Courant Research Centre

'Poverty, Equity and Growth in Developing and Transition Countries: Statistical Methods and Empirical Analysis'

Georg-August-Universität Göttingen
(founded in 1737)

Discussion Papers

No. 56

Multi-product Firms and Product Basket Adjustments in Ethiopian Manufacturing

Admasu Shiferaw

December 2010

Wilhelm-Weber-Str. 2 · 37073 Goettingen · Germany
Phone: +49-(0)551-3914066 · Fax: +49-(0)551-3914059

Email: crc-peg@uni-goettingen.de Web: http://www.uni-goettingen.de/crc-peg

Multi-product Firms and Product Basket Adjustments in Ethiopian Manufacturing

Admasu Shiferaw

Courant Research Centre – PEG
University of Goettingen
Germany

December 2010

This paper is part of the research project "The Dynamics of Job Flows, Investment and Product Mix in African Firms" funded by the German Research Foundation (DFG). I am grateful to Vandana Chandra for her comments. Christian Peuker provided excellent research assistance at various stages. All errors are mine.

Abstract

This paper analyzes firm level adjustment of the product mix and its implications for aggregate output growth. Using firm level panel data from Ethiopian manufacturing during the period 1996-2007, it shows that about 30% of firms adjust their 'extensive margin' annually by adding and/or dropping at least one product and about half of those firms undertake such adjustment only through product adding. At the aggregate level, about 30% of annual growth in sales is accounted for by the adjustment of the extensive margin which is more than four times the net contribution of firm entry and exit. The paper also shows that the likelihood of adding a product tends to decline with firm size and increases dramatically with the incidence of large investment outlays. While the level of productivity does not seem to increase the probability of adding a product, a net increase in the number of products is strongly associated with subsequent growth in sales, productivity and capital stock at the firm level.

Key Words: Product Switching, Multiproduct Firms, Extensive Margin, Intensive Margin, Ethiopian Manufacturing.

JEL: D21, E23, L11, L60

1. Introduction

Firm level adjustment of the product mix begin to be recognized only recently as an important dimension of resource allocation (Bernard, Redding and Schott, 2007, 2010). Previous work on industry dynamics emphasized on market selection and the reallocation of resource across firms based on underlying productivity differences (Jovanovic, 1982; Hopenhayen, 1992; Ericson and Pakes, 1995). While enjoying wide empirical support from firm level studies in developed and developing countries,[1] these models did not address firms' choice of the range of products as a potential source of productivity growth. Even recent developments in trade theory with heterogeneous firms focused on the entry and exit of firms as well as the reshuffling of market share among presumably single-product firms (Melitz, 2003).

Examining the process of product adding and dropping (product switching) is very crucial partly because the process of economic development goes hand-in-hand with economic diversification and partly because multiproduct firms seem to play a critical role in this process (Imbs and Wacziarg, 2003; Klinger and Lederman, 2004). Bernard, Redding and Schott (2010) extended the traditional theoretical models of industry dynamics by allowing for endogenous choice of the products mix at the firm level. In their model, firms incur a fixed cost of introducing a new product and, variation in profitability is driven by underlying differences in firm level productivity and consumer taste. The model predicts that firms with higher innate productivity can afford the fixed cost of introducing a new product. Given the level of productivity, firms that receive positive demand shocks are likely to add a new product while negative demand shocks increase the propensity to terminate a product line. These assertions have been supported

[1] See Bartelsman and Doms (2000) for the evidence from developed countries and Tybout (2000) for the evidence from developing country firms other than Sub-Saharan Africa. Shiferaw (2007) and Van Biesebroeck (2005) provide similar evidence for African countries.

by empirical evidence from US manufacturing whereby multiproduct firms are indeed larger and more productive than single-product firms (Bernard et al. 2010). These authors also show that multiproduct firms receiving negative demand shocks tend to drop the least important product in terms of intra-firm revenue share which is consistent with their theoretical model. Most importantly, product switching in US manufacturing is strongly correlated with observed productivity differences at the firm level whereby a net increase (decrease) in the number of products is positively (negatively) correlated with a revenue based measure of total factor productivity.

Apart from empirically testing the implications of their theoretical framework, Bernard et al. (2010) also show that product switching is widespread and contributes significantly to aggregate outcomes. For instance, multiproduct firms in the US account for 39% of manufacturing firms and 87% of total output. More than half (54%) of US manufacturing firms also adjust their mix of products during the course of five years and, recently added products account for about a sixth of a product's total output - a magnitude equivalent to the contribution of new firms.

Rare evidence on product switching in the developing world comes from Indian manufacturing firms in a recent paper by Goldberg, Khandelwal, Pavcnik and Topalova (2010). They show that multiproduct firms in India are quite similar to their US counterparts in the sense that they are larger and more productive than single-product firms and account for 47% of firms and 80% sales in Indian manufacturing. Unlike US firms, however, Indian firms show substantially less product churning – only 28% of firms change their product mix over a five year interval. Firms that adjust their product mix contribute for about a quarter of overall growth in manufactured sales. The study by Goldberg et al. (2010) does not address the link between productivity and product churning nor does it show the relative importance of the latter with respect to firm entry and exit.

Alvarez, Ortega and Navarro (2009) and Navarro (2008) examine product mix changes among Chilean manufacturing firms. About 24% of firms in the Chilean sample adjust their product mix annually which is close to the average for Indian firms. The authors use difference-in-difference technique to estimate the effect of product switching and find no significant effect on TFP and TFP growth. However, firm level sales, employment and investment increased significantly after adding a product. A non-parametric analysis shows that introduction of a new product in Chilean manufacturing is preceded by negative productivity shocks.

This paper examines the nature and extent of product basket adjustment, its association with firm characteristics and its potential contribution for growth in aggregate manufacturing output in a large Sub-Saharan African country. The analysis is based on a unique panel data of Ethiopian manufacturing firms during the period 1996-2007. Its contribution lies not only in providing a rare evidence on product switching in the African context, but also in making subtle propositions about the empirical interpretation of the role of productivity in product switching and the nature of fixed costs associated with the introduction of new products. The findings in this paper suggest that the expectation of higher productivity or the desire to reverse negative productivity shocks could be driving the propensity to adjust the product mix rather than a high level of productivity leading to product addition. The results also suggest that a large increase in capital stock is a crucial component of the fixed cost of adding a product assumed in the Bernard et al. (2010) model of multiproduct firms.

The paper is organized as follows. Section 2 describes the data and examines the distribution of products and firms across four digit SIC industries. Section 3 discuses the characteristics and relative importance of multiproduct firms in the Ethiopian manufacturing sector. The extent and pattern of product adding and dropping are analyzed in section 4 while section 5 examines the firm characteristics associated with product switching. Section 6 estimates the

contribution to aggregate output growth of product basket adjustment at the firm level. Section 7 concludes the paper.

