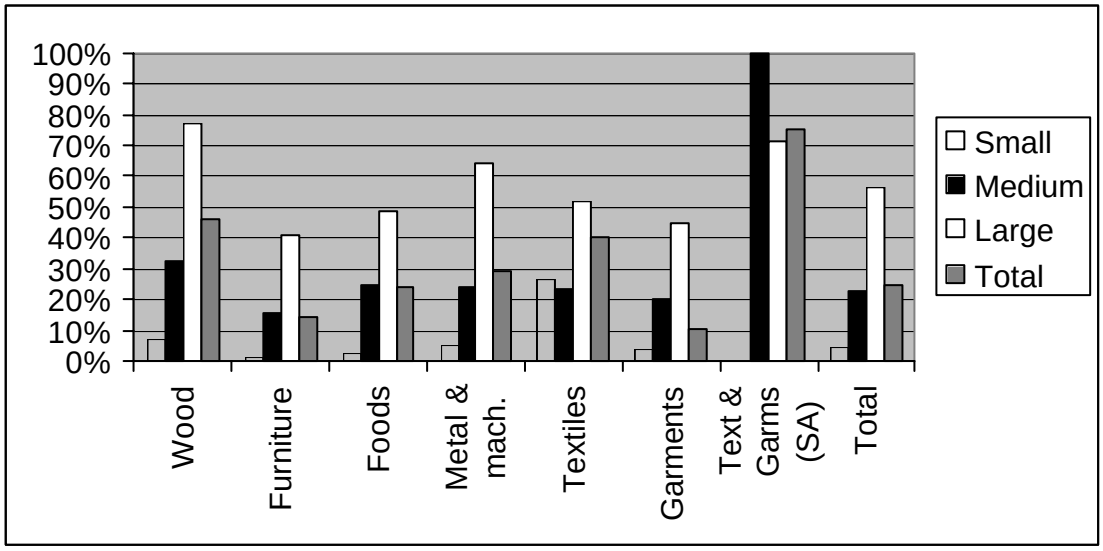
The relationship between size and exporting is presented graphically in Figure 3. The gap between large firms (firms with 75 or more employees) and small ones (those with less than 30 employees) is very substantial - 57 percent of large firms export compared with only 4 percent of small firms. This relationship between export participation and size is present in all the countries. In fact export participation tends to differ more between size categories than between countries within the same size category. Within the large size category Kenyan and South African firms have a very similar propensity to export (72% and 78%). This is followed by Ghana (54%) and Tanzania (43%). Nigeria has a much lower rate of export participation than all the other countries with only 13 percent of large Nigerian firms exporting. In all countries export propensity in the small size group is less than 7%.

Figure 3 Export propensity: by country and size.



Notes: Small < 20 employees, medium 20-74, large >75.
These are no small South African firms in the sample.
These observations are for firms over time thus a firm will be represented by each year it is in the sample.

Figure 4 Export propensity: by size and sector.



Notes: Small < 20 employees, medium 20-74, large >75.
These are no small South African firms in the sample.
These observations are for firms over time thus a firm will be represented by each year it is in the sample.

The relationship between export propensity and size is common across sectors too (Figure 4). In all the sectors, except textiles and the South African textiles and garments sectors, larger firms are more likely to export. In the textiles sector there are more small firms participating in the export market than medium firms. The textile sector also has the highest proportion of small firms exporting (27%) than any other sector. In the South African textiles and garments sector medium sized exporters outnumber large exporters.

As Figure 4 shows export propensity is highest in the South African textiles and garments sector, with 75% of firms exporting. The wood sector (46%) and the textiles sector (40%) have the next highest rates of export propensity. Export propensity is lowest in the garments (11%) and the furniture (14%) sectors. These results suggest that although export propensity differs by sector, this difference is less marked among large firms. These results also suggest that exporting is not concentrated in one sector. In the large size group, at least 40% of observations in every sector are of exporting firms.

In summary in most SSA countries most large firms export. Exporting rates are low because small firms dominate in most SSA countries. Also while these firms are large by African standards they are clearly not large by international ones. The Figures have highlighted both these broad generalities and the exceptions. Nigerian firms are atypically unlikely to export. Exporting is more common in the South African sample because large firms are a larger proportion of the sample. This sampling almost certainly also reflects population differences between South Africa and the other SSA economies on which we have comparative data.

4 The modeling framework

We assume that current export participation is a function of lagged efficiency ($?_{it-1}$), lagged factor inputs (ε_{it-1}), past export participation (X_{it-1}) and unchanging firm-specific effects divided into observed (B_i) and unobserved characteristics (a_i). We use lagged values of factor inputs and efficiency because we are interested in investigating whether there is Granger-causality from factor inputs and/or efficiency to export participation.

Technical efficiency is represented as the residuals, or unexplained part, of a production function. However, instead of using a two step process, the first step of which is to estimate the production function to obtain the residuals and the second to insert these residuals into the export participation function, we chose instead to manipulate the production function and to substitute the components of the production function into the export function.

Equation (1) below illustrates this substitution and the resulting export participation function:

$$\begin{aligned} X_{it} &= f(\eta_{it-1}, z'_{it-1}, B_i, a_i, X_{it-1}) \\ &= \xi_\eta \eta_{it-1} + \xi'_z z'_{it-1} + \xi_B B_i + \xi_a a_i + \xi_X X_{it-1} \\ &= \xi_\eta (y_{it-1} - a_i - \phi B_i - \theta'_z z'_{it-1}) + \xi'_z z'_{it-1} + \xi_B B_i + \xi_a a_i + \xi_X X_{it-1} \\ &= \xi_\eta y_{it-1} + (\xi_a - \xi_\eta) a_i + (\xi_B - \xi_\eta \phi) B_i + (\xi'_z - \xi_\eta \theta'_z) z'_{it-1} + \xi_X X_{it-1} \end{aligned} \quad (1)$$

As can be seen from equation (1) the impact of efficiency on export participation is measured by ($?_?$), the coefficient on lagged output per unit of labour (y_{it-1}). Equation (1) also shows that the coefficients on the observed firm specific effects and factor inputs are a combination of two effects. The first of these effects is the efficiency effect ($?_?$). This efficiency effect has the opposite sign to the coefficient on y_{it-1}. (i.e. if there is a positive efficiency effect and no second effect, this will show up as a negative coefficient on the factor inputs and firm specific effects). This efficiency effect is scaled by the coefficient on the variable in the production function (i.e. $?_z'$ in the case of the factor inputs and ϕ in the case of the observed firm characteristics). In the case of constant returns to scale in the production function the coefficient on labour ($?_l$ in the $?_z'$ vector of factor inputs) will be equal to zero. This means that there will be no efficiency effect present in the coefficient on labour. The second effect present in the coefficients is the direct effect of that variable on export participation ($?_z$). By using this one-step technique, we cannot isolate the direct effect unless the coefficient on the variable in the production function is equal to zero, as it will be on employment if we assume constant returns to scale. The interaction between the productivity (efficiency) effect and the direct effect, and the impact on the coefficient in the export participation function can be better understood with an example. Suppose that there is a positive efficiency effect ($?_?$) and that there is also a positive direct effect of capital intensity ($?_k$) on export participation.[1] If a firm increases its capital stock, whilst everything else remains constant, this reduces productivity which in turn reduces the probability of exporting. However, at the same time it increases the probability of exporting through the direct effect because the firm is now more capital intensive. Thus the estimated coefficient on capital intensity in the export participation equation is measuring these two, and in this case opposite, effects.

Although the possible presence of these two effects in the coefficients on the factor inputs makes it difficult to isolate the individual effects, we can still draw conclusions from the

[1] This positive direct effect may be because capital-intensity is a proxy for the technology available to the firm. Firms that are more capital intensive may use newer technology. This technology may be required to produce goods that are of the required standard to compete on the export market.

coefficients on the factor inputs provided we are able to sign the efficiency effect. Since we know $?_z'$ and ϕ from the production function estimates in the previous chapter, we know the scaling factor, and thus can work out whether a direct effect exists.

Another factor to consider when analysing the results is the possible correlation between size, efficiency, capital-intensity and other factor inputs. The possible multicollinearity between these variables will increase their standard errors and subsequently lower their z-statistics. In the estimations we attempt to deal with this by restricting some coefficients to be equal to 0. We now turn to consider the models to be estimated.

5. Modeling Export Participation

To investigate the relationship between efficiency, size and export participation we estimate equation (1) making a number of different assumptions, and using a variety of estimation procedures. We begin by estimating the least general, or most restrictive, case and assume homogenous firms and no state dependence. We then sequentially relax the restrictions until we arrive at a more general specification. We estimate the model using either a maximum likelihood probit or a logit .[2] We estimate five models:

1. The pooled model. This assumes homogenous firms (a_i is equal across firms), and no state dependence in exporting ($?_X = 0$). This is the most restrictive case and is estimated using a probit estimator.
2. Heterogeneous firms model. We relax the assumption of homogenous firms and allow for unobserved firm effects (a_i), but maintain the assumption of no state dependence in exporting ($?_X = 0$). This is estimated using a random effects probit and a fixed effects, or conditional, logit estimator.
3. Dynamic model with homogenous firms. This assumes homogenous firms (a_i is equal across firms), but allows for state dependence in exporting ($?_X$? 0). It is estimated using a probit estimator.
4. Dynamic model with heterogeneous firms. This allows for unobserved firm effects (a_i), and state dependence in exporting ($?_X$? 0). This is estimated using a random effects probit.
5. Heckman dynamic model. This allows for unobserved firm effects (a_i), and state dependence in exporting ($?_X$? 0) and models the initial conditions or state of export

[2] In most cases the models were also estimated using a maximum likelihood logit but this does not produce substantially different results.

participation (X_{i0}). Both the initial conditions and the export participation function are estimated with a probit estimator.

The assumptions associated with these various estimators are discussed in more detail in the relevant sub-sections.

The Pooled Model

We begin by estimating the most restrictive specification of equation (1). We assume no unobserved firm effects (a_i is equal across firms) and no state dependence in exporting ($?_X = 0$). This restricted form of equation (1) is estimated for individual countries, as well as the pooled sample, using a probit estimator.

Table 5 presents the estimation results for the individual countries. As well as reporting the coefficient estimates we report the change in probability of exporting for an infinitesimal change in each independent, continuous variable, and a discrete change in the probability for a dummy variable. These changes are evaluated at the means of the independent variables.

Size, as measured by the number of employees, is the only variable which is significantly different from zero across all countries. The marginal effect of size, at the respective means, is largest for Kenyan and South African firms, and smallest for Nigeria firms. These results suggest a unit change in size for the mean Kenyan firm would result in an increase in the probability of exporting of 16 percentage points. A unit change in size for the mean South African firm results in a similar increase in the probability of exporting of 14.6 percentage points. This contrasts to an increase of only 3 percentage points for the average Nigerian firm. The marginal effects for exporting from a change in size are not directly comparable across countries as the means at which they are evaluated differ.

Although the coefficients on output per unit labour, the efficiency effect, are positive for all countries, they are only significantly different from zero for Kenya and Nigeria. However, the coefficients for all countries except Nigeria are very similar, suggesting that the data may pool. For Kenya a marginal change in efficiency for the mean firm has a smaller impact on the probability of exporting than a marginal change in size. For Nigeria, a marginal change in efficiency has a slightly larger impact on export probability than a marginal change in size.

For Ghana, Kenya and Tanzania the coefficient on capital intensity is positive and significant. Given that in these three countries the efficiency effect is greater than or equal to zero, this means that the direct effect of capital-intensity on export participation is positive. The marginal effect on export probability of changing capital intensity for the mean firm in these countries is approximately half the effect from a marginal change in size.

Table 5 Parameter estimates for the export participation model. Probit, by country.

