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# Harnessing the Potential of the Philippines' Agricultural Sector: An Assessment using the Product Space

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## Abstract

This paper analyzes the prospects of the country's agricultural sector to evolve into a high value-added sector. In particular, the paper identifies the country's agricultural exports that has forward linkages to other high value adding agricultural products. To do this, this paper uses some metrics from the product space and maps the country's current agricultural exports to products that can be pursued in the short-, medium-, and long-run diversification strategies.

This paper finds that the sophistication content of the Philippines' agricultural exports from 1994 to 2014 has not improved. Despite this, the country can diversify into processed agricultural goods, which have sophistication content relatively higher than that of primary agricultural products such as fresh fruits. This indicates that developing the agro-processing industry appears to be a good strategy if the country is to harness the potential of the agricultural sector to contribute to sustainable economic growth and decent employment. While this portends good news, this also presents challenges on how the country can transform its agricultural sector into a sector that is high value adding. The sector's transformation will definitely not happen overnight and deliberate steps towards the goal is necessary. To this end, the paper offers some broad strategies that the country can pursue so that the agricultural sector will be able realize its actual linkages with the more advanced and sophisticated industries.

**Keywords**: diversification strategy, agricultural sector, agro-processing, product space

## Table of Contents



## List of Tables



## List of Figures

# Harnessing the potential of the Philippines' agricultural sector: An assessment using the product space

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## 1. Introduction

In the context of development, structural transformation, or the movement of resources out of the agricultural sector into the industrial sector, is a stylized fact observed in economies that grow richer due to increased consumption of manufactured goods. However, the path to development in the Philippines does not conform to these broad patterns. Rather, it is characterized by premature aging (Fabella and Fabella 2012) with an agricultural sector that has a declining value added (share of 9.7% to the country's GDP) but continues to employ a still relatively high percentage of workers (around 26% in 2017). The services sector has the most contribution to the country's GDP (around 60% in 2016). Despite this, agriculture is important since it has forward linkages to the industrial sector. This is exhibited in industrialized economies where the share of agro-processing industry in their total manufacturing value added is around 31% (FAO 1997).

In 2012, the Department of Trade-Board of investment (DTI-BOI) has taken a proactive role in steering the country's industrialization through its Investment Priorities Plan (IPP) that promotes the New Industrial Policy (NIP). The NIP aims to transform the manufacturing industry into a globally competitive industry supported by backward and forward linkages to create decent jobs and promote sustainable and comprehensive growth. The 2014 IPP adapts a holistic approach since it aims to strengthen not only the manufacturing sector but also the services, infrastructure and logistics, and agribusiness and fishery as well. In the short-run, the DTI roadmap outlines objectives and strategies for the agribusiness and fishery that aim to strengthen the agro-processing industry with a focus on rubber, coconut, mangoes, coffee, banana, and other high value crops. In the long-run, to transform the Philippines as an agribusiness hub.

In addition, the Philippine government has emphasized the integral role innovation plays in its economy's long-term and inclusive growth through the Philippine Development Plan 2017–2022, which has highlighted the role of innovation in improving sectoral productivity. However, based on the 2018 Global Innovation Index (GII), the Philippines ranked 73$^{rd}$ out of the 126 countries. Compared with the ranking in the 2017 GII, the country has remained in the same spot while its ASEAN neighbors have improved. The Philippines is ahead of Indonesia (85$^{th}$) and Cambodia (98$^{th}$) although it is far behind Singapore (5$^{th}$), Malaysia (35$^{th}$), Thailand (44$^{th}$), and Vietnam (45$^{th}$).

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Given this backdrop, this paper aims to investigate the performance of the country's agricultural exports. In addition, it aims to assess the prospects of the agricultural sector to evolve into a high value-added sector and the sector's potential to contribute to economic development in the process. This is in line with Hirschman (1958) who advocates the development of networks of input markets to industries and with his linkage hypothesis that postulates that the best development path lies in selecting those activities where progress will induce further progress elsewhere (FAO 1997).

In particular, the paper aims to identify the country's agricultural exports that has forward linkages to other high value adding agricultural products. To do this, the paper uses some metrics from the product space developed by Hausmann and Klinger (2006), Hausmann, Hwang and Rodrik (2007), Hidalgo and Hausmann (2009), and Hausmann and Hidalgo (2007, 2011). The product space is a visual representation of how close the goods are to each other, the closeness of which is defined by the proximity measure. The development of the product space has started with Hausmann and Rodrik (2003) who put forth the idea of cost discovery process of firms, or their ability to venture into the production of a new good. Cost discovery generates positive externalities when new firms, encouraged by the profits earned by the leader, join the production of the new good.

In this scenario, firms will earn profits through innovation, which eventually pushes the country's production frontier. Innovation through horizontal specialization is embedded in the product space's proximity measure where the development of goods sharing similar structures is less costly than that of goods with different production requisites. This has significant implications for developing economies aiming to produce highly sophisticated and presumably high value adding goods. To do this, they need to undertake substantial upgrades in their production structures and capabilities. However, development does not happen overnight and it requires deliberate and well-thought-out strategies. This paper aims to contribute to this end and it does so by identifying agricultural products that the country can diversify into in the short-, medium-, and long-run.

## 2. Product Space: some theory and metrics

Traditional trade theory, such as the Hecksher-Ohlin, explains that the country's pattern of specialization is dictated by its abundant resources. New trade theory, such as the varieties model (Romer 1986) and the quality ladders model (Grossman-Helpman 1991; Aghion-Howitt 1992) follow the Dixit-Stiglitz model, which makes strong assumptions about the symmetry of goods in terms of demand and cost functions (Hausmann and Hidalgo 2011). However, there are some observations that are not easily supported by these theories. These include the idea that goods have different consequences in economic performance since specializing in some goods will bring higher growth than specializing in others (Hausmann and Hidalgo 2007) and more diversified countries tend to export products that are on average less ubiquitous (Hausmann and Hidalgo 2011).

Using existing theories, no detailed predictions can be made on the impact of initial specialization on the country's future export portfolio or on the products a country can diversify into given their existing export portfolio. These led to a new approach to understanding development, which postulates that countries specializing in goods that rich countries produce are likely to grow faster (Hausmann and Hidalgo 2007). This implies that a country's export portfolio has implications on the country's economic growth. To do this, the statistical physics

of networks is used to exploit the richness of information contained in the network of exported goods to create the now known product space (Hausmann and Klinger 2006; Hausmann, Hwang and Rodrik 2007; Hidalgo and Hausmann 2009; Hausmann and Hidalgo 2007, 2011).

The product space is a visual representation of how close the goods are to each other, the closeness of which is defined by the proximity measure. The latter is a formal representation of the idea that the closeness of goods is defined by their production requisites. The theory behind this set-up is that a country has a productive structure that is defined by capabilities (infrastructures, human capital, institutions) and horizontal specialization between products sharing similar production structure is less costly compared to specialization between products with different production requirements. Indeed, fewer modifications are needed to the production structure of footwear when moving to textiles than when moving to electronics.

In the context of productive structures and capabilities, product sophistication is related to the number of capabilities that the product requires and the complexity of a country's economy is related to the set of capabilities that is locally available (Hidalgo 2009). Countries with many set of capabilities can produce goods that are sophisticated and their productive structures can accommodate diversification into even more sophisticated products. Therefore, a country's export basket matters in a country's future development. Given these, the product space and economic complexity can provide policy directions related to a country's capabilities and structural transformation efforts.

