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**MULTI-PRODUCT FIRMS, TARIFF
LIBERALIZATION, AND PRODUCT
CHURNING IN VIETNAMESE
MANUFACTURING**

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Abstract

Utilizing firm-level data covering the 2010–2015 period, this study documents the frequency and characteristics of multi-product firms in Vietnamese manufacturing. Our major findings are as follows. First, multi-product firms are larger, more capital-intensive, more productive, and are more likely to export. Second, multi-product firms are active in the market. Approximately 60% of firms adjust their product scope within a 6-year period. Third, the contribution of firms' product extensive margin to aggregate output growth is limited due to the prevalence of product dropping, which offsets the positive impact of product adding. Most output growth during the period is thus generated by the intensive margin. Turning to the link between tariff reduction and product shedding, we do not detect any significant impact. However, we find that exporters play an important role in product adding, which suggests that they may contribute to aggregate growth through the channeling of product scope expansion. Contrary to our expectations, our analysis offers limited support for the heterogeneity of product turnover across ownership types. While we find that state-owned enterprises are more likely to spread economic activities across products and industries, there is little difference in terms of product churning amongst foreign direct investment, state-owned enterprises, and the domestic private sector.

Keywords: multi-product firms, trade liberalization

JEL Classification: F15, L23

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1. INTRODUCTION

Multi-product firms are the dominant players in international production and trade (Bernard et al., 2010; Goldberg et al., 2010a). Moreover, these firms are active in alternating their combination of product varieties. In fact, Bernard et al. (2010) have documented a frequent change in the product mix in the United States (US), where almost 50% of multi-product firms change their product mix every five years. Indeed, firms' adjustment in product scope constitutes one important layer of firm heterogeneity (Nocke and Yeaple, 2006).

Understanding firms' product adjustment is crucial for several reasons. First, changes in the commodity mix of manufacturing firms affect firms' output and productivity, through which they exert an impact on the economy's aggregate growth. For example, Bernard et al. (2006) have demonstrated that the contribution to output growth of a product margin outweighs that of firm entry and exit. Goldberg et al. (2010a) have observed a similar phenomenon in Indian manufacturing, where changes in firms' product mix contributed to as much as 25% of output expansion. In this regard, the changing of product lines is a nontrivial channel of resource reallocation within firms. Second, switching production activities has important implications for the structural shift across sectors. For instance, a shift away from resource-based and primary products to more capital-intensive products, a source of industrial upgrading, will induce the economy to move to the next stage of the industrialization process.

Why some firms diversify their production is not a new question in the industrial organization literature. For instance, Penrose (1955) has suggested that product diversification provides firms with greater opportunities for market expansion, which can be limited if they only manufacture a single product. Recent studies on international trade and firm heterogeneity, however, have proposed a different approach. Most of the theoretical models on firms' responses to trade at the product level predict that product dropping is popular amongst all multi-product firms (Eckel and Neary, 2010; Mayer et al., 2014). Competition pressure instigates firms to narrow down their product range by dropping peripheral products and reallocating resources to their core competencies, defined as the product with the largest cost advantage compared to other products of the firm. Just as the least productive single product firms are swept out of the market due to competition, the least productive product for each multi-product firm should also be dropped.

However, several studies suggest a more heterogeneous picture, where an adjustment in product scope is contingent on the firm's position in the productivity distribution, firm size, or ownership type (Qiu and Zhou, 2013; Lopresti, 2016). Lopresti (2016), for example, examined changes in the product structure of US firms following the Canada–US Free Trade Agreement of 1989. Utilizing Bayesian econometric techniques, the author found that heterogeneity exists in firms' response conditioning regarding their engagement in global markets. In particular, more domestically oriented firms narrow down their product range, while more internationalized firms either add more products or do not respond to tariff reduction. Nevertheless, the adjustment is mixed when sales are used as an additional dimension of firm heterogeneity. Given these inconsistent theoretical findings, a conclusion remains an empirical matter.

This research adds to the growing literature on firm–product dynamics by investigating product turnover in Vietnamese manufacturing, a developing country with impressive economic growth and a high level of trade openness. We utilize the Vietnam Enterprise Survey covering the 2010–2015 period. Our research objectives are threefold. We first present several stylized facts about multi-product firms, including their presence in

manufacturing, their relative performance compared to single product enterprises, and the frequency of product turnover. We then utilize the decomposition framework in Goldberg et al. (2010a) to examine the contribution of the extensive and intensive firm–product margin to aggregate output growth. Finally, we link product refocusing to trade liberalization as one of the most significant policy reforms during this period. In particular, we address two questions. First, does a reduction in tariff impact firms' product scope? Second, do responses vary depending on firms' trade status and ownership types?