	Ghana		Kenya		Nigeria		South Africa		Tanzania	
	Coef	dF/dx	Coef	dF/dx	Coef	dF/dx	Coef	dF/dx	Coef	dF/dx
	Z	x-bar	z	x-bar	z	x-bar	Z	x-bar	z	x-bar
Ln (Output/ labour)$_{t-1}$	0.139	0.022	0.248	0.079	1.032	0.044	0.234	0.074	0.370	0.056
	(0.59)	8.114	(1.76)*	8.872	(2.21)**	8.639	(0.59)	10.665	(0.97)	8.126
Ln (Labour)$_{t-1}$	0.389	0.062	0.514	0.163	0.711	0.031	0.460	0.146	0.329	0.049
	(4.12)***	3.233	(5.77)***	3.493	(3.08)***	3.692	(2.6)***	4.930	(3.3)***	3.108
Ln (Capital/ labour)$_{t-1}$	0.133	0.021	0.212	0.067	-0.094	-0.004	-0.109	-0.035	0.171	0.026
	(1.82)*	7.075	(2.51)**	8.637	(-0.54)	8.750	(-1.02)	9.586	(1.89)*	7.670
Ln (Materials/ labour)$_{t-1}$	-0.074	-0.012	0.096	0.031	-0.564	-0.024	0.333	0.106	-0.280	-0.042
	(-0.47)	7.342	(0.89)	8.179	(-1.5)	7.836	(1.31)	9.904	(-1.05)	7.384
Ln (Other costs/ labour)$_{t-1}$	0.065	0.010	-0.010	-0.003	0.087	0.004	0.087	0.028	-0.028	-0.004
	(0.85)	5.396	(-0.08)	6.418	(0.37)	6.673	(0.56)	7.719	(-0.13)	5.903
Age	0.011	0.002	-0.044	-0.014	-0.174	-0.007	-0.005	-0.002	0.003	0.001
	(0.46)	18.266	(-1.51)	21.349	(-2.87)***	20.992	(-0.25)	21.191	(0.11)	17.285
Age^2	0.000	0.000	0.000	0.000	0.003	0.0001	0.000	0.000	0.000	0.000
	(-1.2)	479.656	(0.78)	635.383	(2.67)***	544.977	(0.65)	746.823	(0.27)	459.363
Foreign ownership	-0.046	-0.007	0.527	0.182	-1.459	-0.045	0.037	0.012	0.256	0.043
	(-0.17)	0.207	(2.11)**	0.197	(-1.42)	0.290	(0.12)	0.245	(0.84)	0.195
Wood	1.265	0.346	-1.223	-0.249					0.131	0.021
	(2.12)**	0.094	(-2.26)**	0.091					(0.3)	0.090
Furniture	-0.476	-0.062	-0.340	-0.099			0.444	0.124	-0.859	-0.093
	(-0.87)	0.201	(-0.63)	0.167			(0.65)	0.129	(-1.72)*	0.211
Foods	-0.906	-0.107	-1.047	-0.257	-1.106	-0.021			0.167	0.027
	(-1.66)*	0.243	(-1.99)**	0.206	(-1.37)	0.092			(0.37)	0.217
Metal & mach.	-0.464	-0.062	0.004	0.001	-1.213	-0.046	0.698	0.243	-0.092	-0.014
	(-0.83)	0.234	(0.01)	0.264	(-1.57)	0.366	(1.09)	0.762	(-0.23)	0.293
Garments	-0.262	-0.037	-0.933	-0.234	1.829	0.216			0.655	0.138
	(-0.41)	0.196	(-1.86)*	0.197	(1.55)	0.267			(1.22)	0.094
Textiles & garms (SA only)							1.021	0.217		
							(1.19)	0.054		
Log pseudo-likelihood	-221.7		-160.6		-24.2		-74.3		-156.0	
pseudo R-squared	0.43		0.47		0.43		0.16		0.29	
N	836		462		131		147		488	
obs. P.		0.177		0.361		0.099		0.707		0.166
Pred P. at xbar		0.087		0.249		0.017		0.751		0.081

Notes:	*** significant at the 1% level, ** significant at the 5% level, * significant at the 10% level. Values in parenthesis are z-statistics. Inputs and output are expressed in natural logarithms. The base sector is textiles in all countries except South Africa, where it is other. Time dummies are included. dF/dx is the change in export probability as a result of a marginal change in x at the means of the independent variables. x-bar is the mean value of the variable. Observations are clustered for individual firms

Firm age is only significantly different from zero for Nigerian firms. This relationship is negative, although it does decrease with time. Since firm age and productivity are unrelated among Nigerian firms this suggests that there is a direct relationship between age and export probability among Nigerian firms – older Nigerian firms are less likely to export.

Foreign ownership is only significantly different from zero for Kenyan firms. Foreign owned firms in Kenya are more likely to export than firms with no foreign ownership. This is also a direct effect given that we found little evidence among Kenyan firms that foreign owned firms are more productive. At the mean values of the Kenyan sample foreign owned firms are 18% more likely to export than wholly domestically owned firms.

The sector of the firm makes no significant difference to export probabilities in Nigeria and South Africa. In Ghana wood firms are more likely to export than textile firms. This is in contrast to Kenya where wood firms are less likely to export. In both Kenya and Ghana firms in the food sector are less likely to export than firms in the textile sector. Kenyan garment firms are less likely to export than textile firms. In Tanzania firms in the furniture sector are the least likely to export. These are all direct effects and are not driven by differences in productivity across sectors.

Across all the countries, except for Nigeria, the factors influencing export participation are similar. This suggests that we can pool the data. We pool together all countries except Nigeria.[3] We estimate the export participation on this pooled data, and on a dataset that excludes South Africa. We exclude South Africa, because we only have two years of South African data, and thus cannot use South Africa when we examine entry and exit later. We interact the country and sector dummies to allow for sector specific determinants of exports to differ by country. Table 6 presents the results.

The estimation results for the pooled dataset are similar to those for the individual countries. The coefficient on size is positive and significant for both pooled data sets. A marginal increase in the size of the mean firm results in an increase in the probability of exporting of 9%. If the South African firms are excluded the marginal increase is 7.6%. The capital-intensity of the

[3] In fact Nigeria has very few exporting firms. This is another reason why we exclude Nigeria.

Table 6 Parameter estimates for the export participation model. Probit estimators, pooled sample

	Pooled, without Nigeria				Pooled, without Nigeria and South Africa			
	Coef z	dF/dx x-bar	Coef z	dF/dx x-bar	Coef Z	dF/dx x-bar	Coef Z	dF/dx x-bar
Ln (Output/ labour)$_{t-1}$	0.180 (1.62)	0.042 8.492	0.190 (2.85)***	0.044 8.492	0.196 (1.68)*	0.039 8.313	0.165 (2.39)**	0.032 8.313
Ln (Labour)$_{t-1}$	0.392 (7.35)***	0.091 3.393	0.392 (7.3)***	0.091 3.393	0.386 (6.94)***	0.076 3.266	0.386 (6.9)***	0.076 3.266
Ln (Capital/ labour)$_{t-1}$	0.133 (2.84)***	0.031 7.789	0.133 (3.02)***	0.031 7.789	0.161 (3.14)***	0.032 7.641	0.163 (3.38)***	0.032 7.641
Ln (Materials/ labour)$_{t-1}$	0.008 (0.1)	0.002 7.747			-0.029 (-0.34)	-0.006 7.570		
Ln (Other costs/ labour)$_{t-1}$	0.002 (0.03)	0.000 5.945			0.000 (0)	0.000 5.799		
Age	0.006 (0.48)	0.001 18.977	0.006 (0.48)	0.001 18.977	0.010 (0.68)	0.002 18.795	0.010 (0.66)	0.002 18.795
Age^2	0.000 (-0.87)	0.000 532.070	0.000 (-0.87)	0.000 532.070	0.000 (-1.21)	0.000 514.394	0.000 (-1.19)	0.000 514.394
Foreign ownership	0.518 (2.27)**	0.139 0.204	0.516 (2.27)**	0.138 0.204	0.516 (2.25)**	0.121 0.201	0.522 (2.28)**	0.122 0.201
Foreign ownership x Ghana	-0.586 (-1.77)*	-0.103 0.089	-0.585 (-1.76)*	-0.103 0.089	-0.606 (-1.83)*	-0.088 0.097	-0.608 (-1.84)*	-0.088 0.097
Foreign ownership x Tanzania	-0.420 (-1.08)	-0.079 0.049	-0.417 (-1.09)	-0.078 0.049	-0.409 (-1.05)	-0.064 0.053	-0.415 (-1.08)	-0.065 0.053
Foreign ownership x South Africa	-0.329 (-0.88)	-0.064 0.019	-0.328 (-0.87)	-0.064 0.019				
Wood	-1.491 (-2.74)***	-0.172 0.085	-1.492 (-2.74)***	-0.172 0.085	-1.449 (2.64)***	-0.140 0.092	-1.443 (-2.63)***	-0.139 0.092
Wood x Ghana	2.726 (3.32)***	0.818 0.041	2.726 (3.33)***	0.818 0.041	2.705 (3.31)***	0.823 0.044	2.704 (3.31)***	0.823 0.044
Wood x Tanzania	1.927 (2.63)***	0.661 0.023	1.925 (2.63)***	0.660 0.023	1.878 (2.55)**	0.632 0.025	1.886 (2.56)**	0.634 0.025
Furniture	-0.570 (-1.1)	-0.109 0.190	-0.573 (-1.11)	-0.109 0.190	-0.548 (-1.05)	-0.088 0.195	-0.537 (-1.03)	-0.087 0.195
Furniture x Ghana	0.110 (0.14)	0.027 0.087	0.111 (0.15)	0.027 0.087	0.080 (0.11)	0.016 0.094	0.072 (0.09)	0.015 0.094
Furniture x Tanzania	-0.116 (-0.16)	-0.025 0.053	-0.116 (-0.16)	-0.025 0.053	-0.169 (-0.23)	-0.030 0.058	-0.171 (-0.23)	-0.031 0.058
Furniture x South Africa	0.112 (0.14)	0.027 0.010	0.115 (0.14)	0.028 0.010				
Foods	-0.918 (-1.88)*	-0.159 0.213	-0.918 (-1.88)*	-0.159 0.213	-0.882 (-1.8)*	-0.131 0.226	-0.884 (-1.8)*	-0.131 0.226
Foods x Ghana	-0.082 (-0.11)	-0.018 0.105	-0.082 (-0.11)	-0.018 0.105	-0.114 (-0.15)	-0.021 0.114	-0.116 (-0.16)	-0.022 0.114
Foods x Tanzania	1.021 (1.58)	0.333 0.055	1.021 (1.58)	0.333 0.055	0.994 (1.53)	0.294 0.059	0.996 (1.54)	0.294 0.059
Foods x South Africa	0.314 (0.35)	0.084 0.004	0.316 (0.35)	0.085 0.004				
Metal & mach.	-0.217 (-0.46)	-0.048 0.296	-0.217 (-0.47)	-0.048 0.296	-0.211 (-0.45)	-0.039 0.258	-0.209 (-0.45)	-0.039 0.258
Metal & mach x Ghana	-0.303 (-0.41)	-0.061 0.101	-0.302 (-0.41)	-0.061 0.101	-0.291 (-0.4)	-0.050 0.110	-0.299 (-0.41)	-0.051 0.110
Metal & mach x Tanzania	0.113 (0.18)	0.027 0.074	0.113 (0.18)	0.027 0.074	0.097 (0.15)	0.020 0.080	0.095 (0.15)	0.020 0.080
Metal & mach x South	-0.008	-0.002	-0.007	-0.002				

Africa	(-0.01)	0.058	(-0.01)	0.058				
Garments	-1.048	-0.162	-1.049	-0.162	-1.016	-0.133	-1.013	-0.133
	(-2.18)**	0.156	(-2.18)**	0.156	(-2.11)**	0.169	(-2.1)**	0.169
Garments x Ghana	0.789	0.241	0.790	0.241	0.756	0.204	0.750	0.202
	(1)	0.085	(1.01)	0.085	(0.96)	0.092	(0.96)	0.092
Garments x Tanzania	1.834	0.634	1.834	0.634	1.792	0.603	1.793	0.603
	(2.54)**	0.024	(2.54)**	0.024	(2.48)**	0.026	(2.48)**	0.026
Ghana	-0.603	-0.134	-0.606	-0.135	-0.572	-0.111	-0.559	-0.108
	(-0.84)	0.432	(-0.85)	0.432	(-0.8)	0.468	(-0.79)	0.468
Tanzania	-1.099	-0.191	-1.100	-0.191	-1.067	-0.160	-1.063	-0.160
	(-1.89)*	0.252	(-1.89)*	0.252	(-1.83)*	0.273	(-1.83)*	0.273
South Africa	-0.461	-0.086	-0.464	-0.086				
	(-0.67)	0.076	(-0.67)	0.076				
Constant	-4.094		-4.100		-4.178		-4.160	
	(-5.62)***		(-5.64)***		(-5.55)***		(-5.54)***	
Log pseudo-likelihood	-641.58		-641.59		-559.28		-559.34	
Pseudo R-squared	0.42		0.42		0.41		0.41	
N	1933		1933		1786		1786	
obs. P		0.259		0.259		0.222		0.222
pred. P (at x bar)		0.148		0.148		0.117		0.117

Notes:
*** significant at the 1% level, ** significant at the 5% level, * significant at the 10% level.
Values in parenthesis are z-statistics. Inputs and output are expressed in natural logarithms. The base sector is textiles in all countries except South Africa, where it is other.
dF/dx is the change in export probability as a result of a marginal change in x at the means of the independent variables.
Observations are clustered for individual firms
x-bar is the mean value of the variable.
Time dummies are included.

firm also has a positive and significant effect on export participation. A marginal increase in the capital-labour ratio results in an increase in export probability of 3.1 percentage points for the non-Nigerian sample, and is similar for the sample that excludes both Nigeria and South Africa. There is no evidence that the ratio of raw materials to labour, or other costs to labour impact on export participation.