2. Data and the range of products

The paper uses an unbalanced panel-data of manufacturing firms over the period 1996 to 2007 based on annual census of manufacturing carried out by the Ethiopian Statistical Authority (CSA). The census captures all establishments that employ at least 10 workers and use power driven machinery. The census uses ISIC classifications to define industrial sectors and CSA's internal definition of products within industries. Table 1 shows the number of four-digit ISIC industries and the corresponding range of products (excluding the printing and paper, and wood and furniture sectors). There are about 41 four-digit ISIC industries with 138 different products produced by about 1008 firms, the average size of which was about 104 workers in 2007.

3. Multiproduct firms and the intra-firm distribution of sales

Relative importance of multiproduct firms

Table 2a shows that about 34% of Ethiopian manufacturers are multi-product firms while the remaining nearly two-thirds are single-product firms. While this pattern is relatively stable during the sample period, the fraction of multi-product firms has remained at about 30% since 2004 suggesting a modest decline in recent years. Table 2b shows that multiproduct firms account on average for about 42% of sales during the sample period. Further disaggregation in Table 3 shows that the overwhelming majority of multi-product firms (26.8% out of the total 34%) actually produce only two products with only a small fraction (about 7%) of firms producing three or more products. This shows that although multiproduct firms in Ethiopian manufacturing are quite important, their role is

much less than that of multiproduct firms in the US and Indian manufacturing where they account for 87% and 80% of total sales, respectively.

While the majority of manufacturers are single-product firms, the decision to diversify the product basket at the firm level is not trivial in terms of intra-firm product share distribution. Table 4 shows that as the number of products increases, the share of the most important product declines significantly. Among firms that produce two products, the dominant product accounts on average for about 80% of sales. The share of the most important product declines to about 66% of sales among firms with three products and drops further to 45% for firms that produce six different products[2]. The second important product accounts for 20% of total sales for firms with two products and reaches a maximum of 27% of sales among firms with five products. The product with the 3rd ranking accounts for 9% to 16% of total sales.

Figure 1 compares the relative importance of multiproduct firms across sectors in terms of shares in total sales and number for firms. There is a positive correlation between these two measures of the significance of multiproduct firms. The beverage industry having the lowest share of multiproduct firms while the tannery, textile and, metal and machinery industries are dominated by multiproduct firms.

[2] The share of the most dominant product declines relatively fast as firms add the second and third product in the Ethiopian sample while its share remains above 70% of total sales in the case of India and the US (Bernard et al., 2010 p 91; Goldberg et al., 2010 p.1045).

Characteristic of multiproduct firms

Having examined the distribution and significance of multiproduct firms, we now turn to highlight their key characteristics. We look particularly at firm size, age, productivity, export status, and investment behavior. Firm level productivity is measured in terms of both total factor productivity (TFP) and labor productivity (value added per worker). Firm level TFP is estimated as a residual from the regression of real value added on real capital stock and employment using the Blundell and Bond (1998) system GMM estimator. Investment activity is captured by two dummy variables: one variable indicating whether a firm has a non-zero investment, and another one indicating whether a firm has a lumpy investment or not. A lumpy investment is an investment rate (calculated as the ratio of current investment to lagged capital stock) in excess of 20%.

Table 5a shows the coefficients from an OLS regression of each firm characteristic on a dummy variable distinguishing multiproduct and sing-product firms. The model also controls for industry fixed effects and the statistical significances are based on standard errors that are clustered at the industry level. The results are essentially t-tests for mean difference between two sub-samples after controlling for industry fixed effects.

The results show that multiproduct firms are larger in size, both in terms of sales and employment, than single-product firms in the same industry. They are also older and more likely to invest than sing-product firms. This is not surprising if expanding the product basket requires acquisition of capital, new technologies and experiences. The observations are consistent with the findings of Bernard et al. (2010) and Goldberg et al. (2010) about multiproduct firms in the US and Indian manufacturing, respectively. There is no evidence, however, that multiproduct firms in Ethiopia are more efficient or more likely to export than single-product firms. This is quite different from the situation in the US and does

not corroborate with the prediction of the multiproduct firm model by Bernard et al. (2010). It is rather similar to the observation from Chilean manufacturing firms where product adding is preceded by productivity decline (Alvarez et al., 2009).

To consolidate the characterization of multiproduct firms, we run a panel logit model where the dependent variable is a dummy variable identifying multiproduct firms. The firm characteristics whose bivariate correlations are shown in Table 5a now enter the model as explanatory variables simultaneously to estimate their relative importance. We consider a one period lag of the firm characteristics to minimize the endogeneity problem arising, for instance, from the joint adjustment of the product basket and firm size. The model includes a complete set of industry and time fixed effects and the results are presented in Table 5b.

Table 5b shows that the probability of producing more than one product increases with firm size and age. As indicated in column 3, firm size has a convex relationship with the probability of being a multiproduct firm – the latter declines first as firm size increases and then starts to increase among large firms. Once the size and age effects are taken into account, the probability of becoming a multiproduct firm seems to be inversely related with productivity growth. This might reflect a situation in which single-product firms prefer not to add a new product as long as productivity is increasing. In other words, firms receiving negative productivity shocks are more likely to experiment with new products and become multiproduct firms. Another possibility is that introducing a new product could temporarily lead to a productivity decline until the firm musters the capabilities to manufacture it efficiently. The latter is however unlikely to be the case as the model takes the lagged value of productivity. Table 5b reveals that it is lumpy investment and not just any amount of investment that is strongly associated with being a multiproduct firm. This finding underscores that product basket adjustment requires a large investment episode.

Put together, the results from Tables 5a and 5b indicate that becoming a multiproduct firm is rather costly, at least in terms demanding a large investment. Firms therefore seem to be cautious to diversify their scope of production and they are more likely to become multiproduct firms when they experience negative productivity shocks. The fact that most firms remain single-product firms and that the fraction of multiproduct firms is higher among large firms supports the view that being a multiproduct firm is an expensive choice and to a certain extent a reaction to adverse shocks. While the negative correlation with productivity is contrary to the prediction of the theory on multiproduct firms, the positive correlation with lumpy investment seems to concur with the assumption of a fixed cost of introducing a new product (Bernard et al., 2010).

4. Adjustment of the Extensive Margin

This section examines firm level adjustment of the extensive margin as products are added and dropped. A product is considered to be added if it is produced in year t but not in year t-1 and we consider a product to have been dropped if it existed in year t-1 but not in year t.