To the best of our knowledge, this is the first study on Viet Nam. Our paper is closely related to Goldberg et al. (2010a), who examined product turnover in response to a reduction in tariff in Indian manufacturing. However, our study deviates from Goldberg et al. (2010a) in two important respects. First, we consider the potential differences in scope decisions depending on firms' ownership. In Viet Nam there exists a large gap in competitiveness and efficiency amongst multinational enterprises (MNEs), state-owned enterprises (SOEs), and small and medium-sized enterprises (SMEs). SMEs account for over 90% of firms and make an important contribution to job creation. However, this sector has low competitiveness and limited innovation and internationalization activities (Trinh and Doan, 2018). Facing financial and managerial constraints, it is possible that these firms have limited flexibility to adjust their product mix. Foreign investors, on the other hand, are larger, more productive, and are the main exporters.¹ Therefore, it is likely that MNEs are more proactive in product adjustment. Given the country's heavy dependence on exports by MNEs, MNEs' internal resource reallocation is expected to exert a non-negligible impact on aggregate trade and industrial performance. The third group, SOEs, tend to behave differently from MNEs and SMEs, as profit-maximization may not be their business target. This implies that the core-competency argument does not necessarily apply to SOEs.

In addition, we take into account differences in a firm's response to trade depending on its export status. More diverse output markets allow exporters to better cope with increased competition in one market, while their productive performance encourages them to take advantage of better market access to expand their scope. Lopresti (2016) has shown that domestic-oriented firms become leaner in response to trade shocks. In contrast, firms with a greater share of foreign sales expand. Baldwin and Gu (2009) have found that trade liberalization induces non-exporting firms to narrow down their scope, but there is no significant effect on exporters. Although we do not have data on exports by product, trade status could reveal potential heterogeneity according to firms' engagement in the international market.

From a policy perspective, our study can contribute in the following ways. First, to the extent that changes in product mix account for a nontrivial fraction of aggregate growth, a study on multi-product firms can shed light on another important channel for enhancing allocative efficiency. While better resource reallocation is crucial for any economy, for Viet Nam productivity improvement is currently one of the top priorities for policymakers. As one of Asia's fastest growing economies, Viet Nam has lifted itself out of poverty and achieved the status of a lower-middle income country. However, impressive economic growth during the last two decades primarily originates from an extraordinary structural shift from agriculture and considerable labor expansion. The contribution of productivity, the third component of growth, remains limited (World Bank, 2017). Second, examining the product scope decision can also facilitate understanding of the changes in the commodity composition of production observed at the aggregate level. According to Nguyen (2015), the contribution of resourced-based industries to

¹ FDI sector accounts for 50% of output and approximately 70% of export turnover in 2016.

overall manufacturing output has fallen markedly. For example, the ratio of output of the chemical products industry plunged from 7% to just 0.1%, while that of processed food fell from 32.4% to 24.2% over the 1995–2009 period. There has been a shift to more capital-intensive industries, such as electronics and computing. We expect, therefore, that our study can contribute to the discussion on industrial upgrading and sustainable growth.

2. LITERATURE REVIEW

Our study is related to the literature on multi-product firms and trade liberalization. On the theory side, most models predict that more competitive markets stimulate firms to drop their least profitable product and refocus on the product with the largest cost advantage, or the core product. Eckel and Neary (2010) have constructed a model in which globalization affects both the extensive and intensive margin of multi-product firms through a competition effect and a cannibalization effect. Adjustment of internal demand linkages, or the cannibalization effect, allows firms to improve productivity by becoming leaner. In contrast, competition implies a decline in product variety. Bernard et al. (2010) have extended Melitz's (2003) model by allowing firms to produce multiple products. The theoretical model suggests that severe competition in more liberalized industries drives the least productive firms and the least profitable products of firms out of the market. Mayer, Melitz, and Ottaviano (2014) assume that firms face a product ladder. Productivity or quality is negatively associated with the number of varieties produced. Tougher competition results in lower mark-ups across products, rendering firm sales skewed towards core competences.

However, Qiu and Zhou (2013) have predicted product scope expansion for more productive firms. They argue that if we relax the assumption of a fixed fee for the introduction of each new variety and allow the fees to increase steeply, highly productive firms can still earn a profit by expanding their product scope. Dhingra (2013) has argued that the varieties produced by one firm are more substitutable than varieties across firms. Product expansion then reduces demand for existing products within the firm.

