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FIRM HETEROGENEITY AND MARKET SELECTION IN SUB-SAHARAN AFRICA: DOES IT SPUR INDUSTRIAL PROGRESS?

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ABSTRACT[a]

This paper investigates the processes of market selection and industry dynamics in a Sub-Saharan Africa context. Using census based longitudinal data it examines the distribution of productivity within an industry to determine whether patterns of firm entry, exit and survival are driven by underlying efficiency differences. It also estimates the contribution to industry level productivity growth of the reallocation of resources and market share from less efficient producers to more efficient ones. The paper concludes that markets in Sub-Saharan Africa, as represented by Ethiopia, are at least as strong as other regions in selecting efficient firms. Tolerance of inefficient firms also declines with the degree of exposure to international competition. While reallocation of resources played a positive and significant role for industry level productivity, it has only managed to offset the declining tendency in intra-firm productivity.

Keywords: Efficiency – Productivity growth – Heterogeneity – Entry – Exit – Market Selection – Reallocation of resources – Decomposition – Ethiopian Manufacturing.

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CONTENTS

1 INTRODUCTION

The poor economic performance of sub-Saharan Africa is perhaps best revealed in its fragile manufacturing sector. It is the only developing region with a declining manufacturing value added to GDP ratio during the 1990s. Although the region has never been an important player in export markets, its share in the export of manufactures originating from the developing world has declined since the 1970s. It is also the only region in the world that does not exhibit the global shift in the technological composition of exports from natural resource based and low technology products to that of high technology commodities. This section provides some details on these problems followed by some explanations.

The industrial landscape of African economies is dominated by micro-enterprises in the informal sector whose role for economic growth has been the subject of a number of firm level studies. A key finding of such studies is that micro enterprises have not served so far as the seedbed for modern small and medium size enterprises (SMEs), a situation particularly evident in Africa. Modern small enterprises (with more than 10 employees) do not often evolve through the size structure but emerge directly to this size category (Liedholm, 1990). Moreover, unlike in developed countries where the number of small enterprises increases with overall economic activity, it is not quite sure if the same holds true in developing counties; their number tends to increase during periods of recession and economic shocks casting doubt on their sustainability (Liedlholm and Mead, 1999). Most if not all micro-enterprises also derive their competitiveness from their ability to evade laws and regulations, which implies that a reduction of the regulatory requirements may lead to their disappearance (Fafchamps, 1994). Government and non-government organizations however make several efforts to help micro-enterprises essentially as a poverty alleviation strategy. A viable long term development strategy however needs to reach beyond targeted anti-poverty programs and address issues of competitiveness and industry dynamics in a liberalized environment; an issue this paper deals with.

Even the formal and relatively modern segment of manufacturing in Africa has a long way to go to become internationally competitive and serve as a driver of long-term growth. Manufacturing value added as a share of GDP has either stagnated or declined in the majority of African countries. For the entire region, the share of manufacturing actually declined during the 1990s (see figure 1 below) leading some researchers to believe that de-industrialisation is taking place in Africa (Noorbakhsh and Paloni, 1998).[1] Given that most African countries have ongoing economic reform programs since the mid 1980s, the decline in the importance of a supposedly progressive sector is in fact a disconcerting observation.

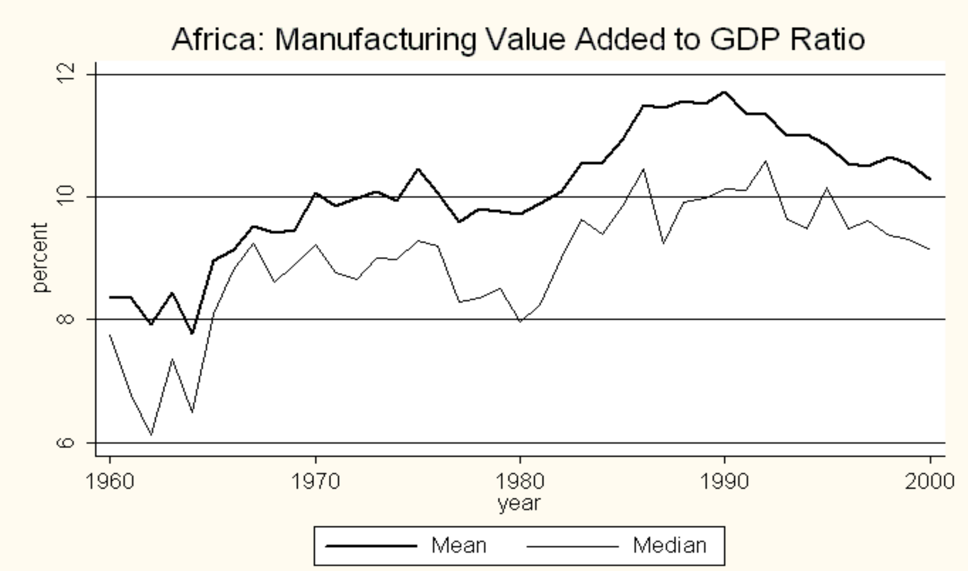

Figure 1

Table 1 shows that only 14 out of 50 countries have seen their manufacturing valued added to GDP ratio increased since 1985 relative to the average for the period 1960-1985. For the remaining 70% of countries, the share of manufacturing has either stagnated or declined. Most importantly, there was substantial slow down in the average

Table 1
Average Growth Rate and Ratio to GDP of Manufacturing Value Added

	Countries Where Manufacturing Value Added to GDP Ratio						All Countries	
	Increased		Stagnated[a]		Declined			
	Growth	Ratio GDP	Growth	GDP Share	Growth	GDP Share	Growth	GDP Share
1960-1985	8.7	12.7	6.0	8.7	6.1	10.5	6.8	10.1
1986-2000	4.8	16.0	3.1	8.8	0.6	7.9	3.5	10.6
No. of countries	14		23		13		50	

Source: Own computation based on World Bank Data.
[a] based on a linear time trend.

[1] The difference in the mean and median shows that the distribution of manufacturing value added to GDP ration is skewed to the right.

growth rate of manufacturing value added since the mid 1980s which has been the case even in countries where the share of manufacturing in GDP has increased. For East and even South East Asian economies the average growth rate of manufacturing value added since 1985 was much higher than the period before.

African countries also performed badly in export of manufactures. The region’s share in total export of manufactures from the developing world has decline from 5% in the 1970s to less than 2% in recent years. The gradual increase in the technological content of exports that we observe in the developing world is completely missing in the African context. As figures 2 and 3 reveal, developing countries in general and Asian economies in particular have been moving away from resource based (RB) and low technology (LT) exports toward high (HT) and medium

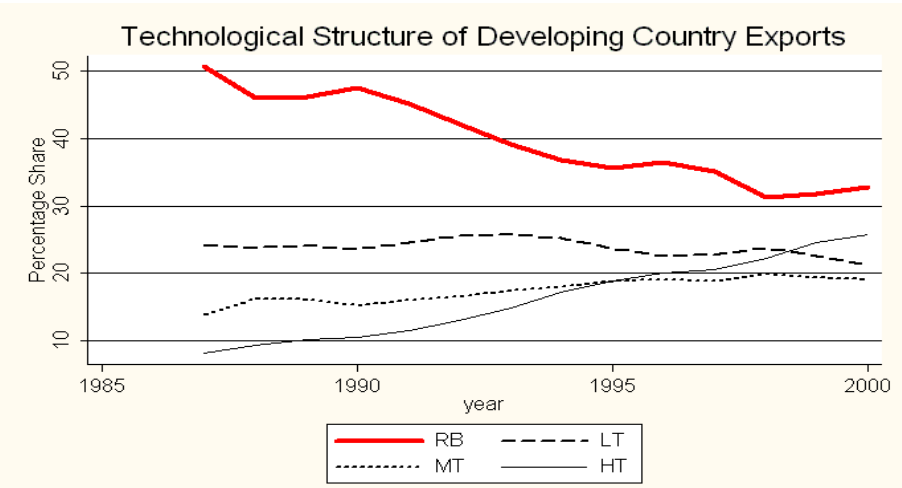

Figure 2

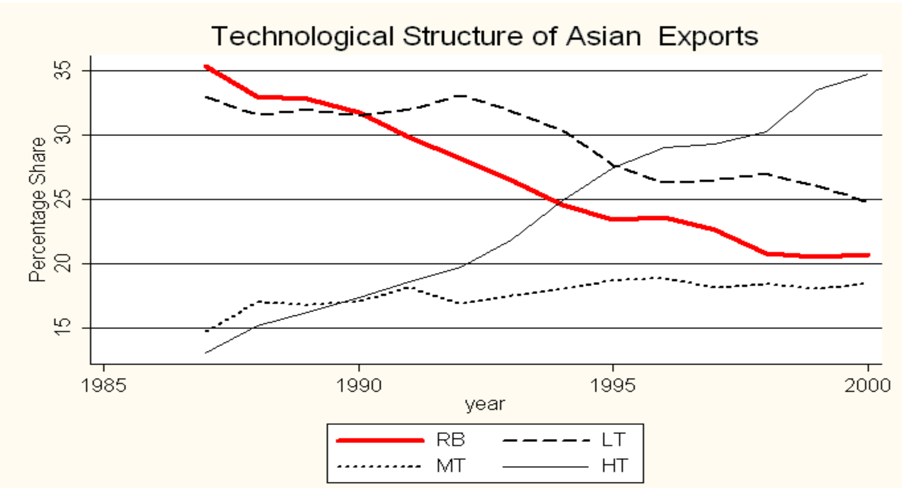

Figure 3

technology (MT) commodities over time. This shift has been particularly impressive in the Asian countries where the share of high technology manufactured exports accounted for more than one third of total exports and exceeded the share of both resource based and low technology exports since 1998. Despite some limitations, this transition indicates the technological capabilities and long-term competitiveness of economies (Lall 2001).

The situation in Africa is rather bleak; the region's export is overwhelmingly resource based and the entire structure suffers from lack of dynamism. See figure 4 below.

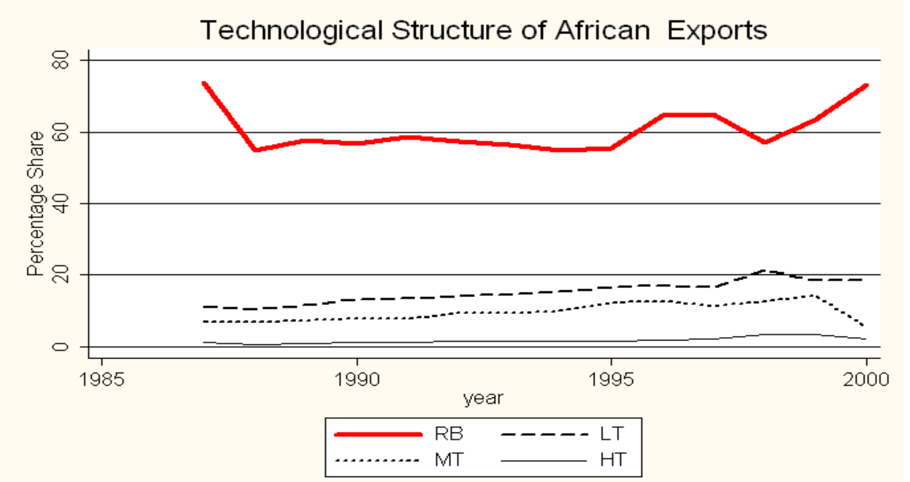

Figure 4

What explains the problem?

Most economists would agree that developing countries in general have structural features that tend to restrain the rate of industrial progress. These problems include small domestic markets, dependence on imported inputs/capital, low levels of human capital and poor infrastructure. Other factor relate to government policies affecting competition, macroeconomic stability and policy predictability (Tybout, 2000). There is also little disagreement that these problems are more pervasive in Sub-Saharan Africa.