Table 6 reports the frequency of product adding across sectors. It shows that 77.7% of firms (firm-years) do not add any product relative to the previous year. The remaining 22.3% of surviving firms adjust their extensive margin by adding at least one product to their product mix. The majority of these firms, i.e. about 16.5%, adjust their product mix by adding only one product. Only 6% of firms add more than one product at a point in time. Across industries, the fraction of firms that diversify their product basket by adding at least one product varies from a high of about 31% in the metal and light machinery sector, to a low of about 6% in the beverage sector.

Table 7 shows that product dropping is less frequent than product adding. Only about 13% of firms drop at least one product from their previous year's basket of products which is nearly 10 percentage points lower than the percentage of firms adding at least one product. The majority of product dropping firms, i.e. 10.3%, drop only one product. The textile sector has the highest product dropping rate at about 25% while the beverage industry has the lowest dropping rate at 5.4%. If knowledge and skills needed to add new products are scarce and costly, one would expect firms to be hesitant to drop a product – a presumption that is supported by the data.

Table 8 provides further detail on the nature of the extensive margin adjustment. It shows that while 70.7% of continuing firms do not adjust their product basket, the remaining 30% adjust the composition of their products either by adding, dropping or simultaneously adding and dropping products. Firms that adjust their extensive margin only through adding a product(s) accounting for 16.4% of (the total 30%) firms that adjust their extensive margin. About 7% of firms adjust their extensive margin only by dropping at least one product while about 6 % of firms change their mix of products by simultaneously adding and dropping products.

Compared with Indian manufacturing, Table 8 shows a higher degree of product mix adjustment for Ethiopian firms. About 90% of Indian manufacturing firms do not adjust their product mix during the course of one year while 72% do not adjust their mix over a five year interval. The Ethiopian average is also better than the Chilean experience where only 24% of firms adjust their product mix in one year. As already mentioned, more than half of US firms adjust their extensive margin.

Table 8 also shows that small firms are slightly more likely (30.4%) to adjust their product baskets than large firms (27.5%). The difference in the probability of adjusting the extensive margin is quite significant when we compare single-product and multi-product firms. The latter have on average a 45% chance of adjusting their product mix as compared to only 21% chance in the former. Most of this difference comes in terms of product adding whereby multiproduct firms are more than three times as likely to add at least one product as are single-product firms.

5. Product Basket Adjustment and Firm Characteristics

This section examines the relationship between extensive margin adjustment and firm characteristics. The idea is to find out the nature of firms that are more likely to adjust their product scope and contribute to diversification of the manufacturing sector at large. We take into account firm size in terms of employment and total value added, productivity as measured by value added per person and TFP, average age and investment rate.

Table 9 reports the summary statistics for the variables of interest and the last column shows the sector wide mean regardless of differences in product basket adjustment. Firms that adjust their product mix only through product adding have below average number of workers and below average age in years. This suggests that small firms seem more likely to experiment with new products perhaps in an effort to grow in size. This observation seems to be reinforced by the higher than average investment rate (17.7%) among firms which expand their extensive margin only through product addition. However, the productivity of the latter, measured in terms of labor-productivity and TFP, is far below the sector average.

On the other hand, firms that adjust their extensive margins only through dropping products are much larger in size and slightly older than the average firm in the manufacturing sector. They also record above average productivity levels. This might suggest that as firms grow larger and older, they tend to focus on fewer products by eliminating less desirable products. Firms that add and drop products concurrently are very similar to those that only drop products except that they are a lot more efficient and slightly smaller in size. Firms that do not adjust their product baskets at all have characteristics that are closer to the overall sectoral average mainly because this group of firms account for about 70% of manufacturers as pointed out in Table 8.

The preceding discussion highlights the average characteristics of firms with respect to product basket adjustment. We consolidate this analysis by putting these covariates together in an econometric model to better understand their correlation with the probability of adding or dropping a product. Accordingly, Table 10 presents the results of a panel logit model which controls for industry and time fixed effects. The dependent variable in the first three columns is a dummy that takes the value 1 if a firm adjusts its extensive margin only by adding a product and zero otherwise. For columns 4 to 6, the dependent variable is a dummy variable that takes the value 1 if a firm adjusts its extensive margin only by dropping a product and zero otherwise. The covariates are included sequentially to find out their relative importance and as a robustness check.

Similar to the results in Table 9, the first column of Table 10 indicates that the probability of product adding declines with firm size. However, once investment activities of the firm are taken into account by including the rate of investment (column 2) and a dummy variable for a lumpy investment episode (column 3), firm size becomes statistically insignificant although it maintains its negative sign. It shows that the most important correlate of product adding is a large investment

episode. Firm size, on the other hand, remains to be the best predictor of product dropping as the latter is more likely to take place among large firms.

Having seen which firms are likely to add or drop products, it remains to be seen how product switching actually affects firm outcomes. Once again we aim at best to capture equilibrium correlations rather than causal relations as product switching is an endogenous choice.

In what follows we examine relative change in firm characteristics vis-à-vis product switching. Table 11 provides OLS estimates of growth in selected firm characteristics in response to net product adding and dropping.

$$\Delta Q_{it} = \alpha_{jt} + \beta_1 NetAdd + \beta_2 NetDrop + v_{it} \quad (1)$$

Where ΔQ_{it} represents the annual change in the logarithm of firm characteristics, with the exception of investment spike which is represented by a dummy variable taking the value 1 if a firm has a lumpy investment, i.e., investment rate in excess of 20%. α_{jt} represent industry and year fixed effects and their interactions. The standard errors are clustered within an industry. *NetAdd* is a dummy variable taking the value 1 if a firm experiences a net increase in the number of products and zero otherwise. Similarly, *NetDrop* is a dummy variable taking the value 1 if a firm decreases its net number of products. The model is similar to the one estimated by Bernard et al. (2010).

The results in Table 11 indicate that a net increase in the number of products has statistically significant positive correlations with growth in real sales as well as growth in productivity measured in terms of labor or total factor productivity. A net increase in the number of products is also very likely to be accompanied by a large increase in the capital stock but not with growth in firm level employment. A

net decline in the number of products on the other hand does not have a statistically significant correlation with firm outcomes although the coefficients on *NetDrop* have the expected negative sign in most cases.