Inconclusive theoretical predictions suggest the essential role of empirical analysis. Baldwin and Gu (2009) have found that tariff reduction leads small firms to narrow down product scope, whereas large firms do not. Moreover, non-exporters drop products, whereas the impact on exporters is not significant. The authors argue that once firms enter the export market, they are more affected by factors other than tariff, including learning-by-exporting, competition in the export market, and opportunities for better market access. Goldberg et al. (2010a) have identified a non-negligible impact of changes in product mix on changes in output in Indian manufacturing. Trade liberalization (proxied as tariffs), however, does not have a significant impact on a firm's extensive margins. They postulate that strict industrial regulations in India may limit firms' flexibility in shedding existing product lines. Iacovone, Rauch, and Winters (2013) have found import competition from the People's Republic of China (PRC) to result in a fall in sales and number of products in the case of Mexican firms. The impact is highly heterogeneous across extensive and intensive margins. Smaller plants and more marginal products are negatively affected. In contrast, large firms and core products do not seem to be affected. Moreover, large firms benefit from access to cheaper imported intermediate inputs from the PRC. Arkolakis and Muendler (2010) have investigated the case of Brazilian exporters and demonstrated that firm-product extensive margin is heterogeneous across firm sizes. Liu (2010) has noted that Canadian multi-product firms are more likely to refocus on their core products in response to trade liberalization. The author constructed indices of product relatedness and demonstrated that the weaker the

linkages between marginal products and the core product, the more likely it is that peripheral products are dropped. Goldberg et al. (2010b) have examined another aspect of within-firm reallocation, asking whether exposure to trade liberalization affects the input allocation of firms. The empirical results showed a positive impact of lower input tariff on the introduction of new products thanks to better access to new intermediate inputs.

3. DATA SOURCE

Our primary data source is the Vietnam Enterprise Survey (VES) provided by Viet Nam's General Statistics Office. Data have been collected annually since 2000, and the VES is by far the most comprehensive dataset available on Vietnamese firms; it is the main source of firm-level statistics in the formal agriculture, industry, and service sectors.

The VES includes a general questionnaire covering basic statistics at the firm level, including ownership, assets and liability, employment, sales, capital stock, and industry code from January to December of a particular year. The survey covers all SOEs and FDI without any firm size threshold. As for domestic private firms, however, a certain threshold is applied.² All formal firms with employment size above the threshold are included, while firms below the threshold are chosen by random sampling. Since 2010, the VES has also provided information on total exports and imports.³ There is a consistent and unique tax code assigned to each firm, which allows us to track the firm across years.⁴

Apart from the general module, GSO also designs industry-specific modules to survey the activities of each sector. For manufacturing, production data are provided at the plant level. The data comprise the list of products, the quantity produced for each product, unit of measurement, the value of sales and product codes, amongst others. GSO applies an internal product classification developed based on Viet Nam Standard Industrial Classification (VSIC) version 2007, Europe's Classification of Products by Activity 2008, United Nations' Central Product Classification 2.0, and Harmonized System 2007. Products are classified at eight digits, where the first five digits correspond to VSIC 2007. Under this classification there are approximately 2,400 products in the manufacturing sector.

3.1 Variables

The key variables for our analysis are product codes and product sales. Product sales are deflated by the producer price index (PPI) at the 2-digit sectoral level. Due to a change in product classification in 2010, our analysis is limited to the 2010–2015 period. In addition, we also utilize information on firms' unique ID to construct the panel, and firms' industry as indicated in the general module. Value-added deflated by PPI and employment data are used to compute labor productivity.

Given that the production module is at the plant level whereas the general module is at the firm level, we aggregate all data in the production module to firm level for consistency. As the production decision is made at the firm level, an analysis at the firm level is also

² The threshold varies across years, provinces, and sectors. For example, in 2015 the threshold goes up to 100 in certain sectors for firms located in Ha Noi and Ho Chi Minh city. On the other hand, the maximum threshold for 2008 is only 10. For the census years (2006, 2011, and 2016), all formal firms were included.

³ Before 2010, trade status is only available for a few years.

⁴ A detailed description of the firm-level dataset is provided in Ha and Kiyota (2014).

more appropriate (Bernard et al., 2010). Furthermore, we only focus on the manufacturing products of firms.

To complement our firm-product data, we use tariff data from World Integrated Trade Solutions (WITS) database at 4-digit International Standard Industrial Classification (ISIC) revision 3. We match ISIC with VSIC codes based on a concordance table provided by the GSO. We utilize effectively applied tariff, which is defined as the lowest available tariff. We favor trade-weighted tariff over simple average tariff, as the former can capture the relative importance of each industry's import share.

To account for the impact of trade liberalization on access to imported intermediate inputs, we also measure input tariff following Amiti and Konings (2007) as follows

$$in_{st} = \sum_1^p a_{sp} * out_{pt}$$

where in_{st} and out_{pt} denote input tariff of downstream sector s and output tariff of 2-digit upstream sector p , respectively. a_{sp} denotes imported input coefficients, defined as the value of intermediate imports from sector p over total output of sectors.⁵ To compute input coefficients, we utilize the Organisation for Economic Co-operation and Development's (OECD) Inter-country Input-Output Table (ICIO) edition 2016. ICIO provides annual information on inter-industry and across-country trade transactions for 63 countries including Viet Nam over the 1995–2011 period. Industrial classification is based on ISIC Rev.3 at 2-digit level. Accordingly, 34 sectors are covered.