The underlying assumption of arguments that emphasize market size is the importance of scale economies. If domestic demand for manufactures is very small and markets are fragmented because of poor infrastructure, firms tend to be smaller and cannot benefit from returns to large scale of operation. Low income also means demand is limited to basic consumption goods (such as food and clothing) which constitute industries that are not characterised by increasing returns to scale technologies. Moreover, technological possibilities for such industries are rather limited and less dynamic, offering little scope for long-term productivity growth. Nonetheless, empirical studies do not find very large and significant scale economies in manufacturing. Estimates of production functions that are based either on small enterprises or samples that also include large enterprises often get constant or mildly increasing returns to scale (Biggs et al., 1995; Little, Mazumdar and Page, 1987). The implication is that the dominance of small enterprises in developing countries may not be a serious problem as it is often thought to be in the simulation based literature (Tybout, 2000).

Export orientation is supposed to provide countries a way-out from limited domestic markets as witnessed in East Asian economies. However, initial levels of human capital determine how successful countries can be in adopting new technologies and products that are highly demanded in international markets. Competitiveness in export markets is also affected by the availability and quality of domestic infrastructure. Companies in developing countries are at times forced to provide their own facilities (power and water, for instance) which on top of higher transport and other service costs seriously damage their competitiveness. Apart from the scale effect, exports are believed to provide learning externalities that enhance productivity. There is lack of evidence in support of the role of exports for productivity growth. Although in most cases exporting firms are more productive than firms serving only domestic markets, this could be the result of efficient firms self selecting to export markets. Bigsten et al. (1999) have however show that for a group of four Sub-Saharan African countries there is learning by exporting after controlling for self selection into export markets. But it has yet to be seen if this is generally the case.

Apart from the structural issues highlighted above, there are a number of policy related arguments that explain economic growth in general with implications for industrial development. The expected externalities from industrial development and the infant industry argument had motivated developing countries to follow protective trade policies. The failure of the import substituting industrialization (ISI) strategy has however led to the rise of openness and liberalization as a new orthodoxy. Its wide acceptance is mainly due to the promises of technical efficiency and change. Whether variation in technological progress and industrial success, across countries and/or over time, is strongly associated with trade policy choice remains a question with no clear answer.

From a theoretical point of view, it has been made very clear that trade theory does not provide a strong foundation for liberal trade policy on the basis of improvement in technical efficiency (Rodrik, 1992). Short of a general theoretical presumption, however, there are a number of arguments in support of trade liberalization for efficiency purposes.

One such argument is the reduction of X-inefficiency with trade liberalization. This is supposed to be realized as increased foreign competition induces more entrepreneurial effort to innovate, cut costs and acquire technological capabilities. The assumption is that entrepreneurs choose the 'quiet-life' in the absence of foreign competition leading to productivity slowdown (Balassa, 1988). However, there are a number of assumptions that need to be made (including weak domestic competition, backward bending labour supply curve of managers and a substitution effect larger than income effect) if this argument is ever to hold water (Cordon, 1994). The practical relevance of the X-inefficiency argument also depends on how important scale economies is for industrial growth.

The other important argument for liberalization is based on the observation that inward oriented economies are prone to stop-go policies that instigate macroeconomic instability. Productivity growth suffers as a result of macroeconomic instability and fluctuation of import levels that undermine capacity utilization as well as the incentive to upgrade technology. Liberalization is expected to reverse this situation by promoting stability, improving the reserve positions and enhancing capacity utilization as availability of imported inputs improves (Pack, 1992). While it is often true that the level and stability of macroeconomic incentives affects productivity growth, it is not an argument about trade liberalization in the strict sense of the term. Productivity decline due to volatile macroeconomic environment should be dealt with macroeconomic policy and not trade policy reform (Rodrik, 1992).

The new trade theories bring to surface what was the original thinking about the gains from free trade, i.e., cultivating dynamic scale economies and specialization. By opening global markets for domestic firms, liberalization permits exploitation of increasing returns to scale. The static benefits from trade could be compounded by productivity growth if trade liberalization leads to the emergence or expansion of industries featuring increasing returns to scale technologies. The catch is that there is no guarantee these possibilities would be realized. There is a strong emphasis on exports in this argument, which also happens to be its weakness. Protection cannot be considered as the major reason why domestic firms did not take advantage of exports if there are increasing returns to it. Export of manufactures from some developing countries actually started to grow well before trade liberalization. On the other hand, if import competing industries are also the ones that exhibit increasing returns to scale technologies, then trade liberalization cannot ensure productivity gains because of falling market shares (Rodrik, 1988).

Most of the empirical evidence linking trade policy with technical efficiency has been inconclusive so far. What makes these studies less useful has less to do with their inconclusive findings but rather with their failure to distinguish macroeconomic from trade policies. Coming back to our point, tracing poor industrial performance in Sub-Saharan Africa to protection or incomplete liberalization has not provided much light.

Although developing countries tend to protect their manufacturing industries, they also have burdensome administrative maze that stifle firm entry, growth and exit. A recent body of theoretical and empirical literature argues that hampering these processes of firm dynamics is likely to reduce aggregate (industry) level productivity growth if such processes are indeed driven by underlying differences in efficiency. In other words, even in the absence of scale economies, industries can experience productivity growth if technological heterogeneity predisposes more productive firms to grow and become larger while forcing inefficient firms to contract and exit. Any government policy that reduces entry and exit barriers, and enhances competition (include trade policy), is likely to lead to productivity growth.

According to this argument, sluggish industrial growth in Sub-Saharan Africa and other developing countries is thus partly explained by weak market selection that tolerates inefficient firms. In his review of manufacturing firms in developing countries, Tybout (2000) remarked:

> If extensive regulations and taxation combine with credit market problems to keep small firms from challenging their entrenched larger competitors, we should observe few firms graduating from informal to formal status. Further, those firms that graduate should show relatively little mobility up the size distribution and market shares should be relatively stable among the largest firms.

Based on firm-level panel data from Ethiopian manufacturing, this paper closely examines firm-level technological heterogeneity and determines whether observed patterns of entry, exit and survival are driven by underlying productivity differences. It also analyses the processes of producer turnover and reallocation of resources from less efficient to more efficient producers and their respective roles for industry level productivity growth. In doing so the paper addresses two central questions: How strongly do African markets, as represented by Ethiopia, select efficient firms? Does market selection play an important role for long-term industrial competitiveness?

This paper is the first attempt, as far as I am aware, to test the assumptions of market selection models based on a manufacturing census data for a Sub-Saharan African economy (Gunning and Mengistea, 2001). The organization of the paper is as follows: Section two briefly reviews the theoretical and empirical literature on market selection. Section three provides background on Ethiopian manufacturing. The nature of the data and estimation methods are discussed is section four. Section five presents the evidence on firm exit, entry and survival. Section six discusses alternative methods of decomposition of productivity growth and the corresponding results. Section seven concludes.

2 LITERATURE ON MARKET SELECTION

2.1 Dynamic theories of industrial evolution

From a broader perspective, there is ample evidence showing that Total Factor Productivity (TFP) growth is a major driver of economic growth both in developing and developed countries with its role being slightly higher in the latter (Chenery et al., 1986). However, a major theoretical and empirical challenge in the growth literature has been the identification of the sources of productivity growth.

The analysis of productivity growth either in the growth accounting framework or in relation to trade policy suffers from a methodological problem. Most studies rely on productivity estimates at an aggregate level assuming that all firms in an industry, sector or country employ the same technology. Under such representative firm approach, productivity growth is regarded as an orderly shift in technology among all firms. Empirical observations based on increasing availability of industrial census data have revealed otherwise. Even within a narrowly defined industry, firms exhibit considerable degree of heterogeneity in terms of size, capital intensity, profitability, etc (Tybout, 1991). This diversity seems to sustain an autonomous state of flux even in the absence of any change in relative prices. Some firms grow while others contact; some firms enter an industry while others exit simultaneously. Therefore it is futile to attempt to capture the true productivity dynamics at industry level through the representative firm approach (Nelson, 1981). Not only is there no single production function but productivity growth involves a process of learning, innovation, investment, entry and exit rather than a smooth shift across all firms (Roberts and Tybout, 1996). It also implies that policies could influence industry level productivity through their effect on market selection even when technology does not exhibit increasing returns.

There are several explanations for the existence of plant level heterogeneity and how it is linked to aggregate productivity. Some of them are in a general equilibrium framework while others follow partial equilibrium analysis. In the general equilibrium analysis attention is paid either to the rate at which new products are introduced to the economy (Lucas 1993) or to the rate at which low quality products are progressively replaced by higher quality products (Stokey, 1991). The focus in this paper is on partial equilibrium models partly because the representation of productivity growth in general equilibrium models is less extensive.

Significant progress has been made in explaining firm heterogeneity in productivity using dynamic partial equilibrium models. These models recognize technological heterogeneity as a major source of inter-firm differences in productivity. Popular among such models is the passive learning model suggested by Jovanovic (1982). In this model producers learn about their endowments of relative efficiency by participating in the market. Firms that receive positive productivity shocks expand and achieve their true level of productivity during which they grow in size. Those firms that learn that they are relatively inefficient contract and would eventually exit. Therefore, even under competitive product markets, firms of varying levels of productivity can coexist because it takes time to discover one’s true efficiency. This model has important testable implications: growth is relatively faster among small firms which are also relatively less productive and more likely to exit. For a given age cohort the model predicts survival rate to be higher among large firms which also exhibit relatively narrow productivity differences.

This is unlike the model by Lucas (1978) where firms have accurate knowledge of their relative efficiency prior to entry. This difference does not disappear over time and generates a skewed distribution of firm size reflecting heterogeneous productivity that originates from permanent differences in managerial talent. Hopenhayn (1992) provides a model in which productivity differences persist over time mainly because the competitive advantages acquired by firms (for what ever reason) do not decay quickly. In this model, a large productivity shock in the current period increases the probability that the firm has a larger productivity shock next period. The Hopenhayn model suggests that simultaneous entry and exit of firms with offsetting results would take place with sufficiently low sunk entry cost. However, the latter would also increase competitive pressure on incumbents and hence lead to productivity growth at industry level. That means, even though entry and exit my not have significant immediate impact on aggregate productivity, they may have important implications in the long run (Tybout, 1996). Policies that raise sunk entry cost may therefore lead to uncompetitive industries by protecting incumbents from market selection.

The models discussed above abstract from firm level effort to enhance productivity. Ericson and Pakes (1995) developed a market selection model that incorporates firm level investment in productivity enhancing activities. The source of heterogeneity is therefore idiosyncratic shocks or uncertainties to the outcomes of productivity enhancing investment. In their model, profitability tends to decline if firm level effort to improve profit-earning capability (upgrading product quality, improving production organization and techniques, exploring new market channels, etc.) does not succeed. Eventually there comes a point where the firm decides it is optimal to abandon the business. Therefore exit decision is made conditional on returns to productivity enhancing efforts. If the firm’s effort succeeds, it moves up in the productivity distribution of the industry in which it operates.

Heterogeneity could arise not only because of differences in returns to investment in technology but also because of the effect of uncertainty on the decision to invest or not. Dixit (1989) shows that unpredictable incentive regimes increases entrepreneur reluctance to invest in technology. This would mean that firms of different technologies could coexist in the market reflecting differences in vintage of different cohort of firms. Improvements in policy predictability would thus affect the rate of change of productivity.

A competitive diffusion model was also provided by Jovanovic and MacDonald (1994) in which innovation and imitation are alternative and costly sources of productivity growth, the relative desirability of which depends on the current know how of the firm as well as the state of knowledge of the industry. One of the implications of this model is that small firms tend to grow faster than large firms because the probability of success from a given learning effort is higher for small firms than for large, technologically leading firms.