The correlation of change in product mix with the occurrence of a lumpy investment should be emphasized as it remains significant in all the regression models tested in this paper. Shiferaw (2009) finds that more than 50% of Ethiopian manufacturing firms have zero investment rate at any point in time and only a small fraction of firms (less than 15%) undertake lumpy investment (i.e. investment in excess of 20%). According to Shiferaw (2009), uncertainty of demand as well as supply shocks such as disruption of electric power supply tend to undermine investment activities of Ethiopian manufacturing firms. This negative effect of demand and supply side uncertainty is particularly strong among large firms since investment by the majority of small firms is mainly for maintenance purposes and hence relatively less sensitive to shocks. Removing the constraints to sizable investment activities is thus very crucial for product diversification which as shall be seen in the next section contributes significantly to aggregate output growth.

6. Product Switching and Implications for Aggregate Output

Having looked at the patterns of product basket adjustment and its association with firm characteristics, we now turn to the implications of this micro-level process for aggregate output. For this we follow a decomposition analysis in Bernard, Redding and Schott (2006). We start first by distinguishing the sources of growth in sales based on firms' survival status, i.e., whether a firm has just entered (N), exited(X) or continues to operate (C) in an industry:

$$\Delta Y_{jt} = \sum_{i \in C} \Delta Y_{it} + \sum_{i \in N} \Delta Y_{it} + \sum_{i \in X} \Delta Y_{it} \qquad (2)$$

where ΔY is change in sales, *j* indexes industrial sectors, *i* indexes firms and *t* indexes years. For surviving firms, sales growth can be decomposed further into the contributions of products that are added (A), dropped (D), reintroduced (R) or continue to be produced (U):

$$\Delta Y_{jct} = \sum_{g \in U} \Delta Y_{cit} + \sum_{g \in A} \Delta Y_{cit} + \sum_{g \in D} \Delta Y_{cit} + \sum_{g \in R} \Delta Y_{cit} \qquad (3)$$

Where *g* indexes products.

By substituting the two equations we can decompose total growth in manufacturing sales as follows:

$$\Delta Y_{jt} = \sum_{i \in C} \left[\sum_{g \in U} \Delta Y_{cit} + \sum_{g \in A} \Delta Y_{cit} + \sum_{g \in D} \Delta Y_{cit} + \sum_{g \in R} \Delta Y_{cit} \right] + \sum_{i \in N} \Delta Y_{it} + \sum_{i \in X} \Delta Y_{it} \qquad (4)$$

The decomposition results corresponding to equation (4) are reported in Table 12a. Table 12b shows the same results in net terms by putting together the contribution of net product adding (combining the last three terms of the first block of terms) and the contribution of net-entry (the combined effects of the last two terms of equation (4)). All the terms in (4) are divided by the lagged value of total sales at the two-digit SIC level to express the changes in terms of growth rates. The numbers in Tables 12a and 12b are average growth rates for the period 1997-2007.

Total manufacturing sales grew by about 11% per annum on average during the period 1996 to 2007. As indicated in Table 12a, most of this growth was driven by growth in the intensive margin of surviving firms which contributes for nearly 7% (out of 11%) annual growth in sales. This is about 64% of growth and shows how important continuous products are for overall growth in sales among surviving firms. This finding is very similar to that of US and Indian manufacturing sectors although in these countries, the intensive margin contributed for more than three-quarters of output growth.

Adding new items to the product basket has also contributed significantly to overall sales growth at an annual rate of 5.8%. However, the latter has been offset to a large extent by the simultaneous dropping of products causing a 4.9% annual decline sales. Firms also tend to reintroduce products that were dropped earlier which accounted for 2.5% of growth in sector-wide sales. If we includes reintroduction of formerly dropped products, the net effect of product switching or net product adding for total sales growth is 3.4% as indicated in Table 12b. This is about 30% of total sales growth which is about one-half of the contribution the adjustment of the intensive margin.

It is interesting to note that the increase in total sales due to product adding (5.8%) is about one percentage point higher than the contribution of firm entry (4.7%). The contribution of net-entry (the difference in sales growth due to firm entry and exit) to total sales growth is less than one percent per annum. That means the net effect of firm churning for industrial expansion (about 7% of total) is significantly lower than the contribution of product switching by incumbents. The intra-firm reallocation of resources as surviving firms adjust their extensive margin by adding and dropping products is therefore more important for sales growth than the reallocation of resources associated with firm entry and exit.

There are some important inter-industry differences in the decomposition of sales growth that are worth mentioning. Only two industrial sectors, textile and metal and light machinery exhibit growth in sales that has been driven mainly by the adjustment of the extensive margin rather than the adjustment of the intensive margin. For other sectors, the main source of growth is the intensification of the existing set of products. This is particularly the case in the non-metal and garments sectors where existing products play a predominant role.

Net-entry of firms mostly has a positive contribution for growth except for tanneries. As already indicated, the contribution of firm churning is relatively small with the highest contribution recorded in the food, garments, footwear and, chemical and plastic sectors where it accounted for about 2% of growth in sales. Table 12b reveals that certain sectors experienced sharp growth in the period 2002-2007 as compared to 1996-2001. The textile and garments industry noticeable in this regard where a 1.2% annual decline in sales during the period 1996-2001 was followed by a 10.6% growth during 2002-2007. This rapid growth was driven mainly by the intensification of existing products in the garments industry but by a net increase in the number of products in the textile industry. The leather and footwear sector also grew very fast since 2002 primarily due to the expansion of the intensive margin. The important distinction is that growth in the footwear industry was almost exclusively accounted for by existing products.

In general Table 12b shows that while continuous products have a predominant role for sales growth in both sub-periods, the rapid growth during 2002-2007 has seen an increase in their contribution, i.e., from accounting for about 48% of overall growth during 1996-2001 to about 58% during 2002-2007. The role of net product adding also increased slightly from 30% to about 33% of overall growth while the contribution of net firm entry dropped from 22% during 1996-2001 to about 9% during 2002-2007. This suggests that the relative importance of product switching has increased during the rapid growth in the second half of the study period while the leading role of existing products has become even more important.

The results in Tables 12a and 12b show that the Ethiopian experience is similar to that of the US and India in the sense that aggregate growth in manufactured output is driven primarily by the adjustment of the intensive margin, i.e., increasing the scale of production of existing items. In India, product switching accounted for 25% of growth in sales by surviving firms. Direct comparison with the evidence from India is not possible as Goldberg et al. (2010) did not include

the role of firm entry and exit in their growth decomposition analysis. However, the fact that net adding accounted for over 30% of annual sales growth in Ethiopia even after taking into account the role of firm churning suggests that product switching is more important in the Ethiopian context.

7. Conclusions

This paper examines multiproduct firms and their importance in the Ethiopian manufacturing sector as well as the patterns of product adding and dropping. The paper shows multiproduct firms play a crucial role in Ethiopian manufacturing accounting for about one-third of firms and about 42% of total manufacturing sales. While significant, these proportions are far less than the role of multiproduct firms in the US and India. Multiproduct firms in Ethiopia are larger and more likely to have lumpy investment than single-product firms although they are not particularly more productive. The lack of significant association with productivity differs from theoretical expectations as well as the evidence from US and Indian manufacturing firms.

