Change, yes they can!*

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Abstract

This paper examines the export switching and co-exporting of products of Philippine firms over a time period of 22 years. In order for Middle –Income countries to become High–Income countries they must upgrade and produce high quality goods is a policy recommendation frequently given. The model of Aghion and Howitt (1992) and Acemoglu et al. (2006) show that the relationship between competition and innovation depends on the distance of the product to the world technology frontier. Therefore it might not be optimal for firms in Middle–Income countries to innovate or even upgrade over time. The question that arises is how do exports of firms in Middle–Income countries change? This paper is an attempt to unravel the change in exports using a new dataset of 1991-2012 Philippine import and export (7-digit) customs data merged with manufacturing firm surveys of the Philippine Statistics Authority. By identifying main export product changes and the export products produced by the same firm this paper maps out the changes in export products over time and the similarities between products. This paper finds that switches in main products are frequent over time and that switching behavior depends, among other factors, on exporter age, size and the similarity of the main product exported in terms of other main export products.

JEL Classification: F14, L11, L25

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Contents

List of Figures

List of Tables

1 Introduction

Hausmann et al. (2006) stress that what a country exports matters; when countries export the products that rich countries export then this will foster economic growth and development. This paper focuses on a fundamental issue that is presupposed in Hausmann et al. (2006) and that is whether or not firms change export products and even more important how they change export products over time?

In order to observe change an (initial) specific skill set has to be defined from which a firm can change. In this paper the skill set is revealed by the "Core competency" product of a firm. The term "Core competency" originates from the theoretical literature initially developed by Eckel and Neary (2010) in which it is assumed that each firm has a product which it can produce most efficiently, the "Core competency" product.[3] Therefore, in line with this theoretical literature, it is assumed that the core competency of a firm is revealed by the main export product, in terms of yearly export revenue.[4] A firm will, always, want to make the products that it can produce efficiently enough in order to sell without a loss and preferably with a profit. This is especially true when referring to products sold on the international market as competition is even fiercer. The main export product therefore embodies the "Core competency" of a manufacturing firm.[5] Focusing on the main export product is a relatively minor simplification as the main export product dominates the exports sales and should therefore embody the main skills of a manufacturing firm while avoiding issues with export products that are not produced by the firm (i.e Carry–along trade).

If the core competencies of firms are fixed over time then firms will keep exporting the same or related main products and this should lead to small changes. If on the other hand firms adjust their core competency over time than greater changes can be expected in main export products. Take, for example, an textile producing exporter that at first exports shirts for men as the main export product but over time switches to womens shirts. Even though there is a change in main export product the firm itself has, most likely, made very little adjustments over time in terms of core competency. However if this same firm has gone to exporting high end shoes then the firm has, most likely, made adjustments in core competency. Now if this same firm starts exporting simple electronic products then clearly changes have been made in core competency.

The importance of export product switching was signified by Bernard et al. (2010). However the export product switching analyzed in Bernard et al. (2010) refers to the adding and dropping of products over time (i.e a change in the product mix). Timoshenko (2015) continues with this product mix analysis and finds, apart from similar results as Bernard et al. (2010), that changes in the product mix depend on exporter age. This gives a dynamic view of exporters where they add and drop products to their export mix over time. Cross section evidence that the ranking of products is almost unaltered over the destinations to which firms export seem to indicate a more static view where firms are centered around their main export product. (see Arkolakis and Muendler (2010) and Mayer et al. (2014)) The findings of Arkolakis and Muendler (2010) and Mayer et al. (2014) are in line with the core competence model that predict that the closer the product is to the core competence product the more a firm will export of it as it can be produced more efficiently. On one side there is evidence that products are added and dropped and on the other side evidence that more important products are very stable and dominate the sells of a firm in a export market. These two empirical facts seem to contradict. However they could be corroborated under the idea that main products or products close to the core competency do not (frequently) change and that it are the smaller products or products further away from the core competency that are more likely to be dropped and added over time. The data used in this paper finds similar empirical results as found in Mayer et al. (2014) and Timoshenko (2015). However this paper also finds that the main product also switches frequently.

[3] A firm can produce other products however with declining efficiency.

[4] I refer to one- two-, four- and 7-digit PSCC (Philippine Standard Commodity Classification) categories as "sector", "division" "industries," and "products" . This classification corresponds until 5 digits to the SITC rev. 3 classification.

[5] The main export product switches are of course a simplification of the changes that occur within a firm. It could be the case that the firm has upgraded within the same product category. This type of change would not be captured in the switching analysis. However given the level of detail, 7-digit level categories, product changes will quickly be captured.

In fact in 34.4% of the firm-year observations firm main product changes occur.[6] The highest digit change of the 7-digit PSCC (Philippine Standard Commodity Classification) classification can be used as a quick and dirty measure for the extent to which firms change in core competency after a main product switch. The higher the highest digit change, after a main product switch, the greater the difference between the two products.[7] It can be observed that most changes occur in the 1^{st} digit level which potentially indicates major changes in core competencies of firms.[8] What do these changes in main products reflect?

Do changes in main product reflect changes in core competencies due to, for example, innovation? This does not seem very likely as R&D in Middle–Income countries is often scarce. The World Bank development indicators show that for 2007 R&D expenditure is equal to 0.1% of the GDP for the Philippines; which even by Middle–Income country standards is low.[9] The model of Aghion and Howitt (1992) and Acemoglu et al. (2006) show that the relationship between competition and innovation depends on the distance of the product to the world technology frontier. Therefore it might not be optimal for firms in Middle–Income countries to innovate as many firms are not located on this frontier. The fact, however, that firms do change main product over time does indicate that adjustments are made. The question is what type of adjustments? This paper focuses on main product switching which is, as previously argued, a frequent phenomenon and therefore must have economic rational.

2 Literature review

Bernard et al. (2010) signified the importance of product switching. However the product switching that has been analyzed refers to the adding and dropping of products to the total number of products exported; basically referring to a change in the product mix. This paper however defines product switching as a main product switch for the firm. A change indicating that for some reason the previously most important export product is not the most important export product any more. This seems a more appropriate definition of product switching as a firm adding one small insignificant product to the export list will be dubbed as a product switching firm in the previous literature while in this analysis the main export product of a firm has to change. The focus on the main product also avoids issues with Carry–Along Trade. Bernard et al. (2012) uncover this phenomena for Belgium manufacturing firms and find that more than $\frac{3}{4}$ of the exported products and more than $\frac{1}{4}$ of the export value are in products that are not produced by the firm. This Carry–Along trade could therefore, to a certain extent, explain the trend in adding and dropping of products of firms over time. However this Carry–Along trade would have a harder time explaining changes in the main product over time as manufacturing firms are more likely to be involved with the production of the main export product. The fact that the main export product dominates the export sales and that main product switching is quite frequent signifies the importance.

Timoshenko (2015) shows that both added and to–be–dropped products account for, on average, 29% of the export revenue for firms in Brazil. However this percentage differs by exporter age; for firms with two years of exporting added products account for 51% while firms with 5 years of experience derive 28% of their exports from added products. Timoshenko (2015) also shows that product mix changing is frequent as, on average, 72% of the firms change their product mix in a given year. Bernard et al. (2010) find that recently added and about–to–be dropped products each account for roughly $\frac{1}{6}$ of a producer's output, 54% of the manufacturing firms alter their mix every five year and 40% of the firms added products outside their existing set of four–digit SIC industries between census years. Especially the fact that relatively unrelated products account for a large part of the added products

[6] 82.9% of the main product changes happen within the same export spell of a firm. Where a spell is defined as the uninterrupted length of time that a firm exports.

[7] If the highest digit change is the 7^{th} digit then most likely little has changed while when the highest change is at the 1^{st} digit one might expect larger changes in core competencies for the firm.

[8] 36.9% of the highest digit changes occur in the first digit of the PSCC product code. While only 8.2% of the highest digit changes occur in last digit on the product code.

[9] The average R&D expenditure as a percentage of GDP for Middle–Income countries in 2007 is 0.9%.

seems to hint on Carry–along trade driving, at least part of, the results.

The narrower the product classification the more frequent product switching will occur. This paper uses 7–digit PSCC classification changes while Bernard et al. (2010) analyze 5-digit SIC (Standard Industrial classifications) product mix changes per 5 years and Timoshenko (2015) analyze 6–digit HS (Harmonized tariff system) changes. Even though the level on analysis is lower for the other authors they none the less also point out that product switching is frequent, widespread and influential.