2.2 Empirical studies of industrial evolution

The empirical counterpart of this literature comes in two broad strands: those that test the assumptions of market selection models and those that test their implications. Studies that assess the assumptions of selection are based on industrial census data and tend to be limited to industrial countries. There are only few studies on developing countries in which a handful of semi-industrialised countries are studied. Absence of reliable industrial census data coupled with the confidentiality problem has prevented so far studies that test the assumptions of selection models in Sub-Saharan Africa (Gunning and Mengistea, 2001). An exception is the recent paper by Frazer (2005) which provided evidence that the probability of firm exit varies inversely with productivity for Ghanaian manufacturing firms. His study is however based on a series of sample surveys which he clearly indicates as a disadvantage.

On the other hand, there are several empirical studies that assess the implications of market selection models. For evidence on Ethiopian firms, for instance, see Gunning and Mengistea (2001) and Mengistea (1995). Such studies test the age and size effects on firm growth to find out which proposition of selection holds in a particular circumstance. Such studies almost invariably find evidence in support of the passive learning model according to Jovanovic (1982) whereby small firms tend to grow faster than large firms but are also very likely to exit. Growth also declines with age but older firms are more productive and less likely to exit than younger firms. Evidence from these studies shows that African markets are as competitive as others.

Studies that assess the assumption of selection on the other hand seek evidence on the existence and extent of productivity differences among entrants, exiters and incumbent firms, or among exporters and non-exporters. They also investigate whether there is reallocation of resources and market shares away from less efficient firms to more efficient ones. The evidence in this respect is more complex and not very easy to summarise. One common finding is that incumbents are more productive than both exiters and entrants, and the latter two are largely represented at the lower end of the productivity distribution. In Taiwanese manufacturing, for instance, entrants are less productive than incumbents in seven out of nine industries, and average productivity of exiters is less than that of continuing firms for every industry and time period studied (Aw et al., 1997). The role of net entry for industry level productivity growth in Taiwan was also very important ranging between 1% to 35 %. They also find that intra firm productivity growth (the within effect) was much more important and closely related to the pattern of productivity growth in an industry. When it comes to the US, net entry had no significant role for aggregate productivity acting at times as a net drag (Baily et al., 1992). However, their study shows that both exiting and entering firms are less productive than incumbents.

The divergence of evidence is more stark regarding the importance of productivity reallocation, i.e., reallocation of resources and market share among firms based on productivity differences. The literature from developed countries finds evidence in support of positive and significant contribution of share effect. Baily et al. (1992) show that the reallocation of market share contributed 30-40 % of industry level productivity growth during periods of productivity improvement, and helped offset sharp decline during periods of productivity loss. Bernard and Jensen (1999) for US firms find similar evidence in which the reallocation effect was greater than 40%. For Taiwan, the reallocation effect was close to zero (Aw et al., 1997). In the case of Colombia, reallocation had little long run effect on aggregate productivity growth despite important year to year differences (Liu and Tybout, 1996).[2] Like Aw et al. they find that the within effect is very significant in explaining industry level changes productivity in Colombia. On the other hand, Pavcnik (2000) reported that about 70% of productivity growth in Chilean manufacturing is explained by reallocation of resources from less efficient to more efficient firms. In a recent paper, Petrin and Levison (2003) find a positive and significant role of reallocation for Chilean firms based on an alternative decomposition method that is also used in this paper.

[2] Note that their study used factor share to aggregate firm level productivity to industry level productivity and the decomposition is based on productivity growth rather than level of productivity.

Comparing these results is complicated by differences in the methodology applied for decomposition, the weights used for aggregation and the industries studied.

3 BACKGROUND ON ETHIOPIAN MANUFACTURING

Modern manufacturing in Ethiopia has not been the natural progression of the country's ancient civilization and cottage industries. It has its foundations in the emergence of a strong central government and the construction of the now tattered Ethio-Djibouti railways at the beginning of the 20th century. Foreign capital played a leading role at this stage of industrial development – by 1974 foreign nationals had had either full or majority ownership in 143 (52%) enterprises. The imperial government preferred to play a facilitating role in the development of the sector rather than managing its own manufacturing firms.

The ownership structure and production organization of manufacturing changed radically after the military regime took office in 1974. All medium and large scale manufacturing enterprises in the hands of local and foreign private owners were nationalized. The management of enterprises were placed under few corporations that decided on quantity and price of output. Government also established a number of new manufacturing enterprises and controlled the factor markets in such a way that public enterprises get preferential access to credit, foreign exchange and skilled labour. Import substitution remained to be the main strategy, this time with very high tariff and non-tariff barriers than the previous regime.

The country also began to implement structural adjustment programs with the coming to power of a new government in 1991. The reform measures encompass macroeconomic stabilization, trade liberalization as well as some aspects of industrial policy reform. By trade policy reform reference is made to the reduction of import tariffs, elimination or reduction of export taxes, non-tariff barriers and import licensing requirements, as well as introduction of export promotion schemes. Tariffs were slashed substantially: the maximum tariff was reduced from 240% in 1991/92 to about 40% most recently. The weighted average tariff now stands at 19% and is expected to decline as the country adheres to COMMESA trade agreement.

A number of reform measures, which are best regarded as part of the country's industrial policy have also been put in place. Most of them are contained in the investment law that was first issued in 1992 with subsequent revisions/improvements. These policies aim at enhancing private sector participation by allowing entry into areas that were reserved for the state sector, by removing caps on private investment, and providing a range of incentives including tax holidays for investors with initial capital above a given threshold. Also part of the industrial policy reform is the public enterprises reform act (1992) with the aim of instituting managerial autonomy and financial responsibility for public enterprises, and putting them on a level playing field with their private sector counterparts.

At the macro-level, the government has committed itself to fiscal and monetary discipline, which has so far been judged credible by the Britton Woods institutions. Another key feature of the macroeconomic environment has been the exchange rate regime, which has increasingly been market driven. It is with this background that the manufacturing census data will be analysed.

Ethiopian manufacturing shares most of the features of SSA with a MVA to GDP ratio that has stagnated at about 11% since the 1980s. Basic information about the state of manufacturing in Ethiopia is provided in Appendix table 1. The industrial and size structure of the manufacturing sector reflects the dominance of low technology, consumer goods oriented industries with large number of small enterprises. There is a sharp decline in the proportion of public enterprises during the period under study partly due to the process of privatization but mainly due to the entry of new private enterprises. The allocation of resource between public and private enterprises is not however as stark as the trend in proportion of enterprises. Public enterprises still account for 58% manufacturing employment in 2002, down from 85% in 1996. In terms of manufacturing value added, the share of public enterprises has gone down from 87% in 1996 to 60% in 2002.

4 DATA AND METHODOLOGY

4.1 Data

This study is based on an establishment level panel data obtained from the Central Statistics Authority (CSA) of Ethiopia. The CSA undertakes annual census of manufacturing enterprises that employ at least 10 persons and use power driven machinery. The micro-data is highly confidential and was made available to the researcher through official request. The relatively small number of manufacturing enterprises of the mentioned size and their concentration in and around the capital city Addis Ababa has made it possible for the census to be carried out every year.[3]

The data contains all the relevant information for productivity analysis. Each establishment is identified by a unique identification number in combination with a region code and four digit ISIC code. Data is collected on labour, intermediate inputs and their import component, beginning and end of period book value for different kinds of capital, energy consumption, and other industrial and non-industrial costs. The labour data is in terms of number of employees by broad occupational categories and not in hours worked. In the absence of industry whole sale price indices, I used output unit prices reported by the firm to construct firm and industry specific price indices. For firms with missing values on prices the industry price index is used for deflating output and inputs. Similarly input costs and capital stock are deflated by similar industry price index. I used 1996 as a base year for the industry price index (the year 1995/96 is also the base year for the new consumer price index being used in the country). The time series on capital stock obtained from the reported beginning and end of period capital stock was not very consistent and for that reason a new capital stock was generated using the perpetual inventory method. Use is made of 5% depreciation rate for building and 10% depreciation rate for machinery and equipment.

As would be expected, the data were not without problems. The original number of observations was 5167 firm-years for the period 1996-2002. During the cleanup process 171 observations (about 3%) were dropped for several reasons. Major reasons include missing data either on output or key inputs for productivity analysis, non-unique firm identification numbers, or cases where levels of input or output were found to be extreme outliers. However, the problem was not concentrated in particular industries or years, and hence it is hoped that the exclusion of these firms does not bias the analysis. The number of enterprises included in this study increases from 605 in 1996 to 823 in 2002.[4]

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[3] In advanced countries like the USA, manufacturing census are carried out every five year with sample survey filling the inter census periods.

[4] The researcher has benefited from close cooperation from experts of the CSA in the process of identifying problem cases.

4.2 Estimation of productivity

An important assumption of dynamic models of industrial evolution is the relationship between productivity shock and input levels. Productivity shocks are supposed to form part of the information needed for the decision to stay in a market as well as for the choice of level of inputs in case the firm stays. The presence of such correlation between inputs levels and firm specific productivity shocks that are unobservable to the researcher creates a simultaneity problem. Estimation methods that ignore these phenomena (like OLS) provide estimates of factor elasticities that are biased and inconsistent. Hence productivity analysis based on such estimates will also be unreliable.

Earlier attempts to solving this problem relied on the use of fixed effects estimation method on panel data that sweeps away any relationship between firm fixed effects and inputs. While this method minimizes the simultaneity bias, it assume, as the name indicates, that the firm fixed effects are time invariant. Interest however developed on time varying idiosyncratic shocks as they allow empirical tests on policy outcomes as well as implications/assumptions of theories of industry dynamics. Researchers attempted to over come this by regressing the firm effect from a fixed effects model as some function of time. There are two approaches along this line both of them in the stochastic frontier production function tradition. The first one is according to Cornwell et al. (1990) which starts by estimating a fixed effects model, the residual of which is regressed against time and time squared. Their models can be represented as:

$$Y_{it} = \beta_0 + \beta x_{it} + \beta_k k_{it} + \eta_{it} + u_{it} \qquad (1)$$

$$\eta_{ti} = \alpha_{1i} + \alpha_{2i} t + \alpha_{3i} t^2$$

Where all variables i.e. output *Y*, variable inputs *x* and capital *k* are in logarithms, η_{ti} is the productivity term and u_{ti} the standard zero mean constant variance residual; t and t^2 stand for time and time squared. While this approach makes the productivity term vary over time it still assumes no correlation between the unobservable and factor levels.

Another approach in the stochastic frontier production function for a time varying efficiency term runs as follows:

$$Y_{it} = f(x_{it}, \beta)\lambda_{it} \exp(v_{it}) \quad (2)$$

Where Y_{it} is output, x_{it} is input(s), λ_{it} is the level of efficiency for firm *i* at time *t* and lies in the interval (0,1], whereas v_{it} is pure random shock that includes measurement errors. Equation (2) can be expressed in logarithmic terms as:

$$\ln Y_{it} = \ln\{f(x_{it}, \beta)\} + \ln \lambda_{it} + v_{it} \quad (3)$$

Given the range of λ_{it} we can define $u_{it} = -\ln \lambda_{it}$ and express the equation as

$$\ln Y_{it} = \ln\{f(x_{it}, \beta)\} + v_{it} - u_{it} \quad (4)$$

In a time invariant model $u_{it} = u_i$ but for a time varying approach Battese and Coelli (1992) chose a particular function of time that multiplies the fixed effect:

$$u_{it} = \exp\{-\eta(t - T_i)\}u_i \quad (5)$$

Where T_i is the last time period for a particular firm, and η is a decay parameter (η=0 would amount to a time invariant model). Again in this definition the time varying element is derived from the time invariant efficiency term with a particular function of time which has little economic implication.

Olley and Pakes (1996) suggested an innovative approach using a proxy variable method. In their method investment is used as a proxy for unobserved effects. They defined a production function with two error components: one representing a white noise and another one representing a firm specific productivity shock. They modelled investment as a non-decreasing function of productivity shock and other state variables. By inverting the investment function, they defined a functional form for estimating productivity. The Olley-Pakes approach requires non-zero investment and truncates firms with no investment. Its application to data from developing countries is thus limited where nearly 50% of firms do not invest in a given period. Moreover, adjustment cost in investment implies that the proxy may not catch the whole productivity shock.