About 70% of Ethiopian firms do not adjust their product basket during the course of a year. As a result of this more than 60% of the annual average growth in manufactured sales (7% out of 11%) is due to the adjustment of the intensive margin. Product adding is more than twice as frequent as product dropping in the Ethiopian sample. Most importantly, the net adjustment of the extensive margin (net product adding) accounts for about 30% of the sector's annual average growth. The latter is more than four times the contribution of net firm entry and it shows that despite its limited occurrence, adjustment of the product basket plays a much more important role in Ethiopian manufacturing as compared to the net effect of firm entry and exit.

While small firms are more likely to add new products than larger firms, the most significant factor for product adding is the episode of lumpy investment. In fact large firms are more likely to drop than they are likely to add products. Although product adding or being a multiproduct firm does not depend on the level of productivity, the paper shows that growth in productivity as well as sales are positively and significantly correlated with a net increase in the number of products. An industrial policy that aims at diversification should therefore target the young and smaller firms which are more likely to introduce new products while addressing the propensity to drop products as firms grow larger and older. Since the most important correlate of product adding is a large investment episode, improving the investment climate remains very crucial in stimulating the growth of the manufacturing sector not least through its effect on diversification of the product basket.

References:

Alvarez, R., C.B. Ortega and L. Navarro. 2009. " The Effect of Product Mix Changes on Productivity among Chilean Manufacturing Plants" http://www.merit.unu.edu/MEIDE/papers/2010/Alvarez_Ortega_Navarro.pdf

Bartelsman, E. and M. Doms. 2000. " Understanding Productivity: Lessons from Longitudinal Microdata," *Journal of Economic Literature* 38,3,569-594.

Bernard, B. A., S.J. Redding and P. K. Schott. 2010. " Multiple-Product Firms and Product Switching," *American Economic Review* 100, 1, 70-97.

Bernard, B. A., S.J. Redding and P. K. Schott. 2006. " Products and Productivity," *National Bureau of Economic Research Working Paper 11575*.

Bernard, B. A., S.J. Redding and P. K. Schott. 2006. " Multi-Product Firms and Product Switching," *National Bureau of Economic Research Working Paper Working Paper* 12293.

Blundell, R. and S. Bond. 1998. "Initial Conditions and Moment Restrictions in Dynamic Panel Data Models," *Journal of Econometrics* 87, 115-143.

Ericson, R. and A. Pakes. 1995. "Markov-Perfect Industry Dynamics: A Framework for Empirical Work," *Review of Economic Studies* 62,1, 53-82.

Goldberg, K.P., A.K. Khandelwall and N. Pavcnik, P. Topalova. 2010. "Multiproduct Firms and Product Turnover in the Developing World: Evidence from India," *Review of Economics and Statisics* 92, 4, 1042-1049.

Hopenhayen, H. 1992. "Entry, Exit and Firm Dynamics in Long Run Equilibrium," *Econometrica* 60, 5, 1127-50.

Imbs, J. and R. Wacziarg. 2003. "*Stages of Diversification*," *American Economic Review* 93,1, 63-86.

Jovanovic, B. 1982. "Selection and The Evolution of Industry," *Econometrica* 50, 3, 649-670.

Klinger, B. and D. Lederman. 2004. "Discovery and and Development: An Empirical Exploration of 'New' Products," World Bank Policy Research, Working Paper No. 3450.

Melitz, M. 2003. " The Impact of Trade on Intra-Industry Reallocation and Aggregate Industry Productivity," *Econometrica* 71, 6, 1695-1725.

Navarro, L. 2008. "Plant-Level Evidence on Prouct Mix Changes in Chilean Manufacturing," ILADES-Georgetown University Working Paper No. 210.

Shiferaw, A. 2007. "Firm Heterogeneity and Market Selection in Sub-Saharan Africa: Does it Spur Industrial Progress," *Economic Development and Cultural Change* 55,2, 393-423.

Shiferaw, A. 2009. "Which Firms Invest Less Under Uncertainty? Evidence from Ethiopian Manufacturing," Courant Research Center-PEG, University of Goettingen , Discussion Paper No.2

Tybout, J.R. 2000. "Manufacturing Firms in Developing Countries: How Well Do They Do?" *Journal of Economic Literature* XXXVIII, 11-44.

Van Biesebroeck, J. 2005. "Firm Size Matters: Growth and Productivity Growth in African Manufacturing," *Economic Development and Cultural Change* 53, 3, 545-583.

Table 1: Structure of Ethiopian Manufacturing

Two Digit ISIC Industries (Grouped)	No. of 4 digit ISIC Industries	No. of Products	Total No. of Firms in 2007	Maximum No. of products per firm	Average firm size in2007 (workers)
Food & Beverage	13	44	346	6	93
Food	9	35	313	6	74
Beverage	4	9	23	2	270
Textile & Garments	4	29	73	4	379
Textile	2	19	33	4	603
Garments	2	10	40	4	194
Leather & Footwear	2	12	72	4	110
Tannery	1	4	18	4	202
Footwear	1	8	54	4	79
Chemical & Plastic	7	22	128	6	108
Non-metal	5	10	273	5	42
Metal & Machinery	10	21	116	3	69
Total	41	138	1008	6	104

Note: The table excludes the printing and paper, and the wood and furniture industries because of inadequate data on the number of products.

Table 2a: The Fraction of Multi-product Firms

	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	Average
Food & Beverage	39.7	41.3	38.1	32.7	28.4	44.8	34.7	26.9	25.7	19.6	23.2	25.2	***30.6***
Food	43.9	45.6	41.7	36.0	31.3	50.5	38.1	28.9	27.1	21.5	25.5	26.5	***34.7***
Beverage	10.5	10.0	5.3	4.8	4.5	0.0	4.0	8.0	12.0	7.4	3.1	12.5	***6.8***
Textile & Garments	38.6	34.6	35.3	28.0	37.2	59.6	45.6	33.9	34.9	37.3	40.7	37.9	***38.5***
Textile	58.8	47.4	45	43.5	50.0	87.0	72.0	42.3	44.4	40.7	50.0	41.4	***51.9***
Garments	25.9	27.3	29	14.8	26.1	33.3	25.0	26.7	27.8	34.4	33.3	34.5	***28.2***
Leather and Footwear	21.3	25.0	28.1	30.6	30.8	30.0	22.4	20.0	22.6	38.3	17.2	20.0	***25.3***
Tannery	57.1	63.6	54.5	35.7	40.0	40.0	42.9	40.0	47.1	70.6	25.0	50.0	***47.2***
Footwear	16.7	16.3	21.7	28.6	27.0	25.7	14.3	12.5	13.3	25.6	14.3	11.1	***18.9***
Chemical	35.0	34.6	32.1	29.1	28.3	27.7	21.3	21.4	16.7	16.3	16.3	22.1	***23.7***
Non-Metal	22.8	15.9	59.7	52.0	59.7	57.0	49.5	46.2	45.5	41	41.9	30.9	***41.9***
Metal & Machinery	20.0	14.3	73.3	53.8	55.6	54.1	64.7	65.9	50.0	55.8	61.5	50.8	***57.2***
Manufacturing Sector	***32.4***	***31.9***	***41.8***	***35.9***	***36.2***	***45.7***	***38.4***	***32.5***	***30.6***	***29.1***	***30.2***	***28.5***	***33.9***