We favor the use of ICIO over the Vietnamese domestic input-output table for two reasons. First, ICIO adopts the ISIC classification, which can be matched directly with output tariff data from WITS. Second, and more importantly, ICIO contains information on imported intermediates, which is not available in the domestic IO table. To better capture the impact of tariff changes on a firm's adjustment along the supply chain, it is more appropriate to measure the imported input coefficient than the domestic input coefficient. Although the database is available for 1995–2011 period, we only use ICIO for year 2011, assuming that the structure of the economy is relatively stable across 2010–2015 period.

4. A PROFILE OF MULTI-PRODUCT FIRMS

This section documents the characteristics of multi-product firms and the pervasiveness of product churning in Vietnamese manufacturing during a 6-year period from 2010 to 2015. Following Iac et al. (2010) and Goldberg et al. (2010a), we define sector and industry at the 2- and 4-digit levels of VSIC 2007, respectively. Product classification is defined at the 8-digit level.

⁵ Note that we can only measure input tariff at the 2-digit sectoral level due to data availability.

Table 1: Frequency and Output Shares of Firms

	Single Product	Multiple Product	Multiple Industry	Multiple Sector
Whole sample				
Share of firms	0.81	0.19	0.07	0.05
Share of output	0.59	0.41	0.24	0.20
Average number of products, industries or sectors per firm	1	2.62	1.45	1.28
FDI				
Share of firms	0.81	0.19	0.07	0.04
Share of output	0.56	0.44	0.28	0.24
Average number of products, industries or sectors per firm	1	2.73	1.39	1.25
SOE				
Share of firms	0.53	0.47	0.25	0.19
Share of output	0.26	0.74	0.50	0.46
Average number of products, industries or sectors per firm	1	2.93	1.80	1.50
Domestic private				
Share of firms	0.82	0.18	0.07	0.05
Share of output	0.72	0.28	0.13	0.08
Average number of products, industries or sectors per firm	1	2.58	1.45	1.28

Note: FDI sector includes 100% foreign-invested firms and joint-ventures of which the share of foreign capital exceeds 50% of total legal capital. Sector and industry are defined at 2 and 4-digit of VSIC 2007, respectively.

Source: Author's calculations from the VES data.

Table 1 illustrates the presence of multi-product firms in our sample. We include in Table 1 four groups of firms – firms that produce only one product, firms that produce at least two products, firms that operate in more than one 4-digit industry, and firms with activities spread across 2-digit sectors. Two features stand out. First, Vietnamese firms are relatively specialized. On average, only 19% of firms produce more than one product. An average multi-product firm manufactures 2.6 products. The proportions of multiple-industry and multiple-sector firms are even smaller, accounting for 7% and 5% of firm share, respectively. The figure is significantly lower than that reported in Bernard et al. (2010) on the US and Goldberg et al. (2010a) on India. Both studies documented a share of around 40% of multiple product firms. The difference, however, is not surprising as in Viet Nam over 90% of firms are micro, small, and medium-sized firms with limited technological capability and low competitiveness.

Second, multi-product firms tend to be larger. Despite the modest firm share, they contribute to 41% of total output, which is similar to the US and India, where the output share of multi-product firms is also double that of firm share. Third, there exists heterogeneity across ownership types. Contrary to the overall trend, we observe the prevalence of multi-product firms in the SOE sector. They constitute nearly 50% of total SOEs and account for 74% of output. The average number of products is also higher than the overall, reaching 2.93. In contrast, the FDI and domestic private sectors show a similar structure, closely in line with the overall trend.⁶ One possible explanation for the specialization of MNEs is their exploitation of economies of scope. On the other hand,

⁶ It should be noted that SOEs account for a minority of our sample. Therefore, it is likely that the overall trends are driven by domestic private firms and FDI.

small capacity may limit domestic private firms in terms of diversifying their product portfolio.

Studies on multi-product firms highlight the premium in terms of performance of more diversified enterprises. Firms face fixed costs when expanding their scope. Just as more productive firms self-select into export markets, only better-performing firms will choose to become multi-product firms. We check if this is also the case for Viet Nam by looking at the relative characteristics of multi-product firms compared to their single-product counterparts. Table 2 documents the characteristics of multi-product firms. We find consistent evidence within the existing literature regarding their superiority. In particular, Vietnamese multi-product firms are more productive; their labor productivity is higher (0.27 log point), they produce larger output, employ more workers, and are more capital-intensive. They are also more active in international markets, being 16% more likely to export. In short, multi-product firms outperform single-product firms.