Bernard et al. (2010) stipulate three broad categories for possible alternate explanations for explaining the facts they uncover. The first category are explanations that focus on factors that are specific to products but common to all firms. (i.e relative demand) The second class of explanations focuses on factors that are specific to firms but uncommon to products. (i.e firm productivity) The third class focuses on firm–product attributes in influencing product switching. In the last class the model of Bernard et al. (2010) falls. The model Bernard et al. (2010) propose has both idiosyncratic shocks to firm productivity and firm–product demand that fosters both the selection of firms and that of products within firms.

The focus on the main product of this paper is related to the "Core competency" literature that is initially developed by Eckel and Neary (2010). The authors assume that each firm has a product that it can produce most efficiently also called the "Core competence". A firm can produce other products with declining efficiency. The inefficiency in the model translates into higher marginal labor requirements. In the framework of Eckel and Neary (2010) a firm produces less of each variety the further it is from its core competence. Which implies a direct link between quantity produced and the efficiency with which the firm can produce the product. Therefore the Core competence product is by definition the product that the firm produces the most and generates the highest revenue. In this framework a firm will stop producing the less efficient varieties before it stops producing the core competence. Therefore main product switches will not frequently occur. Both Mayer et al. (2014) and Arkolakis and Muendler (2010) use the notion of "Core competency" which assumes that the firms' productivity declines in the rank of its products which is in line with their findings. Mayer et al. (2014) finds that variation in the toughness of competition causes firms to increase the relative share of better preforming products as there is a downward shift in the distribution of markups. Using cross section data Mayer et al. (2014) find that ranking of products is almost unaltered over different destinations only the number of products exported changes. Implying that the firms main product in terms of export revenue is also the main product in the destination to which a firm exports. Arkolakis and Muendler (2010) document that within firms and destination, exports are concentrated in a few top-selling products and that firms that export many products (wide–scope exporters) sell small amounts of their lowest–selling products.

"Core competency" literature predicts that firms will not quickly change main product as it is the product that the firm can produce most efficiently. If shocks happen other less efficiently produced products will be dropped before the main product is dropped from the existing export range. However the fact that the main export product does change over time seems at odds with the results of the "Core competency" literature and could imply the following: Firstly it could simply be due to the fact that the core competency changes over time. In the framework of Eckel et al. (2015) quality upgrading is deemed most likely to happen in the products that are closest the firms' core competency.[10] Therefore changes within the main product over time could be due to quality upgrading that takes place within a firm and is often centered around the core competence. However given the frequency of main product changes this is not likely to be the whole story. Secondly it might be the case that the firms' core competence are less fixed in one product. Instead the firm has a core competence that applies to a group of products leading to more frequent switches of main product without the firm changing its core competence. Then demand side shocks (e.g transient firm–destination–year preference shocks and firm–destination appeal) could lead to changes in the main product exported over time. Thirdly it could be the case that the "Core competence" is less well known to smaller/younger exporters and

[10] Although a distinction is made between "cost—based" and "Quality—based" competence, the last being proxied by differentiated goods as classified by Rauch (1999), where "Quality—based" competence firms invest more in enhancing the quality of the core–products.

therefore main product switching is more frequent as self discovery takes place. While older/larger exporters are less likely to switch main product over time and when they change they change to products that are related to their previous main product. This is in line with Timoshenko (2015) who finds that the share of added and dropped products decreases with exporter age. Timoshenko (2015) underpins his findings with a demand learning model. This model implies that older exporting firms know better what the true appeal of their products are than younger exporting firms. This will imply that main product switching is more likely for younger exporters than older exporters. Also it should be expected that younger firms are more likely to make relatively unrelated changes than older firms in the quest of their core competence.

3 Data

In order to insure that the firms in the sample are involved in the production of the products that they export some corrections are necessary. Firstly the sample only consists of manufacturing firms.[11] Secondly the products that cannot be directly linked to a firms production and exports to unknown destinations are deleted.[12] Thirdly products that for a firm amount to a real value that is less than $1000 in a year are deleted from the sample; this in order to insure that products sporadically exported and very small firms are deleted from the sample. After the corrections the author is left with 6,074 exporters and 6,046 products which account, on average, for 70.2% of total yearly export revenue.[13]

The firms analyzed in this paper are firms of which the trader code has been matched to the Establishment Control Number (ECN) from the list of establishments. These firm have been traced to the manufacturing survey and can therefore, with a high degree of certainty, be dubbed manufacturing firm. None the less a firm can change over time. Of the 2,999 main products produced by these firms 81.9% are products that are often classified as manufacturing products (i.e fall in sections 5–8 of SITC rev. 3 classification). None the less this does imply that 18.1% of the main products are products which are usually not classified as manufacturing products. Firms that change to these "non-manufacturing" product categories are not dropped from the sample. The sample is constructed in such a manner that with a high degree of certainty all the firms in the sample are or were manufacturing firms. More importantly the unique trader codes and ECN ensures that the same firm is followed through time.

Another important aspect of the data is product classification consistency over time. This in order to insure that main product changes are observed instead of classification changes over time. The classification in the Philippines changes from a 7–digit to a 10–digit classification in 2006. This meant matching the PSCC 7-digit classification (harmonized to the SITC rev. 3 until 5 digits) to the PSCC 10-digit classification (Harmonized to the HS classification) which was used from 2006 onwards. The difficulty with correcting this change in classification is that in some cases a single 10-digit category matches with multiple 7-digit categories. Clearly indicating that the change in classification is not merely a switch to a more detailed classification. Actually the reverse is true in a few cases. The PSCC 7-digit classification was tailored to the Philippine economy while the 10-digit classification was set up in order to harmonize trade statistics between ASEAN (Association of Southeast Asian Nations) member countries. Whenever multiple 7–digit products match to a single 10–digit product the 7–digit product that a firm previously exported will be chosen, this to insure consistency over time. For example 10-digit product category A matches with 7-digit product categories B, C and D however firm 1 only produced product B the year before then B is assigned to all products from 2006 onwards

[11] Therefore name deletion and matching to manufacturing firm surveys is applied in order to insure that the respective sample consist of manufacturing firms. Firms that had in their names the following keywords, Moving, Shipping, Logistic, Trading, Trader, Export and Import, are deleted from the sample.

[12] Pscc product codes 93103 – 93109 , IIb and New are deleted

[13] The manufacturing survey could only be obtained from 1996 onwards. This implies that the matching was done from 1996 onwards and that the export activity of firms that export between 1991–1995 however never export after 1996 do not appear in the sample. Therefore for the years before 1996 the exporters in the sample only accounts, on average, for 48.9% of total yearly export revenue. While in the years from 1996 onwards the firms account for 76.5% of yearly export revenue.

that are classified A. The number of single PSCC 10-digit categories with multiple 7-digit categories is very limited however when they where encountered this strategy is applied in order to ensure within firm consistency.[14]

4 Same results

4.1 Product ranking over destinations

The cross section evidence in Arkolakis and Muendler (2010) and Mayer et al. (2014) seems to point out that the core competency model is a good fit as the ranking of products is almost unaltered over the destinations to which firms export. This finding is in line with the core competence model that predicts that the closer a product is to the core competence the more a firm will export of it as it can be produced more efficiently and therefore overcome more barriers. Mayer et al. (2014) construct a global ranking which ranks products in terms of total export revenue and then compares this ranking to the ranking of the products exported to a destination (the local ranking). The Spearman rank coefficient formula is used to calculate the rank correlation between the global ranking and the local ranking for firms. The Spearman rank coefficient will obtain its maximum value when the ranking of products is unaltered. Therefore if in a destination products with global ranking 1 and 8 are ranked 1 and 2 locally then the maximum value is obtained as the ranking is unaltered; this in the sense that the product ranked 1 globally is ranked higher locally than the product ranked 8 globally. Even though the method of Mayer et al. (2014) show that the ranking might be unaltered they do not correct for the fact that certain products sold frequently globally are not exported to the respective country locally. Therefore no correction is made for the fact that products 2 till 7 are not exported locally. This can be attributed to demand factors as certain countries might not demand all products exported by the respective firm. The method of Mayer et al. (2014) only takes the ranking of the exported products into consideration thereby avoiding factors related to local demand preferences. Similar results are obtained when using the method applied in Mayer et al. (2014) on the data in this paper. (see Table 1) The average firm Spearman Rank correlation between the global and local rankings in this paper of 0.897 is higher than the Spearman rank coefficient obtained in Mayer et al. (2014) of 0.676 and more comparable to the rank correlation of 0.837 obtained in Arkolakis and Muendler (2010).