Following the same strategy as Olley and Pakes (1996), Petrin and Levinsohn (2003) devised a model where intermediate inputs are used as proxy for unobservables. One important advantage of the Petrin and Levinsohn method is that it avoids truncating firms with zero investment since almost all firms use intermediate inputs. In addition to the data advantage, the PL method also picks up substantial amount of the productivity shock as intermediate inputs are often easily adjustable compared to investment. The fact that intermediate inputs do not form part of the state variables that determine the firm's relative position in the market also makes them very good proxy variables.

The production function has the following two error component form:

$$y_t = \beta_0 + \beta_l l_t + \beta_k k_t + \beta_m m_t + w_t + \eta_t \qquad (6)$$

Where y_t represents logarithm of the firms gross revenue or value added; l_t and m_t are the logarithms of labour and other freely variable intermediate inputs, and k_t is the logarithm of state variable capital. The error term w_t is the firm specific productivity term while η_t is white noise.

To overcome the simultaneity bias, Petrin and Lenvinsohn (2003) proceed by assuming demand for intermediate inputs to be a function of the state variables k_t and w_t:

$$m_t = m_t(k_t, w_t) \qquad (7)$$

Assuming demand for intermediate inputs to be monotonically increasing in productivity w_t, one can invert equation (7) to get a functional form for w_t as follows:

$$w_t = w_t(k_t, m_t) \qquad (8)$$

Equation (8) now expresses the unobservable term as a function of two observables.

A final identification restriction requires a first-order Markov process for the productivity term following Olley and Pakes (1996):

$$w_t = E[w_t \mid w_{t-1}] + \xi_t \qquad (9)$$

Where ξ_t is innovation to productivity that is not correlated with k_t, but not necessarily with l_t; PL identify this as part of the source of the simultaneity problem.

In a value added production function equation (6) will take the form:

$$v_t = \beta_0 + \beta_l l_t + \beta_k k_t + w_t + \eta_t \qquad (10)$$

Where v_t is the logarithm of value added.

Using the inverted demand function for intermediate inputs given in (8) and substituting it in (10) we get:

$$v_t = \beta_0 + \beta_l l_t + \phi_t(k_t, m_t) + \eta_t \quad (11)$$

where $\phi_t(k_t, m_t) = \beta_0 + \beta_k k_t + w_t(k_t, m_t)$.

By substituting a third-order polynomial expansion in k_t and m_t in place of $\phi_t(k_t, m_t)$, it is possible to find a consistent estimator of the parameters of the value added equation using OLS:

$$v_t = \delta_0 + \beta_l l_t + \sum_{i=0}^{3}\sum_{j=0}^{3-i}\delta_{ij} k_t^i m_t^j + \eta_t \quad (12)$$

where β_0 is not separately identified from the intercept of $\phi_t(k_t, m_t)$. This first stage estimation provides a consistent estimate of β_l that is not contaminated with the correlation of labour with current period productivity. It also gives an estimate of $\phi_t(k_t, m_t)$. However, since k_t appears twice in $\phi_t(k_t, m_t)$ it is not identified without further restrictions.

The second stage therefore begins by computing the predicted value of ϕ_t from (12):

$$\hat{\phi}_t = \hat{v}_t - \hat{\beta}_l l_t$$
$$= \delta_0 + \sum_{i=0}^{3}\sum_{j=0}^{3-i}\hat{\delta}_{ij} k_t^i m_t^j - \hat{\beta}_l l_t$$

For any candidate value of β_k^* (say from a Cob-Douglas production function) a predicted value for w_t can be estimated using

$$\hat{w}_t = \hat{\phi}_t - \beta_k^* k_t \quad (13)$$

Using these values a consistent non-parametric approximation (locally weighted regression) to $E[w_t \mid w_{t-1}]$ is given by the predicted values from the regression

$$\hat{w}_t = \gamma_0 + \gamma_1 w_{t-1} + \gamma_2 w_{t-1}^2 + \gamma_{t-1}^3 + \varepsilon_t \quad (14)$$

Levinsohn and Petrin (2003) call this $E\left[w_t \mid w_{t-1}\right]$. Given $\hat{\beta}_l$, β_k^*, and $E\left[w_t \mid w_{t-1}\right]$, LP write the sample residual of the production function as

$$\hat{\eta}_t + \hat{\xi}_t = v_t - \hat{\beta}_t l_t - \beta_k^* k_t - E\left[w_t \mid w_{t-1}\right] \tag{15}$$

The estimate for $\hat{\beta}_k$ of β_k is defined as the solution to

$$\min_{\beta_k^*} \sum_t \left(v_t - \hat{\beta}_l l_t - \beta_k^* k_t - E\left[w_t \mid w_{t-1}\right]\right)^2 \tag{16}$$

The analysis of productivity in this paper is based on productivity estimates derived from the PL method applied on the value added of Ethiopian manufacturing firms as discussed in Petrin, Poi, and Levinsohn (2004).

5 FIRM HETEROGENEITY AND PRODUCER TURNOVER

Theories of market selection presume that firms within a narrowly defined industry exhibit considerable heterogeneity, which is underpinned by efficiency differences. Research based on micro-data both in developing and developed countries lends support to this presumption. The benefits of using micro-data over the representative firm approach could however be attenuated by doubtful data quality particularly those from developing countries. One wonders how much of the firm level heterogeneity is a pure measurement error and how much is technology related (Bartelsman and Doms, 2000). Evidence must be sought by looking at patterns of firm entry, exit and survival, as well as reallocation of market share vis-à-vis productivity differentials. An alternative and widely applied method of testing market selection examines firm growth conditional on age and size. As discussed earlier such studies investigate the implications of the selection process rather than the underlying assumptions.

Data from Ethiopian manufacturing shows considerable degree of heterogeneity in firm level efficiency. Table 2 below compares selected percentiles from the distribution of productivity relative to the 90th percentile. At the level of the manufacturing sector in general, the tenth percentile is about 5% as productive as the 90th percentile while the median firm is only 22 % as productive. On the other hand, the 90th percentile is more than twice as efficient as the 75th percentile. Industry specific differences in this pattern of distribution are rather limited. The only exception is the printing and paper industry where the relative productivity of the 10th and 25th percentiles are nearly twice the respective sectoral averages showing relatively narrow productivity dispersion in this industry.

Table 2
Firm Productivity Relative to the 90th percentile

Industry	***Percentiles***			
	10th	***25th***	***50th***	***75th***
Food & Beverage	5.6	11.2	24.7	51.0
Textile & Garments	2.6	6.5	13.1	34.7
Leather & Footwear	4.0	10.0	18.0	38.1
Wood & Furniture	6.4	12.1	22.5	44.3
Printing & Paper	10.2	19.2	32.2	52.6
Chemical & Plastic	3.6	8.2	17.2	42.9
Non-Metal	4.5	10.5	20.8	42.9
Metal	5.0	10.7	17.7	39.0
Light Machinery	7.3	13.6	25.0	44.4
Manufacturing Sector	***5.3***	***11.0***	***21.8***	***45.8***

Source: Own computation based on CSA data

The importance of this heterogeneity in driving the survival and exit of producers is explored by way of constructing transition matrices following Baily et al. (1992). These matrices trace the movement of firms along ranks of productivity distributions during the study period. Tables 3a and 3b below provide this transition over the period 1996 to 2002. Firms are ranked and divided into quintiles based on productivity indices in 1996 and 2002. The most productive quintile is quintile 1 in both tables and years and the least productive firms are in quintile 5. The tables are for the entire manufacturing sector; the fact that the analysis is based on an index rather than the level of productivity allows inter-industry and across time comparisons.[5] Table 3a shall be read row wise and table 3b column wise. Accordingly, table 3a talks about productivity ranks of firms in 1996 and where they ended up in 2002. On the other hand table 3b talks about firms in 2002 and traces their origin in 1996.

[5] Industry specific transition matrices can be made available by the author upon request.

Table 3a
Ranking of firms based on Unweighted Productivity Index in 1996 and 2002.[6]

	Quintiles in 2002							USA exit rate
	Rank	1	2	3	4	5	Exit	
Quintiles in 1996	1	38.8	19.8	9.9	4.1	1.7	25.6	14.0
	2	21.5	15.7	11.6	6.6	2.5	42.1	20.3
	3	14.9	14.0	11.6	9.1	5.8	44.6	22.5
	4	6.6	12.4	11.6	9.1	5.0	55.4	28.7
	5	3.3	6.6	12.4	5.0	13.2	59.5	32.3
	Entry	12.4	16.6	19.3	25.2	26.6		

Source: Author's Computation. Exit rates for US manufacturing are from Baily et al.(1992) and include both switching out and death rates.

Table 3a shows substantial degree of persistence at the top end of the productivity distribution while the bottom end is in a state of flux. Close to 40% of firms that were in the top quintile in 1996 managed to stay in the top quintile after 6 years. About 20% of the top ranking firms in 1996 have moved to the second quintile in 2002. Taken together, 58.7 percent of the most productive firms in 1996 have managed to remain among the top 40% of firms in 2002. This result is consistent with the finding of most longitudinal studies and shows that relative productivity, no matter what its source is, tends to persist. The first runners up in the 1996 productivity ranking also behaved similarly; 21.5% of them upgraded to the top quintile in 2002 while 15.7% maintained their position. About 48% of firms in the top two quintiles in 1996 managed to stay put in the top 40% in 2002. Once again being relatively efficient maximizes not only the probability of staying in the market but also the probability of remaining on top of the productivity distribution.

A consistent but different story emerges when we look at the lower tail of the distribution. A remarkable 60% of the least efficient firms in 1996 have exited the manufacturing sector. Similarly, 55% of firms in the 4th quintile have faced the same fate of exiting the market. This shows that markets are very competitive and exert strong power of selection. This observation is very important and runs against the

[6] Unlike manufacturing census from developed countries, the Ethiopian data does not allow differentiating the exact status of exiting firms. While some of the exiters are truly dead firms, some could simply be slipping below the 10 persons employment threshold while others are shifting their line of production to other industries in manufacturing or to an entirely different sector. Similarly, not all entrants are new firms; some are graduating into the census size category, while others are switching in from other industries or sectors. While merger is another possibility for disappearance of firms, it is very unlikely to be an important case in the Ethiopian data.

popular argument that African markets tolerate inefficient firms. Table 3a shows that although exit is not restricted among the inefficient firms, the exit rate declines substantially as we go up the productivity rank. Among the most productive firms, for instance, only a quarter have exited the market. Although productivity is not the only reason for exit, less efficient firms are more likely to exit the market providing evidence that underlying productivity differences drive the decision to exit. Comparison with US manufacturing as reported in Baily et al. (1992) reveals that exit rates in Ethiopian manufacturing are nearly twice as high in all quintiles.

Table 3a contains another important piece of information about entry. Nearly 500 firms have joined the manufacturing sector since 1996 of which 26.6 and 25.2 percent were in the bottom 5th and 4th quintiles in 2002, respectively. In other words more than half of the entrants since 1996 are in the bottom 40 percent of the productivity distribution in 2002. This is consistent with the assumptions of the passive learning model according to Jovanovic (1982) that new firms are relatively small and inefficient. Therefore, for most entrants there seems to be a process of learning that precedes movements up the productivity ladder or out of the market. But that is not the entire story. About 29 % of the entrants were among the top 40% of firms - 12.4% in the 1st and 16.6% in the 2nd quintile, respectively. It will be shown latter that this is more of a size effect while the vintage effect might also have a role.