### *2.1 Product sophistication*

The development of the product space has started with Hausmann and Rodrik (2003) who put forth the idea of cost discovery process of firms, or their ability to venture into the production of a new good. Cost discovery generates positive externalities when new firms, encouraged by the profits earned by the leader, join the production of the new good. However, this will dissipate profits and firms will innovate, which will ultimately push the country's production and technological boundaries outward.

To quantify the process of cost discovery, Hausmann et al. (2007) assume that each exported good has a productivity level to represent the units of output generated by an investment of a given size to construct an index that measures a product's sophistication (*PRODY*) and an index that measures the overall sophistication of a country's export basket (*EXPY*). Taking off from the idea that countries export goods that they are productive in, Hausmann et al. (2007) use the COMTRADE data to construct *PRODY* and *EXPY*. The earlier versions of these sophistication indices make use of Balassa (1965) revealed comparative advantage (RCA)[1] and this is interpreted as a network connecting countries to the products they export. The product's

[1] where RCA is computed as following Balassa (1965) $RCA_{jk} = \frac{c_{jk}}{c_k}$ where $c_{jk} = \frac{X_{jk}}{\sum_k X_{jk}}$ is the ratio between the country *j*'s export of good *k* and its total export and $c_k = \frac{\sum_j X_{jk}}{\sum_{jk} X_{jk}}$ is the ratio between the world's export of good *k* and the total world export

sophistication is constructed as $PRODY_p = \frac{1}{\sum_c R_{cp}} \sum_c R_{cp} * Y_c$ where $Y_c$ is the GDP per capita income, $R_{cp}$ is the RCA index, and the subscripts $c$ and $p$ represent country and product, respectively. The overall sophistication of a country's export basket is, then, constructed by summing *PRODY* weighted by the RCA, $EXPY_c = \frac{1}{\sum_p R_{cp}} \sum_c R_{cp} * PRODY_c$. EXPY and *PRODY* are measures of sophistication that mix information on income, $Y_c$, with the information on the network structure, $R_{cp}$. These indices are indirect measures of productivity/sophistication.

Due to the use of income, these indices have been criticized to be circular (e.g. rich countries export sophisticated goods and sophisticated goods are exported by rich countries). These indices have been reconstructed so that the indices make use of the information on RCA alone. Assuming that $M_{cp} = 1 \; if \; R_{cp} > R^*$ where $R^*$ is a threshold and $Y_c = k_c$ for all c, Hidalgo (2009) constructs a *diversity* measure that conveys the information on the number of products a country makes and is given by $k_c = \sum_p M_{cp}$ and a *ubiquity* measure that conveys the number of countries that export a product and is given by $k_p = \sum_c M_{cp}$. Using these, *PRODY* and *EXPY* becomes $PRODY_p = \frac{1}{k_p} \sum_c M_{cp} * k_c$ and $EXPY_c = \frac{1}{k_c} \sum_p M_{cp} PRODY_p$, respectively.

## 2.2 Proximity

Highlighting the importance of horizontal specialization, Hausmann and Klinger (2006) have developed a measure called proximity, or the revealed distance between products, which measures the similarity of production requisites of a given pair of goods. In this setting, horizontal specialization between products sharing similar production structure is less costly compared to specialization between products with different production requirements. For example, fewer modifications are needed to the production structure of footwear when moving to textiles than when moving to electronics.

Formally, the proximity of product $p$ and $p'$ is defined as $\phi_{pp'} = \frac{\sum_c M_{cp} M_{cp'}}{\max(k_p, k_{p'})}$ [2]. The proximity index is related to the standard measure of similarity like the cluster of products found in Leamer (1984). However, the proximity measure is an outcomes-based approach that identifies the similarity of products without making a priori assumptions on how goods are going to be related.

Having a comparative advantage in a good means having the right endowments and capabilities and if two goods require the same capabilities, the proximity measure would show up in a higher probability of a country having comparative advantage in both (Hausmann and Klinger 2006). $\phi_{pp'}$ close to 1 means that the products will be close to each other in the product space. In the

[2] As an illustration, given that 17 countries export wine, 24 export grapes and 11 export both, all with RCA>1, the proximity between wine and grapes is 11/24 (Hausmann et al. 2011).

above example of products, the $\phi_{pp'}$ for footwear and textile will have values closer to 1 than the $\phi_{pp'}$ for footwear and electronics. Indeed, Hausmann and Klinger (2006) have demonstrated that a country's speed of structural transformation depends on whether its existing exports have, in their vicinity, high value-added goods in the product space.

As illustrated in Hidalgo, Klinger, Barabasi and Hausmann (2007), the product space has regions where goods are densely connected to many products (core) and regions where goods are sparsely connected with each other (periphery). Goods that are in the periphery have low *PRODY* and are labor intensive-goods like garments, cereals and tropical agriculture. Machinery and high-technology manufactured goods are in the denser regions of the product space and have high *PRODY*. Indeed, the export portfolio of wealthier countries is mostly found in the denser regions of the product space while that of the developing economies is mostly found in the periphery (see for example, Hausmann and Klinger 2006; Hidalgo et al 2007).

For developing economies, the location of their existing export portfolio has two important implications. One, there are few sophisticated products that these economies can potentially diversify into. Two, these economies need to undertake significant transformation in their production structure, including upgrade in their technology, infrastructure, institutions, and human capital, to be able to diversify into sophisticated products.

## 3. Evolution of the agricultural products in the product space, 1995 to 2014

To describe the evolution of the Philippines' agricultural exports, export shares, RCA, and the metric for product sophistication (PRODY) are computed for the Philippines using the COMTRADE HS 1992 at the 6-digit disaggregation. Products in the export basket are those that have revealed comparative advantage, or $RCA = 1$, and are substantially exported, or have at least 0.5% share to the country's total exports. In addition, we leverage the imports data to create an index for imports intensity (MRCA), which is computed analogous to Balassa's revealed comparative advantage.

From table 1, there are many agricultural products in the country's 2014 export basket. These include primary agricultural commodities such as bananas, pineapples, coconut/copra oil-cake, shrimps, and tuna, and commodities that use agricultural inputs such as textiles, footwear, and basketwork. Together, these goods account for around 27% of the total export value in 1995. In 2005, the country's export basket accounts for 64% of the country's total exports and only 2% of this is contributed by agricultural exports (bananas and copra). In 2014, the country's export basket accounts for 59% of the country's total exports and 10% of this is contributed by agricultural exports, which are composed mostly of bananas, copra, and some mining products.