The coefficient on output per unit labour (the efficiency effect) is not significant at the 10% level for the pooled sample that excludes Nigeria. However, it is significant at this level if we exclude the South African firms. A possible reason for why the efficiency effect may not be significant in the larger pooled sample may be because of the colinearity between output per unit of labour and other inputs. In order to investigate this we restrict the coefficients on raw materials per unit labour and other costs per unit labour to be equal to 0. These coefficients are not significantly different from zero in either of the estimations. If we do this efficiency becomes significant at the 1% level for the broader pooled dataset, and significant at the 5% level for the dataset that excludes South Africa. In this specification the marginal effect of a change in efficiency on export probability is 4.4 percentage points for the broader dataset and 3.2 percentage points for the dataset that excludes South Africa. These marginal effects are not very

different from the marginal effects obtained without the restrictions, indicating that colinearity between the variables has resulted in larger standard errors on the efficiency term. A unit change in size has more than double the effect of a unit change in productivity or capital-intensity. This suggests that size is the most important determinant of export participation of these three factors.

There is no evidence that the age of the firm has a significant influence on export participation in any of the countries. As the individual country results showed, foreign ownership has a positive and significant affect on export participation in Kenya. The pooled results also indicate that the impact of sector specific factors on export participation differ by country. This is especially noticeable in the wood and garments sectors.

Heterogeneous firms

The pooled model makes the assumption that firms are homogeneous. Since we have panel data we can relax this assumption to investigate whether firm specific effects (both observed and unobserved) are important determinants of export determination. The first technique we consider to deal with possible firm specific effects is a fixed effects model. This assumes that a_i (the firm specific effect) is fixed and that both a_i and β (the vector of coefficients on the non-firm specific variables) are parameters to be estimated. When T (the number of time periods) tends to infinity, the maximum likelihood estimator (MLE) is consistent (Hsiao, 2003, p194). However, if, as in our case, T is small, there are only a limited number of observations to estimate a_i which leads to Neyman and Scott's (1948) incidental-parameter problem. Unfortunately, unlike the linear case where the firm-specific effects (a_i) can be eliminated by taking a linear transformation such as the first difference, no simple transformation exists for the nonlinear model (Hsiao, 2003).

Neyman and Scott (1948) have suggested a general principle to find a consistent estimator for the parameter β in the presence of the incidental parameters a_i. Their idea is to find K functions

$$\Psi_{Nj}(y_1,\ldots,y_N \mid \beta),\ j=1,\ldots,K$$

that are independent of the incidental parameters a_i and have the property that when β are the true values, $?_N(y_1,\ldots,y_N \mid \hat{\beta})$ converges to zero in probability as N tends to infinity. Then an estimator $\hat{\beta}$ derived by solving $?_N(y_1,\ldots,y_N \mid \hat{\beta}) = 0$ is consistent under suitable regularity conditions. McFadden (1974) has demonstrated that a conditional maximum likelihood estimator of β can be obtained by using standard maximum likelihood logit programmes, and is consistent under mild conditions. However, this is not true for the probit specification. We therefore cannot use a fixed

effects probit estimator to control for possible firm heterogeneity but instead need to use a fixed effects (or conditional) logit estimator.

In addition to a fixed effects logit estimator, we also estimate the export participation function using a random effects probit:

$$P(X_{it} = 1 \mid z_i, \alpha_i) = P(X_{it} = 1 \mid z_{it}, \alpha_i) = \Phi(z_{it}\beta + \alpha_i), \quad t = 1,...T$$

Using a random effects probit requires us to make three strict assumptions. The first is that z_{it} (the explanatory variables) is strictly exogenous conditional on a_i. The second is that the outcomes are independent conditional on (z_i, a_i). The third is that a_i and z_i are independent and that a_i has a normal distribution.

In our context these assumptions, particularly the last, are very restrictive. It is difficult to imagine the unobserved firm effects (a_i) and efficiency, size, or capital-intensity being unrelated. However, despite this we use the random effects probit to investigate the robustness of the results. The estimation results using these two techniques are presented in Table 7. The conditional or fixed effects logit is estimated on the dataset that excludes Nigerian and South African firms. South African firms are excluded because none change export status. The results from the fixed effects logit indicate that even after we control for possible firm heterogeneity size and capital intensity still remain significant determinants of export participation. The coefficient on output per unit labour (the efficiency effect) is not significant at the 10% level even if we restrict the coefficients on raw materials per unit labour and other costs per unit labour to be equal to 0. This is in contrast to the results from the random effects probit estimation. These results suggest that efficiency is significant at the 10% level even if we do not impose restrictions on the factor inputs. Size and capital intensity are also significant determinants of export participation in the random effects probit. A likelihood ratio test which tests whether the panel estimator is different from the pooled estimator suggests that it is, indicating that firm heterogeneity is important.

The random effects probit model is calculated using quadrature. As the panel size increases, the quadrature approximation becomes less accurate (STATA, 2003). We check whether changing the number of quadrature points affects the results. Changing the number of quadrature points does influence the coefficient estimates, but it does not change the sign nor the significance of almost all the coefficients. However, we do need to interpret these results with care as the quadrature approximation may not be accurate.

Table 7 Parameter estimates for the export participation model. Heterogeneous firms, pooled sample.

	Fixed effects logit		Random effects probit			
	Pooled, no Nigeria or South Africa		Pooled, no Nigeria		Pooled, no Nigeria or South Africa	
Ln (Output/ labour)$_{t-1}$	0.382	0.316	0.378	0.423	0.399	0.408
	(0.78)	(1.12)	(1.76)*	(3.93)***	(1.69)*	(3.79)***
Ln (Labour) $_{t-1}$	2.879	2.876	1.155	1.173	1.188	1.169
	(2.22)**	(2.22)**	(6.41)***	(7.27)***	(7.92)***	(7.4)***
Ln (Capital/ labour)$_{t-1}$	1.973	1.927	0.397	0.455	0.577	0.500
	(1.69)*	(1.66)*	(3.06)***	(4.03)***	(5.43)***	(5.25)***
Ln (Materials/ labour)$_{t-1}$	-0.021		0.111		0.020	
	(-0.06)		(0.65)		(0.11)	
Ln (Other costs/ labour)$_{t-1}$	-0.145		0.005		-0.028	
	(-0.52)		(0.04)		(-0.24)	
Age			-0.027	-0.018	0.039	0.014
			(-1.19)	(-0.76)	(1.59)	(0.49)
Age^2			0.000	0.000	-0.001	-0.001
			(1.18)	(0.88)	(-2.4)**	(-1.5)
Foreign ownership			1.587	1.571	1.825	1.759
			(3.08)***	(3.08)***	(3.34)***	(2.9)***
Foreign ownership x Ghana			-2.711	-0.767	-0.896	-3.082
			(-4.01)***	(-1.12)	(-1.52)	(-4.08)***
Foreign ownership x Tanzania			-1.274	-1.124	-1.476	-1.651
			(-1.75)*	(-1.55)	(-1.9)*	(-2.36)**
Foreign ownership x South Africa			-0.989	-0.953		
			(-1.01)	(-0.97)		
Wood			-4.568	-4.615	-3.983	-4.505
			(-3.62)***	(-3.56)***	(-3.41)***	(-3.15)***
Wood x Ghana			6.736	8.566	8.012	6.252
			(4.7)***	(4.89)***	(5.46)***	(4.04)***
Wood x Tanzania			6.186	6.232	5.628	5.865
			(3.86)***	(3.92)***	(3.91)***	(4.87)***
Furniture			-2.966	-3.058	-2.344	-2.952
			(-1.99)**	(-1.99)**	(-1.84)*	(-1.73)*
Furniture x Ghana			1.273	3.266	2.646	0.829
			(0.88)	(1.75)*	(1.81)*	(0.5)
Furniture x Tanzania			0.296	0.268	-0.700	-0.203
			(0.19)	(0.17)	(-0.47)	(-0.14)
Furniture x South Africa			1.990	2.054		
			(0.84)	(0.84)		
Foods			-3.706	-3.631	-3.169	-4.154
			(-3.18)***	(-3.09)***	(-2.87)***	(-2.51)**
Foods x Ghana			1.214	1.078	0.273	1.524
			(1.03)	(0.92)	(0.21)	(0.94)
Foods x Tanzania			2.973	3.001	2.651	3.467
			(2.34)**	(2.41)**	(2.07)**	(2.77)***
Foods x South Africa			2.010	1.890		
			(0.88)	(0.81)		
Metal & mach.			-1.596	-1.605	-1.065	-1.652
			(-1.79)*	(-1.76)*	(-1.15)	(-1.42)
Metal & mach x Ghana			-0.726	-0.686	-1.258	-0.651
			(-0.71)	(-0.66)	(-1.06)	(-0.55)
Metal & mach x Tanzania			1.174	1.254	-0.028	0.942
			(0.95)	(0.98)	(-0.02)	(0.85)
Metal & mach x South Africa			1.317	1.278		
			(0.72)	(0.67)		
Garments			-3.290	-3.235	-2.532	-3.161
			(-3.11)***	(-3.01)***	(-2.41)**	(-2.73)***
Garments x Ghana			2.210	4.137	3.490	1.764
			(1.91)*	(3.05)***	(2.72)***	(1.41)
Garments x Tanzania			5.068	5.173	4.345	4.464
			(3.26)***	(3.38)***	(2.93)***	.
Ghana			-1.190	-3.111	-2.464	-0.859
			(-1.19)	(-2.45)**	(-2.15)**	(-0.64)
Tanzania			-3.623	-3.746	-2.936	-3.296
			(-2.79)***	(-2.97)***	(-2.47)**	(-3.63)***
South Africa			-2.032	-1.869		
			(-1.08)	(-0.97)		

Constant			-10.466 (-6.55)***	-10.673 (-6.83)***	-12.844 (-5.92)***	-11.148 (-5.72)***
Log likelihood	-84.50	-84.63	-523.91	-521.87	-438.56	-441.96
N	254	254	1933	1933	1786	1786
N(firms)	57	57	841	841	694	694
LR-test (p-value)			0	0	0	0
Notes:	*** significant at the 1% level, ** significant at the 5% level, * significant at the 10% level. Values in parenthesis are z-statistics. Inputs and output are expressed in natural logarithms. The base sector is textiles in all countries except South Africa, where it is other. Time dummies are included. The random-effects probit is estimated using 12 quadrature points.					

State dependence in exporting

Numerous empirical studies that investigated whether sunk costs of entry into the export market influence export participation. These studies all used a dynamic probit or logit equation to investigate whether past export participation significantly influences current export participation. A finding of a significant effect of past export participation on current export participation is interpreted as state dependence.

In order to investigate whether there is state dependence in exporting in our sample, we add a lagged dependent variable to our specification. We initially assume that this is exogenous, and make no attempt to model the exporting process prior to when we observe it. We do not allow for firm heterogeneity. Table 8 presents the results of the estimates using the pooled sample. As with the estimations in the previous section the broader dataset includes Ghana, Kenyan, Tanzanian and South African firms. The smaller dataset excludes South African firms.

The lagged dependent variable is positive and significant for all estimations. These results suggest that an average firm that participated in the export market in the previous period has a 72% higher probability of participating in the export market in the current period than a firm that did not export in the previous period. If South African firms are excluded this decreases slightly to 67%. This indicates a high degree of export participation persistence, or state dependence.

As with the static pooled model estimated earlier, if the coefficients on raw materials per unit labour and other costs per unit labour are restricted to equal 0, then efficiency enters as a significant determinant of export participation. The change in probability of exporting for a marginal change in efficiency is 3.3 percentage points for the broader sample and 2.4 percentage points for the narrower sample. This is only slightly smaller than for the model that does not allow for state dependence. Size and capital-intensity remain significant and positive if state dependence is controlled for.

Table 8 Parameter estimates for the export participation model. Dynamic probit model, pooled sample.