Table 3b
Ranking of firms based on Unweighted Productivity Index in 1996 and 2002

		Quintiles in 2002						**USA exit rate**
	Rank	1	2	3	4	5	Exit	
Quintiles in 1996	1	28.7	14.5	7.3	3.0	1.2	11.3	11.84
	2	15.9	11.5	8.5	4.8	1.8	18.5	17.11
	3	11.0	10.3	8.5	6.7	4.2	19.6	19.55
	4	4.9	9.1	8.5	6.7	3.6	24.4	25.56
	5	2.4	4.8	9.1	3.6	9.7	26.2	25.94
	Entry	37.2	49.7	57.9	75.2	79.4		

Source: Authors computation. Exit rates for US manufacturing are from Baily et al. (1992) and include only firm death.

Turning to the information contained in table 3b, the most efficient 20% of firms in 2002 came from almost everywhere but most, i.e. about 29%, are from the top quintile in 1996. A decreasing proportion of firms originate from the lower quintiles; for instance, only 2.4% of firms in the bottom quintile in 1996 managed to upgrade productivity to the 1st quintile in 2002. This shows once again that relative efficiency not only increases the probability of survival but also the probability of remaining or moving towards higher levels of productivity. Very few firms (less than two percent) that were in the top two quintiles in 1996 have moved down to the 5th quintile in 2002.

It is interesting to note that although entrants account for quite significant proportions of every quintile in 2002, they are overly represented in the bottom two quintiles. Entrants account for 75 and 79 percent of the 4th and 5th quintiles, respectively, in 2002. Combining this with the information from table 3a that exit is prevalent at the lower end of the distribution; it becomes obvious that most of the exiting firms are also among the new entrants. Table 3b also shows that the proportion of exiting firms varies inversely with the productivity ranking. Only 11% of the exiting firms are from the top quintile in 1996 while the bottom two quintiles together accounted for half of the exiters. The similarity with the distribution of exiting firms in the US manufacturing is very striking.

Data also reveals that across the productivity distribution in 2002, firms which stayed in the top quintile between 1996 and 2002 exhibit productivity which is above the average for the top quintile in 2002. This shows that firms that remain in the top quintile throughout the study period tend to be among the most productive even within the top 20%. This is not however the case for the remaining four quintiles in which case the quintile average is equal to the average productivity of firms from all origins in 1996. The only exception is that firms which slipped down to lower ranks from the top quintile in 1996 still remain slightly above the average productivity of the relevant quintile revealing once again that relative efficiency may erode but very slowly as pointed out by Hopenhayen (1992).

While the results discussed above are consistent with the findings of micro-data based longitudinal studies from developed and developing countries, the magnitude of turnover appears to be very high in Ethiopia (table 3a). Employment weighted dynamics changes the magnitude but leaves the pattern intact. The only exception is the story on entrants which will be discussed later on. As show in table 3c, which is an employment weighted version of table 3a, an employment weighted 34% of firms in the bottom quintile of 1996 exited the market before 2002 which is nearly five times higher that the rate of exit (7.4%) from the top quintile. On the other hand, the tenacity of relative efficiency seems to be magnified when weighted by employment. About 46% firms in the top quintile in 1996 remained in the same quintile after six years while a weighted 32% moved down to the second quintile. The increase in the degree of persistence at the top of the distribution and the attenuation in exit rates when transition is weighted by employment show that employment is concentrated among the most productive firms. It also shows that exiting firms are relatively small in size. Employment weighted exit rates are also more comparable with that of US manufacturing although they are still on the higher side.

Table 3c
Ranking of firms based on Employment Weighted Productivity Index

		Quintiles in 2002						**USA exit rate**
	Rank	1	2	3	4	5	Exit	
Quintiles in 1996	1	46.1	31.9	10.0	1.9	2.7	7.4	6.27
	2	51.0	33.5	2.3	6.2	0.3	6.7	8.20
	3	9.5	23.9	47.9	6.9	2.6	9.1	8.73
	4	8.5	14.4	39.3	10.5	8.9	18.5	12.27
	5	1.7	4.7	29.3	14.7	15.4	34.2	11.23
	Entry	34.6	15.0	18.3	14.8	17.3		

Source: Authors Computation. Exit rates for US manufacturing is from Baily et al.(1992) and includes both switching out and death.

Table 3c differs from table 3a in one important aspect, i.e., the distribution of entrant firms. Unlike table 3a, employment weighted entrants seem to be highly represented in the top two quintiles than the bottom quintile. A weighted 34.6 and 15 percent of entrants appear in the first and second quintile in the productivity ranking of 2002. This piece of information reveals that most of the entrants begin their journey at the bottom of the productivity distribution but they are very small firms that account for a relatively small fraction of manufacturing employment. On the other hand entrants which are among the top ranking incumbents are relatively large firms. This is also an indication that size and productivity are closely related. Given that most employment is concentrated among the most productive firms which tend to maintain their relative efficiency, the high <unweighted> producer turnover rate in tables 3a and 3b does not say much about employee turnover.

Let's now compare transition matrices among groups of industries with varying degrees of exposure to international competition. The idea is to examine if market selection gets stronger with more competition. For this purpose we distinguish industries with import penetration rates below and above 50%.[7] Industries with relatively low international competition, i.e., less that 50% import penetration ratio include food and beverages, leather and footwear, and the non-metal industries. Industries with high international competition include textile and garments, chemical and plastics, metal, light-machinery, printing and paper, and wood and furniture.

In both high and low competition groups, the basic features observed above still obtain: that the probability of exit decreases with the productivity ranking of the firm and that there is considerable degree of persistence at the top of the productivity distribution. Tables 4 and 5 provide the addition information that exit rates among inefficient firms are significantly higher in industries facing high competition from imports as compared to those industries where competition is relatively low. For the latter, exit rates of firms from the 4th and 5th quintiles in the 1996 distribution amount to 50% and 56%, respectively, while in the former the corresponding exit rates are 60% and 61.5%. On the other hand, the exit rate from the top quintile is 15.6% in high competition industries, which is less than half of the corresponding rate for industries with low import competition, i.e., 35.7%. Exposure to international competition therefore tends to reduce the degree of tolerance of inefficient producers while increasing the probability of survival for productive firms.

Table 4
High competition industries: ranking of firms by Unweighted Productivity Index

		Quintiles in 2002						**USA exit rate**
	Rank	1	2	3	4	5	Exit	
Quintiles in 1996	1	43.75	20.31	14.06	4.69	1.56	15.63	43.75
	2	18.46	16.92	10.77	7.69	3.08	43.08	18.46
	3	15.63	14.06	14.06	6.25	6.25	43.75	15.63
	4	4.62	15.38	6.15	9.23	4.62	60.00	4.62
	5	4.62	6.15	9.23	3.08	15.38	61.54	4.62
	Entry	12.18	15.87	20.30	25.83	25.83		12.18

Employment weighted transition matrices (not shown here) indicate that employment is concentrated among efficient firms in both groups of industries. However, the degree of persistence at the top of the distribution is higher among

Table 5

[7] Assuming no exports, an import penetration ratio of 50% means imports equal domestic production; therefore, industries with import penetration ratio greater than 50% have imports to domestic production ratio of greater than 100% on average during the study period.

Low competition industries:
ranking of firms by Unweighted Productivity Index

	Quintiles in 2002						
	Rank	1	2	3	4	5	Exit
Quintiles in 1996	1	37.50	12.50	7.14	5.36	1.79	35.71
	2	16.07	17.86	14.29	7.14	1.79	42.86
	3	16.07	10.71	10.71	7.14	8.93	46.43
	4	8.93	14.29	10.71	10.71	5.36	50.00
	5	5.26	7.02	12.28	7.02	12.28	56.14
	Entry	12.16	18.02	19.37	24.32	26.13	

industries with lower international competition than others. This indicates that part of the efficiency gain in industries with more exposure to international competition may involve down-sizing which reduces the degree of concentration of employment at the top of the distribution relative to protected industries. The employment weighted exit rates are much lower that the firm exit rate in both cases showing that exiting firms are predominantly small firms. However, the link between smallness and inefficiency appears stronger in industries with high import penetration rates as the employment weighted exit rates are lower in these industries.

6 TURNOVER AND INDUSTRY DYNAMICS

We have seen that an industry comprises of heterogeneous firms and the processes of entry, survival and exit reflect underlying differences in relative efficiency. In this section we address the question: how important have these processes been for aggregate (industry) productivity?

The growth accounting or representative firm approach pays utmost attention to intra-firm productivity growth as the sole source of aggregate productivity growth. Research based on micro-data reveal that firm entry and exit as well as reallocation of inputs and market share from less productive to more productive incumbents could also play an important role. Existing evidence however shows mixed results in the sense that reallocation does not always play a positive role for aggregate productivity, and in those cases where it played significant role the magnitude is widely different across industries and time. This has led to renewed interest in checking the theoretical foundations and methodological consistency of the decomposition of aggregate productivity growth based on micro data. The following paragraphs briefly review the literature along this line before providing new evidence from Ethiopia.

In the growth accounting literature, total factor productivity (TFP) is computed as the difference between the growth of output net of the contribution of input growth. Until recently TFP computation has been based on industry level data. In this method researchers are forced to assume that all firms have the same level of technology and productivity growth is a smooth shift in industry wide technology. With increased availability of micro-data one need not make this assumption. The firm level counterpart of the growth accounting method would look like:

$$\ln w_{it} = \ln y_{it} - \beta \ln x_{it} \qquad (17)$$

Where w_{it} is productivity index, y_{it} is output and x_{it} vector of inputs. The measurement of industry level productivity growth between two periods based on firm level productivity indices has been done in accordance to the method suggested by Baily et al. (1992):

$$\sum_i s_{it} \ln w_{it} - \sum_i s_{i,t-1} \ln w_{i,t-1} \qquad (18)$$

where s_{it} represents the establishment's share in industry level output or employment.

The growth in aggregate productivity can then be decomposed into four components: intra-firm productivity growth with fixed share, reallocation of market shares, a covariance term and net entry.

$$\sum_i s_{it} \ln w_{it} - \sum_i s_{i,t-1} \ln w_{i,t-1} = \left(\sum_{i \in c} s_{it} \Delta \ln w_{it} + \sum_{i \in c} \ln w_{it} \Delta s_{it} + \sum_{i \in c} \Delta s_{it} \Delta \ln w_{it} \right) + \left(\sum_{i \in N} s_{it} \ln w_{it} - \sum_{i \in X} s_{i,t-1} \ln w_{i,t-1} \right) \qquad (19)$$

The first term in the RHS of (19) represents the contribution of continuing firms (represented by subscript C) to aggregate productivity growth which is decomposed further into changes in productivity, change in market share and a covariance term that combines changes both in productivity and market share. The last term represents net entry that is the share weighted net effect of entrants (N) after deducting the role of exiters (X). However, in most empirical studies the covariance term is often lumped together with the share effect to avoid ambiguity.

Studies using this method of aggregation or a variant of it have recently been criticised for lack of theoretical soundness and comparability with the growth accounting procedure. At the core of the critique is the confusion that arises as a result of including the market share effect as part of the productivity growth story. Also important is the critique on the use of output and employment shares as weights for aggregation and decomposition.

Petrin and Levinson (2004) brought together two guiding principles for aggregating plant level productivity in the growth accounting approach and use it as a bench mark for assessing the validity of aggregation/decomposition exercises. The first guiding principle is according to Domar (1961) and underscores that aggregating and disaggregating the economy over different industries, outputs and over time should be possible without affecting the magnitude of the residual. This would mean that computation of productivity based on one method should be able to predict productivity patterns based on another. The second guiding principle states that productivity growth should measure the impact on final demand of changes in plant level factor efficiency (Hulten, 1978). The second principle is very important when considering manufacturing activities in which part of an establishment's output is used as input by others. In this situation an increase in plant level efficiency leads to an increase in aggregate demand both directly through more final output as well as through increased availability of inputs for use by other plants. The implication of this analysis is that when the plant level productivity index is derived from a production function based on total output, the appropriate weight for aggregating the industry level productivity index should be the ratio of plant level output to industry value added (Petrin and Levinson 2004). $\Delta w = \sum \alpha_i \Delta w_i \quad \text{where } \alpha_i = \frac{q_i}{\sum v_i}$ q_i is total output and v_i is value added.