Even though the Spearman rank coefficient cannot be calculated when only 1 product is exported to a destination Mayer et al. (2014) assume that the rank coefficient reaches it maximum value of 1 in that case. This assumption increases the value of the average Spearman rank correlation. Therefore dropping observations where a firm only exports 1 product to a destination leads to a lower average firm Spearman rank coefficient of 0.778. (See Tabel 2) Therefore similar results are obtained as Mayer et al. (2014) in the cross section data.[15]

[14] There are 401 10-digit products which match in most cases to two (68.1%) up to a maximum of 35 7-digit product categories. Most of the products with this matching problem are also of less importance as the average importance ranking in terms of total revenue of these products is 3135. Indicating that this complication is mostly contained to relatively unimportant products for the Philippine economy. Also only 410 observations in the sample have this multiple matching difficulty.

[15] Although the author only shows the results for the year 2000 similar results are obtained when taking another year as bench mark.

Table 1: Spearman Correlation Between Global and Local Rankings

Firms exporting at least:	Number of products				
To number of countries	1	2	5	10	20
1	0.897	0.872	0.827	0.785	0.729
2	0.851	0.844	0.809	0.775	0.719
5	0.809	0.805	0.782	0.754	0.705
10	0.797	0.795	0.776	0.756	0.704
20	0.793	0.791	0.783	0.758	0.717

Notes: This table summarizes the average Spearman correlation between the Global and local ranking for firms in the year 2000.

Table 2: Spearman Correlation Between Global and Local Rankings (Excluding destinations to which a firm only exports 1 product)

Firms exporting at least:	Number of products				
To number of countries	1	2	5	10	20
1	0.778	0.778	0.728	0.680	0.624
2	0.725	0.724	0.700	0.666	0.610
5	0.656	0.656	0.639	0.625	0.582
10	0.640	0.639	0.618	0.612	0.569
20	0.641	0.641	0.631	0.610	0.570

Notes: This table summarizes the average Spearman correlation between Global and local ranking for firms when destinations to which only 1 product is exported are excluded in the year 2000.

4.2 Adding and Dropping

The definition of product switching used in previous papers (i.e the adding and dropping of products is defined as a change in the product mix for the rest of this paper) will be retained and analyzed in this section. This to show how the results of product switching will relate to the product switching analysis preformed by Timoshenko (2015) and Bernard et al. (2010). For firms that continue with exporting the next period the dropping and adding of products can be analyzed.[16] A product is added by a firm when it is not exported at time $t-1$ however it is exported at time t. A product is dropped when it is exported at time t however not exported at time $t+1$. Added (dropped) products account for 26.7% (25.9%) of total export revenue. There are however examples of firms that change there complete product mix when going from year t to $t+1$. This would automatically imply that a surviving exporter drops 100% of their revenue (products) in year t and adds 100% of their revenue (products) in year $t+1$. In 10% of the cases exporters do indeed change their complete product mix when going from one year to next. This is of course more frequently the case for small exporters than larger ones. In only 12.8% of the firm–year observations no products are added or dropped by surviving firms, so called inactive exporters. This implies that among surviving exporters 87.2% alter their product mix. This is notably higher than the 72% observed for Brazilian exporters in Timoshenko (2015). This difference is partly due to the fact that 7-digit switches are considered in this paper contrary to 6-digit switches (e.g Timoshenko (2015)).[17]

Table 3 and 4 shows that size has a negative effect on the percentage of revenue added by new products and the percentage of revenue dropped. Both size measured as total export revenue and

[16] Analyzing adding at entry does not make much sense as all product exported that year are added product. The same logic holds for the dropping of product but then for exit

[17] Also sample differences play a role. In this paper firms that have been matched to the manufacturing firm survey are kept in the sample. The products that these firms export are not always products that are categorized as manufacturing products. (Generally speaking manufacturing goods are SITC rev. 3 5–8. Sometimes section 9 is included or division 68 is excluded.) However the exporter must export at least $1000 worth of the product (in real terms) in order for it to be included in the analysis. There are 6,046 products exported of which 4,833 are classified as manufacturing goods.(i.e Fall in SITC rev 3. section 5–8)

the number of products exported has a significant negative effect. Export age is the uninterrupted number of years that a firm has been exporting in the sample.[18] In line with Timoshenko (2015) older exporters are less likely to alter their product mix over time. Older and larger firms are both less likely to add and drop products over time. (See Table 3 and 4) Therefore using the product mix definition will lead to similar results as Timoshenko (2015) found.

Table 3: Percentage of revenue added by new products

	(1)	(2)	(3)	(4)
$Log(Exports_{t-1})$	-0.067^{***}		-0.062^{***}	
$Log(Scope_{t-1})$		-0.112^{***}		-0.098^{***}
$ExportAge_{t-1}$			-0.007^{***}	-0.012^{***}
Constant	0.797^{***}	0.071	0.730^{***}	0.041
No. of Obs.	39103	39103	39103	39103
AIC	6502.9	11801.1	6027.4	10635.5
Log likeli.	-2836.4	-5485.6	-2597.7	-4901.7
R-squared	0.34	0.25	0.35	0.27
Year dummies	Yes	Yes	Yes	Yes
Division dummies	Yes	Yes	Yes	Yes
Destination dummies	Yes	Yes	Yes	Yes

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$ ***Notes: The division (2-digit) dummies are main product classification dummies in terms of revenue. Destination dummies are dummies for the destination that is the most important for the firm in terms of revenue. (i.e the main destination)***

Table 4: Percentage of revenue lost by to be dropped products

	(1)	(2)	(3)	(4)
$Log(Exports_{t-1})$	-0.048^{***}		-0.047^{***}	
$Log(Scope_{t-1})$		-0.048^{***}		-0.040^{***}
$ExportAge_{t-1}$			-0.003^{***}	-0.008^{***}
Constant	0.591^{***}	0.055	0.564^{***}	0.034
No. of Obs.	35668	35668	35668	35668
AIC	2167.9	6745.0	2086.6	6217.0
Log likeli.	-847.0	-3135.5	-805.3	-2870.5
R-squared	0.25	0.14	0.25	0.15
Year dummies	Yes	Yes	Yes	Yes
Division dummies	Yes	Yes	Yes	Yes
Destination dummies	Yes	Yes	Yes	Yes

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$ ***Notes: The division (2-digit) dummies are main product classification dummies in terms of revenue. Destination dummies are dummies for the destination that is the most important for the firm in terms of revenue. (i.e the main destination)***

Therefore the data used in this paper finds cross section evidence that ranking is almost unaltered over destinations and evidence that product switching is frequent and dependent on exporter size and age. The next section however adds a new dimension to the analysis as it shows that main product switching is also a frequent phenomena. Which given the cross section evidence would not be expected.

[18] Therefore in line with citetTim15 left censored exporters receive an exporter age of 1 in the first year of the sample. Deleting left censored observation leads to similar results.

5 Empirical evidence of changing main product

Manufacturing firms are involved with the production of the products they export. Therefore the products they export are a reflection of the competencies of a firm. What these competencies are is left in the middle, however, they are assumed to be revealed by the main export product of the firm. Products that a firm exports are a strong reflection of the firm competencies even more so than domestically sold products. For the mean (median) firm the main export product accounts for 72.1% (75.9%) of a firms total revenue within a year. Looking at table 5 it can be seen that even for firms that export more than 51 products in a year the main product, on average, still accounts for 24.7% of total export revenue. Clearly demonstrating the importance of the main export product and thereby making a strong case for classifying a firm on the basis of the main product it exports as a revealed firm core competency.

Table 5: Top 5 products shares, by firm type, average 1991-2012

	Firm's products scope					
	1	2	3	4-10	11-50	51+
1	100.0	81.3	74.1	65.7	51.1	24.7
2		18.7	19.3	18.7	17.7	12.4
3			6.6	8.2	9.3	8.0
4				4.0	5.8	6.0
5				2.4	3.9	4.8

Notes: This table summarizes the number of products exported by a firm in a year and the importance of the top 5 products in terms of total yearly export revenue. The observation level is firm–year implying that firm that export more years appear more often in the table.

Of the manufacturing firms that export 72.7% change main product over time. Keep in mind that some firms stop exporting after one year and can therefore never change main export product by definition. In fact of the firms that export for at least two years in the sample 86.9% change main product. Firms that export, on average, 1 main product are, with 53.4% unchanging firms, the least likely to change. Table 6 indicates that the more products a firm exports the more likely it is that a firm changes main product category. The number of products exported is synonym for firm size in many cases. Larger firms generally have longer export spells and therefore have longer time periods in which they can change export product. This to a certain extent drives the results in Table 6.