**Table 1: Evolution of the Philippines' agricultural export portfolio, 1995-2014**

| | Share total exports, 1995 | PRODY | MRCA |
|---|---|---|---|
| Coconut (copra) oil crude | 4.7 | 312 | |
| Bananas, including plantains, fresh or dried | 3.18 | 403 | |
| Shrimps and prawns, frozen | 1.57 | 488 | |
| Copper ores and concentrates | 1.5 | 493 | 1 |
| Iron ore, concentrate, not iron pyrites, agglomerated | 1.3 | 477 | |
| Tuna, skipjack, bonito, prepared/preserved, not mince | 1.19 | 459 | |
| Pineapples, otherwise prepared or preserved | 1.07 | 586 | |
| Men, boys trousers & shorts, of cotton, not knit | 1.01 | 624 | |
| Brassieres and parts thereof | 0.99 | 693 | |
| Men, boys shirts, of cotton, knit | 0.92 | 670 | |
| Hybrid integrated circuits | 0.89 | 697 | |
| Basketwork, wickerwork products of vegetable material | 0.86 | 584 | |
| Pullovers, cardigans of cotton, knit | 0.83 | 675 | |
| Pullovers, cardigans of manmade fibers, knit | 0.76 | 712 | |
| Coconut (copra) oil or fractions simply refined | 0.69 | 455 | |
| Men, boys shirts, of cotton, not knit | 0.69 | 729 | |
| Women, girls trousers & shorts, of cotton, not knit | 0.67 | 699 | |
| Babies garments, accessories of cotton, knit | 0.64 | 680 | |
| Babies garments, accessories of cotton, not knit | 0.63 | 769 | |
| Coconut or copra oil-cake and other solid residues | 0.59 | 354 | |
| Hats and other headgear, knit or crochet | 0.53 | 571 | |
| Raw sugar, cane | 0.51 | 466 | 1 |
| | **Share total exports, 2005** | **PRODY** | **MRCA** |
| Bananas, including plantains, fresh or dried | 1.34 | 403 | |
| Coconut (copra) oil crude | 0.71 | 312 | |
| | **Share total exports, 2014** | **PRODY** | **MRCA** |
| Nickel ores and concentrates | 3.74 | 706 | |
| Bananas, including plantains, fresh or dried | 2.36 | 403 | |
| Copper ores and concentrates | 1.01 | 493 | 1 |
| Coconut (copra) oil crude | 0.97 | 312 | |
| Copper cathodes and sections of cathodes unwrought | 0.96 | 644 | |
| Coconut (copra) oil or fractions simply refined | 0.72 | 455 | |

Source: Authors' computation using COMTRADE HS 1992 at the 6-digit disaggregation. Export goods in the 1995, 2005, and 2014 export basket account for 54%, 64%, and 59% of the total exports, respectively. Average *PRODY* of the agricultural products in the Philippines' export basket is 573, 358, and 502 in 1995, 2005, and 2014, respectively.

To provide context into the discussion of the sophistication of the Philippines' agricultural exports, table 2 shows the top and bottom 10 products in the world at the first and fifth quintile of $PRODY_{world}$. The average *PRODY* in the world market, $PRODY_{world}$, is around 1001 and the average PRODY of agricultural products in the world market, $PRODY_{agricultural\ products\ world}$, is around 790. Table 3 shows the number of agricultural products in the world market in each quintile of $PRODY_{world}$. Out of the 665 agricultural products, around 77% of products are in the lowest two quintiles while around 11% are in the highest two quintiles. Kentucky seed for sowing and chilled rabbit/hare meat have the highest PRODY at 1330 and cocoa beans have the lowest at around 259.

**Table 2: 2014 Top and bottom 10 agricultural products in the world, first and fifth quintile of $PRODY_{world}$**

| Bottom 10, first quintile | PRODY | Top 10, first quintile | PRODY |
|---|---|---|---|
| Cocoa beans, whole or broken, raw or roasted | 259 | Malt extract & limited cocoa pastry cooks products | 780 |
| Gum arabic | 289 | Bulbs, tubers, corms in growth, chicory plants | 780 |
| Coffee, not roasted, not decaffeinated | 303 | Animal products and domestic animal carcass (non-food | 778 |
| Coconut (copra) oil crude | 312 | Soya-bean oil-cake and other solid residues | 778 |
| Lobsters (Homarus) frozen | 322 | Nutmeg | 777 |
| Sheep cuts, bone in, frozen | 322 | Herrings, frozen, whole | 777 |
| Coconut or copra oil-cake and other solid residues | 354 | Scallops, live, fresh or chilled | 777 |
| Sesamum seeds | 365 | Rasp-, mulberries, (uncooked, steam, boil),froze | 776 |
| Arrowroot, salep, fresh or dried and sago pith | 380 | Cod, frozen, whole | 776 |
| Tuna(yellowfin) fresh or chilled, whole | 382 | Oats | 775 |
| **Bottom 10, fifth quintile** | **PRODY** | **Top 10, fifth quintile** | **PRODY** |
| Eggs, bird, not in shell not dried | 1201 | Seed, Kentucky blue grass, for sowing | 1330 |
| Poppy seeds | 1202 | Rabbit or hare meat, offal, fresh, chilled or frozen | 1328 |
| Swine cuts, fresh or chilled | 1206 | Cheese, blue-veined | 1327 |
| Residues of starch manufacture and similar residues | 1210 | Frog legs, fresh, chilled or frozen | 1321 |
| Fructose, chemically pure | 1221 | Caraway seeds | 1310 |
| Egg yolks except dried | 1222 | Truffles, prepared or preserved, not in vinegar | 1309 |
| Chicory, fresh or chilled, except witloof | 1230 | Egg yolks dried | 1283 |
| Opium sap | 1233 | Swine edible offal, fresh or chilled | 1278 |
| Pears, otherwise prepared or preserved | 1239 | Bellies (streaky) of swine, salted, dried or smoked | 1277 |
| Lard, other pig fat and poultry fat, rendered | 1241 | Plaice, fresh or chilled, whole | 1261 |

Source: Authors' computation using COMTRADE HS 1992 at the 6-digit disaggregation. The average $PRODY_{world}$ is around 1001. PRODY in the first quintile is between 90-790, second quintile is between 791-937, third quintile is 938-1063, fourth quintile is 1064-119, and the fifth quintile is between 1200-2332.

From table 1, the average *PRODY* of the Philippines' agricultural products is in the first quintile of the $PRODY_{world}$ and it has barely improved from 1995 to 2014 (573, 358, and 502 in 1995, 2005, and 2014, respectively). This is likely due to the fact that that the Philippines have started to diversify into circuits and data processing goods, which resulted in a streamlined agricultural exports in the early 2000s.

The Philippines is exporting 622 agricultural products in 2014. From figure 1, the country is exporting the most number of products in the *fish/seafood* category, around 75 products with an average *PRODY* that is lower than the $PRODY_{agricultural\ productsworld}$. The country is exporting around 60 products from the *cereals/pasta/bread* and *fruits/nuts* categories, which have an average PRODY that is lower than the $PRODY_{agricultural\ productsworld}$ as well. However, there is also a big number of exports from the *tubers/legumes/vegetables* and *live animals or /fresh/chilled meats* categories, which have average sophistication index higher than $PRODY_{agricultural\ productsworld}$.

Among the agricultural products, *processed meats* (which include sausages, meat/cured offal, extracts/juices of meat/fish/aquatic invertebrates, and salted/dried/smoked swine meat, bovine