In this setting Δw represents industry productivity growth in the growth accounting approach and it measures the rate of change of the social production possibility frontier, holding primary inputs constant (*ibid.*, 2004: 6). It is also possible to calculate the firm level productivity index from a value added production function. In the latter case, the firm's share in industry level value added should be used as weight. Hulten (1978) refers to the growth in industry productivity index calculated from a value added production function as the effective rate of productivity growth.

The reason is that in the value added context growth in aggregate productivity measures the cumulative impact of plant level technical efficiency on final demand (output).

If output growth in firm *i* is represented by dy_i , its total differential can be written as:

$$dy_i = \beta l_i dl_i + \beta k_i dk_i + \beta m_i dm_i + du_i \qquad (20)$$

Where β_j denotes the elasticity of output with respect to input *j*, dj_i represents growth in input *j*(i.e. capital *k*, lablour *l* or intermediate inputs *m*), du_i is Hick's neutral technological change. Using Hulten's (1978) insight on the second rule of aggregation, growth in value added can be computed as:

$$dv_i = \frac{dy_i - \beta m_i dm_i}{1-\beta m_i} = \frac{\beta l_i dl_i + \beta k_i dk_i + du_i}{1-\beta m_i} \qquad (21)$$

In this equation the value added growth is obtained by deducting the contribution of intermediate inputs in total output growth and raising the difference by a multiplier equal to $\frac{1}{1-\beta m_i}$. The latter accounts for the role of plant level technical efficiency through increased availability of intermediate inputs. The aggregation to industry level growth rate of value added is given by $\sum s_{vi} dv_i$ where s_{vi} is a plant's share in industry value added. Accordingly, the effective rate of productivity growth can be calculated by deducting the role of primary inputs from the growth rate of value added:

$$dw_i = dv_i - \frac{\beta l_i dl_i + \beta k_i dk_i}{1-\beta m_i} = \frac{du_i}{1-\beta m_i} \qquad (22)$$

The growth accounting approach therefore suggests that aggregate productivity growth should be obtained as the difference between the rate of growth of industry output and aggregate primary inputs where value added shares are used as weights.

$$dw = \sum s_{vi} dw_i = \sum s_{vi} dv_i - \sum s_{vi}\left(\frac{\beta l_i dl_i + \beta k_i dk_i}{1-\beta m_i}\right) = \sum s_{vi}\frac{du_i}{1-\beta m_i} \qquad (23)$$

It is interesting to note that unlike the Baily et al. (1992) approach, the growth accounting procedure does not have room for reallocation of inputs as a source of aggregate productivity growth. This is because of the way the effective rate of productivity growth is computed at the firm level and not as such the denial of the fact that resources are reallocated in response to productivity shocks. However, Petrin and Levinsohn (2004) suggest and test an alternative approach in which a reallocation effect can be separately identified. In their method the focus is on changes in the growth rate of productivity instead of growth in the level of productivity. In this method a reallocation effect is realised as resources are shifted toward firms with relatively higher rate of productivity growth.

The decomposition of change in productivity growth in the Petrin-Levinsohn approach requires data on three successive periods and is given by:

$$\sum \frac{s_{vi,t+2} + s_{vi,t+1}}{2}\left(\ln w_{i,t+2} - \ln w_{i,t+1}\right) - \sum \frac{s_{vi,t+1} + s_{vit}}{2}\left(\ln w_{i,t+1} - \ln w_{it}\right) \qquad (24)$$

Like the Baily et al (1992) method, they identify continuing firms (C), entrants (N) and exiters (D) for the decomposition. They also identify three sources of productivity growth: intra-firm productivity growth, reallocation effect and net-entry with no covariance term which is a source of confusion if the BHC method. The productivity and reallocation effects are computed only for continuing firms that exist in periods *t, t+1* and *t+2*. For firms that exist only in *t* and *t+1* (exiters) and in period *t+1* and *t+2* (entrants) their contribution to overall productivity growth is captured through net-entry.

The intra-firm productivity term is represented as:

$$\sum_{i \in c} \frac{s_{vi,t+2} + 2 * s_{vi,t+1} + s_{vit}}{4} * \left(\ln \frac{w_{i,t+2}}{w_{i,t+1}} - \ln \frac{w_{i,t+1}}{w_{it}}\right) \qquad (25)$$

For incumbent firms, part of their contribution to change in productivity growth is the summation of the difference in their productivity growth weighted by the average value added share for the three periods with the share in *t+1* taken twice.

The reallocation effect is captured by:

$$\sum_{i \in c} \frac{1}{2} * \left(\ln \frac{w_{i,t+2}}{w_{i,t+1}} + \ln \frac{w_{i,t+1}}{w_{it}}\right) * \left(\frac{s_{vi,t+2} - s_{vit}}{2}\right) \qquad (26)$$

This term represents the change in value added share weighted by the average rate of productivity growth between period **t** to *t+1* and *t+1* to *t+2*.

The third term is net entry. Unlike the BHC approach, the role of net entry for change in rate of growth of aggregate productivity requires both exiters and entrants to be observed for two successive periods. This means that firms that enter in the current period (*t+2*) and exiters that exited in period *t* will not be included in this estimation. Net-entry is calculated as follows:

$$\sum_{i\in N}\left(\frac{s_{vi,t+2}+s_{vi,t+1}}{2}\right)*\left(\ln\frac{w_{i,t+2}}{w_{i,t+1}}\right)-\sum_{i\in D}\left(\frac{s_{vi,t+1}+s_{vit}}{2}\right)\left(\ln\frac{w_{i,t+1}}{w_{it}}\right) \qquad (27)$$

According the PL method, if inputs are not reallocated away from firms with low productivity growth, aggregate productivity growth will change only through the effect of share weighted change in intra-firm productivity assuming no entry and exit. On the other hand, if the productivity effect is zero, growth rate of aggregate productivity may change due to reallocation of market share to firms with higher growth rate of productivity. Firm exit will be a drag on productivity growth if there are no entrants or if share weighted productivity growth among entrants is slower than that of exiters.

Decomposition of productivity growth

This section discusses the results of decomposing industry level productivity from Ethiopian manufacturing based on the BHC (1992) and the PL (2004) methods. We compare how best they predict the aggregate productivity growth estimated independently at the industry level using the Divisia index in line with the growth accounting method. The purpose is to identify the role of heterogeneity and turnover for aggregate productivity growth while discriminating among methods of decomposition as far as the data allows.

The analysis is carried out for nine industries and Appendix tables 3a present the decomposition of productivity growth in the BHC tradition. Unlike other studies, value added shares are used as weights for aggregating firm level productivity. However, results are essentially the same if output shares are used. This has much to do with the facts that inter industry relations in terms of input use are rather limited in Ethiopian manufacturing. Appendix table 3b provides the decomposition of changes in the rate productivity growth according to the PL method. Both tables are compared with the industry productivity growth based on the representative firm approximation in a competitive market where factor shares in revenue represent factor elasticities. The tables also provide analysis at the manufacturing sector level whereby industries are aggregated using their average share in sector wide value added over the study period.

Columns 3 and 4 in Appendix table 3a report productivity growth based on the Tonquist method applied to the Divisia index and the BHC method, respectively, for an industry. The two series are highly correlated showing that they capture the same trend. The most important and clear observation emerging from this exercise is that productivity has been declining in Ethiopian manufacturing with little inter-industry differences. It is hard to find industries with a steady productivity growth except the textile and light machinery industries where productivity grew for three years in a row during 1998-2000. At the manufacturing sector level, productivity was declining except for 1999. In some industries like food and beverage, leather and footwear and printing and paper, the decline has been more serious. It also appears that loss of productivity within the firm has been the major source of negative aggregate productivity growth. The within effect has been negative for more that 80% of the (annual) observations on productivity growth taking all industries together.

On the other hand, reallocation of resources from less efficient to more productive incumbents has played positive role with few exceptions. Although it was not sufficient to completely offset the secular decline in intra-firm productivity decline, market selection forces have mitigated the decline in aggregated productivity by reallocating market share to more efficient firms. It is important to note that (the logarithm of)firm level productivity has been indexed to the representative firm in 1996 such that an increase in market share for a particular firm would contribute to industry productivity growth only if the firm was above the industry average in the base year. Similarly, a decline in market share could boost industry productivity if the firm's efficiency was below the mean industry practice in 1996. The Petrin-Levinson critic on the BHC approach notwithstanding, Appendix table 3a shows that underlying productivity differences and the selection power of markets have played important role in industry evolution. If we look the manufacturing sector as a whole, reallocation of resources has managed to offset 60% of the decline in the level of productivity growth that would have occurred due to intra-firm productivity decline. In individual industries, the contribution of reallocation manifested in offsetting a potential 40% productivity decline in the food and metal industries, and more than 60% of the decline in other industries.

The table also reveals that net-entry has been a source of productivity growth in five out of nine industries during the study period. It shows that share weighted productivity of entrants has been higher than that of exiters in these industries. The industries in which net entry has a negative effect on productivity seem to be non-import competing industries such as wood and furniture, non-metal, printing and paper. In these sectors, the observed situation is more likely to be the result of entry of less efficient firms. The leather and footwear industry also experienced a small but negative net entry effect which is mainly due to exit of relatively productive firms out of market due to intense competition largely from Chinese imports. Nonetheless, except for few years, the role of net entry has not been very large suggesting that productivity of entrants was only marginally higher/lower than exiters. This also reaffirms that entry and exit take place at the bottom end of the productivity distribution which is the locus of small firms with small market share.

Appendix table 3b shows the Petrin-Levinsohn (PL) aggregation of firm level changes in productivity growth which closely captures the movements in the industry productivity index according to the growth accounting approach. In most cases it picks the exact level of change despite the fact that it does not include firms which exited in time t and firms that joined an industry in $t+2$. Although productivity growth has been negative during the study period for most industries, column 4 in Appendix table 3b shows that the change in the rate of productivity growth was rather cyclical. If productivity keeps on declining but at a decreasing rate in column 3, this phenomena shows up as a positive outcome in column 4 accounting for some of the cyclical trend in the LP index. Productivity in the food industry was declining, for instance, at a decreasing rate between 1997 and 1999 according to the growth accounting measure; column 5 captures this as an improvement.

What is interesting about the PL decomposition is that it reaffirms declining tendency in intra-firm productivity (column 5) which has been the major source of productivity decline at the industry level. Like the BHC method, the reallocation effect has been positive and significant. The difference compared to the BHC method is that the reallocation effect was positive for all industries and all time periods with no exceptions. In the BHC method, there were cases in which the reallocation effect was negative which always coincided with a productivity decline at the industry level showing a pro-cyclical tendency in this component. The PL method shows that the reallocation effect is positive even during periods of productivity decline. The results of the PL method suggests that reallocation always plays a positive role when resources are reallocated to firms with higher productivity growth and not just to firms with higher that average level of productivity. During periods of sector wide decline in the rate of productivity growth, reallocation of market share has offset 45% of the decline that would have occurred due to decline in intra-firm productivity and due to negative net-entry effects. On the other hand, reallocation has contributed to more than 60% of the increase in the rate of productivity growth during periods of improvement. In the food and beverage, and chemical and plastic industries for instance, reallocation has more than offset the negative effect from the other two sources. In other industries it offset 60-90% of the potential decline in the rate of productivity growth.