	Pooled, no Nigeria				Pooled, no Nigeria or South Africa			
	Coef est	dF/dx	Coef est	dF/dx	Coef est	dF/dx	Coef est	dF/dx
	Z	x-bar	z	x-bar	z	x-bar	z	x-bar
$Export_{t-1}$	2.548	0.726	2.534	0.723	2.413	0.670	2.398	0.667
	(21.41)***	0.254	(21.51)***	0.254	(19.41)***	0.219	(19.52)***	0.219
Ln (Output/ $labour)_{t-1}$	0.120	0.023	0.167	0.033	0.130	0.020	0.154	0.024
	(0.86)	8.492	(2.85)***	8.492	(0.93)	8.313	(2.63)***	8.313
Ln $(Labour)_{t-1}$	0.214	0.042	0.209	0.041	0.213	0.034	0.209	0.033
	(4.42)***	3.393	(4.25)***	3.393	(4.38)***	3.266	(4.22)***	3.266
Ln (Capital/ $labour)_{t-1}$	0.109	0.021	0.092	0.018	0.128	0.020	0.112	0.018
	(2.44)**	7.789	(2.18)**	7.789	(2.71)***	7.641	(2.5)**	7.641
Ln (Materials/ $labour)_{t-1}$	0.084	0.016			0.066	0.010		
	(0.85)	7.747			(0.65)	7.570		
Ln (Other costs/ $labour)_{t-1}$	-0.069	-0.013			-0.072	-0.011		
	(-1.06)	5.945			(-1.09)	5.799		
Age	-0.002	0.000	-0.001	0.000	-0.002	0.000	-0.001	0.000
	(-0.2)	18.977	(-0.07)	18.977	(-0.15)	18.795	(-0.04)	18.795
Age^2	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	(-0.18)	532.070	(-0.34)	532.070	(-0.3)	514.394	(-0.43)	514.394
Foreign ownership	0.300	0.065	0.290	0.062	0.314	0.056	0.306	0.055
	(1.57)	0.204	(1.54)	0.204	(1.69)*	0.201	(1.67)*	0.201
Foreign ownership x Ghana	-0.149	-0.027	-0.191	-0.034	-0.182	-0.026	-0.224	-0.031
	(-0.52)	0.089	(-0.67)	0.089	(-0.66)	0.097	(-0.81)	0.097
Foreign ownership x Tanzania	-0.053	-0.010	-0.062	-0.012	-0.074	-0.011	-0.084	-0.013
	(-0.16)	0.049	(-0.19)	0.049	(-0.23)	0.053	(-0.27)	0.053
Foreign ownership x South Africa	-0.268	-0.044	-0.257	-0.043				
	(-0.84)	0.019	(-0.82)	0.019				
Wood	-0.706	-0.095	-0.743	-0.098	-0.720	-0.075	-0.756	-0.078
	(-2.02)**	0.085	(-2.1)**	0.085	(-2.08)**	0.092	(-2.15)**	0.092
Wood x Ghana	0.729	0.199	0.733	0.201	0.816	0.199	0.821	0.201
	(1.15)	0.041	(1.15)	0.041	(1.3)	0.044	(1.3)	0.044
Wood x Tanzania	1.343	0.436	1.310	0.423	1.337	0.395	1.313	0.387
	(2.26)**	0.023	(2.22)**	0.023	(2.32)**	0.025	(2.3)**	0.025
Furniture	-0.282	-0.049	-0.316	-0.055	-0.279	-0.039	-0.308	-0.043
	(-0.67)	0.190	(-0.76)	0.190	(-0.69)	0.195	(-0.77)	0.195
Furniture x Ghana	-0.538	-0.079	-0.474	-0.072	-0.515	-0.061	-0.454	-0.056
	(-0.88)	0.087	(-0.77)	0.087	(-0.86)	0.094	(-0.75)	0.094
Furniture x Tanzania	0.372	0.087	0.380	0.090	0.295	0.055	0.303	0.057
	(0.57)	0.053	(0.58)	0.053	(0.46)	0.058	(0.48)	0.058
Furniture x South Africa	-0.058	-0.011	-0.009	-0.002				
	(-0.1)	0.010	(-0.02)	0.010				
Foods	-0.344	-0.059	-0.349	-0.060	-0.361	-0.050	-0.367	-0.051
	(-0.97)	0.213	(-0.99)	0.213	(-1.04)	0.226	(-1.06)	0.226
Foods x Ghana	-0.982	-0.118	-0.960	-0.117	-0.936	-0.090	-0.914	-0.090
	(-1.78)*	0.105	(-1.73)*	0.105	(-1.71)*	0.114	(-1.67)*	0.114
Foods x Tanzania	0.329	0.075	0.320	0.073	0.340	0.065	0.334	0.064
	(0.63)	0.055	(0.62)	0.055	(0.67)	0.059	(0.67)	0.059
Foods x South Africa	-0.116	-0.021	-0.074	-0.014				
	(-0.21)	0.004	(-0.13)	0.004				
Metal & mach.	0.166	0.034	0.146	0.029	0.142	0.023	0.120	0.020
	(0.49)	0.296	(0.43)	0.296	(0.42)	0.258	(0.36)	0.258
Metal & mach x Ghana	-1.095	-0.124	-1.037	-0.121	-1.035	-0.095	-0.979	-0.093
	(-2)**	0.101	(-1.88)*	0.101	(-1.91)*	0.110	(-1.79)*	0.110
Metal & mach x	-0.343	-0.055	-0.331	-0.054	-0.326	-0.042	-0.312	-0.041

Tanzania	(-0.65)	0.074	(-0.63)	0.074	(-0.64)	0.080	(-0.62)	0.080
Metal & mach x South Africa	-0.140	-0.025	-0.119	-0.022				
	(-0.3)	0.058	(-0.26)	0.058				
Garments	-0.524	-0.081	-0.539	-0.084	-0.531	-0.066	-0.543	-0.067
	(-1.42)	0.156	(-1.46)	0.156	(-1.48)	0.169	(-1.51)	0.169
Garments x Ghana	-0.119	-0.022	-0.030	-0.006	-0.096	-0.014	-0.011	-0.002
	(-0.2)	0.085	(-0.05)	0.085	(-0.16)	0.092	(-0.02)	0.092
Garments x Tanzania	1.070	0.328	1.072	0.330	1.074	0.293	1.077	0.296
	(1.83)*	0.024	(1.85)*	0.024	(1.9)*	0.026	(1.93)*	0.026
Ghana	0.360	0.072	0.305	0.061	0.330	0.053	0.280	0.045
	(0.66)	0.432	(0.56)	0.432	(0.62)	0.468	(0.52)	0.468
Tanzania	-0.858	-0.130	-0.880	-0.133	-0.827	-0.103	-0.850	-0.106
	(-1.69)*	0.252	(-1.74)*	0.252	(-1.7)*	0.273	(-1.76)*	0.273
South Africa	-0.242	-0.041	-0.280	-0.047				
	(-0.5)	0.076	(-0.58)	0.076				
Constant	-4.220		-4.224		-4.229		-4.208	
	(-6.89)***		(-6.86)***		(-6.82)***		(-6.76)***	
Log pseudo-likelihood	-336.02		-336.90		-316.14		-316.91	
Pseudo R-squared	0.70		0.70		0.67		0.66	
N	1933		1933		1786		1786	
Obs P.		0.259		0.259		0.222		0.222
Pred P.		0.115		0.116		0.086		0.087

Notes:
*** significant at the 1% level, ** significant at the 5% level, * significant at the 10% level.
Values in parenthesis are z-statistics. Inputs and output are expressed in natural logarithms. The base sector is textiles in all countries except South Africa, where it is textiles and garments.
Time dummies are included.
dF/dx is the change in export probability as a result of a marginal change in x at the means of the independent variables.
x-bar is the mean value.
Observations are clustered for individual firms

Controlling for both firm heterogeneity and state dependence

The finding of state dependence in exporting may be spurious in that certain unobserved characteristics, which are not influenced by the experience of the event, may influence the probability of a firm exporting. Hsiao (2003) suggests that if these variables are correlated over time and are not properly controlled for, previous experience may appear to be a determinant of future experience solely because it is a proxy for such temporally persistent unobservables. We need to determine whether spurious or true state dependence – where as a consequence of past export participation, the constraints, prices or preferences of the firm are altered – is present. In the case of true state dependence an otherwise identical firm which has not experienced the effect will behave differently in future to a firm that has experienced the event. In order to determine which of these processes account for the observed state dependence we need to control for firm heterogeneity.

As discussed before, controlling for firm heterogeneity in a probit model is not straightforward. Ideally we would like to estimate a fixed-effects probit model where we do not impose any restrictions on the relationship between the individual effects (a_i) and the explanatory variables (z_i). However in a probit model we cannot obtain a consistent estimation of the slope parameters without making an assumption about the relationship between a_i and z_i. We thus need to assume that a_i and z_i are independent and that a_i has a normal distribution, and estimate equation (1) using a random effects probit model.

We do not use a fixed effects logit estimator once we introduce a lagged dependent variable. Chamberlain (1993) has demonstrated that if individuals are observed in only three time periods and the dependent variable is lagged once, then the parameters of a logit model are not identified. Honoré and Kyriazidou (2000) have demonstrated that the parameters of the model are identified (subject to regularity conditions), if the econometrician has access to 4 or more observations per individual. The number of firms with four or more observations in our data is small, and thus we cannot use Honoré and Kyriazidou's technique to estimate a fixed effects logit.

Table 9 presents the results for the random effects probit. Unlike the previous random effects estimations these results do not change if we change the number of quadrature points. These results are identical to the dynamic probit estimation that does not allow for firm heterogeneity. A likelihood ratio test of the panel versus pooled model confirms that the panel estimation is no different from the pooled estimation. This is different to the results from the estimation of the model that allowed for heterogeneous firms but no state dependence in exporting, which suggested that firm heterogeneity mattered. These results suggest that once we control for previous export participation firm heterogeneity no longer affects export participation. Part of the explanation for this is that there is a high degree of export persistence. This persistence together with size, capital-intensity and efficiency may dominate other firm effects. These results are for export participation only. In a later section we will examine whether firm heterogeneity matters for entry into and exit from the export market.

Table 9 Parameter estimates for the export participation model. Dynamic model with heterogeneous firms. Pooled sample.

	Random effects probit			
	Pooled, no Nigeria		Pooled, no Nigeria or South Africa	
$Export_{t-1}$	2.548	2.534	2.413	2.398
	(21.58)***	(21.64)***	(19.63)***	(19.69)***
Ln (Output/ labour)$_{t-1}$	0.120	0.167	0.130	0.154
	(0.86)	(2.82)***	(0.92)	(2.61)***
Ln (Labour) $_{t-1}$	0.214	0.209	0.213	0.209
	(4.51)***	(4.44)***	(4.5)***	(4.43)***
Ln (Capital/ labour)$_{t-1}$	0.109	0.092	0.128	0.112
	(2.46)**	(2.17)**	(2.8)***	(2.55)**
Ln (Materials/ labour)$_{t-1}$	0.084		0.066	
	(0.75)		(0.57)	
Ln (Other costs/ labour) $_{t-1}$	-0.069		-0.072	
	(-1.06)		(-1.08)	
Age	-0.002	-0.001	-0.002	-0.001
	(-0.19)	(-0.07)	(-0.14)	(-0.04)
Age^2	0.000	0.000	0.000	0.000
	(-0.17)	(-0.32)	(-0.29)	(-0.42)
Foreign ownership	0.300	0.290	0.314	0.306
	(1.19)	(1.16)	(1.27)	(1.25)
Foreign ownership x Ghana	-0.149	-0.191	-0.182	-0.224
	(-0.46)	(-0.6)	(-0.58)	(-0.72)
Foreign ownership x Tanzania	-0.053	-0.062	-0.074	-0.084
	(-0.15)	(-0.17)	(-0.21)	(-0.24)
Foreign ownership x South Africa	-0.268	-0.257		
	(-0.53)	(-0.52)		
Wood	-0.706	-0.743	-0.720	-0.756
	(-1.44)	(-1.54)	(-1.51)	(-1.6)
Wood x Ghana	0.729	0.733	0.816	0.821
	(1.15)	(1.16)	(1.31)	(1.33)
Wood x Tanzania	1.343	1.310	1.337	1.313
	(2.03)**	(2)**	(2.07)**	(2.05)**
Furniture	-0.282	-0.316	-0.279	-0.308
	(-0.69)	(-0.77)	(-0.69)	(-0.77)
Furniture x Ghana	-0.538	-0.474	-0.515	-0.454
	(-0.97)	(-0.86)	(-0.94)	(-0.83)
Furniture x Tanzania	0.372	0.380	0.295	0.303
	(0.57)	(0.59)	(0.46)	(0.48)
Furniture x South Africa	-0.058	-0.009		
	(-0.06)	(-0.01)		
Foods	-0.344	-0.349	-0.361	-0.367
	(-0.91)	(-0.92)	(-0.98)	(-0.99)
Foods x Ghana	-0.982	-0.960	-0.936	-0.914
	(-1.86)*	(-1.81)*	(-1.79)*	(-1.75)*
Foods x Tanzania	0.329	0.320	0.340	0.334
	(0.63)	(0.61)	(0.66)	(0.65)
Foods x South Africa	-0.116	-0.074		
	(-0.11)	(-0.07)		
Metal & mach.	0.166	0.146	0.142	0.120
	(0.45)	(0.39)	(0.39)	(0.33)
Metal & mach x Ghana	-1.095	-1.037	-1.035	-0.979
	(-2.12)**	(-2.02)**	(-2.03)**	(-1.93)*
Metal & mach x Tanzania	-0.343	-0.331	-0.326	-0.312
	(-0.63)	(-0.6)	(-0.61)	(-0.58)
Metal & mach x South Africa	-0.140	-0.119		
	(-0.16)	(-0.14)		
Garments	-0.524	-0.539	-0.531	-0.543
	(-1.24)	(-1.28)	(-1.28)	(-1.31)
Garments x Ghana	-0.119	-0.030	-0.096	-0.011
	(-0.2)	(-0.05)	(-0.17)	(-0.02)
Garments x Tanzania	1.070	1.072	1.074	1.077
	(1.62)	(1.63)	(1.67)*	(1.67)*
Ghana	0.360	0.305	0.330	0.280
	(0.74)	(0.63)	(0.69)	(0.59)
Tanzania	-0.858	-0.880	-0.827	-0.850
	(-1.77)*	(-1.82)*	(-1.74)*	(-1.8)*