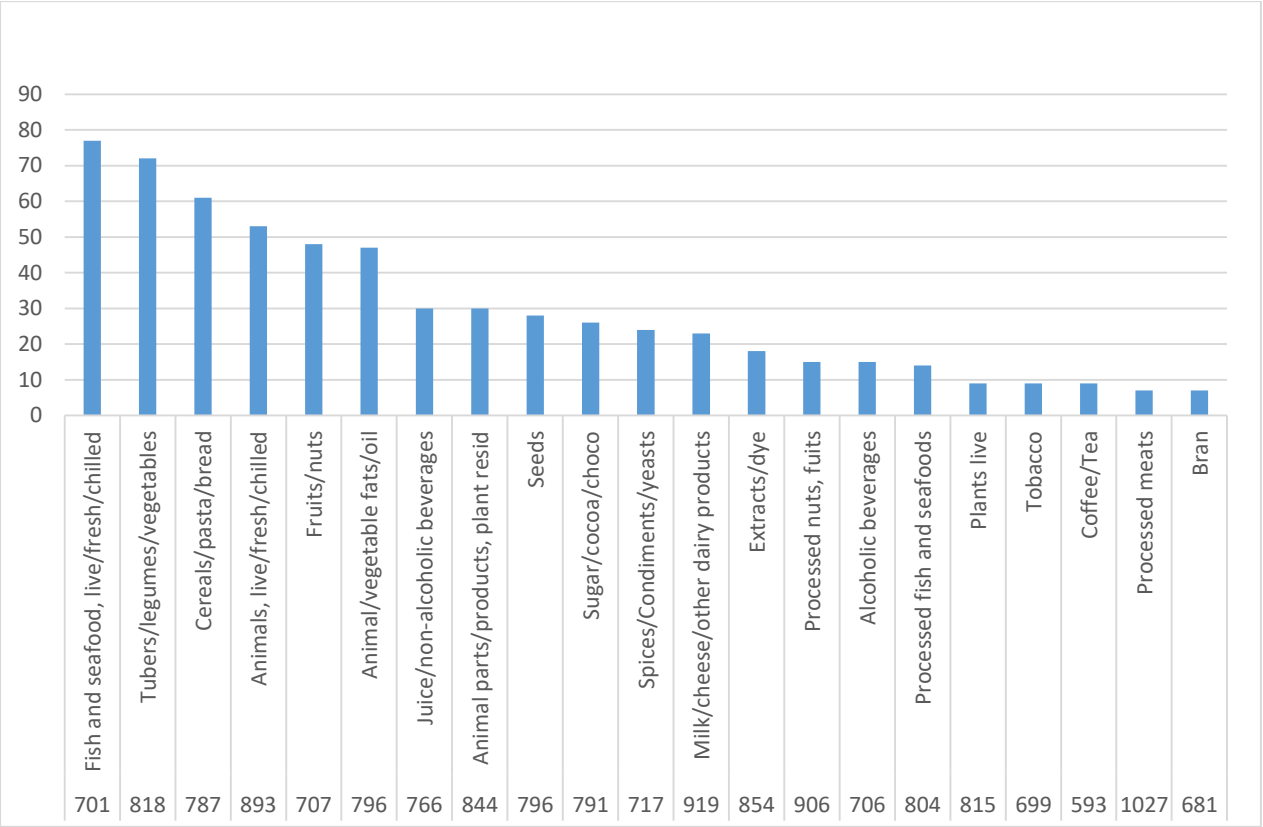
meat, hams/shoulders/swine, and bellies of swine) has the highest average sophistication index of agricultural exports in the world and are least exported by the Philippines. *Bran and feeds* (which include bran/residues of maize, rice, wheat, and cereal and flour/pellets for animal feeds) is also least exported although it is not as sophisticated as processed meats.

**Table 3: Number of agricultural products in the world market, by $PRODY_{world}$ quintile**

| | Number of agricultural products | | | | |
|---|---|---|---|---|---|
| | Quintile 1 | Quintile 2 | Quintile 3 | Quintile 4 | Quintile 5 |
| Alcoholic beverages | 11 | 4 | | | |
| Animal parts/products, plant residual | 17 | 7 | 7 | 3 | 3 |
| Animals, live/fresh/chilled | 20 | 13 | 11 | 8 | 7 |
| Bran | 6 | 1 | | | |
| Cereals/pasta/bread | 32 | 19 | 8 | 3 | 1 |
| Coffee/Tea | 7 | 2 | | | |
| Extracts/dye | 8 | 3 | 2 | 3 | 2 |
| Fish and seafood, live/fresh/chilled | 61 | 17 | 7 | 1 | 1 |
| Fruits/nuts | 35 | 11 | 3 | 1 | |
| Juice/non-alcoholic beverages | 16 | 11 | 3 | | |
| Milk/cheese/other dairy products | 7 | 6 | 4 | 2 | 4 |
| Animal/vegetable fats/oil | 26 | 13 | 8 | 2 | 2 |
| Plants live | 6 | 4 | 1 | 1 | 1 |
| Processed fish and seafood | 4 | 6 | 4 | | |
| Processed meats | | 2 | 1 | 3 | 1 |
| Processed nuts, fruits | 4 | 3 | 5 | 2 | 1 |
| Seeds | 15 | 10 | 4 | 2 | 3 |
| Spices/Condiments/yeasts | 17 | 5 | 1 | | 1 |
| Sugar/cocoa/chocolate | 13 | 5 | 6 | 1 | 1 |
| Tobacco | 6 | 3 | | | |
| Tubers/legumes/vegetables | 32 | 21 | 11 | 6 | 4 |
| **Total** | **343** | **166** | **86** | **38** | **32** |

Source: Authors' computation using COMTRADE HS 1992 at the 6-digit disaggregation. The average $PRODY_{agricultural\ products world}$ is around 790. The PRODY of agricultural products in the first quintile is between 259-789, second quintile is between 791-937, third quintile is 938-1063, fourth quintile is 10656-1195, and the fifth quintile is between 1201-1608.

**Figure 1: Number of PH agricultural exports and average PRODY of agricultural exports in the world market, by category**



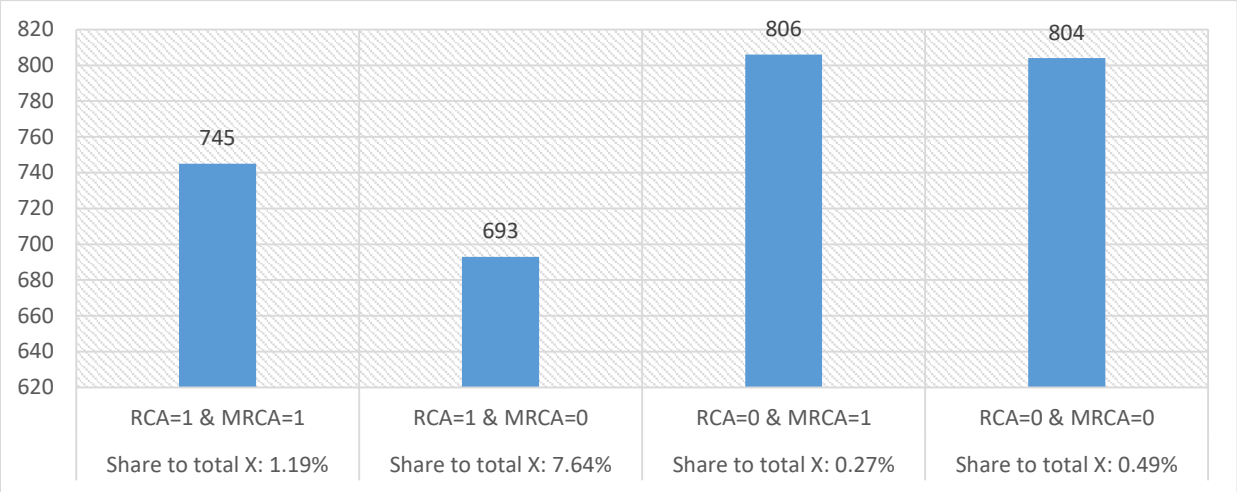

Source: Authors' computation using COMTRADE HS 1992 at the 6-digit disaggregation. Figures at the bottom are average *PRODY*. The average $PRODY_{agricultural\ products\ world}$ is around 790.

## 4. Diversification strategies

While the efforts of the government are directed towards the New Industrial Policy and Manufacturing Resurgence Program, the exports of the agricultural sector need not be left behind since there are agricultural products that have high sophistication content and have the potential to contribute to the agricultural value added. In fact, the DTI's agro-processing roadmap for structural transformation, job creation, and poverty reduction includes the strengthening of some agricultural crops in the short-run and the transformation of the country as an agribusiness hub in the long-run.