Table 2: Superiority of Multi-product Firms

	Multiple Product	Multiple Industry	Multiple Sector
Output	1.131	1.067	0.98
Export probability	0.161	0.143	0.153
Labour productivity	0.278	0.262	0.224
Employment	0.704	0.705	0.675
Capital intensity	0.25	0.22	0.185

Note: Sector and industry are defined at 2- and 4-digit of VSIC 2007, respectively. Each column reports the regression result of firms' characteristics according to status – multi-product, multi-industry, and multi-sector. We use a dummy variable on the right-hand side to indicate each status. Industry-fixed effects are also included. All estimates are significant at the 5% level.

Source: Author's calculations from the VES data.

Having examined the frequency and overall performance of multi-product firms, we now turn to the product structure of these firms. Table 3 presents the sales distribution of products within firms. It is clear that the distribution is highly skewed, meaning that a large proportion of firm sales is generated from few primary products, which is indicative of the core-competency hypothesis.

Table 3: Sales Distribution across Products

Rank of sales in descending order	Number of Products Produced by the Firm									
	1	2	3	4	5	6	7	8	9	10+
	100	74	63	57	53	48	45	43	43	42
		26	26	25	24	24	23	22	21	21
			11	13	13	14	14	14	13	12
				6	7	8	8	9	9	8
					3	4	5	6	6	6
						2	3	4	4	4
							2	2	3	3
								1	1	2
									1	1
										1

Note: The columns indicate number of products; the rows indicate the sales share of each product in firms' total manufacturing sales.

Source: Author's calculations from the VES data.

The average sales share of the largest product decreases from 74% to 42% as the firm's production increases from 2 to 10 or more. However, even for firms with a large number of products, sales of the 'core' product accounts for at least 42% of total manufacturing sales.

5. FIRM'S ADJUSTMENT OF PRODUCT SCOPE AND AGGREGATE OUTPUT GROWTH

The existing literature suggests the importance of product churning for aggregate economic outcome. To investigate the issue, we begin this section by documenting the dynamics of product adjustment. We classify firms' activities into one of four mutually exclusive groups. The 'No activity' category includes firms that do not change their product line in the period of study. 'Add' refers to firms that produce new products in period t that are not in their product line in period $t-1$. 'Drop' means that firms stop producing a product in period t , which was produced in period $t-1$. Finally, 'Add and Drop' includes firms that alternate their product mix by both adding and dropping. We focus on changes in product structure of the firm over time. Therefore, in this section we only use a sub-sample of continuing firms that appear in the sample throughout the whole period.

Table 4 shows the share of firms that alternate their product mix over 1-year, 3-year, and 6-year periods. A balanced panel is used for this analysis. The main findings from Table 4 are threefold. First, product churning is pervasive amongst Vietnamese manufacturing firms. Sixty percent of all firms adjust their product range over a 6-year period. The corresponding numbers for 3-year and 1-year periods are 50% and 40%, respectively. When we weigh our sample by firm sales, the number changes slightly, with 65% of firms changing their product mix over the whole period. The annual pattern, while less pervasive, also shows a high level of product turnover, with 40% of firms changing their product mix. Furthermore, we observe that multi-product firms are more active in adjusting their product scope compared to single product firms. Over 80% of the former group add and/or drop some products within 6 years. In addition, product dropping is much more popular than product adding. Firms that only add products account for less than 10% of the unweighted sample.

To further investigate the pattern of product churning, we categorize firms by ownership types. The FDI sector includes 100%-foreign-invested enterprises and joint-venture companies in which foreign capital accounts for at least 51% of total legal capital. The SOE sector includes state-owned enterprises. The domestic private sector covers the rest of our sample. We conjecture that the behavior of these groups is heterogeneous along product dimension given their performance gap. Table 5 reports the results.

The left panel of Table 5 presents results without output weight, while the right panel includes output weight. Table 5 suggests that compared to SOEs, MNEs and domestic private firms are more active in adjusting their product mix. 85% of MNEs and 90% of domestic private firms change their product portfolio over a 6-year period. Moreover, albeit modest compared to the other three activities, the ratio of product adding is larger for MNEs and domestic private firms than for SOEs.

Table 4: Frequency of Product Turnover

	Percentage of Firms (Unweighted)								
	6-year Period			3-year Period			1-year Period		
	All	Single Product	Multiple Product	All	Single Product	Multiple Product	All	Single Product	Multiple Product
	No activity	40.0	50.6	13.0	49.4	57.7	21.8	63.6	71.3
Add only	7.3	7.9	5.9	5.9	5.8	6.4	5.0	4.7	6.4
Drop only	8.8	NA	31.0	6.6	NA	28.5	5.7	NA	25.5
Add and drop	43.9	41.4	50.2	38.1	36.5	43.3	25.7	24.0	31.5

	Percentage of Firms (Weighted by Sales)								
	6-year Period			3-year Period			1-year Period		
	All	Single Product	Multiple Product	All	Single Product	Multiple Product	All	Single Product	Multiple Product
	No activity	34.5	46.1	16.5	45.9	56.9	29.4	64.2	77.1
Add only	8.7	8.6	8.8	15.1	10.0	22.6	12.3	7.0	18.9
Drop only	10.3	NA	26.3	7.6	NA	18.9	6.5	NA	14.4
Add and drop	46.5	45.3	48.4	31.5	33.1	29.1	17.0	16.0	18.3

Note: No activity means that the firm's product mix does not change between two consecutive periods. A product is added if it was produced in period t but not in the previous period. Similarly, a product is dropped if it was produced in period t-1 but not in period t. The statistics are computed on a balanced panel.

