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The Philippine mango global value chain: An empirical study using the gravity model approach

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ABSTRACT

To maintain the Philippines' competitive edge in the trading of agricultural products, this study identifies factors that significantly influence the Philippines' participation in the mango global value chain. The study employs a causal research design with panel regression analysis using pooled regression, a fixed effect model and a random effects model and determines the robustness of the models using the Hausman test. The resulting fixed effect model reveals that gross domestic product, remoteness and global competitiveness have a significant positive effect on gross exports and value-added, while being land-locked and bilateral distance have a significant negative effect. Among the identified variables, remoteness has the greatest influence. The resulting model is limited to the analysis of the Philippine mango global chain's integration in terms of gross exports and value-added contribution to the economy of the country. The underlying factors not included in the model are not given emphasis. This study identifies the factors that correctly estimate the Philippines' mango global integration. The policy recommendations, if implemented, can guarantee strong integration of Philippine mangoes in the global chain, which will facilitate the flow of factor payments in the economy, thereby raising the standard of living of Philippine citizens and creating more social protection for the Philippine people.

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Previous studies have been conducted describing the Philippine global value chain integration, but these studies are limited in that they use descriptive analysis and did not identify the factor/s that will improve the mango global value chain's integration.

1. Introduction

The Philippines occupies a relatively significant position in the Mango Global Value Chain. Since 1980, the country has notably participated in the global mango market, with increasing exports in the 1990s. By 2017, the Philippines ranked ninth in exports of fresh and dried mangoes, which is $US 67.9 million or 2.6% of the global market (UN Comtrade, 2018). The country has exported mangoes to Hong Kong (China), Japan, Singapore, Switzerland, the UK and the USA. The increase in mango exports can also be attributed to the low export tariffs, which allows Philippine mangoes to enter duty-free markets, as provided by the World Trade Organization and Japan.

The Philippines is regarded as one of the leading producers and exporters of processed dried mangoes, with 85% of its total processed products being exported. Although the country occupies a significant position in the industry, there are still certain constraints that hinder the Philippines' potential to improve its ranking. One of these problems is the inability to meet strict sanitary and phytosanitary (SPS) market requirements. In addition, production difficulties have been experienced by the Philippine mango, including erratic annual production and quality yields because of environmental aspects, pest and diseases, and the high costs of inputs in the Philippine mango industry (PCARRD-DOST, 2011). Moreover, the industry also faced a lack in technological development in order to survive environmental hazards, inadequate irrigation equipment, a lack of fertilization management and equipment and abuse in the use of pesticides (Briones et al., 2015). Lastly, significant challenges in terms of lack of financial resources and infrastructure are considered a threat.

Meanwhile, other significant mango exporters including Mexico, Peru, Brazil, India and Thailand have emerged in the industry. These countries have threatened the status of the Philippines in the global trade. Mexico and Peru have placed considerable focus on developing and upgrading farming techniques and many of their farms are certified and follow the standards set by GAPs. At the same time, countries such as India have allocated additional budget for research and development (R&D) to solve problems of low productivity and seasonality.

Hence, the development of a model for the Philippine Global Value Chain is necessary to upgrade the global value chain participation status of the country and to compete internationally. These new opportunities for the country will upgrade their integration in global trade and expand their exports. Historically, developing countries are contained in exporting unprocessed raw materials with the traditional thought of intricateness in the process of integrating in the chain. Today, because of the various opportunities, many countries are opened to exporting manufactured goods.

Various literature cited on the global value chain utilized the descriptive approach (Chen et al., 2011; Tsolakis et al., 2013; Parwez, 2014; Lemma et al., 2014). Their work dealt with identifying factors relating to increasing chain integration in qualitative discussion and dealing only in certain case scenarios. However, analysis on the quantitative approach was very limited on thus wasn't able to capture accurate chain integration. This missing information is important in identifying factors that will improve the Philippine's global value chain integration.