Table 6: Number of main product changes by average number of products exported between 1991-2012

	Products Exported				
Changes	1	2	3	4-10	11+
0	53.4	18.5	18.6	15.8	9.7
1	18.0	21.6	15.0	13.5	10.0
2	12.8	14.8	13.0	13.6	9.1
3	6.3	15.0	9.6	11.8	12.0
4	5.2	8.7	9.9	10.4	10.4
5	2.1	5.8	7.9	8.8	9.7
6+	2.3	15.7	26.0	26.1	39.2

Notes: This Table summarizes the number of main product changes per mean number of product exported. Main export product is defined as the 7–digit category of which the Fob value in a respective year is the greatest. Therefore a mean of 1 implies that the firm exported yearly on average 1 product. The mean values are rounded of to the nearest integer. A main export product change is defined a change in main export product between two consecutive export observations of the same firm. These two export observation do not have to take place in consecutive years.

Table 7 shows the export spell duration of a firm and the number of times the firm changes main product. Where a spell is the uninterrupted length of time that a respective firm f exports. As can

be expected the longer the export spells lasts the more likely it is that the firms changes main product at least once. For firms that have export spells that last 10 or more years 34.9% change main product category 6 or more times. But even firms that have export spells that last 2 years change main export category in 73.2% of the cases. Firms with short spells have a relatively high tendency to change main product given the time frame. Even though firms with longer time spells are more likely to change they are less likely to the change the maximum amount of times, given the the time frame, compared to firms with shorter time spells.

Table 7: Number of main product changes by export spell duration

	Export Spell Duration						
	2	3	4	5	6	7-10	10+
0	26.8	19.9	21.0	14.6	17.0	15.5	17.3
1	73.2	26.4	19.0	17.5	14.5	14.9	10.3
2		53.7	28.0	16.4	13.5	13.0	11.7
3			32.0	23.7	19.0	12.6	9.8
4				27.8	19.3	11.8	8.4
5					16.7	14.3	7.7
6+						17.8	34.9

Notes: This Table summarizes the number of main product changes per spell duration. A spell is the uninterrupted length of time (In years) that a respective exporter exports. Left censored spells are not deleted from the analysis and assumed to start in 1991. Main export product is defined as the 7 digit category of which the Fob value in a respective year is the greatest. A main export product change is defined a change in main export product between two consecutive export observations of the same firm. These two export observations do take place in consecutive years. Firms that only export for one year are excluded in this table as by definition they never can change main product category.

The export product changes are defined as changes in the 7-digit PSCC code. Around 37% of the product changes have highest 7-digit code changes that are in the 1^{st} digit, possibly indicating distinct product changes. (See Table 8) However, most 7-digit main product changes occur without the 1^{st} digit changing. (see Table 9) Main products located in the Food and live animals section (section 0) and Miscellaneous manufactured articles (section 8) are, when they switch, more likely to remain within the same 1-digit section than other products. Although main product switching occurs in each section it occurs most frequently, in decreasing order, in sections Machinery and transport equipment (section 7), Chemicals (section 5), Manufactured goods classified chiefly by material (section 6) and Miscellaneous manufactured articles. Interestingly enough Firm in these sections have the tendency to change to each others sections. Animal and vegetable oils, fats and waxes (section 4), Mineral fuels, lubricants and related materials (section 3) and Beverages and tobacco (section 1) are small sections in terms of number of firms. Firms within these sections are also less likely to change main export product over time. Although firms that export on consignment basis have the lowest tendency to switch main product over time. This however is partly due to the product definitions for the consignment based products which is notably larger than that of other 7-digit classifications.[19]

The 1-digit classification is very broad and does not give a clear indication of the type of product one is looking at. A classification of the UNCTAD of products by technological categories based on Lall (2000) is more insightful.[20] This classification gives a clearer overview of main export changes of firms. The frequency of changes is relative similar for most product groups. Only firms that produce a primary product as main product are, notably, less likely to change main product over time.

[19]The product definitions for consignment based goods are broader. Instead of having separate categories. For example there is one product category for mens clothes manufactures from materials on consignment basis while when not made on consignment basis a distinction is made between the type of clothing and material from which it is made. Partly due to this phenomena firms that have their main product in a consignment based product change less frequently and why changes within its own category are the lowest of all classification

[20]Consignment product groups are not classified by this classification. Therefore they are categorized by related product sections

Table 8: Highest digit change of main product changes

digit	Percentage
1^{st}	36.9
2^{nd}	17.1
3^{rd}	13.5
4^{th}	13.6
5^{th}	7.8
6^{th}	2.9
7^{th}	8.2

Table 9: Percentage of 7-digit changes Per 1-Digit Sector

Changed	**Changed to**										
from	0	1	2	3	4	5	6	7	8	9	$\frac{\#changes}{\#obs}$
0	**70.4**	1.4	3.8	0.1	1.8	6.0	4.4	5.0	6.5	0.5	**25.9**
1	15.6	**64.9**	1.3	0.0	0.6	1.3	3.2	8.4	4.5	0.0	**30.2**
2	6.5	0.1	**42.7**	0.3	0.4	4.9	22.1	8.7	12.4	1.7	**33.9**
3	2.6	0.0	7.7	**69.2**	0.0	5.1	0.0	15.4	0.0	0.0	**29.1**
4	15.2	0.0	2.3	0.0	**65.9**	9.8	3.8	0.8	2.3	0.0	**27.0**
5	5.7	0.2	2.2	0.2	0.7	**57.5**	8.1	10.7	13.6	1.3	**39.1**
6	2.1	0.3	4.5	0.0	0.1	3.2	**50.5**	14.9	22.2	2.2	**38.0**
7	1.8	0.4	1.5	0.1	0.1	3.6	12.5	**64.2**	12.0	3.8	**40.4**
8	1.0	0.1	1.1	0.0	0.0	2.6	11.1	6.2	**72.9**	4.9	**36.6**
9	0.5	0.2	1.1	0.0	0.3	2.7	7.2	14.8	33.5	**39.8**	**16.3**

Notes: This figure summarizes the number of main product changes by the product section (1st digit of the Pscc classification). The **Changed from** category indicates the original section the firms product was classified in. **Changed to** is the new section in which the product is now classified after a change has taken place.

When firms within this section change they often change to other primary products or resource based products. Firms that produce low, medium and high tech products are the most likely to change. Low tech products producing firms tend to change to other low technological products. While firms producing medium technological products tend to change to other medium and low product categories. A firm producing a high technological product will when it changes main export product change to a medium or high technological product in 79.3% of the cases. Displaying that most export switches happen to products that require relatively similar skills. [21]

[21] One category that was added to the classification is consignment basis. This category comprises of products manufactured from materials on consignment basis. This implies that the inputs that a firm uses in it production are owned by a third party. The firm puts these inputs together and then exports the finished product. The product categories where matched to corresponding product categories that are classified by UNCTAD.

Table 10: Percentage of Product changes per Product Category

Changed from	**Changed to** Primary Com.	Resource Based	Low Tech.	Med. Tech.	High Tech	$\frac{\#changes}{\#obs}$
Primary Com.	**49.2**	22.5	15.5	9.5	3.3	**26.1**
Resource Based	8.7	**57.2**	18.7	12.1	3.2	**32.4**
Low Tech.	1.7	6.5	**79.9**	9.0	3.0	**34.3**
Medium Tech.	2.3	7.7	19.9	**57.4**	12.7	**39.4**
High Tech.	2.1	5.0	13.7	31.0	**48.3**	**34.3**

Notes: This figure summarizes the number of main product changes by UNCTAD classification of products by technology categories (based on Lall (2000)). The **Changed from** category indicates the original section the firms product was classified in. **Changed to** is the new section in which the product is now classified after a change has taken place.

6 Method

6.1 From Tobit to selection models

In this paper the switching of main product and the type of switching is analyzed. The first part of the analysis is a binary analysis that can be analyzed by using a Probit or Logit regression. The second part of the analysis is more complicated as it involves a truncated regression containing only the observations of firm main product changes. Both the first and the second part can be estimated with Tobit, Hurdle and Selection models. The dependent variable of the second part, similarity between main products, is observed only when a firm changes main product. Therefore the sample will be a mixture of observations with zero and positive values. The Tobit 1 model makes a strong assumption that the same probability mechanism generates both the zeros and the positive values. This assumption is not likely to hold as the variables that influence the decision to change main product might not be the same factors that influence the type of change made. Therefore this paper uses more flexible models such as the Hurdle model and the selection model which allow for different mechanism to generate the zero and positive values. The problem with Hurdle regressions is that they assume that the two parts, changing main product and similarity of product switched to, are independent. It is conceivable that, after controlling for regressors, that the firms that change are not randomly selected from the population. This will imply that the regression of the second part would suffer from selection bias. The selection model considers the possibility of selection bias by allowing for possible dependence between the two parts of the model. Given the implausibility that the same probability mechanism generates both the zeros and the positive values and the plausibility of sample selection the selection model will be used in the analysis.