South Africa	-0.242 (-0.29)	-0.280 (-0.33)		
Constant	-4.220 (-6.37)***	-4.224 (-6.42)***	-4.229 (-6.37)***	-4.208 (-6.39)***
N	1933	1933	1786	1786
Number of firms	841	841	694	694
Log likelihood	-336.02	-336.90	-316.14	-316.91
Likelihood-ratio test - pooled vs panel (p value)	1	1	1	1
Notes:	*** significant at the 1% level, ** significant at the 5% level, * significant at the 10% level. Values in parenthesis are z-statistics. Inputs and output are expressed in natural logarithms. The base sector is textiles in all countries except South Africa, where it is textiles and garments. Time dummies are included. The random-effects probit is estimated using 12 quadrature points.			

Initial conditions and the dynamic Heckman probit technique

Although we have included a lagged dependent variable in an attempt to capture the effect of state dependence we have assumed that this is exogenous. We do not observe the export process from its beginning, and thus the initial export status is a function of unobserved past export status, which may also be related to firm specific factors. In order to deal with this we need to model the probability of the initial state. To do this we use a technique suggested by Heckman (1981b-Hsiao) where we model the initial conditions together with the full model.[4]

This technique approximates the initial conditions for a dynamic discrete choice model by the following procedure:

1. Approximate the probability of X_{i0}, the initial state in the sample, by a probit model, with index function

$$X_{i0}^{*} = Q(z_i) + \varepsilon_{i0}$$

and

$$X_{i0} = \begin{cases} 1 \text{ if } X_{i0}^{*} > 0, \\ 0 \text{ if } X_{i0}^{*} \le 0, \end{cases}$$

Where $Q(z_i)$ is a general function of $z_{it}, t=0,\ldots,T$, usually specified as linear in z_{it}, and e_{i0} is assumed to be normally distributed, with mean zero and variance 1.

2. Permit e_{i0} to be freely correlated with v_{it} (error term in the dynamic model), $t=1,\ldots,T$.

3. Estimate the model by maximum likelihood without imposing any restrictions between the parameters of the structural system and parameters of the approximate reduced-form probability for the initial state of the sample.

[4] This discussion closely follows Hsiao (2003, p210).

Table 10 Parameter estimates for the export participation model. Heckman dynamic probit controlling for initial conditions. Pooled sample of Ghanaian, Kenyan and Tanzanian firms.

$Export_{t-1}$	2.426	2.424
	(20.25)***	(20.25)***
Ln (Output/ labour)$_{t-1}$	0.125	0.193
	(0.92)	(2.74)***
Ln (Labour) $_{t-1}$	0.215	0.215
	(4.74)***	(4.73)***
Ln (Capital/ labour)$_{t-1}$	0.121	0.118
	(2.72)***	(2.68)***
Ln (Materials/ labour)$_{t-1}$	0.064	
	(0.58)	
Ln (Other costs/ labour) $_{t-1}$	-0.056	-0.058
	(-0.88)	(-0.92)
Wood	-0.805	-0.813
	(-1.65)*	(-1.68)*
Wood x Ghana	0.785	0.782
	(1.26)	(1.26)
Wood x Tanzania	1.229	1.200
	(1.91)*	(1.88)*
Furniture	-0.334	-0.357
	(-0.83)	(-0.89)
Furniture x Ghana	-0.518	-0.499
	(-0.96)	(-0.92)
Furniture x Tanzania	0.245	0.247
	(0.39)	(0.40)
Foods	-0.444	-0.436
	(-1.21)	(-1.19)
Foods x Ghana	-0.936	-0.935
	(-1.81)	(-1.81)
Foods x Tanzania	0.231	0.224
	(0.46)	(0.45)
Metal & mach.	0.086	0.085
	(0.24)	(0.23)
Metal & mach x Ghana	-1.022	-1.008
	(-2.02)**	(-1.99)**
Metal & mach x Tanzania	-0.359	-0.357
	(-0.69)	(-0.68)
Garments	-0.582	-0.590
	(-1.42)	(-1.44)
Garments x Ghana	-0.112	-0.096
	(-0.20)	(-0.17)
Garments x Tanzania	0.912	0.909
	(1.49)	(1.48)
Ghana	0.464	0.437
	(1.03)	(0.98)
Tanzania	-0.623	-0.627
	(-1.45)	(-1.46)
Constant	-4.161	-4.181
	(-6.71)**	(-6.76)***
Variance of the individual effects	0.00	0.00
	(1)	(1)
N	1778	1778
Log likelihood	-629.903	-630.072

Notes:
*** significant at the 1% level, ** significant at the 5% level, * significant at the 10% level.
Values in parenthesis are z-statistics. Inputs and output are expressed in natural logarithms. The base sector is textiles and the base country is Kenya.
The initial state is a function of log output per employee, log factor inputs, sector, country and time controls.
Age, age^2 and foreign ownership are not included as explanatory variables in this model as the model fails to converge if they are included.
Time dummies are included.
The quadrature procedure uses 5 nodes.

The random effects are assumed uncorrelated with all the explanatory variables in the model except the lagged dependent variable. These random effects are assumed to be normally distributed. A Gauss-Hermite quadrature is used to integrate out the random effects, and five nodes are used. This procedure is best suited for panels with large N and short T. The longer the time period, the less important it is to model the initial conditions.

We assume that the initial state is a function of log output per employee, log factor inputs, sector, country and time controls. This is estimated jointly with the dynamic specification of export participation. Age, age^2 and foreign ownership are not included as explanatory variables as the model fails to converge if these are included. Table 10 presents these results.

The results from the Heckman dynamic estimation are very similar to the dynamic probit that does not model the initial conditions. The lagged dependent variable is significant indicating that previous export participation is an important determinant of current export participation. Size and capital intensity are also significant determinants of export participation. Efficiency is not significant at the 10% level if all factor inputs are included in the specification. However, if we restrict the coefficient on raw material per unit labour to be equal to 0, efficiency becomes significant at the 1% level.[5]

Very few of the sector and country dummies are significant. Kenyan wood firms are less likely to export than Kenyan textile firms. Tanzanian wood firms are more likely to export than Kenyan wood firms. Ghanaian metal and machinery firms are less likely to export than Kenyan firms in this sector. There is no evidence that firm heterogeneity plays a significant role in determining export participation – the variance of the individual effects is equal to 0. This is consistent with the results obtained in the dynamic probit estimation that allowed for firm specific effects.

A summary of the export participation results

Table 11 below provides a summary of the estimation results obtained for all the models. These are for the sample that excluded Nigeria and South Africa as this allows comparisons to be made across all models. Regardless of the technique used or the assumptions made the results are remarkably robust. Size of the firm, as measured by the number of people employed, is a significant determinant of export participation in all models. The capital-labour ratio is also significant in all models. The coefficient on output per unit labour – the efficiency effect – is only occasionally significant if no restrictions are placed on the coefficients of the factor inputs.

[5] We do not restrict the coefficient on other cost per unit labour to be equal to 0 because if we do the model fails to converge.

Table 11 Parameter estimates for the export participation model. All techniques. Pooled sample (excludes Nigeria and South Africa)

	Pooled model	Hetero. Firms		Dynamic model	Dynamic model & hetero firms	Initial conditions
	Probit	Fixed effects logit	Random effects probit	Dynamic probit	Random effects probit	Heckman dynamic probit
$Export_{t-1}$				2.413	2.413	2.426
				(19.41)***	(19.63)***	(20.25)***
Ln (Output/ labour)$_{t-1}$	0.196	0.382	0.399	0.130	0.130	0.125
	(1.68)*	(0.78)	(1.69)*	(0.93)	(0.92)	(0.92)
Ln (Labour) $_{t-1}$	0.386	2.879	1.188	0.213	0.213	0.215
	(6.94)***	(2.22)**	(7.92)***	(4.38)***	(4.5)***	(4.74)***
Ln (Capital/ labour)$_{t-1}$	0.161	1.973	0.577	0.128	0.128	0.121
	(3.14)***	(1.69)*	(5.43)***	(2.71)***	(2.8)***	(2.72)***
Ln (Materials/ labour)$_{t-1}$	-0.029	-0.021	0.020	0.066	0.066	0.064
	(-0.34)	(-0.06)	(0.11)	(0.65)	(0.57)	(0.58)
Ln (Other costs/ labour) $_{t-1}$	0.000	-0.145	-0.028	-0.072	-0.072	-0.056
	(0)	(-0.52)	(-0.24)	(-1.09)	(-1.08)	(-0.88)
Age	0.010		0.039	-0.002	-0.002	
	(0.68)		(1.59)	(-0.15)	(-0.14)	
Age^2	0.000		-0.001	0.000	0.000	
	(-1.21)		(-2.4)**	(-0.3)	(-0.29)	
Foreign ownership	0.516		1.825	0.314	0.314	
	(2.25)**		(3.34)***	(1.69)*	(1.27)	
Foreign ownership x Ghana	-0.606		-0.896	-0.182	-0.182	
	(-1.83)*		(-1.52)	(-0.66)	(-0.58)	
Foreign ownership x Tanzania	-0.409		-1.476	-0.074	-0.074	
	(-1.05)		(-1.9)*	(-0.23)	(-0.21)	
Wood	-1.449		-3.983	-0.720	-0.720	-0.805
	(2.64)***		(-3.41)***	(-2.08)**	(-1.51)	(-1.65)*
Wood x Ghana	2.705		8.012	0.816	0.816	0.785
	(3.31)***		(5.46)***	(1.3)	(1.31)	(1.26)
Wood x Tanzania	1.878		5.628	1.337	1.337	1.229
	(2.55)**		(3.91)***	(2.32)**	(2.07)**	(1.91)*
Furniture	-0.548		-2.344	-0.279	-0.279	-0.334
	(-1.05)		(-1.84)*	(-0.69)	(-0.69)	(-0.83)
Furniture x Ghana	0.080		2.646	-0.515	-0.515	-0.518
	(0.11)		(1.81)*	(-0.86)	(-0.94)	(-0.96)
Furniture x Tanzania	-0.169		-0.700	0.295	0.295	0.245
	(-0.23)		(-0.47)	(0.46)	(0.46)	(0.39)
Foods	-0.882		-3.169	-0.361	-0.361	-0.444
	(-1.8)*		(-2.87)***	(-1.04)	(-0.98)	(-1.21)
Foods x Ghana	-0.114		0.273	-0.936	-0.936	-0.936
	(-0.15)		(0.21)	(-1.71)*	(-1.79)*	(-1.81)
Foods x Tanzania	0.994		2.651	0.340	0.340	0.231
	(1.53)		(2.07)**	(0.67)	(0.66)	(0.46)
Metal & mach.	-0.211		-1.065	0.142	0.142	0.086
	(-0.45)		(-1.15)	(0.42)	(0.39)	(0.24)
Metal & mach x Ghana	-0.291		-1.258	-1.035	-1.035	-1.022
	(-0.4)		(-1.06)	(-1.91)*	(-2.03)**	(-2.02)**
Metal & mach x Tanzania	0.097		-0.028	-0.326	-0.326	-0.359
	(0.15)		(-0.02)	(-0.64)	(-0.61)	(-0.69)
Garments	-1.016		-2.532	-0.531	-0.531	-0.582
	(-2.11)**		(-2.41)**	(-1.48)	(-1.28)	(-1.42)
Garments x Ghana	0.756		3.490	-0.096	-0.096	-0.112
	(0.96)		(2.72)***	(-0.16)	(-0.17)	(-0.20)
Garments x Tanzania	1.792		4.345	1.074	1.074	0.912
	(2.48)**		(2.93)***	(1.9)*	(1.67)*	(1.49)
Ghana	-0.572		-2.464	0.330	0.330	0.464
	(-0.8)		(-2.15)**	(0.62)	(0.69)	(1.03)
Tanzania	-1.067		-2.936	-0.827	-0.827	-0.623
	(-1.83)*		(-2.47)**	(-1.7)*	(-1.74)*	(-1.45)
Constant	-4.178		-12.844	-4.229	-4.229	-4.161
	(-5.55)***		(-5.92)***	(-6.82)***	(-6.37)***	(-6.71)**
Log (pseudo-) likelihood	-559.28	-84.50	-438.56	-316.14	-316.14	-629.903
Pseudo R-squared	0.41			0.67		
N	1786	254	1786	1786	1786	1778

N (firms)	57	694	694
LR test pooled vs panel (p-value)		0	1
Notes:	*** significant at the 1% level, ** significant at the 5% level, * significant at the 10% level. Values in parenthesis are z-statistics. Inputs and output are expressed in natural logarithms. The base sector is textiles in all countries except South Africa, where it is other. The base country is Kenya. In the probit, logit, and dynamic probit logit models observations are clustered for individual firms. In the Heckman dynamic probit the initial state is a function of log output per employee, log factor inputs, sector, country and time controls. Age, age^2 and foreign ownership are not included as explanatory variables in this model as the model fails to converge if they are included. Time dummies are included.		