Source: CSA's Annual Census of Manufacturing

Table 2b: The Share of Multi-product Firms in Sales

	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	Average
Food & Beverage	41.1	40.5	47.0	38.7	38.5	41.3	34.0	33.9	36.7	20.9	17.8	34.1	***35.4***
Food	64.3	64.7	71.8	56.4	53.6	65.0	58.0	53.4	53.8	29.9	29.2	52.0	***54.3***
Beverage	6.9	6.2	5.6	5.6	5.6	0.0	3.9	1.0	8.1	9.3	0.3	7.0	***5.0***
Textile & Garments	73.8	71.8	67.5	63.3	62.9	86.7	73.0	58.2	53.4	63.1	75.9	66.7	***68.0***
Textile	76.6	72.8	68.3	65.1	62.7	88.5	75.6	59.8	52.9	63.2	78.2	65.1	***69.1***
Garments	40.9	58.2	57.6	36.8	64.2	54.9	36.6	36.3	59.8	61.4	43.7	73.3	***52.0***
Leather and Footwear	60.3	68.8	51.2	44.2	47.8	49.8	61.2	54.4	55.7	70.5	40.3	56.7	***55.1***
Tannery	66.8	80.9	61.5	55.3	66.3	66.2	76.0	67.4	69.1	83.8	46.6	71.7	***67.6***
Footwear	40.9	32.9	23.7	25.6	11.9	12.7	16.3	9.3	14.1	25.1	19.7	15.5	***20.6***
Chemical	57.1	62.6	63.7	67.2	59.9	60.8	58.4	30.2	32.0	36.7	45.2	49.4	***51.9***
Non-Metal	16.5	11.6	18.5	7.5	13.6	17.5	12.6	12.9	7.9	10.0	7.2	4.5	***11.7***
Metal & Machinery	63.2	58.3	63.5	63.2	60.3	98.4	91.0	57.0	61.1	62.8	57.0	56.0	***66.0***
Manufacturing Sector	***41.9***	***43.7***	***48.0***	***41.9***	***43.1***	***53.1***	***48.5***	***33.4***	***33.7***	***39.2***	***33.7***	***43.2***	***42.0***

Table 3: Disaggregation of Multi-product firms (%)

	Multi-product Firms	Two products only	Three or more products
1996-2007			
Food & Beverage	30.6	23.8	6.8
Textile & Garments	38.5	27.2	11.3
Leather & Footwear	25.3	18.0	7.3
Chemical & plastic	23.7	20.2	3.5
Non-metal	41.9	33.4	8.5
Metal	57.2	52.2	5.1
Manufacturing Sector	***33.9***	***26.8***	***7.1***

Table 4: Intra-firm sales share of products

Number of products	Ranking of products within a firm					
	1st	2nd	3rd	4th	5th	6th
1996-2007						
1	1					
2	0.80	0.20				
3	0.66	0.25	0.09			
4	0.57	0.26	0.11	0.05		
5	0.46	0.27	0.15	0.08	0.04	
6	0.45	0.24	0.16	0.08	0.04	0.03

Table 5a: Characteristics of Multiproduct Firms

Firm Characteristics	Multiproduct Firms
Ln(Sales)	0.2157***
Ln(Employment)	0.0853***
Ln(Age)	0.0599**
Probability of Export	0.0069
Probability of Investment	0.0719***
Probability of Lumpy Investment	0.0481***
Ln(TFP)	0.0147
Ln(Labor Productivity)	-0.1015

Note: Statistical significance at the 10%, 5% and 1% level are indicated by *,** and *** , respectively.

Table 5b: Characteristics of Multiproduct Firms

	1	2	3
$\ln(\text{employment})_{t-1}$	0.4227*** (0.1273)	0.4139*** (0.1267)	-0.7444* (0.4093)
$(\ln(\text{employment})_{t-1})^2$			0.1542*** (0.0515)
$\ln(\text{age})_{t-1}$	0.3372** (0.1573)	0.3086*** (0.1554)	0.2752* (0.1563)
Exporter-dummy $_{t-1}$	0.4252 (0.4577)	0.4633 (0.4581)	0.3308 (0.4611)
$\ln(\text{TFP})_{t-1}$	-0.1452* (0.0741)		-0.1587** (0.0743)
$\ln(\text{labor productivity})_{t-1}$		-0.1871*** (0.0597)	
Investment-dummy $_{t-1}$	-0.0333 (0.2151)	0.0040 (0.2154)	-0.0679 (0.2152)
Investment Spike-dummy $_{t-1}$	0.4559* (0.2335)	0.4722** (0.2335)	0.4477** (0.2337)
Intercept	-3.7003*** (0.6684)	-2.3251*** (0.8358)	-1.4964 (0.9795)
No. Observations (Firm years)	2676	2683	2676
No. Firms	666	669	666

Source: Author's computation based on CSA census data

Note: Standard errors in parenthesis. Statistical significance at the 10%, 5% and 1% level are marked by single, double and triple stars, respectively.