Since global value chain is also trade in a broad term, exports to an exporting country's growth, employment and balance of trade depends in the domestic value-added. Several countries are now specializing on the "tasks" (design, assembly, transport, etc.) rather than goods (Guilhoto et al., 2015). Most of the empirical analyses in international trade use the gravity model. Yet, in the evolution of the "international supply chain", the model estimates is not enough with the use of gross value added as it ignores the share of import content of exports which is not all the same for all countries.

With those missing information, the study aims to identify factors that significantly influence the mango global value chain participation of the Philippines. This research provides the determinants that correctly estimates the Philippines global integration. Using the gravity model approach, the established framework will contribute to a more globally integrated Philippines. Figure 1 illustrates the conceptualized model.

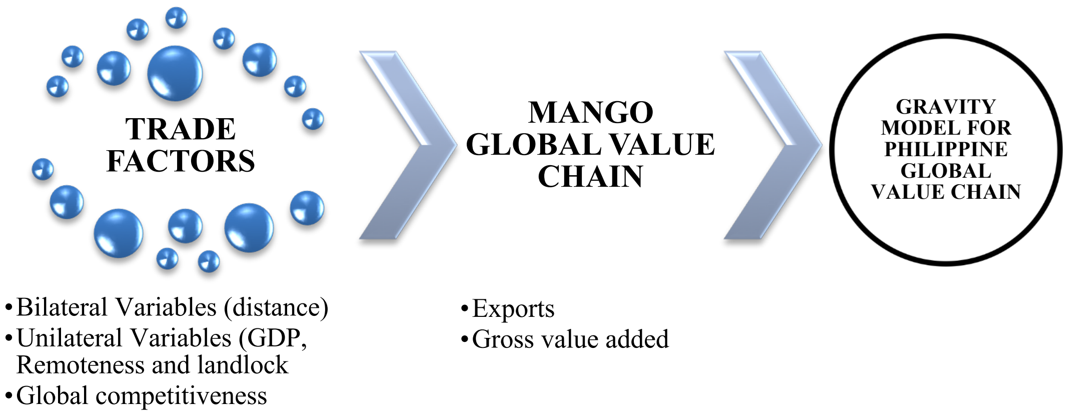


Figure 1. Conceptual framework illustrating the factors that affect the Philippine Mango Global Value Chain and its effect on economic development

2. Literature Review

The term "global value chain" (GVCs) is often expressed as one of the features that shape the current swing of globalization, however little is known on how to efficiently integrate it in the chain. The concept was first introduced in the 1960s, when there is a sudden change in the method of production as a result of the increasing competition globally. As a process strategy, US companies started to outsource some of the key stages in the production to decrease production costs and maximize their profits (Gereffi & Lee, 2012).

The current situation of developing countries like the Philippines motivates these countries to search for efficient and effective ways to integrate GVCs in the global economy. With barriers such as limited resources and policy challenges, developing countries are less competitive and can be left behind by neighbouring developed countries if they will not improve their respective social and economic outcomes.

The term "value chain" refers to all of the activities that firms and workers do to produce goods or provide services, from conception to the end use. This includes activities such as design, production, marketing, distribution and support to the final consumer (WTO & IDE-JETRO, 2011). Likewise, the term "global value chain" covers various firms and geographic boundaries. According to the World Trade Organization (WTO & IDE-JETRO, 2011), through GVCs, countries trade not only products but also know-how. The import and export of goods and services are important in order for GVCs to be successful.

Different stages of production, organized across multiple countries, were captured by the Global Value Chain analysis, where the value-added contributions flowing between the sectors located in different countries were measured at the aggregated sector level (Baldwin & Venales, 2013).

The concept of GVCs is evident in business management studies. Porter (1985) introduced the concept as a guide for constructing a corporate strategy. According to him, to upgrade a firm's competitiveness, it is necessary to focus on the entire system of activities involved in the production and consumption of goods. This is according to the perspective of a value chain in which activities must be organized collectively. The value chains/linkages need to be carefully examined, for example by drawing an anatomical chart of the firm and inspecting the external environment that serves as the firm's competitive advantage.