The PL method also reveals that net entry has been a drag on the rate of change of productivity growth. This appears to be at odds with the result from the BHC method in Appendix table 3a. However it could well be the case that although entrants are relatively more productive than exiters, their productivity has not been growing relatively faster. It would also mean that they have suffered larger negative productivity shocks than exiters but their exit decision is yet to come. Looking at the manufacturing sector as a whole we can see that net-entry tends to slow down the rate of productivity growth for almost the entire study period. This negative effect on the rate of productivity growth has not been more than 5 percentage points for most industries, except for the leather and footwear industry where it exerted a net drag of more than 15 percentage points.

The conclusion from this section is that reform measures have indeed increased the competitive pressure on local firms and sharpened the selection power of markets. We also observe that selection has been consistent with underlying productivity differentials. However, the reallocation of inputs and market share among incumbents or the processes of entry and exit have at best managed to mitigate the more pervasive intra-firm productivity decline which continues to drive a downward spiral in industry productivity. Unleashing market forces therefore do not guarantee that an industry will be on a long term competitive path. Reshuffling of resources has its limits as, according to some theories, firms would discover over time the competitive advantages of the most productive firms. Although perfect imitation of best practices may not be possible due to intangible elements, the gap could be expected to narrow down with time leaving small room for improvement through reallocation. A long term development strategy will have to look beyond the disciplinary and allocative role of markets and explore profound factors that determine intra-firm technological capabilities.

Shifts in the distribution of productivity

An important advantage of census data is that it permits investigation of trajectories in the entire distribution of productivity over time in addition to movements among ranks of the distribution. For instance, productivity growth in an industry will shift the distribution to the right. Figures in Appendix 4 compare kernel density functions of productivity by industry in 1996 and 2002. To formalize our examination of distributions, a Kolmogorove-Smirnove test for the equality of distributions is provided in Appendix table 2.

The figures show that only two industries, namely chemical and plastic, and metal feature a significant right ward shift in the distribution of firm-level productivity during the study period. It is important to note that the improvement in the chemical industry is largely the result of productivity growth among firms that were below the 1996 mean industry practice rather than an increase in the proportion of highly efficient firms. This suggests that the productivity gains of this industry is driven by convergence to the frontier technology in the industry rather than a shift in the frontier. In the metal industry, however, the shift to the right is for the entire range of the distribution and hence both convergence to the frontier and shifts of the frontier must have taken place. The test results in Appendix table 2 indicate that the positive shifts in these two industries are significant at 5%. The weighted distribution is essentially the same except that the shift in the chemical industry is significant only at the 10% level.

On the other hand, the distribution of productivity has shifted to the left in the food and beverage, and wood and furniture industries. The decline in the productivity of the food industry is mainly due to fall in the proportion of firms at the top end of the distribution while in the wood and furniture industry it is due to the entry of less efficient firms. It is important to note that the wood and furniture industry is among the least capital-intensive industries and with a fast growing number of enterprises.

Although import penetration rate is high in this industry, the competition from imports is more apparent than real. Imported furniture serves only the upper end of the market and do not pose significant threat to local firms. In fact major furniture enterprises in the country are also importers of high quality office and hospital furniture showing that the two can go together in a profitable fashion. There is also a demand side story to this development. Greater emphasis on social services in the recent poverty focused reform programs has led to increased government spending on heath and education infrastructure. The growing demand has generated sufficient market even for the least efficient of firms. Formal tests of distribution show that the shift to the left in these two industries is statistically significant. Weighting by market share makes the leftward shift in the food industry significant at 1% showing that the loss in productivity at the top end of the distribution has been practically very important. This simply shows the already indicated fact that firms at the top end of the productivity rank have large market shares. Although the average import penetration rate in the food industry low, data show that it has been on the increase and some branches of the industry like edible oil manufacturing complain from competition from food-aid related imports.

Although the shape of the distribution has changed for the remaining five industries between 1996 and 2002, statistical tests show that it was not significant. Productivity in these industries has essentially remained unchanged regardless of the reshuffling at the firm level. In the leather and footwear, and light-machinery industries for instance, there is a convergence in productivity revealed by the decline in the width of the distribution in 2002. This suggests that although there is no significant shift to the right in industry level productivity, technological practices have tended to converge which is also an impact of growing competition. In fact for the leather and footwear industry, the market share weighted distribution shows a right ward shift that is significant at 10%. Overall it appears that markets are exerting disciplinary influence on firms making them search for the best practice technology.

7 CONCLUSION

The analysis of the micro data from Ethiopian manufacturing shows considerable degree of heterogeneity at the firm level which is very similar to the observation from other regions. There is also evidence that the observed patterns of firm entry, exit and survival are underpinned by productivity differences. Although efficiency is not the only factor behind the observed dynamics, data shows that highly efficient firms are more likely to remain at the top of the productivity distribution while firms at the lower tail of the productivity distribution exit more frequently. This finding corroborates research results from other developing and developed regions and shows that African markets, as represented by Ethiopia, are at least as strongly selective as elsewhere.

In conformity with the assumptions of market selection models, most firms join an industry with a small size at the lower end of the productivity distribution and pass through a process of learning which often leads to early exit or rarely to upward movement in the productivity ladder. Since entry and exit takes place predominantly among less efficient firms which are also small in size, the immediate contribution of producer turnover to aggregate productivity was rather limited. But its long-term effect is expected to be high through maintaining the competitive challenge on incumbents and purging of inefficient producers. There is however significant amount of rationalization as market shares are reallocated from less efficient to more efficient incumbents. And this process has managed to counteract the negative effect of a more or less secular decline in intra-firm productivity during the study period. As a result of this only few industries exhibited a significant shift to the right in the distribution of productivity. Among industries that managed such a positive shift the major source of improvement has been convergence toward the frontier technology instead of a shift in the frontier. Moreover, the industries with a positive shift in productivity are among those which face strong competition from imports suggesting that international competition has additional disciplinary effect. It has been indicated that industries with relatively high import penetration rate demonstrate less tolerance to inefficient firms.

The decline in intra-firm productivity in most industries requires closer investigation. There are preliminary indications that the proportion of firms with positive investment has been declining and so does the rate of investment itself. It can be concluded that while markets have played the expected disciplinary role among African manufacturing firms, it does not offer the core capabilities a developing economy may need for long-term competitiveness.

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APPENDICES

Appendix table 1
Features of Ethiopian manufacturing

	Distribution of firms by Industry		Four Firm Concentration Ratio (%)	Capital per Worker (Birr)	Import Penetration Ratio (%)	Public Enterprises (%)		Employment in Public Enterprises (%)		Enterprises With Foreign Capital (%)		Size Distribution of Firms 1996-2002		
	1996	2002	1996-2002	1996-2002	1996-2002	1996	2002	1996	2002	1996	2002	Small	Medium	Large
Food and Beverage	24.6	29.4	41.4	62.6	14.0	31.8	14.5	86.1	57.6	0.0	3.2	57.4	18.3	24.3
Textile and Garments	10.0	8.0	35.0	27.1	48.8	50.0	34.3	97.0	64.2	4.8	7.5	32.3	22.9	44.9
Leather and Footwear	10.1	5.9	49.4	33.2	30.8	14.8	13.7	74.2	52.7	6.6	9.8	46.3	28.0	25.8
Wood and Furniture	16.2	19.0	40.9	17.3	54.2	17.8	7.4	54.8	22.6	5.0	3.4	72.4	17.8	9.9
Printing and Paper	6.9	8.3	61.7	23.4	48.7	21.4	12.5	80.8	63.4	4.8	2.8	55.0	30.6	14.4
Chemical and Plastic	8.2	9.0	47.1	100.5	69.0	27.5	19.0	77.5	46.1	0.0	8.9	48.0	25.6	26.5
Non-Metal	13.2	10.8	78.6	90.6	21.2	24.6	23.0	74.0	74.1	4.3	1.4	60.8	20.8	18.4
Metal	7.2	7.7	77.5	53.6	61.1	15.6	10.6	62.9	46.6	11.1	9.1	62.1	23.0	14.9
Light Machinery	3.5	1.9	87.2	83.1	98.3	13.6	17.7	70.5	68.2	9.1	23.5	69.5	19.9	10.6

Source: Author's Computation based on CSA data.

Appendix table 2
Test for the equality of distribution of productivity in 1996 and 2002

	Kolmogorove-Smirnove test			
	Unweighted		*Weighted*[a]	
	D	*p-value*	*D*	*p-value*
Food and Beverage	-0.123	0.059	-0.1595	0.009
Textile and Garments	0.109	0.465	0.0831	0.653
Leather and Footwear	0.198	0.114	0.211	0.097
Wood and Furniture	-0.214	0.004	-0.2385	0.001
Printing and Paper	0.087	0.667	-0.1167	0.511
Chemical and Plastic	0.247	0.023	0.2029	0.089
Non-Metal	0.097	0.513	-0.1348	0.276
Metal	0.284	0.013	0.2393	0.048
Machinery	-0.278	0.227	0.2102	0.441

Source: Author's computation.
Note: negative values for *D* indicate that the 2002 level of productivity is lower than 1996.
a-valueadded share is used for weighting.

Appendix table 3a
Decomposition of industry productivity growth: The BHC method

		Industry Productivity Growth		Within effect	Reallocation effect	Net entry
		Tornquist index	BHC aggregate			
Food & Beverage	1997	-15.52	-7.07	-15.46	7.74	0.65
	1998	-1.21	-0.54	-9.92	4.84	4.54
	1999	-1.08	-11.71	-6.53	-25.17	19.99
	2000	-27.30	-4.97	-48.54	50.33	-6.76
	2001	25.17	4.94	-1.41	-3.26	9.61
	2002	-13.75	-9.89	-12.65	2.51	0.26
Textile & Garments	1997	-10.10	-23.47	-18.34	1.29	-6.42
	1998	17.30	10.22	-29.59	39.97	-0.11
	1999	50.44	42.10	17.14	24.87	0.09
	2000	15.63	14.59	-21.36	22.84	13.11
	2001	-38.17	-41.09	-56.81	9.09	6.63
	2002	-1.38	-13.29	-44.62	31.08	0.25
Leather & Footwear	1997	31.80	-5.73	-22.54	-17.86	34.66
	1998	-44.52	-97.38	-127.07	29.65	0.04
	1999	59.80	148.45	-1.14	144.59	5.00
	2000	-84.75	-157.67	-105.39	46.55	-98.83
	2001	-58.12	-29.87	-119.14	31.38	57.89
	2002	-0.09	-37.20	-73.99	36.98	-0.19
Wood & Furniture	1997	17.24	5.30	-7.99	26.50	-13.20
	1998	17.26	23.36	2.78	9.96	10.61
	1999	-44.00	-25.46	-68.93	42.56	0.91
	2000	-5.26	5.36	-14.87	23.22	-2.98
	2001	4.97	3.08	-5.43	12.35	-3.84
	2002	-27.76	-19.23	-37.12	25.01	-7.12
Printing & Paper	1997	-13.75	-1.30	-2.56	27.66	-26.37
	1998	15.34	-3.50	14.86	-28.61	10.25
	1999	11.45	-1.32	-5.92	5.07	-0.47
	2000	-56.68	-26.75	-61.48	32.12	2.61
	2001	39.04	52.08	28.05	26.48	-2.45
	2002	-19.63	-53.17	-50.37	-2.48	-0.33
Chemical & Plastic	1997	2.74	2.00	-43.21	24.95	20.25
	1998	5.48	12.96	-60.06	15.28	57.74
	1999	-30.33	-26.16	-55.57	22.50	6.92
	2000	55.18	77.63	33.80	43.24	0.60
	2001	-37.96	-57.53	-54.79	-2.63	-0.11
	2002	-7.18	12.48	-12.97	20.82	4.63
Non-Metal	1997	8.11	13.62	-7.48	20.63	0.48
	1998	-44.46	-4.10	-82.88	79.92	-1.14
	1999	15.96	26.52	37.45	24.20	-35.14
	2000	-24.15	-20.99	-40.16	20.23	-1.06
	2001	-36.60	-32.33	-30.93	3.47	-4.87
	2002	22.77	20.25	14.67	6.02	-0.43

Source: Author's computation

Continuation Appendix table 3a

		Industry Productivity Growth		Within effect	Reallocation effect	Net entry
		Tornquist index	BHC aggregate			
Metal	1997	-19.46	-2.21	-5.08	-6.22	9.09
	1998	-76.43	-82.76	-108.78	15.95	10.07
	1999	-7.46	-39.18	-74.13	34.94	0.01
	2000	35.22	39.54	21.25	16.66	1.62
	2001	-28.87	-20.35	-48.89	2.92	25.62
	2002	-9.55	31.56	-30.45	37.43	24.58
Light Machinery	1997	-31.61	-0.28	-52.20	56.37	-4.46
	1998	29.18	50.18	6.77	39.34	4.07
	1999	22.95	-10.57	15.40	-26.76	0.79
	2000	6.25	-4.52	-0.03	-30.99	26.49
	2001	-18.42	-19.24	-18.71	-1.33	0.38
	2002	15.66	12.53	8.57	19.74	-15.77
Manufacturing	1997	-8.36	-5.03	-17.45	10.05	2.36
	1998	-6.87	-7.42	-32.77	15.01	10.35
	1999	4.21	0.96	-12.41	4.58	8.79
	2000	-13.26	-0.73	-33.65	39.61	-6.68
	2001	-0.21	-9.94	-22.33	2.87	9.52
	2002	-8.77	-6.91	-20.86	12.11	1.84

Source: Author's computation.