Table 6: The Distribution of Product Adding

	Number of products added				Firm-years
	0	1	2	3-5	
Food & Beverage	1553	361	63	50	2027
	76.6	*17.8*	*3.1*	*2.5*	*100*
Food	1317	348	62	50	1777
	74.1	*19.6*	*3.5*	*2.8*	*100*
Beverage	236	13	1	0	250
	94.4	5.2	*0.4*	0.0	*100*
Textile & Garments	387	105	23	11	526
	73.6	*20.0*	*4.4*	*2.1*	*100*
Textile	175	52	15	6	248
	70.6	*21.0*	*6.1*	*2.4*	*100*
Garments	212	53	8	5	278
	76.3	*19.1*	*2.9*	*1.8*	*100.0*
Leather & Footwear	446	73	13	3	535
	83.36	*13.64*	*2.43*	*0.57*	*100*
Tannery	112	25	5	3	145
	77.2	*17.2*	*3.5*	*2.1*	*100.0*
Footwear	334	48	8	0	390
	85.6	*12.3*	*2.1*	*0.0*	*100.0*
	542	73	8	2	625
Chemical & Plastic	86.7	*11.7*	*1.3*	*0.3*	*100*
Non-metal	614	136	52	7	809
	75.9	*16.8*	*6.4*	*0.9*	*100*
Metal	224	51	49	2	326
	68.7	*15.6*	*15.0*	*0.6*	*100*
	3766	**799**	**208**	**75**	**4848**
Manufacturing Sector	***77.7***	***16.5***	***4.3***	***1.6***	***100***

Note: The upper numbers in each cell are the number of firm-years in which a particular number of products has been added as compared to the basket of products a year earlier. The lower numbers in parenthesis are the percentages that add up to 100 in a row.

Table 7: The Distribution of Product Dropping (percent)

	Number of products dropped				Firm-years
	0	1	2	3-5	
Food & Beverage	1730	225	41	31	2027
	85.35	*11.10*	*2.02*	*1.53*	100
Food	1,487	218	41	31	1,777
	83.7	*12.3*	*2.3*	*1.7*	100.0
Beverage	243	7	0	0	250
	97.2	*2.8*	*0.0*	*0.0*	100.0
Textile & Garments	407	89	28	2	526
	77.38	*16.92*	*5.32*	*0.38*	100
Textile	182	45	19	2	248
	73.4	*18.2*	*7.7*	*0.8*	100.0
Garments	225	44	9	0	278
	80.9	*15.8*	*3.2*	*0.0*	100.0
Leather & Footwear	471	59	5	0	535
	88.04	*11.03*	*0.93*	*0.00*	100
Tannery	119	24	2	0	145
	82.1	*16.6*	*1.4*	*0.0*	100.0
Footwear	352	35	3	0	390
	90.3	*9.0*	*0.8*	*0.0*	100.0
	591	34	0	0	625
Chemical & Plastic	*94.6*	*5.4*	*0.0*	*0.0*	100
Non-metal	726	68	14	1	809
	89.7	*8.4*	*1.7*	*0.1*	100
Metal	299	24	3	0	326
	91.7	*7.4*	*0.9*	*0.7*	100
	4224	**499**	**91**	**34**	**4848**
Manufacturing Sector	***87.1***	***10.3***	***1.9***	***0.5***	**100**

Note: The upper numbers in each cell are the number of continuing firms dropping a particular number of products as compared to the basket of products they produced a year earlier. The lower numbers in italics are percentages adding up to 100 in a row.

Table 8: Distribution of Product Switching (percent)

Industries	No Action	Adding Only	Dropping Only	Adding & Dropping	Firm-years
Food & Beverage	70.7	14.6	5.9	8.8	2027
Food	67.8	15.9	6.3	10.0	1777
Beverage	91.6	5.6	2.8	0.0	250
Textile & Garments	59.5	17.9	14.1	8.6	526
Textile	56.5	16.9	14.1	12.5	248
Garments	62.2	18.7	14.0	5.0	278
Leather & Footwear	75.7	12.3	7.7	4.3	535
Tannery	63.5	18.6	13.8	4.1	145
Footwear	80.3	10.0	5.4	4.4	390
Chemical & plastic	82.6	12.0	4.2	1.3	625
Non-metal	68.6	21.1	7.3	3.0	809
Metal	62.9	28.8	5.8	2.5	326
Firm Size Categories					
Small Firms	69.6	18.1	5.8	6.6	2832
Large Firms	72.5	13.5	9.3	4.8	1802
Product Number Categories					
Single-product Firms	79.4	8.9	7.9	3.8	3151
Multi-product Firms	54.5	30.4	5.3	9.8	1697
Manufacturing Sector	***70.7***	***16.4***	***7.0***	***5.9***	***4848***

Note: percent of firm-years add up to 100% in a row.

Table 9: Product Switching and Firm Characteristics

	No Action	Adding Only	Dropping Only	Adding & Dropping	Manufacturing Sector
Employment	145.7	117.7	241.5	200.4	151.2
Firm Age (years)	17.4	15.6	20.0	18.4	17.4
Value Added ('000 Birr)	4629.1	3590.9	5250.3	44800.0	6877.0
Value Added per Worker ('000 Birr)	30.7	21.4	29.7	188.4	38.3
TFP	18.1	15.8	19.6	24.0	18.2
Investment Rate	12.2	17.7	14.3	10.4	12.9

Table 10: Probability of Product Switching

	Product Adding			Product Dropping		
	1	2	3	4	5	6
ln (Employment)	-0.0847** (0.0386)	-0.0516 (0.0571)	-0.0511 (0.0569)	0.2194*** (0.0490)	0.2126*** (0.0711)	0.2125*** (0.0710)
ln (TFP)	0.0777* (0.0436)	-0.0136 (0.0755)	-0.0059 (0.0756)	0.0352 (0.0629)	0.0797 (0.0987)	0.0799 (0.0987)
ln (Investment rate)		0.0639* (0.0396)	-0.0108 (0.0553)		0.0040 (0.0473)	-0.0006 (0.0645)
Investment Spike			0.4274* (0.2291)			0.0294 (0.2820)
Constant	-1.8747*** (0.2486)	-1.8049*** (0.4261)	-2.1842*** (0.4727)	-3.5692*** (0.3405)	-3.6237*** (0.5547)	-3.6460*** (0.5941)
Observations	3792	1816	1816	3792	1816	1816
Number of Firms	913	554	554	913	554	554

Table 11: Firm Responses to Product Switching

	Net Add	Net Drop	Observations	R^2
Log Change in Employment	0.0055 (0.0233)	-0.0240 (0.0545	4211	0.03
Log Change in Real Sales	0.2992** (0.1319)	-0.1704 (0.1680	4404	0.05
Log Change in Real Sales per Worker	0.2834* (0.1442)	-0.1691 (0.1034)	4211	0.05
Log Change in Value Added per Worker	0.2525* (0.1626)	-0.0508 (0.2203)	3100	0.05
Log Change in TFP	0.1563* (0.0831)	0.0125 (0.1374)	3056	0.05
Log Change in investment Rate	-0.2636 (0.2199)	-0.1672 (0.4106)	1338	0.07
Investment Spike	0.0885*** (0.0171)	0.0285 (0.0323)	4299	0.08

Table 12a: Decomposition of Sales Growth- Gross Flows (1996-2007)