However, if the coefficients on raw materials per unit labour and other costs per unit labour are set equal to zero, the efficiency is significant in all models except the conditional logit. Previous export participation is also significant if it is included. Firm heterogeneity is not an important determinant of export participation if previous export participation is included.

There is little evidence that firm age matters for export participation. Only in Kenya does foreign ownership has a positive effect on export participation. Very few of the country and sector interaction terms have a significant impact on export participation.

The results obtained in this section are broadly consistent with those obtained in previous studies. These previous studies have found that size is an important determinant of export participation in all specifications that include it. Bernard and Jensen (1997, 2001, NBER), Bigsten *et al* (2002) and Söderbom and Teal (2000), all obtain significant coefficients on employment although they use different techniques and specifications. Roberts and Tybout (1997) also find that size, as measured by the capital stock of the firm, is an important determinant of export participation. Efficiency is also significant in most studies, albeit often only at the 10% level (see Söderbom and Teal, 2000; Bigsten *et al*, 2002; Bernard and Jensen, 1997, 2001). Past export participation is significant in all the mentioned studies. The results for these African firms do differ though with respect to age. Roberts and Tybout (1997) find that increases in age increase the probability of exporting. Söderbom and Teal (2000) find a non-linear relationship between export participation and age among Ghanaian firms, where the exporting probability increases up until the age of 16 years and then falls.

The results have indicated that efficiency, size and capital-intensity are significant determinants of export participation. Figure 5 graphs the export probability of the mean firm for various changes in these three variables.[6] This enables us to get an idea of how changes in these

[6] These results are calculated as the predicted values from the dynamic probit model which excludes Nigeria and South Africa, and restricts the coefficients on raw materials per unit labour and other costs per unit labour to be equal to 0. These predicted values are calculated by changing the independent variable of

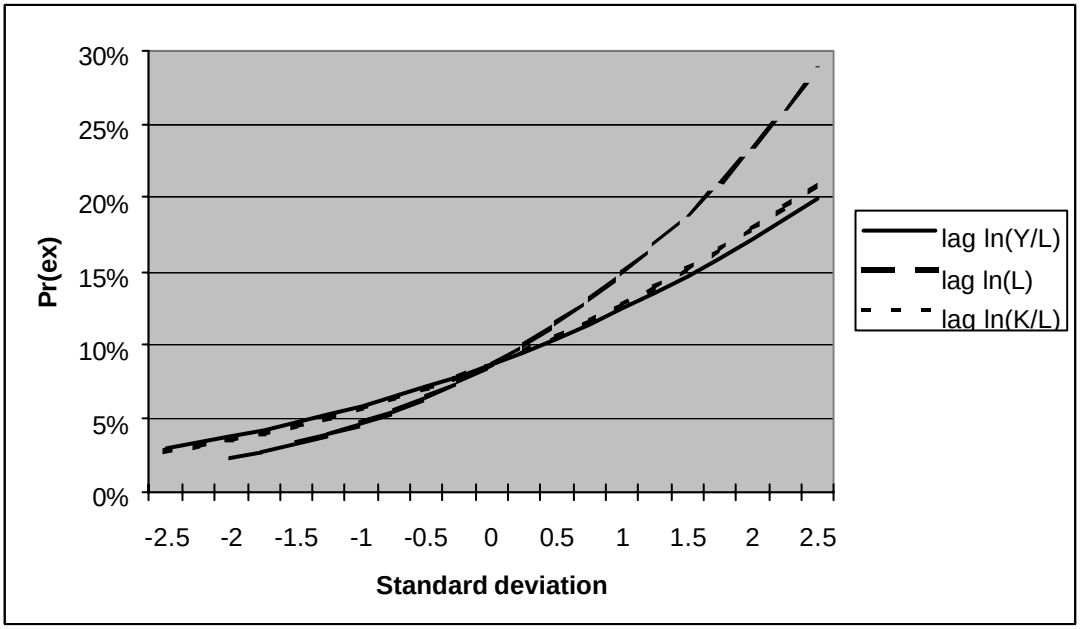
Table 12 Parameter estim ates for the export participation model. All techniques, coefficient restrictions. Pooled sample (excludes Nigeria and South Africa)

	Pooled model	Hetero firms		Dynamic model	Dynamic model and hetero firms	Initial conditions
	Probit	Fixed effects logit	Random effects probit	Dynamic probit	Dynamic random effects probit	Heckman dynamic probit
$Export_{t-1}$				2.398	2.398	2.424
				(19.52)***	(19.69)***	(20.25)***
Ln (Output/ labour)$_{t-1}$	0.165	0.316	0.408	0.154	0.154	0.193
	(2.39)**	(1.12)	(3.79)***	(2.63)***	(2.61)***	(2.74)***
Ln (Labour) $_{t-1}$	0.386	2.876	1.169	0.209	0.209	0.215
	(6.9)***	(2.22)**	(7.4)***	(4.22)***	(4.43)***	(4.73)***
Ln (Capital/ labour)$_{t-1}$	0.163	1.927	0.500	0.112	0.112	0.118
	(3.38)***	(1.66)*	(5.25)***	(2.5)**	(2.55)**	(2.68)***
Ln (Materials/ labour)$_{t-1}$						
Ln (Other costs/ labour) $_{t-1}$						-0.058
						(-0.92)
Age	0.010		0.014	-0.001	-0.001	
	(0.66)		(0.49)	(-0.04)	(-0.04)	
Age^2	0.000		-0.001	0.000	0.000	
	(-1.19)		(-1.5)	(-0.43)	(-0.42)	
Foreign ownership	0.522		1.759	0.306	0.306	
	(2.28)**		(2.9)***	(1.67)*	(1.25)	
Foreign ownership x Ghana	-0.608		-3.082	-0.224	-0.224	
	(-1.84)*		(-4.08)***	(-0.81)	(-0.72)	
Foreign ownership x Tanzania	-0.415		-1.651	-0.084	-0.084	
	(-1.08)		(-2.36)**	(-0.27)	(-0.24)	
Wood	-1.443		-4.505	-0.756	-0.756	-0.813
	(-2.63)***		(-3.15)***	(-2.15)**	(-1.6)	(-1.68)*
Wood x Ghana	2.704		6.252	0.821	0.821	0.782
	(3.31)***		(4.04)***	(1.3)	(1.33)	(1.26)
Wood x Tanzania	1.886		5.865	1.313	1.313	1.200
	(2.56)**		(4.87)***	(2.3)**	(2.05)**	(1.88)*
Furniture	-0.537		-2.952	-0.308	-0.308	-0.357
	(-1.03)		(-1.73)*	(-0.77)	(-0.77)	(-0.89)
Furniture x Ghana	0.072		0.829	-0.454	-0.454	-0.499
	(0.09)		(0.5)	(-0.75)	(-0.83)	(-0.92)
Furniture x Tanzania	-0.171		-0.203	0.303	0.303	0.247
	(-0.23)		(-0.14)	(0.48)	(0.48)	(0.40)
Foods	-0.884		-4.154	-0.367	-0.367	-0.436
	(-1.8)*		(-2.51)**	(-1.06)	(-0.99)	(-1.19)
Foods x Ghana	-0.116		1.524	-0.914	-0.914	-0.935
	(-0.16)		(0.94)	(-1.67)*	(-1.75)*	(-1.81)
Foods x Tanzania	0.996		3.467	0.334	0.334	0.224
	(1.54)		(2.77)***	(0.67)	(0.65)	(0.45)
Metal & mach.	-0.209		-1.652	0.120	0.120	0.085
	(-0.45)		(-1.42)	(0.36)	(0.33)	(0.23)
Metal & mach x Ghana	-0.299		-0.651	-0.979	-0.979	-1.008
	(-0.41)		(-0.55)	(-1.79)*	(-1.93)*	(-1.99)**
Metal & mach x Tanzania	0.095		0.942	-0.312	-0.312	-0.357
	(0.15)		(0.85)	(-0.62)	(-0.58)	(-0.68)
Garments	-1.013		-3.161	-0.543	-0.543	-0.590
	(-2.1)**		(-2.73)***	(-1.51)	(-1.31)	(-1.44)
Garments x Ghana	0.750		1.764	-0.011	-0.011	-0.096
	(0.96)		(1.41)	(-0.02)	(-0.02)	(-0.17)
Garments x Tanzania	1.793		4.464	1.077	1.077	0.909
	(2.48)**		.	(1.93)*	(1.67)*	(1.48)
Ghana	-0.559		-0.859	0.280	0.280	0.437
	(-0.79)		(-0.64)	(0.52)	(0.59)	(0.98)
Tanzania	-1.063		-3.296	-0.850	-0.850	-0.627
	(-1.83)*		(-3.63)***	(-1.76)*	(-1.8)*	(-1.46)

interest by a multiple of the standard deviation. The standard deviation is calculated for the firms used in the estimation.

Constant	-4.160 (-5.54)***		-11.148 (-5.72)***	-4.208 (-6.76)***	-4.208 (-6.39)***	-4.181 (-6.76)***
Log (pseudo-) likelihood	-559.34	-84.63	-441.96	-316.91	-316.91	-630.072
Pseudo R-squared	0.41			0.66		
N	1786	254	1786	1786	1786	1778
N(firms).		57	694		694	
LR test pooled vs panel (p-value)			0		1	
Notes:	*** significant at the 1% level, ** significant at the 5% level, * significant at the 10% level. Values in parenthesis are z-statistics. Inputs and output are expressed in natural logarithms. The base sector is textiles, and the base country is Kenya. In the probit, logit, and dynamic probit logit models observations are clustered for individual firms. In the Heckman dynamic probit the initial state is a function of log output per employee, log factor inputs, sector, country and time controls. Age, age^2 and foreign ownership are not included as explanatory variables in this model as the model fails to converge if they are included. Time dummies are included.					

Figure 5 Predicted probability of exporting for changes in efficiency, size and capital-intensity.



Notes: Predicted probabilities calculated from the dynamic probit model which excludes Nigeria and South Africa, and restricts the coefficients on raw materials per unit labour and other costs per unit labour to be equal to 0. These predicted values are calculated by changing the independent variable of interest by a multiple of the standard deviation. The standard deviation is calculated for the firms used in the estimation.

variables would affect the probability of exporting. The x-axis represents values for these variables in terms of standard deviations from the mean. The graph clearly illustrates that the changes in employment have the largest impact on the probability of exporting. An increase in

size of ½ of a standard deviation from the mean (26 to 56 employees), holding all else constant, increases the probability of exporting from 8.7 to 11.5%. A similar increase in efficiency (i.e. ½ of a standard deviation), increases the probability from 8.7 to 10.5%, and a similar increase of the capital-labour ratio, increases the probability from 8.7 to 10.6%.