Using the Philippines' agricultural export data in COMTRADE, figure 2 shows four categories based on the goods' export and import intensities, their shares to total exports, and the average sophistication of each category. Agricultural products that the country has revealed comparative advantages in have lower sophistication index (*PRODY*s of 745 and 693) compared to agricultural commodities that the country has no revealed comparative advantages in (*PRODY*s of 806 and 804). Among these products, those that are intensively exported but not intensively imported by the country ($RCA = 1, MRCA = 0$) have the highest share to the country's total exports at around 8% but have the lowest average sophistication index (*PRODY* of 693).

**Figure 2: Average PRODY of agricultural exports, by export and import intensity**




Source: Authors' computation using COMTRADE HS 1992 at the 6-digit disaggregation. Figures at the top of each bar are average *PRODY*s.

### *4.1 Short-run diversification strategy*

In the short-run, the country can focus on agricultural commodities that the country has revealed comparative advantages in. These are 1438 products, which are shown in the first two bars of figure 2. To ensure that these products will improve the sophistication content of the agricultural exports, products with sophistication index higher than the average sophistication of agricultural products in the world market are selected from the data of agricultural exports. These means $PRODY_{agricultural\ products} > PRODY_{agricultural\ products,\ world}$. There are 31 products that satisfy this criteria, of which 18 products are intensively exported but not intensively imported ($RCA = 1, MRCA = 0$) and 14 products are both intensively exported and imported ($RCA = 1, MRCA = 1$). These products will compose the list of products for the first and second short-run strategies.

From the upper panel of table 4, commodities that are intensively exported but not intensively imported (strategy 1) include animal parts/products, cereals/pasta/bread, extracts/dye, fish/seafood (live or processed), industrial oil, plants, spices, sugar/cocoa/chocolate, tobacco, and tubers/legumes/vegetables. Specific commodities that have sophistication index higher than that of the average product in the world market include horsehair, carp, acid oils and glycerol. However, countries that intensively import these goods are very few. For example, *horsehair*, which has the highest sophistication index among all agricultural products, is intensively imported by two countries only (Morocco and the USA) and *carp* is intensely imported by twelve economies (Austria, Bosnia and Herzegovina, Brunei, Hong Kong, Hungary, Jordan, South Korea, Macau, Poland, Romania, Serbia, and Slovakia).

*Acid oil* is intensely imported by 24 countries including those in Asia (China, India, Indonesia, Malaysia, Singapore, South Korea, and Thailand), MENA (Iran, Saudi Arabia, and Tunisia) OECD (Belgium-Luxembourg, France, Germany, Italy, Japan, Netherlands, Poland, and United Kingdom), and others (Andorra, Nepal, South Africa, Argentina, Brazil, and Mexico). *Glycerol (glycerine), crude and glycerol waters and lye* are intensively imported by countries coming from Asia (China, Malaysia, and North Korea), OECD (Belgium-Luxembourg, Czech Republic, Denmark, Germany, Latvia, and Netherlands), and others (British Virgin Islands, Croatia, Democratic Republic of the Congo, Dominican Republic, Nepal, Rwanda, Ukraine, and

Zambia). Specific products that have many importers include cereal foods, communion wafers, peas, preserved fish, prepared/preserve fruit mixtures, vinegar, cigarette/pipe tobacco, and tobacco extracts.

In terms of the number of potential markets, *cereal foods* have the most number of importers Out of the 141 importing economies, there are 8 in Asia (Afghanistan, Bhutan, Brunei, Burma, Laos, North Korea, and Timor-Leste), 15 in MENA (Bahrain, Djibouti, Israel, Jordan, Kuwait, Lebanon, Libya, Oman, Palestine, Qatar, Saudi Arabia, Sudan, Syria, United Arab Emirates, and Yemen), 22 in OECD (Austria, Belgium-Luxembourg, Canada, Denmark, Estonia, Finland, France, Greece, Hungary, Iceland, Ireland, Italy, Latvia, Netherlands, New Zealand, Norway, Portugal, Slovenia, Spain, Sweden, Switzerland, and United Kingdom), and 15 in Central and South America (Belize, Costa Rica, El Salvador, Guatemala, Honduras, Nicaragua, Panama, Bolivia, Chile, Colombia, Ecuador, Guyana, Paraguay, Suriname, and Uruguay).

*Communion wafers/rice paper* are imported by 130 countries, of which 8 are in Asia (Afghanistan, Bhutan, Brunei, Burma, Kazakhstan, Laos, Timor-Leste, and Turkmenistan), 14 are in MENA (Armenia, Azerbaijan, Bahrain, Djibouti, Iraq, Kuwait, Lebanon, Libya, Oman, Palestine, Qatar, Saudi Arabia, Syria, Yemen), 25 are in OECD (Australia, Austria, Belgium-Luxembourg, Canada, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Latvia, Netherlands, New Zealand, Norway, Portugal, Slovenia, Spain, Sweden, Switzerland, and United Kingdom), and 11 are in Central and South America (Belize, Costa Rica, El Salvador, Guatemala, Honduras, Nicaragua, Panama, Guyana, Paraguay, Suriname, and Uruguay)

*Peas* (*prepared or preserved*) are imported by 101 countries, of which 6 are in Asia (Brunei, Kazakhstan, Kyrgyzstan, Tajikistan, Turkmenistan, Uzbekistan), 13 are in MENA (Armenia, Azerbaijan, Iraq, Jordan, Lebanon, Mauritania, Oman, Palestine, Qatar, Somalia, Syria, Tunisia, Yemen), 14 are in OECD (Belgium-Luxembourg, Canada, Czech Republic, Estonia, France, Germany, Hungary, Ireland, Italy, Latvia, Poland, Slovenia, Spain, and United Kingdom), and 9 are in Central and South America (Belize, Guatemala, Honduras, Nicaragua, Panama, Guyana, Paraguay, Suriname, Uruguay).

The number of importers and products in the first short-run strategy is summarized in figure 3. These products have many potential markets in OECD economies, including France, Germany, Denmark, the Netherlands, Belgium-Luxembourg, Latvia, Spain, Ireland, Czech Republic, Italy, Australia, Norway, UK, Austria, Portugal, N Zealand, Sweden, and Hungary. In MENA region, Lebanon, Yemen, Jordan, and Syria are potential markets for 7-8 short products. In Asia, Brunei imports the most number of short-run products (10) followed by Timor-Leste, Burma, Kazakhstan, and Afghanistan (5).

From the lower panel of table 4, commodities that are both intensively exported and imported (strategy 2) include cereals/pasta/bread, extracts/dye, juice/non-alcoholic beverages, edible oil, processed nuts/fruits, sugar/cocoa/chocolate, and tobacco. Products that have sophistication index higher than the average sophistication of products in the world market include mucilages and thickeners, opium sap, and Tung oil.