Source: Author's calculations from the VES data.

One may be concerned that the low percentage of product adding could originate from coding or reporting errors. However, if that is the case, one should also expect a lack of evidence on product dropping. Our statistics demonstrate the opposite. Furthermore, if firms deliberately or mistakenly dropped some products in the survey, it is likely that the gap between total manufacturing sales reported in the general module and total product sales from the production module would be remarkable. We have made the comparison between the two datasets and found a good match. Third, if the list of products were not reported correctly, missing information on sales and quantity produced would probably constitute an issue. Our database, on the contrary, provides detailed information on sales and physical output of each product with negligible numbers of missing values. Therefore, it is expected that the number adequately reflects the actual pattern of product churning.

Table 5: Product Turnover of Multi-Product Firms by Ownership Type

	MNEs	SOEs	Domestic Private	MNEs	SOEs	Domestic Private
	Percentage of Multi-product Firms: Unweighted, 6-year Period			Percentage of multi-product firms: weighted by sales, 6-year period		
	No activity	15.37	20.57	10.97	13.64	22.39
Add only	6.77	2.13	5.74	10.07	3.45	7.44
Drop only	35.12	24.82	29.66	23.39	31.6	29.94
Add and drop	42.74	52.48	53.64	52.9	42.56	48.74

Note: No activity means that the firm's product mix does not change between two consecutive periods. A product is added if it was produced in period t but not in the previous period. Similarly, a product is dropped if it was produced in period t-1 but not in period t. The statistics are computed on a balanced panel of multi-product firms only.

Source: Author's calculations from the VES data.

Changes in the product mix make a nontrivial contribution to changes in the output of incumbents. To account for the sources of output growth, we decompose growth of gross sales into two components: changes in the product mix and changes due to existing products. We define these two sources as extensive margin and intensive margin. Growth of output can then be expressed as

$$\Delta Y_{it} = \sum_{j \in C} \Delta Y_{ijt} + \sum_{j \in E} \Delta Y_{ijt}$$

where Y denotes output (sales); and i, j, t denote firm, product, and time, respectively. C represents the set of continuing products (intensive margin), and E represents the set of products that only appear in either period t or period $t-1$.

Following Goldberg et al. (2010a), we further decompose the net extensive margin into the contribution of added products (A) and dropped products (D). Similarly, the net intensive margin consists of two components: the fall (F) and rise (R) of individual product sales. Then aggregate output growth can be computed as follows

$$\Delta Y_t = \sum_i (\sum_{j \in A} \Delta Y_{ijt} + \sum_{j \in D} \Delta Y_{ijt} + \sum_{j \in R} \Delta Y_{ijt} + \sum_{j \in F} \Delta Y_{ijt})$$

Table 6 presents the decomposition. Two major findings stand out. First, the contribution of the intensive margin, or the change in sales of individual products, exceeds that of the extensive margin. On average, out of a 6.4 percentage point growth in output, 6 percentage points are from the intensive margin. Product churning only contributes to 0.4%. Second, on both the extensive and intensive margin, product adding or growing products make a significant contribution to the net increase. In the case of the intensive margin, the growth is large enough to offset the negative impact of shrinking products, leading to high overall output growth. For the extensive margin, however, the negative impact of product dropping is too large to be compensated by product adding. The net extensive margin is thus relatively small. This observation is consistent with our previous analysis, where product dropping is prevalent.

Table 6: Contribution of Product Turnover to Output Growth

	Gross Sales	Extensive Margin			Intensive Margin		
		Net	Add	Drop	Net	Rising Products	Falling Products
2010							
2011	1.5	2.2	13.9	-11.7	-0.7	7.4	-8.1
2012	6.9	-0.8	12.7	-13.5	7.6	18.6	-11.0
2013	15.7	0.6	11.0	-10.4	15.1	24.8	-9.7
2014	1.6	0.5	9.4	-9.0	1.1	13.4	-12.3
2015	6.4	-0.5	11.7	-12.2	6.8	16.2	-9.3

Source: Author's calculation based on the VES data.