Suppose a firm has a latent propensity to change main product, denoted by y_1^*, and a latent similarity between the previous main product and the product switched to, denoted y_2^*. The type of switch y_2^* is only observed if $y_1^* > 0$ and a main product switch takes place. Therefore the two–equation model comprises of a selection into changing main product (y_1), where

$$y_1 = \begin{cases} 1 & \text{if } y_1^* > 0 \\ 0 & \text{if } y_1^* \leq 0 \end{cases} \tag{1}$$

and the result outcome equation for the type of switch (y_2), where

$$y_2 = \begin{cases} y_2^* & \text{if } y_1^* > 0 \\ - & \text{if } y_1^* \leq 0 \end{cases} \tag{2}$$

Therefore y_2 is observed only when a main product change takes place (i.e $y_1^* > 0$) whereas y_2 does not take on any value when no switch takes place. Suppose the model is linear with additive errors:

$$\begin{aligned} y_1^* &= \mathbf{X_1'}\beta_\mathbf{1} + \epsilon_1 \\ y_2^* &= \mathbf{X_2'}\beta_\mathbf{2} + \epsilon_2 \end{aligned} \tag{3}$$

Where ϵ_1 and ϵ_2 are possibly correlated. The correlated errors are assumed to be jointly normally distributed and homoskedastic.

$$\begin{pmatrix} \epsilon_1 \\ \epsilon_2 \end{pmatrix} \sim N\left[\begin{pmatrix} 0 \\ 0 \end{pmatrix}, \begin{pmatrix} 1 & \sigma_{12} \\ \sigma_{12} & \sigma_2 \end{pmatrix} \right] \tag{4}$$

The heckman two–step estination method can be used to estimate the selection. The first step is to estimate the first part of the model which can be estimated with a probit regression. Then the estimated bais correction term, the inverse Mills ratio (i.e λ) can be estimated with:

$$\lambda(\mathbf{X_1'}\beta_\mathbf{1}) = \phi(\mathbf{X_1'}\beta_\mathbf{1}/\sigma)/\Phi(\mathbf{X_1'}\beta_\mathbf{1}/\sigma) \tag{5}$$

The second step of the regression is to preform OLS (Ordinary Least Squares) with the estimated bias term as an additional variable.

$$E(y_2|\mathbf{X}, y_1^* > 0) = \mathbf{X_2'}\beta_\mathbf{2} + \sigma_{12}\lambda(\mathbf{X_1'}\beta_\mathbf{1}) \tag{6}$$

The two–step estimation relies on a univariate normaility distribution and is relatively more robust than the maximum likelihood estination. However the standard errors are larger due to the fact that the inverse Mills ratio can be collinear with the other regressors of the second part regression. When $\mathbf{X_1} = \mathbf{X_2}$ this is likely to be the case. Therefore, for a more robust identification, having an exclusion restriction may reduce the collinearity problem. An exclusion restriction is a variable that should have substantial impact on the probability of changing main product that does not directly effect the type of switch.

6.2 The similarity index

A similarity index is created for all main products that the Philippines export. For the product similarity a binary vector is used to represent patterns of co-exporting similarity. The binary vector for similarity is built up of different components. Firstly all the products that a firms exports within the same year are given the value 1 and all other products the value zero. Therefore the vector displays the products that a firms exports within the same calendar year. The vector only includes products that have been exported by at least one firm as main product in the sample. Therefore the similarity measure is a measure of similarity between main export products. When combining all these firm–year row vectors into a matrix the columns of this matrix are product vectors. These product vectors contain the information for which firm–year the respective product is exported. Take two products, i and j, that are represented by the binary product export vector. Let t denote the time in years and f the firm. Then for product vector i 1 indicates that a firm f exports product i in year t and 0 that it does not. Let then a denote the number of firm–years that both product i and j are exported, also called positive matches; b is the number of firm–years that export product i is exported but not product j, called j absence mismatches; c is the number of firm–years that export product j is exported but not product i, called i absence mismatches; d is the number of firm–years that neither product i nor product j is exported, also called negative matches.

The binary similarity measures use different ways to combine the values of a, b, c, and d to create a similarity measure. Applying an appropriate measure of similarity will lead to more accurate data analysis.[22] The clearest distinction between similarity measures is between measures that include negative matches and those that do not. Negative matches do not necessarily imply any similarity between the two products this because there is almost an infinite number of firms that produce neither products. (Sokal and Sneath (1963)) Considering the large number of negative matches in the data including negative matches quickly leads to a domination of negative matches in the calculation of a similarity index. Due to the fact that the information of negative matches is in most cases significantly less than that of positive matches this paper will reside to similarity measures that exclude negative matches.[23] More specifically this paper uses the Jaccard similarity measure. This measure is defined as follows:

$$S_{ij} = S_{ji} = \frac{a}{(a+b+c)} \tag{7}$$

The S_{ij} calculates the similarity between two distinct products i and j. S_{ij} ranges from 0 till 1. Where 1 indicates that in all firm–year observations when product i is exported product j is also exported but also implies that when product j is exported product i is also exported and 0 indicates that both are never exported together. The Jaccard index matrix is symmetric. (i.e $S_{ij} = S_{ji}$) The Jaccard value therefore automatically implies that for a firm producing product i it is just as easy to produce product j as it is for a firm producing product j to produce product i. This of course does not have to be the case. One direction might be notably simpler than the other. Therefore the Jaccard value signifies a relation between the two products without imposing a direction.[24] A high Jaccard value will therefore be obtained for products which are often co–exported. The fact that the products are related will be picked up by the Jaccard index. Lower values will indicate that co–exporting is not frequent and therefore the products are relatively hard to produce together and therefore not frequently exported together.[25]

One slight alternation of the Jaccard similarity index is to use firm–destination–years vectors. All the products that a firms exports within the same year to the same destination are given the value 1 and all other products the value zero. Therefore the vector displays the products that a firms exports within the same calendar year to a destination. Given that the ranking of products is hardly unaltered over destinations for firms more important products will be exported more frequently together by a firm than less important products. By focusing on the products that a firm exports together to a certain destination more important products will receive higher weights and so will firms that export to more destinations (Which is often synonym for a larger exporter). Of course the drawback of the method is that if a firm produces product that it never exports to the same destination that they will never be linked. The advantage is that small insignificant products get lower weights while more important products for the firm will receive higher weights as they are exported more frequently to different destinations.

[22] See for example Cha et al. (2010) for a more complete overview

[23] Examples of the these measures are Jaccard, Tanimoto, Dice and Sorenson, Ochiai I and Mountford.

[24] However in theory a one direction relation should have lower Jaccard values than a two direction relation. Especially when the one direction relation is between a product that is difficult to produce and a product that is simpler to produce. In most cases there will more firms producing the simpler product but not being able to produce the more advanced product. It might be the case that the more advanced product producers also produce the simpler product however the other way round it is never the case. Due to the fact that there are more simple product producers the Jaccard value will get pulled towards zero even though there is a one directional relation.

[25] One way to correct for this is to give a higher weight to firms for which it is a main product and discriminate between S_{ij} and S_{ji} by imposing higher weights for firms that produce as main product i in S_{ij} and the reverse when calculating Sji. This would impose direction. However the weights should differ by number of firms exporting the respective product.

7 Empirics

7.1 Innovation

The UNCTAD classification of products by technological categories which is based on Lall (2000) can be used to calculate the average technological category to which the products that are co–exported belong to. The UNCTAD categories range from 1 (denoting Primary commodities) to 5 (denoting High–technology). The classification of a product co–exported (CL_j) is multiplied by the Jaccard value (S_{ij}) and divided by the summation of the Jaccard values ($\sum_{j=1;\ i\neq j}^{n} S_{ij}$) of product i. Therefore products that are more intensely related to product i will receive a higher weight in the calculation. When this is summed over all products co–exported (n) the weighted technological category of products that are co–exported with product i is calculated (TC_i).

$$TC_i = \sum_{j=1;\ i\neq j}^{n} \frac{S_{ij}}{\sum_{j=1;\ i\neq j}^{n} S_{ij}} * CL_j \tag{8}$$

Table 11 shows the values of TC_i by UNCTAD classification of product i. Firms that export primary commodities also, on average, export resource based products; while firms that export a high–technological product have a higher weighted mean and are therefore more likely to export other medium and high–technological products. Table 11 shows that as the product increases in technological category the products that are co–exported also often increase in terms of technological category. Therefore firms often co–export goods that require similar skills.