Appendix table 3b
Decomposition of change in productivity growth: The Petrin- Levinsohn method

		Productivity Growth – Tornquist index	Change in productivity growth	Within effect	Reallocation effect	Net entry
Food & Beverage	1997	-15.52				
	1998	-1.21	14.3	4.3	4.8	0.2
	1999	-1.08	0.1	-1.3	2.1	-1.2
	2000	-27.30	-26.2	-7.9	3.2	-22.0
	2001	25.17	52.5	57.1	3.9	0.5
	2002	-13.75	-38.9	-59.8	17.8	0.6
Textile & Garments	1997	-10.10				
	1998	17.30	27.4	-25.5	11.7	-0.1
	1999	50.44	33.1	19.7	32.7	0.0
	2000	15.63	-34.8	-71.0	16.7	4.1
	2001	-38.17	-53.8	-39.6	8.4	-8.3
	2002	-1.38	36.8	3.5	30.4	0.0
Leather & Footwear	1997	31.80				
	1998	-44.52	-76.3	-72.1	1.4	-29.7
	1999	59.80	104.3	68.0	89.7	2.3
	2000	-84.75	-144.6	-188.6	27.6	-30.4
	2001	-58.12	26.6	-1.1	35.4	-1.2
	2002	-0.09	58.0	50.5	12.8	-28.5
Wood & Furniture	1997	17.24				
	1998	17.26	0.0	-14.8	9.5	-1.0
	1999	-44.00	-61.3	-72.8	11.7	-3.7
	2000	-5.26	38.7	46.8	7.2	2.8
	2001	4.97	10.2	-2.8	8.6	2.0
	2002	-27.76	-32.7	-35.9	9.2	0.6
Printing & Paper	1997	-13.75				
	1998	15.34	29.1	10.5	2.3	1.9
	1999	11.45	-3.9	-24.7	5.2	13.0
	2000	-56.68	-68.1	-61.5	2.2	0.8
	2001	39.04	95.7	80.5	14.9	0.4
	2002	-19.63	-58.7	-70.5	5.0	-0.6
Chemical & Plastic	1997	2.74				
	1998	5.48	2.7	-41.7	18.6	-5.7
	1999	-30.33	-35.8	17.2	7.1	-22.0
	2000	55.18	85.5	53.8	24.7	1.0
	2001	-37.96	-93.1	-102.8	12.6	-0.4
	2002	-7.18	30.8	18.4	17.5	0.1
Non-Metal	1997	8.11				
	1998	-44.46	-52.6	-82.2	23.7	3.6
	1999	15.96	60.4	58.7	9.1	3.8
	2000	-24.15	-40.1	-60.6	19.0	-1.7
	2001	-36.60	-12.5	-24.7	15.6	-0.2
	2002	22.77	59.4	52.7	3.0	-0.7
	1997	8.11				

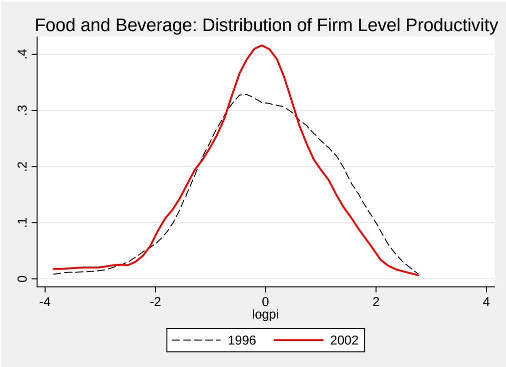
Source: Author's computation.

Continuation Appendix table 3b

		Productivity Growth – Tornquist index	Change in productivity growth	Within effect	Reallocation effect	Net entry
Metal	1997	-19.46				
	1998	-76.43	-57.0	-85.1	14.3	3.5
	1999	-7.46	69.0	-9.9	39.3	-3.3
	2000	35.22	42.7	68.2	9.1	0.5
	2001	-28.87	-64.1	-77.7	14.1	-0.4
	2002	-9.55	19.3	15.6	5.1	-1.4
Light Machinery	1997	-31.61				
	1998	29.18	60.8	64.0	4.4	-3.4
	1999	22.95	-6.2	-22.9	9.2	2.9
	2000	6.25	-16.7	11.6	3.9	-3.3
	2001	-18.42	-24.7	-49.8	11.5	-6.3
	2002	15.66	34.1	35.5	0.8	-3.6
Manufacturing	1997	-8.36454				
	1998	-6.87591	-11.60	-18.81	8.71	-1.51
	1999	4.208171	17.39	6.15	13.47	-2.23
	2000	-13.2598	-18.73	-16.21	9.69	-12.20
	2001	-0.21183	19.53	10.96	9.28	-0.70
	2002	-8.76766	-11.24	-25.57	15.67	-1.34

Source: Author’s computation.

Appendix 4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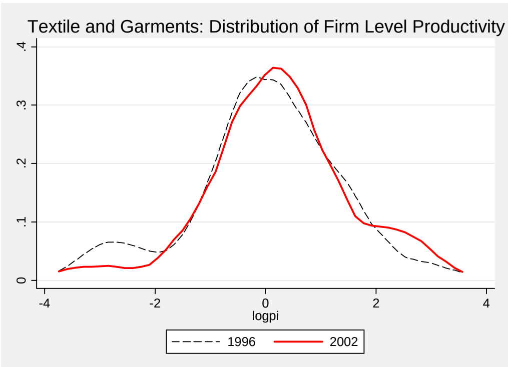
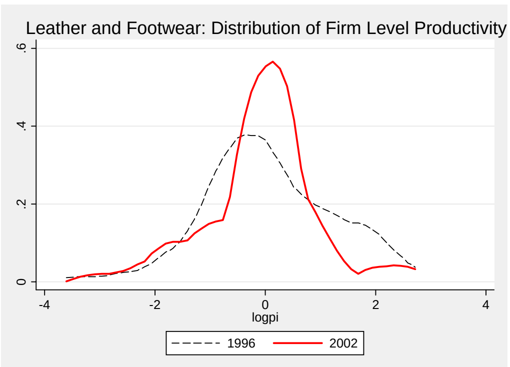
2002


Textile and Garments: Distribution of Firm Level Productivity
logpi
1996
2002


Leather and Footwear: Distribution of Firm Level Productivity
logpi
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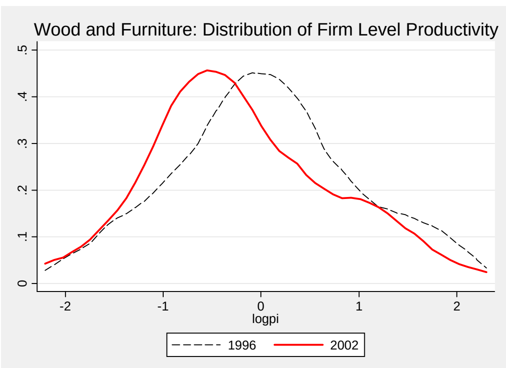
Wood and Furniture: Distribution of Firm Level Productivity
logpi
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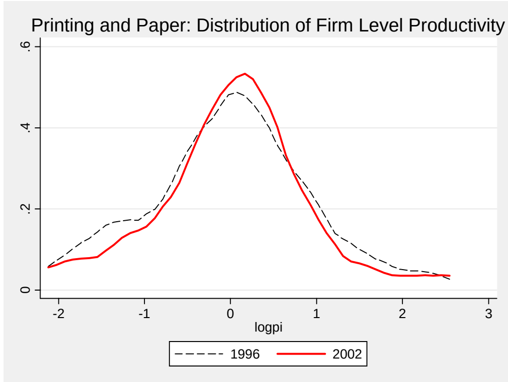
Printing and Paper: Distribution of Firm Level Productivity
logpi
1996
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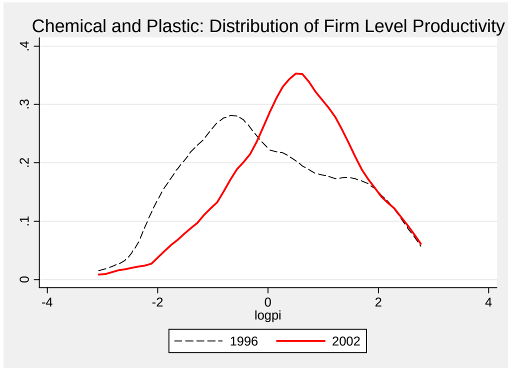
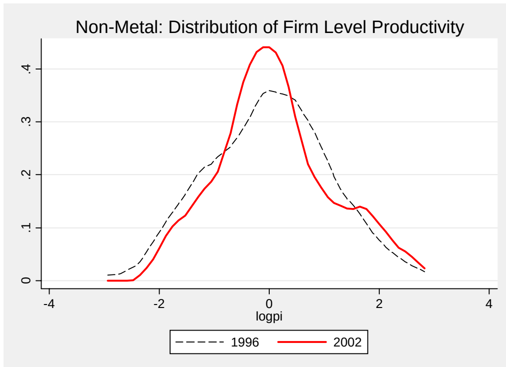

Chemical and Plastic: Distribution of Firm Level Productivity
logpi
1996
2002


Non-Metal: Distribution of Firm Level Productivity
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1996
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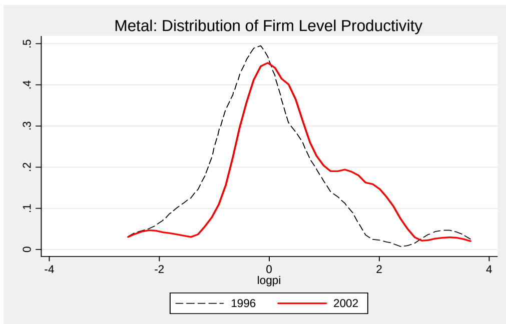
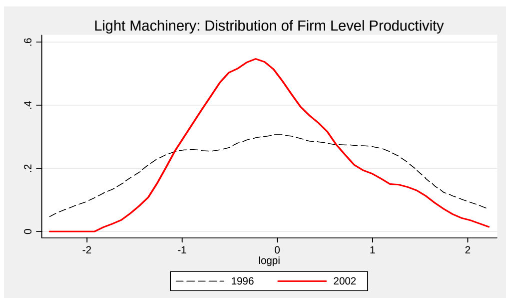

Metal: Distribution of Firm Level Productivity
logpi
1996
2002


Light Machinery: Distribution of Firm Level Productivity
logpi
1996
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