6. TRADE LIBERALIZATION AND PRODUCT TURNOVER

The literature on international trade and firm heterogeneity emphasizes product churning as an important channel of resource reallocation as a result of free trade. While the theoretical predictions and empirical evidence do not provide a clear-cut picture of the direction of impact, most studies suggest a relationship between product dropping and trade liberalization. Given the high rate of product dropping found in the previous sections and the substantial trade reform that the Vietnamese economy has experienced, it is then natural to ask if the relationship holds in the case of Viet Nam. To shed light on this issue, in this section we examine the links between reduced trade costs and firms' extensive margin. In particular, we ask whether firms in industries with larger tariff changes experience product churning. We follow Baldwin and Gu (2009) to estimate the following equation on continuing firms:

$$Y_{jt} = \beta_1 out_{it-1} + \beta_2 in_{it-1} + \beta_3 X_{jt-1} + \beta_4 HHI_{it} + \alpha_s + a_t + u_{jt}$$

where

Y_{jt} represents the number of product varieties of firm j in 4-digit industry i at time t .

out_{it-1} measures lagged output tariff of industry j at time t .

in_{it-1} is lagged input tariff of sector s at time t .

X_{jt} is a vector of firm – specific characteristics, including employment, lagged export status, lagged export share over total output and interaction terms between ownership type and trade variables.

We include concentration index HHI to capture competition at the industry level.

a_t is the year dummy; α_s is the unobserved 2-digit sector s fixed effect.

Our main research question here is whether changes in output tariff affect the number of products of the firm, controlling for input tariff, export status and export intensity, and ownership structure of the firm. The choice of control variables is based on the literature. Input tariff, for example, has been widely used in studies on trade liberalization and firm productivity.⁷ For the literature on product turnover, input tariff is included in the analysis of Goldberg et al. (2010a) and Goldberg et al. (2010b), among others. While the reduction in output tariff could intensify competition pressure, lower input tariff provides access to more intermediate inputs varieties. For a developing country with limited technological capacity like Viet Nam, it is possible that advanced technology embodied in more advanced imported intermediates lowers the cost of innovation and encourages the development of new products, contributing to aggregate output growth.

In addition, as Lopresti (2016) suggests, the impact of trade liberalization on product scope depends on the extent of a firm's participation in the international market. A more globalized firm, defined as one with larger export sales over total output, tends to add more product or keep the product portfolio unchanged in response to lower trade costs. On the other hand, a more domestically-oriented firm drops its product when facing international competition. To check whether this observation holds for Viet Nam, we include in our estimation export intensity, defined as the ratio of export turnover to a firm's total revenue, and its interaction term with output tariff.

Table 7 reports regression results. Columns (1) to (5) demonstrate the relationship between the number of products and tariff in level. Columns (6) to (10) examine the

⁷ See, for example, Amiti and Konings (2007), Topalova and Khandelwal (2011), Bas (2012)

determinants of firms' product extensive margins. Several findings are worth mentioning. First, in level, a higher output tariff is associated with a smaller number of products. The coefficient on output tariff is negative and significant. Firms in industries with lower output tariff are more likely to produce more products. One possible explanation is the competition effect, where firms diversify to reduce competition pressure. This finding is consistent with Dang (2017), who finds that import competition from the PRC stimulates Vietnamese firms to introduce new products. The economic magnitude is small, however. Second, a higher input tariff is associated with a broader product range. We do not find evidence of expansion of product scope thanks to better access to more imported intermediates. One reason could be that via access to more technologically advanced materials, firms are more likely to invest in quality upgrading of existing products.

Table 7: Tariff Reduction and Product Churning

Variables	(1)	(2)	(3)	(4)	(5)
	Number of Products Produced by Firms				
Output tariff	-0.003*** (0.001)	-0.003*** (0.001)	-0.004*** (0.001)	-0.004*** (0.002)	-0.003*** (0.001)
Input tariff		0.071** (0.027)	0.078*** (0.028)	0.077*** (0.028)	0.073*** (0.028)
Export dummy			0.038** (0.016)	0.040** (0.016)	
Export * output tariff			0.000 (0.001)	0.000 (0.001)	
SOE * output tariff				0.003 (0.002)	
FDI * output tariff				0.001 (0.002)	
Export intensity					0.041 (0.036)
Export intensity * output tariff					0.000 (0.003)
Δ output tariff					
Δ input tariff					
Export * Δ output tariff					
SOE * Δ output tariff					
FDI * Δ output tariff					
Export intensity * Δ output tariff					
Employment			0.053*** (0.011)	0.054*** (0.011)	0.054*** (0.011)
HHI			0.021 (0.072)	0.021 (0.072)	0.024 (0.072)
Constant	1.602*** (0.148)	1.490*** (0.156)	1.200*** (0.165)	1.204*** (0.165)	1.200*** (0.164)
Observations	42,908	42,908	42,905	42,905	41,508
R-squared	0.004	0.004	0.006	0.006	0.005
Number of fid	7,294	7,294	7,294	7,294	7,257