Table 11: Technological classification of products co-produced

	Median	mean	St.Dev	N
Primary Com.	2.01	2.02	0.72	277
Resource Based	2.34	2.42	0.67	590
Low–Tech	3.03	3.06	0.52	904
Medium–Tech.	3.65	3.44	0.88	881
High–Tech	4.21	4.00	0.89	305
Total	3.07	3.04	0.92	2957

Notes: Authors own calculations using UNCTAD classification of products based on Lall (2000) At least 1 firm in the Philippines has to export the respective product as main product in order to be included in this sample.

This result is due to the fact that each category has the tendency to be related to products in it own technological category. Table 12 shows that primary commodities are most related to other primary commodities (0.158) followed by resource based products (0.075). While these products are relatively unrelated to low, medium and high technology products. Resource based and low-technological products have the highest average maximum Jaccard value for their own classification and are therefore more intensely related to products within its own classification. High technological products, although being most related to other high technological products, are relatively unrelated to other product classifications.[26]

A revenue weighted technological category for the products that a firm exports (TC_{fy}) will represent the average technological content of the products exported. The values will range form 1 indicating that all the products exported by the firm are primary products till 5 indicating that all the products exported by the respective firm are high–Tech products. TC_{fy} is calculated with the following formula:

$$TC_{fy} = \sum_{i=1}^{n} \frac{rev_{fiy}}{\sum_{i=1}^{n} rev_{fiy}} * CL_i \tag{9}$$

[26]For example the average maximum Jaccard value of all high–technological products to primary commodities is only 0.014. Indicating that these product categories are highly unrelated. As can be expected.

Table 12: Average maximum Jaccard value by UNTAD classification

	1	2	3	4	5
1	0.158	0.084	0.037	0.041	0.014
2	0.075	0.184	0.053	0.059	0.021
3	0.018	0.031	0.178	0.043	0.017
4	0.023	0.039	0.043	0.136	0.038
5	0.016	0.028	0.036	0.076	0.138
Total	0.043	0.068	0.084	0.077	0.036

Notes: For this table the unweighted Jaccard value is used for the n=1 data set. The average is taken over the maximum Jaccard values of all the products belonging to a certain UNCTAD classification. Therefore each product gets a weight of one and these values are not observation weighted.

Where rev_{fiy} is the export revenue generated by product i in year y for firm f and CL_i is the technological category classification of product i. The average weighted technological category for exports of firms in the Philippines is 3.06. Indicating that, on average, firms export low–tech products. In Figure 1 it can be seen that the average weighted technological category of firm exports in the Philippines has changed relatively little over time. It was increasing to a maximum just above 3.1 in 1999 and has shown a slight decreasing trend since then.

Figure 1: Average weighted technological category of firm exports

Source: Author's own calculation

Taking the difference of TC_{fy} over time will indicate whether or not a firm has upgraded the technological content of its exported products. In 35.3% of the cases the technological category does not change and when adjustments over time are made they are often small.[27] The results in Table 13 indicate that firm size matters in terms of upgrading over time. Larger firms have the tendency to slightly upgrade over time. Therefore even though smaller firms are more likely to change main product they are less likely to upgrade over time. Indicating that the changes made by smaller firms are more indicative of survival or experimentation. Their product switching behavior is often not related to an upgrading of skills. Firm export age has a negative coefficient although the significance of this effect differs by the specification. None the less this effect indicates that older firms are less likely to upgrade over time than younger firms.

[27]The average change is -.00427

Table 13: Main results

	(1)	(2)	(3)	(4)
$Log(Exports_{t-1})$	0.003***		0.004***	
$Log(Scope_{t-1})$		0.005**		0.006***
$ExportAge_{t-1}$			−0.001**	−0.001
Constant	0.094	0.128	0.084	0.127
No. of Obs.	38,173	38,173	38,173	38,173
AIC	33235.1	33242.5	33232.1	33242.0
Log likeli.	-16533.6	-16537.3	-16531.1	-16536.0
R-squared	0.053	0.053	0.053	0.053
Year dummies	Yes	Yes	Yes	Yes
Divisions dummies	Yes	Yes	Yes	Yes
Destination dummies	Yes	Yes	Yes	Yes

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$ ***Notes:*** diffWmeanCLlall is the y variable

7.2 Main product switching and co-production similarity

The mean Jaccard value of product i to all main products exported is used as an indicator of overall similarity for product i. Due to the large number of products that are unrelated this value is pulled towards zero. Therefore the mean Jaccard value is normalized between 0 and 1 in order to make the interpretation of the results easier. Table 14 shows that the similarity index has a positive significant effect on the probability that a firm changes main product category. This result remains even after controlling for other variables. Therefore firms that produce main products that are similar to other main products are more prone to switch main product than firms that produce products that are less similar to other main products. The other variables indicate that larger firms and firms that have been exporting for a longer time period are less prone to switch main product.

Table 14: Main results

	(1)	(2)	(3)	(4)	(5)
$Similarity_{t-1}$	0.456***	0.457***	0.564***	0.466***	0.475***
$Log(Exports_{t-1})$		−0.402***		−0.392***	
$Log(Scope_{t-1})$			−0.077***		0.021
$ExportAge_{t-1}$				−0.016***	−0.075***
Constant	−2.425**	2.120**	−2.396**	1.979*	−2.551***
No. of Obs.	39,367	39,367	39,367	39,367	39,367
AIC	48407.4	43313.3	48372.5	43285.7	47633.6
Log likeli.	-24009.7	-21461.6	-23991.2	-21446.9	-23620.8
R-squared	0.062	0.162	0.063	0.162	0.077
Year dummies	Yes	Yes	Yes	Yes	Yes
Division dummies	Yes	Yes	Yes	Yes	Yes
Destination dummies	Yes	Yes	Yes	Yes	Yes

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$ ***Notes:*** Normalized mean Jaccard values. The observations only included products that are exported by at least one firm as main export product. The destination and division dummies are main destination and main division dummies in terms of revenue.

7.3 Deviations from the Jaccard similarity index

The similarity index is influenced by the number of products that product i is related to and the intensity with which it is related to other products. In order to distinguish between these two effects the index is split up. Firstly in order to analyze the intensity of similarity the highest and average

of the two, five and ten highest values of the Jaccard similarity measure for product i with respect to the other products is taken. These values indicates how related product i is to products it is most frequently exported with. Products that are unrelated with all products will have low values and visa versa. The Top 5 Jaccard similarity values range from 0 till 0.61. The highest Top 5 Jaccard value is obtained for the product "Manioc (Cassava) fresh/dried in the form of pellets".[28] While the lowest Top 5 value is zero and it is obtained for 95 different products. These products are exported sporadically by the Philippines. In fact these 95 products get exported for 155 firm–year observations over the whole sample period. The two product that get exported the maximum firm–year observations of the this sample are "Staples in strips" and "Wind musical instruments".[29]

Secondly the number of products to which a product is related, basically the scope of similarity will be analyzed. For the construction of the scope index Jaccard similarity values that are greater than or equal to 0.1 for product i are denoted by 1 and 0 otherwise. A minimum threshold of 0.1 is chosen in order to avoid that products that are only exported once together enter the scope index. The number of products with which product i is related is the scope index. Therefore if product i only has one product with which it has a Jaccard value greater than or equal to 0.1 then the scope index is equal to 1. The mean (median) value of the scope index is 5.8 (2). The mean value of 5.8 implies that product i has 5.8 other products with which it is exported together with a minimal intensity of at least 10% of the firm–year observations. The scope index ranges from 0 till 105. The scope index minimum value of 0 is obtained for 875 products. Indicating that around 29.2% of the main products are relatively unrelated to the other main export products of the Philippines. A majority of these unrelated products are located in sections 7 (259), 6 (211) and 8 (169).[30] These three sections also account for 70% of the main products exported. The maximum value of 105 is obtained for "Dried Herring". The reason for this is that dried herring are frequently exported together with other products, mostly by agri–processing firms. The mean (median) real value of dried herring for a firm–year observation is \$181,101 (\$25,748). In fact 82.9% of the products with which dried herring has a Jaccard value that is 0.1 or higher are located in Food and live animals section.

When adding the Top (intensity) indexes together with the scope index in the same regression the scope index is always significant unlike the Top index.(See Table 15) Indicating that it is the scope of similarity that drives the results instead of the intensity with which products are exported together. Firms with a main export product that is exported more frequently with other products (i.e has a greater scope) are more likely to change main export product. The Top indexes have a positive effect on the probability that the firm will switch main product however they only become significant after Top 5. Therefore there is also evidence that the firm that has a main product that is highly related to a few other products will also be more prone to switch main product over time. However the scope of similarity has an effect that is always significant and therefore drives the similarity index results more than the intensity. Also the more products that are added to the Top index the more this index will correspond to the scope index. This is why, when the Top index becomes significant, the effect of the Scope similarity index drops slightly.