Unlike Porter's value chain concept which is concerned with examining the whole system of activities, Kimura and Ando (2005) have suggested that the value within the system, which is the product of the firm's effort, was also the factor of the value distribution system that influences the firm's selection. The vertical participation of GVCs relies on the hierarchical pattern that has an absolute and unidirectional control of the main company over its subsidiaries.

The complexity of global value chains has created an obstacle in apprehending trade and creating policies that allow firms and governments to take advantage of GVCs.

Conventional measures of trade only compute the gross value of the exchange between partners and does not include the foreign producer's contribution to the value chain, which is also connected to the end value of the chain. The Global Value Chain Report published by the World Bank Group, the Institute of Developing Economies, the Organization for Economic Co-operation and Development, the Research Center of Global Value Chains which has its headquarters at the University of International Business and Economics, and the World Trade Organization, has expanded the analysis by using the value-added of trade data.

The report generated a GVCs index system which incorporate the three component indexes to represent the nature of GVCs such as the production length index for the mean number of production stages and intricacy of the value chain, a participation index for the vehemence of a country's-sectors involvement in GVCs and a position index for the placement of a country-sector pair on a GVCs. Those that are produced and consumed within one country are called pure domestic value-added productions. It represents the simple GVCs's value added. Those that are not involved in indirect exports via third world countries or re-exports or re-imports are also simple GVCs. While complex GVCs value added crosses national borders twice, according to report, GVCs production has been increasing. Figure 4 shows that most of the value added is still locally produced and consumed. However, GDP decreased during the global financial crisis, decreasing from 85% of global value added in 1995 to an estimate 80% in 2008.

In terms of involvement in the GVCs, geography matters in the interconnection and the center of production hubs in terms of trade. These three hubs include the United States, Asia which includes China, Japan and the Republic of Korea and one in Europe, Germany. According to Diakantoni (2017) on his study based on the UN Comtrade database, China is on the boundary and tends to trade with the "hub" that is nearest in geographic distance. Since African countries are far from the existing hubs, trade becomes difficult in these countries. Many developing countries are also far from the existing hubs.

With the limitation of the conventional approach, some studies used input-output tables. Hummels et al. (2001) for instance introduced the concept of vertical specialization and used input-output tables to measure the intermediate inputs used to produce an exported good.

Chen et al. (2001) have introduced the idea of integrating gross exports into the value-added context. The US-China trade imbalances have been given consideration. Another study conducted by Daudin et al. (2006) constructed a multi-country input-output table from 70 countries to compute the domestic value-added of exports. This also includes indices of vertical specialization and regionalization. Moreover, Bems and Johnson (2012) have proposed the concept of a value-added real effective exchange rate. These indicators were used to clear the external imbalances and to evaluate the magnitude of prices. Koopman et al. (2016) introduced the decomposition method of gross export to various sources of value-add. The method breaks down the gross export into local value-add absorbed abroad, local value-add first exported and then returned home, foreign value-added and pure double-counted terms.

Van Melle et al. (2007) have described a value chain that includes all activities needed to produce a product from conception, through production, transformations, and delivery to final consumers, also incorporating the proper final disposal after usage. It includes processes and players from suppliers of inputs to producers and processors to exporters and buyers engaged in the activities required to produce a product for its end use.

Various studies have pointed out different factors that contribute to the increasing integration into the global value chain. These depend heavily on the economic and geographical status of each country. In Asia, for instance, food distribution systems rely on changes in urbanization, consumer preferences and eating habits, infrastructure development and competition. This integration in the supply chains and networks provide a chance for adding value. Moreover, branding lead to high consumer confidence and satisfaction when buying good and services. Likewise, chains help to face challenges by creating partnerships, input providers, marketers and customer within the networks of the value chain (Chen et al., 2005).

By comparison, in Tanzania, flexibility and speed are factors that have greatly contributed to the strategic advantage of manufacturing companies. Shorter lead times, fast responses to market change, and a demand-driven orientation have greatly contributed to the manufacturing supply chain strategy. However, the degree of integration within the supply chains needs improvement because the functional levels are not at the desired level. There is a lack of values and integration between the vertical and horizontal members of the manufacturing industries, which hinder the optimal value chain. Working in a Silos culture leads to a lack of customer focus and top management commitment (Lemenge & Tripathi, 2011).