**Table 4: Agricultural products for diversification in the short-run**

| | | PRODY | Number of importers |
|---|---|---|---|
| **Strategy 1: Products that are intensively exported and not intensively imported** | | | |
| Animal parts/products, plant residual | Horsehair, waste | 1608 | 2 |
| Cereals/pasta/bread | Cereal foods obtained by swelling, roasting of cereal | 930 | 141 |
| Cereals/pasta/bread | Communion wafers, rice paper, bakers wares nes | 840 | 130 |
| Extracts/dye | Vegetable materials nes, used primarily for plaiting | 885 | 38 |
| Fish and seafood, live/fresh/chilled | Carp, live | 1112 | 12 |
| Oil industrial | Glycerol (glycerine), nes including synthetic glycerol | 922 | 57 |
| Oil industrial | Acid oils from refining | 1176 | 24 |
| Oil industrial | Glycerol (glycerine), crude and glycerol waters & lye | 1017 | 17 |
| Plants live | Foliage, branches, for bouquets, etc. - except fresh | 809 | 35 |
| Processed fish and seafood | Fish prepared or preserved, except whole, in pieces | 797 | 85 |
| Processed fish and seafood | Mollusk and shellfish nes, prepared or preserved | 862 | 34 |
| Processed fish and seafood | Crab, prepared or preserved | 826 | 13 |
| Processed nuts, fuits | Fruit mixtures, otherwise prepared or preserved | 998 | 59 |
| Spices/Condiments/yeasts | Vinegar and substitutes for vinegar from acetic acid | 924 | 78 |
| Sugar/cocoa/chocolate | Glucose including syrup of 20%-50% dry weight fructose | 937 | 43 |
| Tobacco | Cigarette or pipe tobacco and tobacco substitute mixe | 811 | 67 |
| Tobacco | Products of tobacco, substitute nes, extract, essence | 865 | 45 |
| Tubers/legumes/vegetables | Peas, prepared or preserved, not frozen/vinegar | 828 | 103 |
| **Strategy 2: Products that are both intensively exported and imported** | | | |
| Cereals/pasta/bread | Cereals, rolled or flaked grains nes | 913 | 62 |
| Cereals/pasta/bread | Rice flour | 909 | 3 |
| Extracts/dye | Mucilages and thickeners nes | 1015 | 51 |
| Extracts/dye | Lac | 809 | 10 |
| Extracts/dye | Opium sap | 1233 | 10 |
| Extracts/dye | Raw vegetable materials for dyeing or tanning | 955 | 5 |
| Juice/non-alcoholic beverages | Soya sauce | 943 | 87 |
| Animal/vegetable fats/oil | Tung oil or fractions not chemically modified | 1526 | 3 |
| Animal/vegetable fats/oil | Processed animal, vegetable oils, industrial preps ne | 801 | 37 |
| Animal/vegetable fats/oil | Industrial fatty alcohols | 875 | 8 |
| Processed nuts, fruits | Fruits, nuts, fruit-peel, etc preserved by sugar | 860 | 91 |
| Seeds | Locust beans and seeds | 1010 | 22 |
| Sugar/cocoa/chocolate | Sugar nes, invert sugar, caramel and artificial honey | 943 | 66 |
| Tobacco | Homogenized or reconstituted tobacco | 833 | 34 |

Source: Authors' computation using COMTRADE HS 1992 at the 6-digit disaggregation.

Among these, *mucilage and thickeners* are imported by a number of countries (51 countries), of which 10 are in Asia (Bangladesh, Burma, Indonesia, North Korea, Pakistan, Philippines, Tajikistan, Thailand, Uzbekistan, Vietnam), 13 are in OECD (Australia, Austria, Belgium-Luxembourg, Denmark, Estonia, France, Germany, Ireland, Latvia, New Zealand, Poland, Spain, Sweden), 3 are in MENA (Algeria, Iran, Israel), and 14 are in in Central/South America (Costa Rica, El Salvador, Honduras, Mexico, Nicaragua, Argentina, Bolivia, Brazil, Chile, Colombia, Ecuador, Peru, Uruguay, Venezuela) . *Opium sap* is imported mostly by OECD countries (France, Japan, New Zealand, Spain, and the USA) and others (Burkina Faso, Senegal, Zimbabwe) while *Tung oil* is imported by North and South Korea.

Specific goods that are intensely imported by a number of countries in include preserved fruits/nuts, soy sauce, sugar, and cereals. *Preserved fruits/nuts* are imported by 8 economies in Asia (Brunei, Burma, Laos, Malaysia, North Korea, Singapore, Thailand, Turkmenistan), 9 in Central/South America (Belize, Costa Rica, El Salvador, Nicaragua, Panama, Argentina, Chile, Suriname, Uruguay), 9 in MENA (Armenia, Azerbaijan, Iran, Israel, Lebanon, Oman, Qatar,

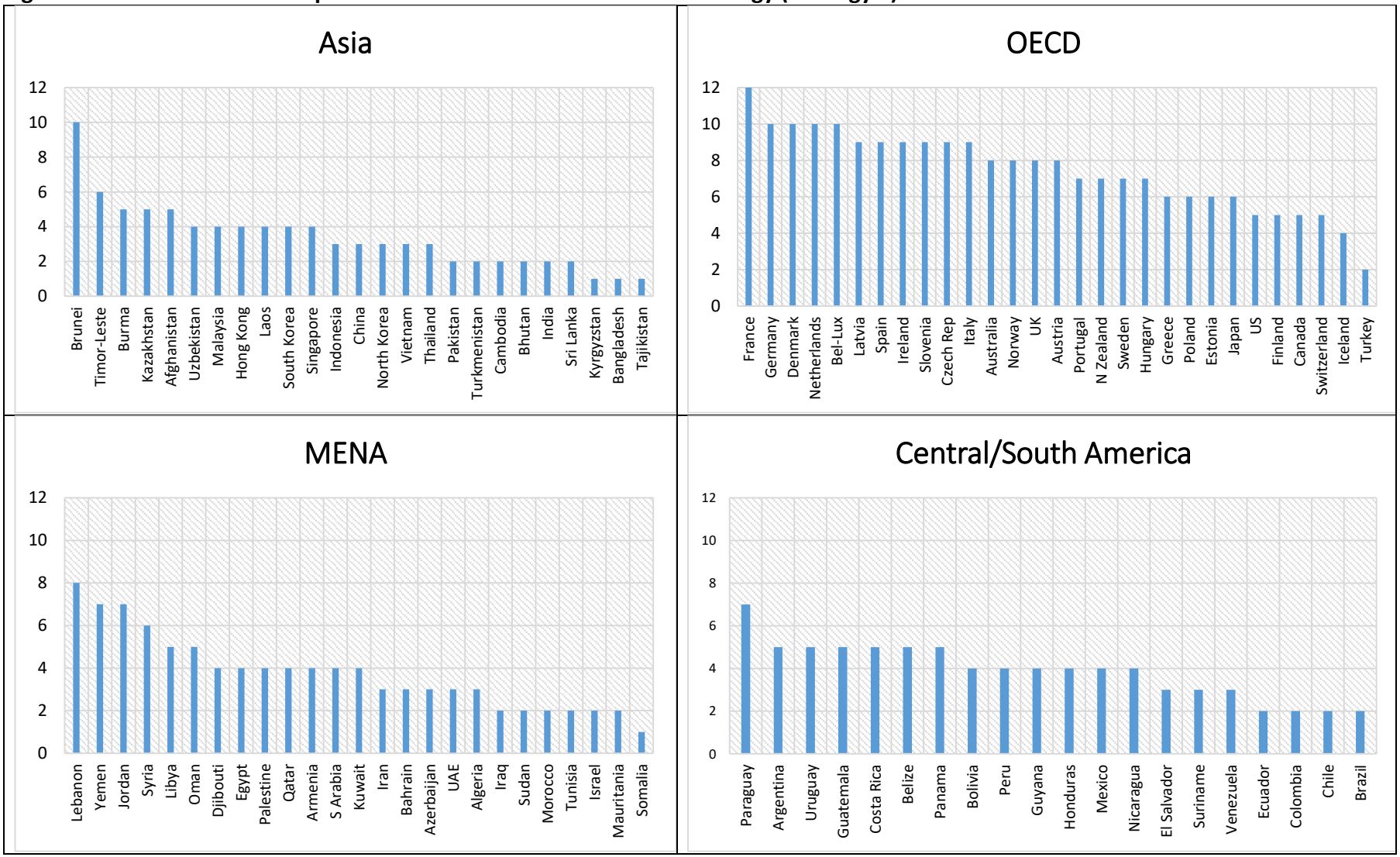
Saudi Arabia, United Arab Emirates), and 11 in OECD (Australia, Austria, Czech Republic, France, Germany, Greece, Ireland, Japan, Latvia, New Zealand, United Kingdom).