Medium–tech products belonging to PSCC section 5 (Chemicals and related products, n.e.s.), Low–tech. and Resource based products and have the tendency to have higher mean Jaccard values (see figure 2). While many medium–tech. and high–tech. products, not belonging to section 5, have relatively low mean values. Indicating that these products are less related to other main products. However in Figure 3 it can be seen that even though many medium and high skilled products have low overall similarity they none the less are often related to at least one other product, as the Top 5 index indicates. But again resource based and low–tech products often have the highest values. Therefore part of the similarity result is driven by inherent characteristics of an industry or product section.[31]

[28]The PSCC code for this product is 0548100.

[29]The PSCC code for these products are 8951202 and 8982309. Both these product get exported for 6 firm–year observations.

[30]These unrelated products account respectively for 36.5%, 30.1% and 24.5% of the products in section 7, 6 and 8.

[31]For example product belonging to the divisions Clothing (division 84), travel goods & handbags (division 83) and furniture & parts (division 82).

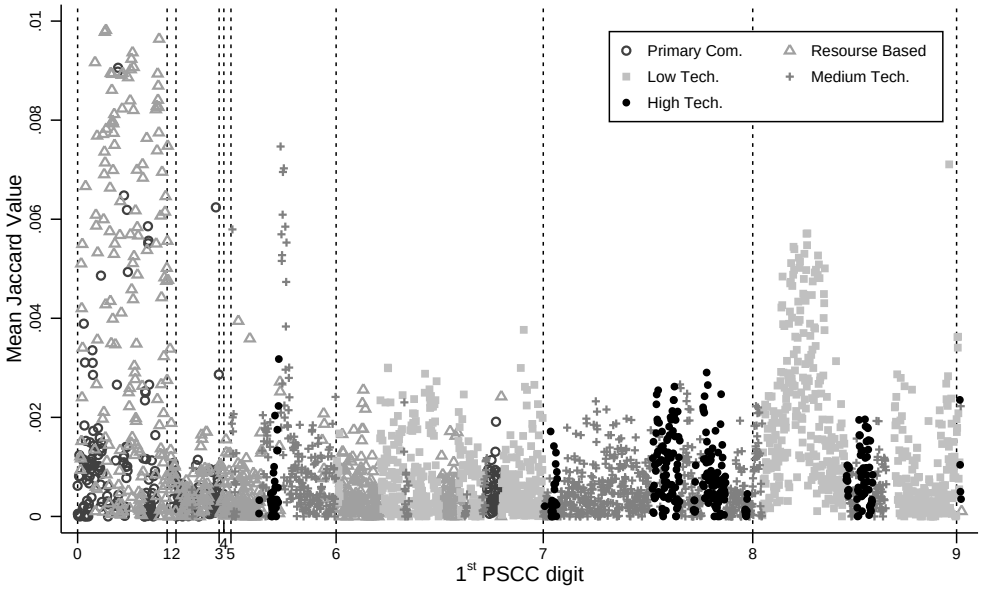
Table 15: Scope of Similarity and Top index

	(1)	(2)	(3)	(4)
$Top1_{t-1}$	0.146			
$Top2_{t-1}$		0.225		
$Top5_{t-1}$			0.608*	
$Top10_{t-1}$				0.809*
$Scope\ Similarity_{t-1}$	0.006***	0.006***	0.005***	0.004**
$Log(Exports_{t-1})$	−0.392***	−0.392***	−0.393***	−0.393***
$ExportAge_{t-1}$	−0.017***	−0.017***	−0.017***	−0.017***
Constant	1.960*	1.960*	1.963*	1.961*
No. of Obs.	39,367	39,367	39,367	39,367
AIC	43248.3	43247.6	43243.4	43243.9
Log likeli.	-21427.1	-21426.8	-21424.7	-21424.9
R-squared	0.163	0.163	0.163	0.163
Year dummies	Yes	Yes	Yes	Yes
Division dummies	Yes	Yes	Yes	Yes
Destination dummies	Yes	Yes	Yes	Yes

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$ ***Notes:*** The observations only included products that are exported by at least one firm as main export product. The destination and division dummies are main destination and main division dummies in terms of revenue.

None the less there is a lot of variation even within the broad product classifications.

Figure 2: Mean Jaccard Value by Main Product

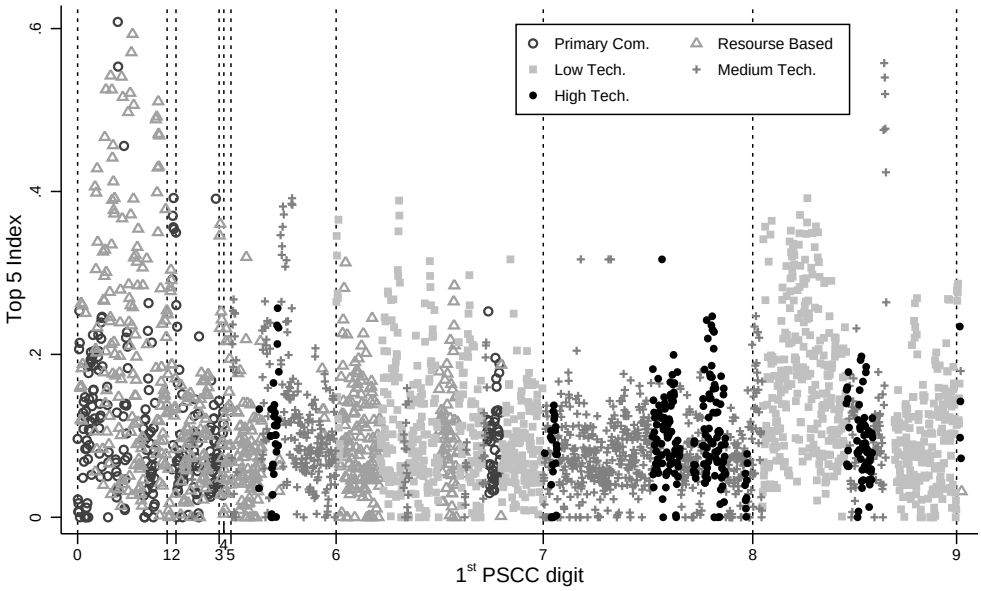


Notes: Authors own calculations using UNCTAD classification of products based on Lall (2000). At least one firm has to export the product as a main product.

7.4 Type of Switches

The mean, Top or scope similarity indexes say something about the general similarity of the product with respect to other main products. However the Jaccard value between two products reveals the actual similarity. Even though the similarity indexes have a significant effect on main product switching

Figure 3: Top 5 Index by Main Product



Notes: Authors own calculations using UNCTAD classification of products based on Lall (2000). At least one firm has to export the product as a main product.

most changes are to relatively unrelated products. This in the sense that the two products have a low Jaccard value indicating that they are not frequently co–exported. (See Table 16) The positive results for the similarity index are driven by the resource based and low–tech products that are more frequently co–exported. The average Jaccard value of a change is 0.108 indicating that on average when a main product change takes place both products are co–exported in 10.8% of the observations when either product i or j is exported. However low–tech and resource based products have the highest Jaccard values indicating that the switches made for these product types are made to products that are more often co–produced. While medium and high technological products often make product changes to products that are less frequently co–exported and therefore seemingly unrelated product switches take place. These two product categories also have a high number of switches to products that are never co–exported. (respectively 22.2% and 15.0%) Therefore the similarity index is not a perfect indicator of possible switches especially for high and medium technological products.

Table 16: Relatedness of changes product type

	All				Zeros	
	Median	Mean	SD	N	N	Percentage
Primary Com.	0.037	0.105	0.145	979	172	17.6%
Resource Based	0.059	0.115	0.137	2708	367	13.6%
Low–Tech	0.100	0.144	0.141	7460	603	8.1%
Medium–Tech	0.015	0.054	0.087	3804	846	22.2%
High–Tech	0.022	0.057	0.078	1552	233	15.0%
Total	0.051	0.108	0.131	16503	2221	13.5%

Notes: This table summarizes the Jaccard values for main product changes. Displaying the similarity between the previous product and the product changed to. For this table the unweighted Jaccard value is used for the n=1 data set. There are 410 main product changes that involve products that are not classified by the UNCTAD and are therefore missing in the table

Firm size is also related to the similarity of the switch. Smaller firms tend to make more unrelated switches and are more likely to switch main product. Therefore smaller exporters seem to search for

products that they can export successfully. While larger firms are less likely to switch main product and when they switch they switch to products that are more related to their previous main product. Huge firms, for example, almost never make unrelated switches while tiny firms make unrelated switches in 24.9% of the cases.