6. Do the determinants of export participation differ by destination?

In our estimation thus far we have not made allowances for the fact that the determinants of export participation may differ by export destination. Regional and international markets may differ in terms of characteristics, barriers to entry, levels of competition etc. Firms that export regionally may have different characteristics, different behaviour patterns and produce different products to those that export internationally. In this sub-section we investigate whether this is the case. Export destination is divided into two groups: international, or outside of Africa; and regional, or African exporters.In order to investigate whether the determinants of regional and international exporting differ we estimate a bivariate probit. The specification takes the following form:

$$
\begin{aligned}
X_{it}^{Region} &= \xi_{XR} X_{it\text{-}1}^{Region} + \xi_{XI} X_{it\text{-}1}^{International} + \theta_R^{'} z_R + \varepsilon_R, \\
X_{it}^{International} &= \xi_{XR} X_{it\text{-}1}^{Region} + \xi_{XI} X_{it\text{-}1}^{International} + \theta_I^{'} z_I + \varepsilon_I, \\
E[\varepsilon_R] &= E[\varepsilon_I] = 0, \\
Var[\varepsilon_R] &= Var[\varepsilon_I] = 1, \\
Cov[\varepsilon_R, \varepsilon_I] &= \rho
\end{aligned}
$$

Where: X_{it}^{Region} is a dummy variable that takes a value 1 if a firm exports to the region and 0 otherwise; $X_{it}^{International}$ is a dummy variable that takes a value 1 if a firm exports internationally and 0 otherwise; z_R is a vector of explanatory variables in the regional equation; z_I is a vector of explanatory variables in the international equation; and e_R and e_I are the respective error terms.

This specification is a natural extension to the probit model used earlier, and similar to the seemingly unrelated regressions model. The two equations are linked through the correlated disturbances. The explanatory variables used in this specification are exactly the same as those for exports in general. We include previous export participation in both export markets to investigate whether state dependence is important, and whether participation in one export market affects participation in the other. As with the general exporting model we exclude Nigeria initially but also estimate the model on a dataset that excludes both Nigeria and South Africa. The results are presented in tables 13 and 14.

Table 13 Parameter estimates for export destination model. Bivariate probit, pooled sample (Nigeria excluded)

	African exports	International exports	African exports	International exports	African exports	International exports	African exports	International exports
(African exports)$_{t-1}$					2.532	0.348	2.528	0.331
					(15.48)***	(2.32)**	(15.58)***	(2.16)**
(International exports)$_{t-1}$					0.385	3.015	0.356	3.019
					(2.46)**	(15.27)***	(2.27)**	(15.45)***
Ln (Output/ labour)$_{t-1}$	0.174	0.089	0.308	0.000	0.234	0.209	0.330	0.019
	(1.56)	(0.72)	(4.32)***	(-0.01)	(1.23)	(0.87)	(4.43)***	(0.25)
Ln (Labour)$_{t-1}$	0.326	0.302	0.323	0.307	0.182	0.258	0.170	0.263
	(5.55)***	(4.68)***	(5.39)***	(4.73)***	(3.28)***	(4.34)***	(3.04)***	(4.38)***
Ln (Capital/ labour)$_{t-1}$	0.110	0.126	0.100	0.140	0.048	0.037	0.027	0.045
	(2.21)**	(2.26)**	(2.09)**	(2.65)***	(1.03)	(0.66)	(0.59)	(0.78)
Ln (Materials/ labour)$_{t-1}$	0.142	-0.107			0.162	-0.175		
	(1.74)*	(-1.21)			(1.08)	(-1.02)		
Ln (Other costs/ labour)$_{t-1}$	-0.022	0.042			-0.103	-0.009		
	(-0.35)	(0.61)			(-1.49)	(-0.13)		
Age	0.005	0.005	0.007	0.004	-0.003	-0.007	-0.002	-0.009
	(0.42)	(0.35)	(0.53)	(0.27)	(-0.24)	(-0.61)	(-0.13)	(-0.72)
Age^2	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	(-0.78)	(-0.24)	(-0.91)	(-0.14)	(-0.39)	(0.71)	(-0.55)	(0.85)
Foreign ownership	0.482	0.343	0.448	0.355	-0.009	0.351	-0.021	0.374
	(2.13)**	(1.19)	(2.01)**	(1.24)	(-0.03)	(1.23)	(-0.08)	(1.23)
Foreign ownership x Ghana	-0.577	-0.486	-0.549	-0.474	0.151	-0.522	0.147	-0.537
	(-1.78)*	(-1.26)	(-1.69)*	(-1.23)	(0.42)	(-1.47)	(0.41)	(-1.45)
Foreign ownership x Tanzania	-0.455	-0.347	-0.441	-0.334	-0.050	-0.388	-0.083	-0.399
	(-0.97)	(-0.7)	(-0.94)	(-0.67)	(-0.12)	(-0.75)	(-0.19)	(-0.74)
Foreign ownership x South Africa	-0.325	-0.051	-0.295	-0.061	-0.009	-0.304	0.009	-0.305
	(-0.91)	(-0.13)	(-0.83)	(-0.15)	(-0.02)	(-0.75)	(0.03)	(-0.72)
Wood	-1.559	-0.709	-1.593	-0.687	-0.832	-1.022	-0.866	-1.003
	(-3.01)***	(-1.42)	(-3.05)***	(-1.39)	(-1.58)	(-2.36)**	(-1.72)*	(-2.35)**
Wood x Ghana	1.551	2.310	1.563	2.315	0.362	1.149	0.339	1.135
	(2.29)**	(2.94)***	(2.31)**	(2.94)***	(0.54)	(1.92)*	(0.53)	(1.9)*
Wood x Tanzania	2.023	0.804	1.965	0.863	0.598	0.447	0.525	0.601
	(2.45)**	(1.01)	(2.39)**	(1.08)	(0.77)	(0.51)	(0.71)	(0.67)
Furniture	-0.861	-0.434	-0.912	-0.393	-0.345	-0.977	-0.456	-0.871
	(-1.72)*	(-0.93)	(-1.82)*	(-0.85)	(-0.7)	(-1.93)*	(-0.93)	(-1.85)*
Furniture x Ghana	-0.101	0.592	-0.051	0.534	-0.429	0.920	-0.271	0.825
	(-0.15)	(0.78)	(-0.08)	(0.71)	(-0.71)	(1.35)	(-0.45)	(1.25)
Furniture x Tanzania	-4.761	0.051	-4.773	0.048	-4.529	1.386	-4.482	1.344
	(-7.41)***	(0.06)	(-7.47)***	(0.06)	(-6.91)***	(1.45)	(-6.71)***	(1.41)
Furniture x South Africa	0.314	0.468	0.377	0.437	-0.054	1.021	0.096	0.948
	(0.4)	(0.57)	(0.48)	(0.53)	(-0.09)	(1.65)*	(0.16)	(1.58)
Foods	-1.669	0.192	-1.656	0.187	-0.685	-0.448	-0.683	-0.467
	(-3.47)***	(0.47)	(-3.44)***	(0.46)	(-1.48)	(-1)	(-1.49)	(-1.02)
Foods x Ghana	0.141	-0.261	0.158	-0.283	-0.934	0.304	-0.902	0.290
	(0.22)	(-0.37)	(0.25)	(-0.39)	(-1.55)	(0.51)	(-1.48)	(0.48)
Foods x Tanzania	1.925	-0.238	1.896	-0.225	0.526	0.259	0.492	0.270
	(2.7)***	(-0.36)	(2.66)***	(-0.34)	(0.77)	(0.32)	(0.74)	(0.33)
Foods x South Africa	1.043	-0.287	1.088	-0.314	0.272	0.360	0.342	0.363
	(1.17)	(-0.33)	(1.21)	(-0.36)	(0.42)	(0.59)	(0.53)	(0.59)
Metal & mach.	-0.349	-1.476	-0.367	-1.459	0.507	-1.447	0.444	-1.426
	(-0.79)	(-3.33)***	(-0.83)	(-3.31)***	(1.18)	(-3.67)***	(1.03)	(-3.63)***
Metal & mach x Ghana	-0.012	0.876	0.057	0.815	-1.144	1.122	-0.968	1.064
	(-0.02)	(1.15)	(0.09)	(1.07)	(-2.13)**	(1.86)*	(-1.76)*	(1.77)*
Metal & mach x Tanzania	0.364	0.997	0.372	0.990	-0.931	1.720	-0.885	1.699
	(0.52)	(1.31)	(0.53)	(1.3)	(-1.31)	(2.01)**	(-1.25)	(1.98)**
Metal & mach x South Africa	-0.286	2.203	-0.257	2.182	-0.867	2.159	-0.774	2.152
	(-0.43)	(3.06)***	(-0.38)	(3.03)***	(-1.59)	(4.2)***	(-1.42)	(4.21)***
Garments	-1.446	-0.304	-1.450	-0.301	-0.398	-1.323	-0.414	-1.289
	(-3.14)***	(-0.72)	(-3.13)***	(-0.71)	(-0.89)	(-2.01)**	(-0.94)	(-1.97)**
Garments x Ghana	1.037	0.595	1.103	0.549	-0.556	0.942	-0.324	0.894
	(1.59)	(0.75)	(1.72)*	(0.69)	(-0.91)	(1.16)	(-0.54)	(1.1)
Garments x	2.323	1.062	2.284	1.088	0.557	1.495	0.509	1.532

Tanzania	(2.89)***	(1.32)	(2.85)***	(1.34)	(0.73)	(1.39)	(0.68)	(1.42)
Ghana	-0.970	-0.148	-1.050	-0.093	-0.224	-0.174	-0.348	-0.103
	(-1.68)*	(-0.21)	(-1.82)*	(-0.13)	(-0.44)	(-0.31)	(-0.67)	(-0.18)
Tanzania	-1.565	-0.174	-1.562	-0.178	-0.719	-0.529	-0.719	-0.524
	(-2.31)**	(-0.27)	(-2.3)**	(-0.27)	(-1.03)	(-0.6)	(-1.05)	(-0.59)
South Africa	-0.709	-0.217	-0.765	-0.188	-0.775	-0.865	-0.828	-0.827
	(-1.06)	(-0.31)	(-1.13)	(-0.27)	(-1.38)	(-1.42)	(-1.51)	(-1.37)
Constant	-4.367	-3.667	-4.429	-3.621	-5.041	-3.480	-4.993	-3.375
	(-5.69)***	(-5.02)***	(-5.78)***	(-4.92)***	(-6.72)***	(-4.57)***	(-6.6)***	(-4.71)***
N	1673		1673		1380		1380	
Log-likelihood	-950.68		-953.59		-371.85		-373.67	
Rho	0.44		0.43		0.20		0.17	
Wald-test (p-value)	0.00		0.00		0.21		0.26	

Notes:

raw materials and other costs per unit labour are restricted to 0. Efficiency is never significant for International exporters. Previous exporting participation, regardless of the destination, is positively related to current export participation in both destinations. As with exports in general age and foreign ownership do not matter for either of the destinations. For regional exporters only three of the country and sector interactions are significantly different from 0 – wood, Tanzanian furniture and foods.[7] Many more of the country and sector interactions significantly affect international exporting.

7. Implications of Efficiency and Exporting

Two major results emerge from the micro analysis of this paper. The first is the robust finding across all the estimations of the export participation decision that size matters for entering the export market. In one sense that was obvious from the descriptive statistics reported in section 3 above. However we have shown that this size effect is not an efficiency effect. Larger firms do have higher levels of labour productivity but, controlling for this, size still matters. Indeed we have shown that its quantitative impact is larger than that for efficiency. Further, this size effect is not due to any sector composition of exports, it is not due to the fact that size is correlated with capital intensity and, remarkably, it remains significant when we control for fixed effects. In other words we have evidence that size is not proxying some aspect of the firm correlated with size which is a time-invariant unobservable. Finally, size remain significant when we control for state dependence with a lagged dependent variable, implying that size is not proxying for fixed entry costs of exporting.

[7] This is for the sample that excludes Nigeria and South Africa.