Natural resources are one of the critical factors that need to be considered in the global value chain, as minerals, a good climate and fertile soil are needed at the beginning of the chain. Any intervention in their supply hinders the chain’s sustainability (Smith, 2015).

Various approaches have been used to analyze global value chain integration. Some studies have used a qualitative approach such as case analysis. A case study of value chain analysis in Kenya by Pelrine (2009) found that mango weevil pests greatly affect mango yields and hinder the development of the mango supply chain at the farm level, the marketing stage, the processing stage, and the export stage. In the study conducted by Mutonyi et al. (2016), the authors explained that price fairness, price reliability, and relative price influence the scope of price contentment, which in turn influences producers’ trust in the buyer. The study found that trust is an important mediating factor which affects producer loyalty and price satisfaction.

Mehdi et al. (2014) utilized the case study method and the application of the triple helix model and causal loop diagram. The results of the study revealed that institutional innovation provides support to farmers, thereby reducing risk. It further provides an opportunity for farmers to be included in the supply chain of the export market. An information scheme should be developed to determine the operation of multi-stakeholder participation in the supply chain and improve policy simulators in order to upgrade the triple helix policy of Indonesia.

However, very few studies have used a quantitative approach such as structural equation modeling (SEM). The study of Mutonyi et al. (2016), which utilized SEM revealed that trust is an important factor that influences producers' loyalty. Relative price, reliability and price fairness influence the scope that establishes producers' loyalty and trust in the supply chain. These findings are reported by latest studies about trust and its role. Since the player's perception of the chain changes over time, it is recommended to rely on a design which is longitudinal. However, the model has established a low disparity in producer loyalty and trust, at only 45%, and therefore other factors need to be addressed in this study.

In the study of Zhu et al. (2018), they used World Input-Output Database (WIOD) in constructing the upstream and downstream global value networks and introduced the network-based measure of node similarity to compare GVCs between countries. This provides quantitative answers on dependency, sustainability risks, and competition.

The recognition of vertical specialization in trade prompts a series of questions on the consistency of conventional statistical tools and/or general concepts of the trade literature, including the gravity model. Some studies have disassociated the notion of home or the origin of goods from the exporter and the notion of destination from the importer. Gross exports do not correctly represent the competitiveness of exporting countries, but rather the entire product chain, especially when the exporting country is situated at the final step of the production process. The use of trade statistics is not an appropriate determinant for the demand-side analysis, since exports to importing countries are mostly driven by the demand in third countries.

In 2010 gravity modeling of the intermediate good trade became of interest. A study by Yi (2010) used calibrated values in a multi-stage production model and estimated a gravity model with calibrated trade flows. The multi-stage model captures the border effects by controlling the intermediate goods trade costs during their exportation. Meanwhile, Egger and Bergstrand (2010) concluded that bilateral final goods trade flows, intermediate trade flows and FDI flows are all driven by a common process and the impact of GDP is similar for the final and intermediate goods trade between developed countries. According to Baldwin and Taglioni (2011), the analysis by Egger and Bergstrand (2010) is plausible when data are pooled from a wide range of countries, including developing countries. Nonetheless, when intermediate goods trade is high, GDP only loosely reflects the structure of trade. In their study that analyzes trade in Asian countries, the gravity model estimates indicate that the intermediate trade share has a significant negative impact in terms of the interactive GDPs of the countries. The result explains the small explanatory power of GDP values to intermediate goods. By contrast, the distance variable and intermediate are positively related to each other. The findings were supported by Bosker and Westbrock

(2014), whose study explained the network structure of trade connections. Intermediate good trade between two countries increases in size and productivity of a third country and declines in each of the two countries trade costs to it. This relation is called the gravity of the third country.