Markets *for Soy sauce* include 13 economies in Asia (Brunei, Burma, Cambodia, Hong Kong, Indonesia, Kazakhstan, Laos, Malaysia, North Korea, Pakistan, Philippines, Thailand, Timor-Leste), 8 in Central/South America (Belize, Guatemala, Honduras, Nicaragua, Bolivia, Chile, Guyana, Suriname), 16 in OECD (Australia, Austria, Canada, Denmark, Estonia, Finland, France, Iceland, Ireland, Latvia, Netherlands, New Zealand, Norway, Sweden, United Kingdom, United States), and 6 in MENA (Bahrain, Israel, Kuwait, Lebanon, Qatar, Saudi Arabia).

Markets for *sugar* include 13 countries in Asia (Bangladesh, Brunei, Burma, Indonesia, Malaysia, North Korea, Pakistan, Singapore, South Korea, Sri Lanka, Thailand, Vietnam), 8 in Central/South America (Costa Rica, Honduras, Mexico, Argentina, Bolivia, Chile, Colombia, Peru), 4 in MENA (Algeria, Egypt, Iran, Yemen) and 14 in OECD (Austria, Belgium-Luxembourg, Denmark, Estonia, France, Ireland, Latvia, Netherlands, New Zealand, Poland, Portugal, Spain, Switzerland, United Kingdom) while those of *cereals* include 4 in Asia (Brunei, Kazakhstan, Laos), 9 in MENA (Armenia, Azerbaijan, Bahrain, Iraq, Israel, Kuwait, Oman, Palestine, Qatar), 17 in OECD (Austria, Belgium-Luxembourg, Czech Republic, Denmark, Estonia, Germany, Greece, Iceland, Ireland, Latvia, Netherlands, Poland, Portugal, Slovenia, Spain, Sweden, United Kingdom), and 3 in Central/South America (Nicaragua, Guyana, Suriname).

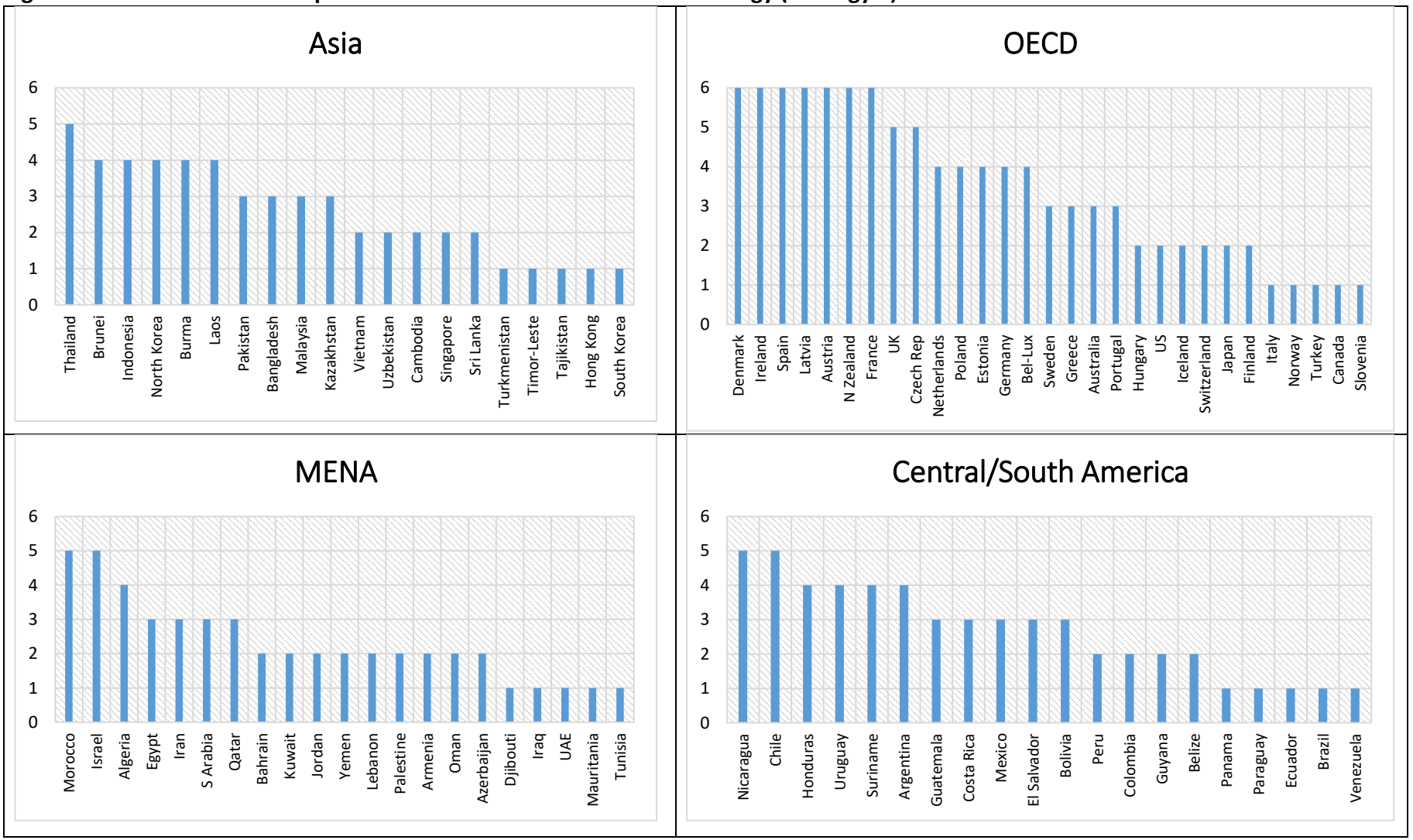
The number of importers of the number of products in the second short-run strategy is summarized in figure 4. These products have many potential markets in OECD economies, including Denmark, Ireland, Spain, Latvia, Austria, New Zealand, France, United Kingdom, and Czech Republic, which are importing between 5-6 short run products. Markets in the MENA region include Morocco and Israel, which are both importing 5 short-run products. In Asia, Thailand imports 5 short-run products.

**Figure 3: Potential markets of products in short-run diversification strategy (strategy 1)**




Source: Authors' computation using COMTRADE HS 1992 at the 6-digit disaggregation.

**Figure 4: Potential markets of products in short-run diversification strategy (strategy 2)**




Source: Authors' computation using COMTRADE HS 1992 at the 6-digit disaggregation.

### 4.2 Medium-run diversification strategy

Potential products for the medium-run strategy are identified using the short-run agricultural commodities listed above as starting points. The idea of choosing the medium-run products centers on the products' contribution to the improvement of the country's agricultural portfolio ($PRODY_{agricultural\ products} > PRODY_{agricultural\ products,\ world}$) and on the expansion of the country's net trade position ($MRCA = 0$). In addition, their production requisites need to be similar with the production structures of the short-run products ($proximity \geq 0.5$).[3]

Using these criteria, there are 5 short-run agricultural products for which 8 potential medium-run commodities are mapped into. Majority of these are processed meats although preserved fruits, edible oil, and woven twill are also included. Table 5 shows that the capabilities that could be developed in the production of *glycerol*, a compound used as sweetener and humectant in pharmaceutical formulations, and *lye*, a tanning agent to preserve foods, can result in the emergence of new and relatively more sophisticated industries such as processed meats like hams and turkey cuts/offals. The development of Tung oil, a drying oil and used for varnishing, can lead to the capabilities necessary in the production of polyester/cotton fabrics.