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Table 7 *continued*

Variables	(6)	(7)	(8)	(9)	(10)
	Change in Number of Products				
Output tariff					
Input tariff					
Export dummy			0.023*** (0.008)	0.023*** (0.008)	
Export * output tariff					
SOE * output tariff					
FDI * output tariff					
Export intensity					0.042*** (0.015)
Export intensity * output tariff					
Δ output tariff	-0.001 (0.001)	-0.001 (0.001)	-0.001 (0.001)	-0.001 (0.001)	-0.001 (0.001)
Δ input tariff		-0.010 (0.017)	-0.011 (0.017)	-0.011 (0.017)	-0.016 (0.018)
Export * Δ output tariff			-0.001 (0.001)	-0.001 (0.001)	
SOE * Δ output tariff				-0.000 (0.001)	
FDI * Δ output tariff				-0.000 (0.001)	
Export intensity* Δ output tariff					-0.002 (0.003)
Employment			0.010 (0.007)	0.010 (0.007)	0.009 (0.007)
HHI			0.005 (0.049)	0.005 (0.049)	0.006 (0.050)
Constant	0.276** (0.124)	0.279** (0.124)	0.219* (0.129)	0.219* (0.129)	0.227* (0.129)
Observations	35,591	35,591	35,588	35,588	34,430
R-squared	0.002	0.003	0.003	0.003	0.003
Number of fid	7,247	7,247	7,247	7,247	7,196

Note: Robust standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1.

Source: Author's calculation from the VES data.

Third, the change in output tariff does not have any significant impact on the extensive margin. One possibility is the increasing numbers of non-tariff measures in Viet Nam (Ing, et al., 2016), some of which can be used with protectionist intent. If this is the case, the rise in NTMs can partly offset the impact of tariff reduction. Although it is desirable to incorporate NTMs in the analysis, distinguishing between protective and non-protective measures is not a simple task. We shall leave this issue for further study.

Fourth, exporters produce more products and are more likely to add products. Coefficients on both export dummy and export intensity are positive and significant in both specifications. One observation is that exporters' extensive margin does not seem to be affected by tariff. Coefficients of the interaction term between export status, including export intensity and export dummy, and output tariff, both in level and difference, do not show any significance. It is possible that once firms enter the export market, market diversification reduces the potential impact of the domestic market's competition on these firms.

Fifth, there is no significant impact of ownership on product churning. This result confirms findings from the previous analysis that three groups of firms are not markedly different in terms of product turnover.

Several implications can be drawn from the regression analysis. First, our result further confirms the potential positive contribution of exporters to aggregate growth through product adding. Second, there is a need to consider other factors of trade policy reform, particularly the incidence of NTMs to capture another important aspect of trade liberalization. Our study suggests that aside from common driving factors in the literature, the pattern of product turnover is heterogeneous across countries, depending on the regulatory environment and the competitiveness of firms, amongst other factors. This implication calls for careful country-specific analysis.

7. CONCLUSION

Here we have studied multi-product firms in Viet Nam. Our major findings are as follows. First, multi-product firms are larger, more capital-intensive, more productive, and are more likely to export. Second, while the share of multi-product firms in Viet Nam is smaller than that found in the US and India, Vietnamese multi-product firms are active in the market. Approximately 60% of firms adjust their product scope within a 6-year period. Third, the contribution of firms' product extensive margin to aggregate output growth is limited due to the prevalence of product dropping, which offsets the positive impact of product adding to output growth. Most output growth during the period is thus generated by the intensive margin.

Turning to the link between tariff reduction and product shedding, we did not detect any significant impact. However, we found the important role of exporters in product adding, suggesting the potential contribution of exporters to aggregate growth through the channeling of product scope expansion. Contrary to our expectations, our analysis offers limited support regarding the heterogeneity of product turnover across ownership types. While we find that SOEs are more likely to spread economic activities across products and industries, there are limited difference in terms of product churning amongst FDI, SOEs, and the domestic private sector.

Our analysis provides several policy implications. First, as product adding contributes positively to aggregate output growth, firms should be encouraged to diversify their product range. This could be done through enhancing innovation, for example through technology transfer and the enhancement of inter-firm linkages and exports. Diversification also supports firms in reducing competitive pressure. Second, as multi-industry and multi-sector firms account for only 5% and 7% of firm shares, respectively, whereas most product shedding occurs within narrowly defined categories, it is less likely that product churning or industry switching can represent a significant source of industrial upgrading towards more capital-intensive sectors. Therefore, rather than aiming at expansion across industries, a feasible policy option towards existing firms is to promote investment in process innovation to further increase the quality of existing products or expansion to closely related products, through which the intensive margin can be boosted.

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