		Decomposition of Sales Growth					
		Incumbent Firms					
	Sales Growth	Continuing products	Added Products	Dropped Products	Reintroduced Products	Firm Entry	Firm Exit
1996-2007	1	2	3	4	5	6	7
Food & Beverage	9.6	6.7	2.4	-2.3	1.4	5.7	-4.3
Food	11.6	7.4	4.2	-3.8	1.9	7.6	-5.8
Beverage	9.8	7.2	1.0	-1.0	1.0	4.7	-3.1
Textile & Garments	5.5	1.6	9.7	-7.9	1.4	3.8	-3.2
Textile	4.4	0.7	10.0	-8.2	1.3	3.2	-2.7
Garments	23.6	13.6	7.4	-3.4	4.0	12.2	-10.1
Leather & Footwear	6.6	4.2	4.0	-4.1	3.0	3.5	-4.0
Tannery	7.2	4.8	3.8	-4.0	3.9	3.2	-4.4
Footwear	7.4	4.1	4.9	-3.7	0.2	4.5	-2.7
Chemical & plastic	13.7	8.6	5.0	-4.1	2.5	4.7	-2.9
Non-metal	21.0	17.0	4.4	-0.9	0.6	1.0	-1.2
Metal & L. Machinery	10.5	3.7	9.0	-9.9	6.3	9.5	-8.1
Manufacturing Sector	**11.2**	**7.0**	**5.8**	**-4.9**	**2.5**	**4.7**	**-3.9**

Note: growth rates in columns 2 to 7 add up to the growth rates in column 1.

Table 12b: Decomposition of Sales Growth - Net Contributions

	Sales Growth	Decomposition of Sales Growth		
		Continuing Products	Net Adding	Net Entry
1996-2007	1	2	3	4
Food & Beverage	9.6	6.7	1.5	1.4
Food	11.6	7.4	2.4	1.8
Beverage	9.8	7.2	1.0	1.6
Textile & Garments	5.5	1.6	3.3	0.7
Textile	4.4	0.7	3.1	0.5
Garments	23.6	13.6	7.9	2.1
Leather & Footwear	6.6	4.2	2.9	-0.5
Tannery	7.2	4.8	3.7	-1.3
Footwear	7.4	4.1	1.5	1.8
Chemical & plastic	13.7	8.6	3.3	1.8
Non-metal	21.0	17.0	4.1	-0.1
Metal & L. Machinery	10.5	3.7	5.4	1.4
Manufacturing Sector	***11.2***	***7.0***	***3.4***	***0.8***
1996-2001				
Food & Beverage	7.6	4.3	0.6	2.7
Food	13.5	8.0	1.7	3.8
Beverage	4.8	2.1	-0.4	3.1
Textile & Garments	-1.2	0.1	-3.0	1.7
Textile	-1.4	-0.1	-3.4	2.0
Garments	9.6	4.7	5.7	-0.7
Leather & Footwear	2.5	-1.1	5.7	-2.1
Tannery	4.2	-0.4	8.1	-3.5
Footwear	2.0	0.5	0.1	1.4
Chemical & plastic	7.5	6.1	1.5	-0.1
Non-metal	10.6	10.1	1.0	-0.5
Metal & L. Machinery	15.5	2.0	4.9	8.6
Manufacturing Sector	***6.3***	***3.0***	***1.9***	***1.4***
2002-2007				
Food & Beverage	9.3	7.6	2.2	-0.6
Food	6.7	5.3	2.6	-1.3
Beverage	14.6	11.5	2.5	0.5
Textile & Garments	10.6	3.5	7.1	-0.1
Textile	9.4	2.6	7.1	-0.4
Garments	26.4	15.3	8.7	2.3
Leather & Footwear	9.2	6.4	3.6	-0.7
Tannery	10.0	6.8	4.9	-1.6
Footwear	8.7	5.4	0.5	2.9
Chemical & plastic	14.9	9.6	4.3	1.0
Non-metal	26.7	20.7	5.7	0.2
Metal & L. Machinery	38.0	12.4	11.5	14.2
Manufacturing Sector	***15.4***	***8.9***	***5.1***	***1.4***

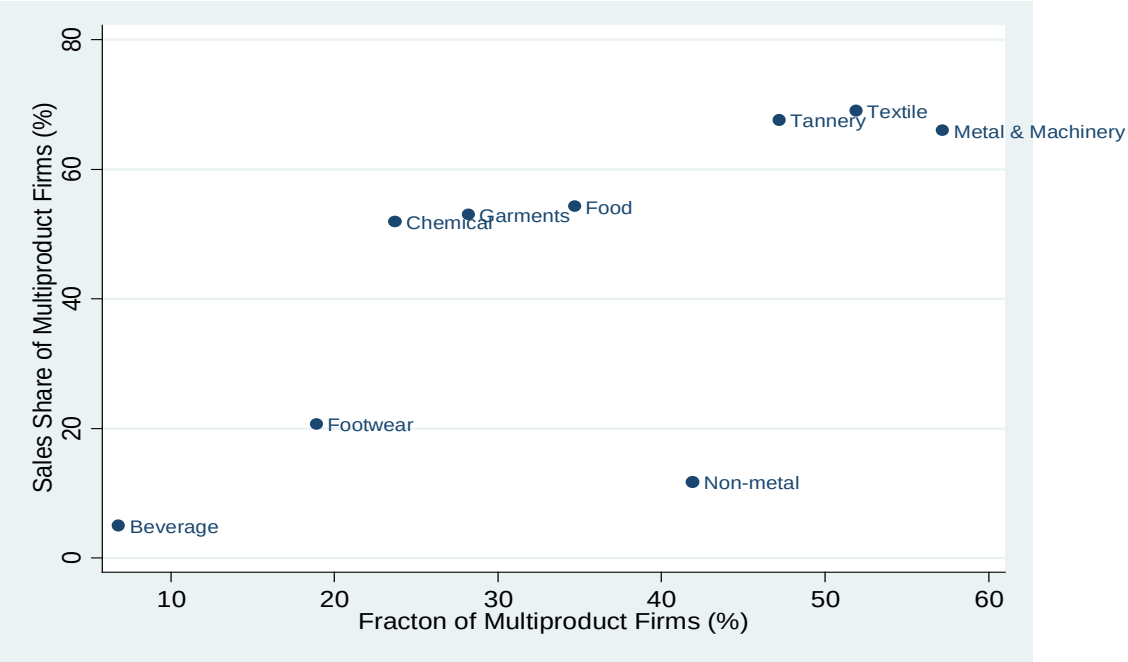

Figure 1: Multiproduct firms' share in total sales and total number of firms (%)