Table 14 Parameter estimates for export destination model. Bivariate probit, pooled sample (Nigeria and South Africa excluded)

	African exports	International exports	African exports	International exports	African exports	International exports	African exports	International exports
(African exports)$_{t-1}$					2.294	0.456	2.285	0.443
					(13.23)***	(2.76)***	(13.31)***	(2.66)***
(International exports)$_{t-1}$					0.462	2.803	0.423	2.808
					(2.5)**	(13.39)***	(2.3)**	(13.52)***
Ln (Output/ labour)$_{t-1}$	0.180	0.070	0.285	-0.020	0.247	0.208	0.321	0.012
	(1.55)	(0.53)	(3.81)***	(-0.25)	(1.26)	(0.84)	(4.23)***	(0.16)
Ln (Labour)$_{t-1}$	0.318	0.300	0.315	0.305	0.179	0.254	0.166	0.258
	(5.06)***	(4.32)***	(4.94)***	(4.36)***	(3.06)***	(4.14)***	(2.82)***	(4.17)***
Ln (Capital/ labour)$_{t-1}$	0.133	0.133	0.124	0.151	0.071	0.043	0.049	0.048
	(2.36)**	(2.1)**	(2.3)**	(2.51)**	(1.39)	(0.72)	(0.98)	(0.78)
Ln (Materials/ labour)$_{t-1}$	0.117	-0.118			0.153	-0.170		
	(1.38)	(-1.25)			(0.97)	(-0.96)		
Ln (Other costs/ labour)$_{t-1}$	-0.023	0.055			-0.115	-0.025		
	(-0.33)	(0.71)			(-1.59)	(-0.35)		
Age	0.014	0.003	0.015	0.002	0.007	-0.013	0.007	-0.015
	(0.86)	(0.15)	(0.91)	(0.1)	(0.39)	(-0.91)	(0.44)	(-0.99)
Age^2	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	(-1.22)	(-0.14)	(-1.28)	(-0.06)	(-1.01)	(1.04)	(-1.08)	(1.12)
Foreign ownership	0.480	0.355	0.452	0.367	0.067	0.292	0.053	0.314
	(2.11)**	(1.22)	(2.01)**	(1.27)	(0.27)	(1.1)	(0.22)	(1.12)
Foreign ownership x Ghana	-0.584	-0.501	-0.561	-0.487	0.045	-0.452	0.040	-0.473
	(-1.8)*	(-1.3)	(-1.73)*	(-1.26)	(0.13)	(-1.37)	(0.12)	(-1.37)
Foreign ownership x Tanzania	-0.454	-0.365	-0.444	-0.347	-0.127	-0.311	-0.160	-0.323
	(-0.96)	(-0.74)	(-0.94)	(-0.7)	(-0.3)	(-0.62)	(-0.39)	(-0.63)
Wood	-1.513	-0.712	-1.544	-0.679	-0.783	-0.917	-0.839	-0.908
	(-2.9)***	(-1.4)	(-2.94)***	(-1.35)	(-1.6)	(-2.17)**	(-1.79)*	(-2.18)**
Wood x Ghana	1.503	2.285	1.513	2.289	0.306	1.140	0.307	1.124
	(2.21)**	(2.9)***	(2.22)**	(2.9)***	(0.48)	(1.92)*	(0.49)	(1.89)*
Wood x Tanzania	1.944	0.780	1.897	0.842	0.562	0.435	0.518	0.591
	(2.36)**	(0.97)	(2.31)**	(1.05)	(0.76)	(0.54)	(0.74)	(0.71)
Furniture	-0.837	-0.435	-0.878	-0.386	-0.346	-0.886	-0.457	-0.792
	(-1.67)*	(-0.92)	(-1.74)*	(-0.83)	(-0.74)	(-1.81)*	(-0.99)	(-1.74)*
Furniture x Ghana	-0.139	0.575	-0.099	0.508	-0.460	0.852	-0.302	0.774
	(-0.21)	(0.76)	(-0.15)	(0.67)	(-0.79)	(1.29)	(-0.51)	(1.2)
Furniture x Tanzania	-4.847	0.022	-4.854	0.018	-4.848	1.245	-4.639	1.221
	(-7.53)***	(0.03)	(-7.58)***	(0.02)	(-7.89)***	(1.39)	(-7.48)***	(1.35)
Foods	-1.635	0.218	-1.621	0.211	-0.795	-0.320	-0.784	-0.344
	(-3.4)***	(0.53)	(-3.36)***	(0.52)	(-1.8)*	(-0.74)	(-1.82)*	(-0.78)
Foods x Ghana	0.125	-0.297	0.136	-0.319	-0.768	0.195	-0.738	0.188
	(0.2)	(-0.42)	(0.21)	(-0.45)	(-1.33)	(0.33)	(-1.27)	(0.32)
Foods x Tanzania	1.897	-0.268	1.870	-0.253	0.642	0.112	0.605	0.133
	(2.66)***	(-0.4)	(2.62)***	(-0.38)	(1)	(0.15)	(0.97)	(0.17)
Metal & mach.	-0.347	-1.462	-0.361	-1.446	0.438	-1.399	0.369	-1.385
	(-0.79)	(-3.29)***	(-0.81)	(-3.27)***	(1.09)	(-3.6)***	(0.92)	(-3.59)***
Metal & mach x Ghana	0.007	0.859	0.065	0.794	-1.027	1.044	-0.844	1.000
	(0.01)	(1.14)	(0.11)	(1.04)	(-1.99)**	(1.74)*	(-1.6)	(1.67)*
Metal & mach x Tanzania	0.343	0.976	0.350	0.971	-0.850	1.591	-0.797	1.580
	(0.49)	(1.29)	(0.5)	(1.28)	(-1.28)	(1.98)**	(-1.2)	(1.95)*
Garments	-1.416	-0.298	-1.417	-0.294	-0.469	-1.149	-0.485	-1.121
	(-3.06)***	(-0.7)	(-3.05)***	(-0.69)	(-1.13)	(-1.9)*	(-1.18)	(-1.85)*
Garments x Ghana	1.007	0.574	1.064	0.520	-0.466	0.797	-0.219	0.763
	(1.53)	(0.73)	(1.65)*	(0.66)	(-0.79)	(1.03)	(-0.38)	(0.99)
Garments x Tanzania	2.247	1.036	2.214	1.065	0.590	1.365	0.554	1.409
	(2.79)***	(1.29)	(2.76)***	(1.32)	(0.81)	(1.37)	(0.78)	(1.4)
Ghana	-0.942	-0.130	-1.009	-0.066	-0.267	-0.102	-0.388	-0.031
	(-1.63)	(-0.19)	(-1.74)*	(-0.09)	(-0.54)	(-0.19)	(-0.78)	(-0.06)
Tanzania	-1.501	-0.160	-1.497	-0.162	-0.704	-0.449	-0.707	-0.447
	(-2.21)**	(-0.25)	(-2.21)**	(-0.25)	(-1.08)	(-0.55)	(-1.11)	(-0.54)
Constant	-4.469	-3.524	-4.502	-3.512	-5.134	-3.407	-5.021	-3.294

	(-5.58)***	(-4.55)***	(-5.62)***	(-4.45)***	(-6.72)***	(-4.51)***	(-6.5)***	(-4.53)
N	1528		1528		1235		1235	
Log-likelihood	-781.44		-783.82		-334.86		-336.56	
Rho	0.42		0.41		0.16		0.14	
Wald-test (p-value)	0.00		0.00		0.34		0.39	
Notes:								

Our second major result is that the efficiency effect we have found on the export decision operates only for the regional export market not for the international one. It needs to be spelt out that efficiency includes, given the way we have modeled it, all the factors that are not included as arguments of the production function. In particular given that we have not used data on human capital in the production function our results imply that such skills do not impact on the ability of firms to enter the international export market. Such efficiency does matter for the regional exporting market, although its quantitative importance is less than size.

What can explain these results, can they be believed and what are their implications? Our result on size as we have tried to show is remarkably robust. The most obvious explanation is that there are continuing costs to exporting that only large firms can meet. If this is so it has important policy implications. We know that large firms are much more capital intensive than smaller ones. We have evidence from Ghana, Söderbom and Teal (2004) that his reflects factor prices not technology. Policies to promote small firms which provide many jobs per unit of capital will not promote firms that can export. Without such export rapid job creation is impossible. Other explanations of the size effect are possible and it requires further work to try to identify the factors that underlie the size effect convincingly. That there is an effect to be identified we think we have demonstrated.

Our most surprising result, and the one about which skepticism seems merited, is that efficiency does not affect the decision to enter the international export market. It is possible that while the results seems clear-cut for our regressions that in our sample, confined as it is to SSA firms, we simply do not have sample of relatively efficient firms that can enter the export market. In other words efficiency matters a lot, so much in fact that the low efficiency of African firms prevent any other than marginal entry into the international market. That remains speculation as we do not yet have the comparative data that will enable us to investigate this speculation. More work is required before the micro firm-level data can more fully inform macro questions.

References

Bernard, A.B. and J.B. Jansen, 1995, 'Exporters, Jobs and Wages in US Manufacturing 1976-87,' *Brookings Papers on Economic Activity Microeconomics*: 67-119.

Bernard, A.B. and J.B. Jansen, 1999a, 'Exporting and Productivity,' National Bureau of Economic Research Working Paper: 7135.

Bernard, A.B. and J.B. Jansen, 1999b, 'Exceptional Exporter Performance: Cause, Effect, or Both?' *Journal of International Economics*, 47: 1-25.

Bernard, A.B and J.B Jensen, 2001, 'Why Some Firms Export,' National Bureau of Economic Research Working Paper: 8349.

Bernard, A. and J. Wagner, 1997, 'Exports and Success in German Manufacturing,' *Weltwirtschaftliches Archiv,* 133(1): 134-157.

Berndt, E. and D. Wood, 1975, 'Technology, Prices, and the Derived Demand for Energy,' *Review of Economics and Statistics*, 57(3): 259-268.

Bhagwati, J., A. Panagariya and T.N. Srinivasan, 1998, *Lectures on international trade*, Second edition. MIT Press, Cambridge and London.

Bigsten, A., P. Collier. S. Dercon, M. Fafchamps, B. Gauthier, J.W. Gunning, J. Haraburema, A. Oduro, R. Oostendorp, C. Pattillo, M. Söderbom, F. Teal and A. Zeufack, 1999, 'Exports of African Manufactures: Macro Policy and Firm Behaviour' *The Journal of International Trade and Economic Development*, 8: 53-71.

Bigsten, A., P. Collier. S. Dercon, M. Fafchamps, B. Gauthier, J.W. Gunning, J. Haraburema, A. Oduro, R. Oostendorp, C. Pattillo, M. Söderbom, F. Teal and A. Zeufack, 2002, 'Do African Manufacturing Firms Learn from Exporting?' Centre for the Study of African Economies Working Paper, WPS/2002-09.

Frankel, J.A. Romer, D., 1999. Does trade cause growth? American Economic Review 89, 379-399.

Greenaway, D., Morgan, W., Wright, P., 2002. Trade liberalisation and growth in developing countries. Journal of Development Economics 67, 229-244.

Griliches, A., Hausman, J.A., 1986. Errors in variables in panel data. Journal of Econometrics 31, 93-118.

Heston, A., Summers, R., Aten, B., 2002. Penn World Table Version 6.1, Center for International Comparisons at the University of Pennsylvania (CICUP).

Honoré, B. and E. Kyriazidou, 2000, 'Panel Data Discrete Choice Models with Lagged Dependent Variables,' *Econometrica*, 68(4): 839-874.

Horstmann, I.J. and J.R. Markusen, 1992, 'Endogenous Market Structures in International Trade,' *Journal of International Economics*, 32(1-2): 109-129.

Hsiao, C., 2003, *Analysis of panel data*, Second edition. Econometric Society Monographs, no. 34. Cambridge University Press, Cambridge, New York and Melbourne.

Irwin, D.A., Terviö, M., 2002. Does trade raise income? Evidence from the twentieth century. Journal of International Economics 58, 1-18.

McFadden, D., 1974, 'The Measurement of Urban Travel Demand,' *Journal of Public Economics*, 3(4): 303-28.

Roberts, M. and J. Tybout, 1997, 'The Decision to Export in Colombia: An Empirical Model of Entry with Sunk Costs,' *American Economic Review*, 87(4): 545-564.

Neyman, J. and E.L. Scott, 1948, 'Consistent Estimates Based on Partially Consistent Observations,' *Econometrica*, 16: 1-32.

Söderbom, M. and F. Teal, 2000, 'Skills, Investment and Exports from Manufacturing firms in Africa,' *Journal of Development Studies,* 37(2): 13-43.

Söderbom, Måns, Francis Teal and Anthony Wambugu. (2002) "Does firm size really affect earnings?" CSAE Working paper WPS/2002-08.

Söderbom, Måns and Francis Teal (2003) "Openness and Human Capital as Sources of Productivity Growth: An Empirical Investigation" CSAE Working paper 2003-06.

Söderbom, Måns and Francis Teal. 2004. "Size and efficiency in African manufacturing firms: evidence from firm-level panel data." *Journal of Development Economics*, 73: 369-394.

Söderbom, Måns, Francis Teal and Anthony Wambugu (forthcoming) "Unobserved Heterogeneity and the Relation between Earnings and Firm Size: Evidence from Two Developing Countries" *Economic Letters*.

Söderbom, Måns, Francis Teal, Anthony Wambugu and Godius Kahyarara, *The Dynamics of Returns to Education in Kenyan and Tanzanian Manufacturing*, CSAE WPS/2003-17

Summers, R., Heston, A., 1991. The Penn World Table Mark 5: An expanded set of international comparisons, 1950-1988. Quarterly Journal of Economics 106, 327-368.