The Philippines holds a relatively significant position in the global mango chain. However, the country's participation is limited to fresh mango exports and it exhibits poor performance in cold chain management. This is so because mango production in the Philippines is often conducted on a small scale compared to its neighbouring countries.The significance of the GVCs phenomenon has stimulated researchers to develop statistics and analyses based on the value added in trade. Studies have also suggested including discrete tasks or phases in the production process. The progress of GVCs has no doubt contributed to the diversification of exports. Developing countries continuously conduct research to intensify their involvement in GVCs.

3. Methodology

This study uses the gravity model in the analysis of the causal relationship of the identified trade variables that explain the Philippine Global Value Chain. The study conducted by Baldwin and Taglioni (2011) suggested the Gravity model to estimate the effects of trade factors for exports and gross value added. The authors called this relation the "gravity" of a third country, which finally contradicts the common theoretical literature of the final goods trade, where third country "gravity", or in traditional terms, lower multilateral resistance, decreases bilateral trade. Furthermore, they suggested the use of GDP to measure output, provided that the import content of exports is similar across entities and over time. The exports and gross value added represents the Philippines' global value chain in terms of mango production. We formulate two models to test the causal relationship of the identified explanatory variables and the dependent variables using the concept of the gravity model, using GDP as the traditional gravity variables in the equations. The functional models were:

$$lnEx_{rc} = \beta_0 + \beta_1 lnD_{rc} + \beta_2 lnGDP_r + \beta_3 lnR_{rc} + \beta_4 LL_r + \beta_5 GGI_{rc} + \varepsilon \quad (1)$$

$$lnV_{rc} = \beta_0 + \beta_1 lnD_{rc} + \beta_2 lnGDP_r + \beta_3 lnR_{rc} + \beta_4 LL_r + \beta_5 GGI_{rc} + \varepsilon \quad (2)$$

where the dependent and explanatory variables are given as:

Explanatory variables

lnD_{rc} denotes natural logarithm of the bilateral distance, and was based on the CEP II table by Mayer and Zignago (2006). Simple distances were calculated following the great circle formula which uses the latitudes and longitudes of the regions and agglomerations in terms of populations. Wherein the share of the regions in the overall country's population was computed. The assumption is that the impact on intermediate goods trade is similar to their impact on the final goods trade (Yi, 2010). However, the effect of gravity estimates of distance on the intermediate goods trade shows evidence to the contrary.

$lnGDP_r$ denotes the natural logarithm of the gross domestic product of the regions.

R_{rc} denotes the remoteness of the region from the rest of the world. This is measured based on the study of Head (2003) in which $m \neq c$, aside from its partner country c.

$$R_{rc} = 1/\sum(GDP_m/D_{rm})$$

in which GDP_m is gross domestic product of importing country and D_{rm} denotes distance of region to importing country. The higher R_{rc} the more distant region r from the importer countries m $(m \neq c)$ and other region r and/or the closer to countries and regions whose GDP are relatively small (Head, 2003). The assumption is that the more remote the region, the higher the trade can be expected to be between r and its partner c since exporter region access to other market is limited.

LL_r is dummy variable whose value is 1 when region r is landlocked.

GGI_{rc} is global competitiveness index of the region to the rest of the world.

Dependent variables

Ex_{rc} is gross exports from mango exporter region r to destination country c.

V_{rc} is value added produced and exported from mango exporter region r to destination country c.

Pangasinan in Luzon, Western and Central Visayas, Davao and Cotabato are the leading exporters of mangoes in the Philippines. These provinces come from four regions of the country. Regions 1, 6, 7 and 11 were chosen as the regions that are assumed to be involved in the mango global value chain. We used secondary data to represent bilateral distance, exports, GDP, and production of mangoes. For some variables that are not quantifiable in nature, such as remoteness and being landlocked, we used dummy variables. Cross-section data across the four mango-producing regions were used in the study, with 11 leading importers of mangoes in the last two years' data and a total of 88 observations. The data were gathered from the agencies Philippine Statistical Authority[2] and UN Comtrade[3].