The development of the production requisites of *preserved fruit mixtures* can be further improved so the country can further diversify into other preserved fruits such as strawberries. Similarly, locust beans and seeds can lead to the capabilities of olive oil production. However, the topography of the country is not suited to growing olive trees, which thrive in Mediterranean climates, and is therefore not a viable option for diversification.

**Table 5: Potential agricultural products for medium-run diversification strategy**

| Short-run products | Proximity | Potential medium-run products | Number of importers |
|---|---|---|---|
| Cereals, rolled/flaked grains (913) | 0.50 | Turkey meat, offal prepared or preserved, except live (1083) | 72 |
| Fruit mixtures, otherwise prepared or preserved (998) | 0.52 | Strawberries, otherwise prepared or preserved (1127) | 57 |
| Glycerol (glycerine), crude and glycerol waters & lye (1017) | 0.58 | Turkey cuts & offal, except livers, frozen (1122) | 88 |
| | 0.50 | Swine hams & cuts thereof, prepared or preserved (1103) | 71 |
| | 0.50 | Swine carcasses and half carcasses, fresh or chilled (1050) | 23 |
| | 0.50 | Swine, live except pure-bred breeding > 50 kg (1256) | 21 |
| Locust beans and seeds (1010) | 0.53 | Olive oil, fractions, refined, not chemically modified (1019) | 69 |
| Tung oil or fractions not chemically modified (1526) | 0.67 | Woven twill >85% polyester + cotton, <170g/m2 printed (1526) | 1 |

Source: Authors' computation using COMTRADE HS 1992 at the 6-digit disaggregation.

### 4.3 Long-run diversification strategy

Potential long-run products are identified following the selection criteria used for the potential diversification strategy in the medium-run. From table 6, there are 4 medium-run agricultural products for which 4 potential commodities are mapped into. The capabilities necessary to produce processed meats such as swine ham/cuts can be further developed to produce other processed meats such as poultry cuts/offal, salted/dried/smoked bellies of swine, and pig/poultry

[3] While higher values of proximity indicate that products have more similar production structures, there is only one product that that has $proximity \geq 0.6$

fats. There is also a potential to diversify into chemical compounds used for fertilizers such as ammonium nitrate limestone.

**Table 6: Potential agricultural products for long-run diversification strategy**

| Medium-run products | Proximity | Potential long-run products | Number of importers |
|---|---|---|---|
| Swine carcasses and half carcasses, fresh or chilled (1050) | 0.62 | Pig and poultry fat, unrendered (1054) | 50 |
| | 0.63 | Poultry cuts & offal, except livers, fresh or chilled (1160) | 42 |
| | 0.68 | Ammonium nitrate limestone etc mixes, pack >10 kg (1089) | 36 |
| Swine hams & cuts thereof, prepared or preserved (1103) | 0.61 | Bellies (streaky) of swine, salted, dried or smoked (1277) | 73 |
| Turkey meat, offal prepared or preserved, except live (1083) | 0.67 | Poultry cuts & offal, except livers, fresh or chilled (1160) | 42 |

Source: Authors' computation using COMTRADE HS 1992 at the 6-digit disaggregation.

## 5. Summary of results and conclusions

This paper has analyzed the performance of the country's agricultural exports using some metrics from the product space. Some results are worth-noting. The sophistication content of the Philippines' agricultural exports from 1994 to 2014 has not improved. Currently, the country's exports are concentrated in *cereals/pasta/bread* and *fruits/nuts* categories. Exports in these categories have average sophistication indices that are lower than the average sophistication of agricultural products in the world market. This has serious implications not only in the sector's productivity but, more importantly, in the skills content of the 26% of the employed population in agriculture.

The Philippines has various efforts to industrialize and this is reflected in the country's diversification into circuits and electronic goods in the early 2000. Hence, the agricultural goods in the export basket have been substantially reduced. Accounting for 27% of the total exports in the 1995 export basket, agricultural products account for only 10% of the total exports in the 2014 export portfolio.

The effort to industrialize is echoed once again in the DTI's Investment Priority Plans (IPP) and its 2014 version aims to strengthen different sectors including the agribusiness and fisheries. Currently, the IPP includes high value-added crops as one of the targets, which is a good starting point of the agro-processing industry since evidence from the product space indicates that processed agricultural goods have relatively high sophistication content than primary agricultural products such as fresh fruits. Agro-processing industry is part of the manufacturing sector that processes and transforms primary and intermediate products from agriculture, forestry, and fisheries into manufactured goods (FAO 1997). The industry uses various methods to process these agricultural inputs, which can be as simple as smoking to the more complex transformation of raw materials into paper or textiles (FAO 1997).

Developing the agro-processing industry appears to be a good strategy if the country is to harness the potential of the agricultural sector to contribute to sustainable economic growth and decent employment. In 2016, the January round of the Labor Force Survey shows that 6%(4%) of working population in the urban(rural) area employed in agro-industrial manufactured goods (food products, beverages, tobacco products, textiles, wearing apparel, leather, wood products, and paper/paper products). In addition, agro-processing is also a way to avoid the oftentimes high transportation, handling, and storage costs of primary agricultural products. Since primary

agricultural products are perishable goods, agro-processing appears to be a sound approach so that agricultural exports will reach markets beyond Asia. OECD economies and countries from the MENA region are some of the potential markets.

The agricultural sector can diversify into the production of goods with higher sophistication content. In the short-run, the country can focus on improving the production structure of agricultural goods for which the country has revealed comparative advantage in but are not yet substantially produced in the country. These include processed fish and seafood, industrial oil, cereals/pasta/bread, animal/vegetable fats/oil, and extracts/dye. In the medium-run, the country can diversify into products with much higher sophistication content, majority of which are processed meats, although preserved fruits, edible oil, and woven twill are also included. In the long-run, the country can further branch into processed meats with sophistication content that is at the 5$^{th}$ quintile of $PRODY_{world}$. While this portends good news, it presents challenges on how the country can transform its agricultural sector into a sector that is high value adding. The sector's transformation will definitely not happen overnight and deliberate steps towards the goal is necessary.

If the Philippines is able upgrade the current production capacities of cereals, fruit mixtures, glycerol, and oils as drying agents, the country will be able to meet the production requisites of processed meats, preserved fruits such as strawberries, and woven twill. This means that in the short-run, investment priorities should also focus on strengthening the production structures of cereals, fruit mixtures, glycerol, and oils due to their forward linkages to more sophisticated agro-processing industries. To do this, the government needs to encourage process innovations to ensure that the industry is linked with financial and marketing services. In addition, there is a need to ensure that the sector that produces oils as drying agents in ink/paint/varnish have linkages with the chemical industry in order to develop high value-added textiles/fabrics.

The identified products do not lead to the most sophisticated among the agricultural products in the world. This is due to the fact that the country's current exports are in the least connected parts of the product space and hence fewer products are available for diversification opportunities. While this is the case, there are relatively high value adding products that can be developed in the future given the existing agricultural basket. Assuming that the country is able to create correct incentives and provide adequate support for process and product innovations to take place, the development of the products herein identified may lead to the emergence of other high value adding agro-industrial exports not listed here. For example, vegetable materials used primarily for plaiting has links to more sophisticated textile/fabric/tapestry industries while raw vegetable materials for dyeing/tanning has links to paper industries. The challenge, therefore, is for the government to take steps that will eventually provide opportunities for the agricultural sector to realize actual linkages with these more advanced and sophisticated industries.

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