Table 17: Relatedness of changes by Firm Size

	All				Zeros	
	Median	Mean	SD	N	N	Percentage
Tiny	0.012	0.056	0.091	4812	1200	24.9%
Small	0.033	0.088	0.118	4330	641	14.8%
Medium	0.070	0.124	0.138	3375	262	7.8%
Large	0.111	0.155	0.142	2566	97	3.8%
Huge	0.152	0.182	0.146	1812	55	3.0%
Total	0.050	0.106	0.130	16895	2255	13.3%

Notes: This table summarizes the Jaccard values for main product changes. Displaying the similarity between the previous product and the product changed to. For this table the unweighted Jaccard value is used for the n=1 data set. Each size variable represents $\frac{1}{5}$ of the yearly distribution of annual revenue. Where tiny represents the first quantile of yearly revenue distribution (containing the lowest yearly revenues) and small the second quantile of firm revenue distribution etc.

The selection model regressions in Table 18 show that even though larger and older firms are less prone to change main product that if they change main product they are more likely to change to products that are more similar to their previous main product. The results indicate that there is selection bias and therefore a selection model has to be used. In order to reduce the collinearity problem and for more robust identification an exclusion restriction is imposed. The exclusion restriction in column (1) is the variable *Ratio* which is the total export value of the second most important export product divided by the export value of the most important export product. Therefore *Ratio* can range from 1 where both products are equally important to 0 where there is no second product exported. The importance of the second product versus the most important product is expect to influence the tendency of a firm to change main product. However this ratio seems less likely to determine the type of switch that a firm makes. In the second regression a second exclusion restriction is added which is a similarity index however then constructed for firm–destination–year observations in order to reduce the correlation between the dependent variable in the second regression. The results remain unaltered and the similarity index still has a significant effect on the tendency to change main product. Although in the regressions of column (2) it would be harder to argue that the similarity index ($SimilarityDes_{t-1}$) is unrelated to the type of switch a firm makes.

Table 18: Selection Model

	(1)	(2)
Second Part: Type of Change		
$Log(Exports_{t-1})$	0.018^{***}	0.019^{***}
$ExportAge_{t-1}$	0.002^{***}	0.002^{***}
Constant	-0.071	-0.068
No. of Obs.	14,005	14,005
First Part: Change		
$Log(Exports_{t-1})$	-0.225^{***}	-0.225^{***}
$ExportAge_{t-1}$	-0.020^{***}	-0.020^{***}
Ratio	1.356^{***}	1.348^{***}
$SimilarityDes_{t-1}$		0.216^{**}
Constant	0.910^{*}	0.905^{*}
Mills λ	-0.051^{***}	-0.055^{***}
rho	-0.434	-0.469
No. of Obs.	39,460	39,459
Year dummies	Yes	Yes
Division dummies	Yes	Yes
Destination dummies	Yes	Yes

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$ ***Notes:*** The observations only included products that are exported by at least one firm as main export product. The destination and division dummies are main destination and main division dummies in terms of revenue.

8 Conclusion

The average technological content of Philippine exporting firms has hardly changed over time, remaining around the low–tech category. Never the less main export product switching for manufacturing firms is a frequent phenomena. Firms that export main products that are more related to other main products have a higher tendency to change main product over time. However many of the main product switches are relatively unrelated, in the sense that they are not frequently co–exported. Also a distinction should be made between the type of main product as main products located in the low–technology and resource based product are more likely to change to relatively similar products. The relatedness of switches also depend on the size of the exporter. Lager exporters are less likely to make unrelated switches, change main product and product mix over time. Older exporting firms are less likely to change main product, less likely to upgrade and less likely to change product mix over time. Smaller/ younger firms seem to experiment more with the products they export. They are therefore more likely to make unrelated switches and change their product mix however they are less likely to upgrade. Hinting on unrelated switches to products that require similar skills. Therefore the core competency of larger/older firms seems to be better defined in terms of a specific product. While smaller export firms seem to experiment more with their export products.

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Table 19: Co-Export Product Firm-Year Matrix

	Also Export (ISIC code)																									
Description	01	02	05	13	14	15	17	18	19	20	21	22	24	25	26	27	28	29	30	31	32	33	34	35	36	93*
Agriculture	1322	56	57	3	13	369	52	14	16	84	37	13	146	66	33	8	51	25	3	16	9	5	5	1	102	11
Forestry	27	178	64	0	5	39	15	0	2	15	4	3	28	22	16	3	11	11	1	3	2	1	1	0	35	5
Fishing	31	32	491	0	20	110	15	10	7	22	5	14	17	13	3	1	8	8	5	11	8	9	3	3	84	4
MiningMetal	0	0	0	99	4	0	0	0	1	1	0	1	9	1	1	14	4	6	0	0	0	3	1	0	2	1
OthMining	12	8	11	2	277	10	8	2	7	29	4	1	23	7	65	1	7	6	0	14	1	3	0	0	33	3
Food	915	260	359	10	74	4614	139	73	100	245	224	151	988	352	178	73	281	237	19	65	41	36	35	19	417	36
Textiles	77	20	12	1	16	82	2233	821	221	199	139	56	199	255	48	16	104	131	46	60	62	40	48	5	373	294
Apparel	29	6	13	0	9	48	1847	3305	325	121	165	37	65	396	24	28	113	131	48	54	90	60	17	3	401	1164
Leather	28	2	9	0	3	32	126	129	795	94	65	28	28	154	32	7	62	35	7	26	14	19	8	6	164	117
Wood	99	78	62	5	24	106	368	253	421	2615	358	75	94	251	545	27	549	66	26	345	36	29	23	8	1369	29
Paper	29	5	15	0	1	51	104	18	44	161	880	150	70	137	61	13	102	85	22	48	28	19	18	6	203	12
Publishing	9	2	10	0	0	25	25	20	27	35	105	646	39	61	12	0	25	11	14	15	19	13	1	0	100	9
Chemicals	170	62	20	13	93	418	129	49	66	110	159	71	2976	438	134	75	189	189	47	82	61	93	33	17	223	57
Rubber	49	14	18	3	17	119	194	128	133	147	198	54	396	2710	223	82	309	521	173	251	242	125	158	30	385	160
Non-metallic	29	9	14	2	130	62	61	22	24	300	80	29	94	203	1373	31	269	139	27	131	37	11	29	4	407	22
BasicMetals	7	3	5	38	9	19	12	12	5	12	12	1	85	59	28	701	180	97	31	74	57	21	29	4	29	31
MetalPro	20	10	13	1	11	49	92	52	35	214	75	22	112	240	169	252	1852	457	122	244	141	91	129	32	294	78
Machinery	29	6	16	0	11	92	73	45	26	48	97	48	209	391	81	152	505	2957	329	372	333	175	303	43	138	110
OfficeMach	11	2	8	5	5	23	47	58	20	30	78	52	121	276	39	109	216	391	1098	383	523	222	192	23	99	179
ElecMach	21	6	21	4	3	53	88	48	35	137	90	45	100	311	103	132	318	370	319	1690	533	207	217	27	279	201
RadioTV	13	1	15	1	4	28	95	98	42	36	148	71	226	450	59	324	305	540	692	705	1784	380	177	21	149	373
Instruments	7	0	16	0	1	14	64	28	56	22	68	27	129	201	38	35	117	186	153	164	202	888	72	11	88	129
Vehicles	15	2	5	2	7	36	52	29	22	53	39	8	71	257	57	57	269	368	200	284	192	137	1197	194	117	77
OthTrans	5	2	4	0	0	21	8	4	7	26	9	4	31	44	20	16	52	70	23	45	29	11	100	333	41	28
Furniture	141	138	320	1	73	255	824	442	618	2770	594	262	186	784	1442	59	1158	208	86	1078	115	120	57	30	7456	278
Consignment	44	5	48	10	30	103	1138	1828	384	182	259	81	234	630	92	346	347	576	504	487	804	357	185	44	616	3861

This table summarizes co-export of 7-digit Pscc categories aggregated by 2-digit ISIC codes across firm-year observations in order to obtain clear defined sectors. The Cells report the number of years a firms also exporting products in the noted sectors between 1991-2012. This matrix includes single product firm year observations. The Darkest shading indicates the main sector the firm is located in that year and by which it is classified. The second (third) darkest shading indicates the (second) most important co-exported product per sector besides the main product. The descriptions are short description of the corresponding ISIC 2-digit codes displayed on the horizontal access. The matrix only contains most export categories however some small categories were omitted.(i.e ISIC codes 10, 11, 16, 23, 74 92)