Since the data set has cross-sections, we utilized the cross-section regression model. According to Gujarati (2011), by integrating the time series of cross-sectional observations, the so-called panel data gives more informative data, more variability, less co-linearity among variables, more degrees of freedom and more efficiency. Since time observations are the same across the four regions and 11 leading importers of mango countries, the set of data is called a balanced panel. Furthermore, the data are also called a short panel, because the number of cross-sectional N or leading importers of mango countries ($N = 11$) is greater than the number of time periods T ($T = 2$). To produce robust estimates of the model, three panel

[2] Data retrieved from https://psa.gov.ph/

[3] Data retrieved from https://comtrade.un.org/

data modelings were addressed in this research, namely Pooled OLS regression, Fixed Effect Model (FEM) and Random Effect Model (REM). Likewise, we used the panel regression unit root test, that is the Im-Pesaran-Shin (IPS) test by Im et al. (2003) and the Hausman test to test the robustness of the models.

4. Result and Discussion

4.1. Philippine's in the mango global value chain

The Philippines holds a relatively significant position in the Mango Global Value Chain. Since 1980, the country notably participated in the mango global market with increasing exports in the 1990s. By 2017, the Philippines ranked ninth in exports of fresh and dried mangoes which is $US 67.9 million or 2.6 percent share of the global market (UN Comtrade, 2018). The country has exported mangoes to Hong Kong (China), Japan, Korea and the USA. The increase in mango exports can also be attributed to the low tariff in exports, which allows Philippine mangoes to enter duty-free markets, as provided by the World Trade Organization and Japan (Figure 2).

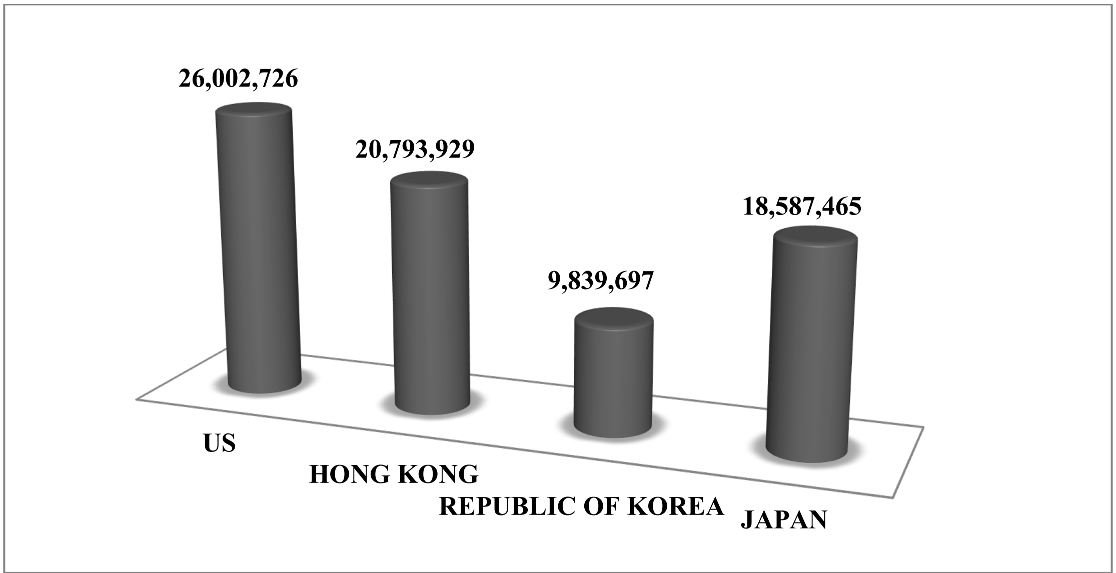


Figure 2. Value of mango in US$ exported to the major export destination of Philippines' fresh and dried mango, 2017

Source: Philippine Statistics Authority (2017)

However, the current situation of mango in the farming industry posts problems in terms of the area planted and volume of production. Figure 3 shows that the land area planted with mangoes decreases at an average of 0.20% in five years with an average farm size of

1.34 hectares. Correspondingly, volume of production decreases at an average of 1.78% in five years (Figure 4).

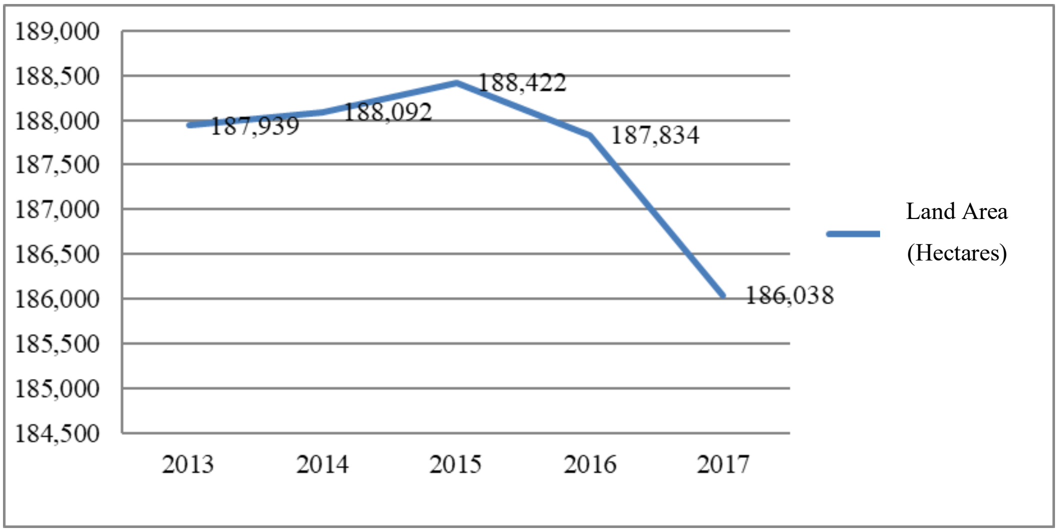


Figure 3. Land area planted with mango in hectares, the Philippines, 2013–2017

Source: Philippine Statistics Authority

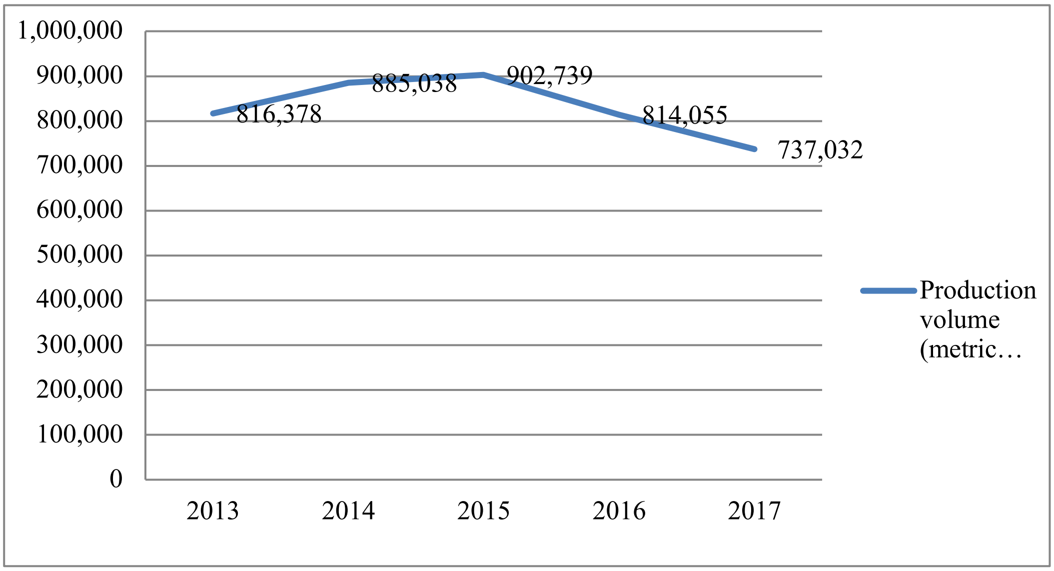
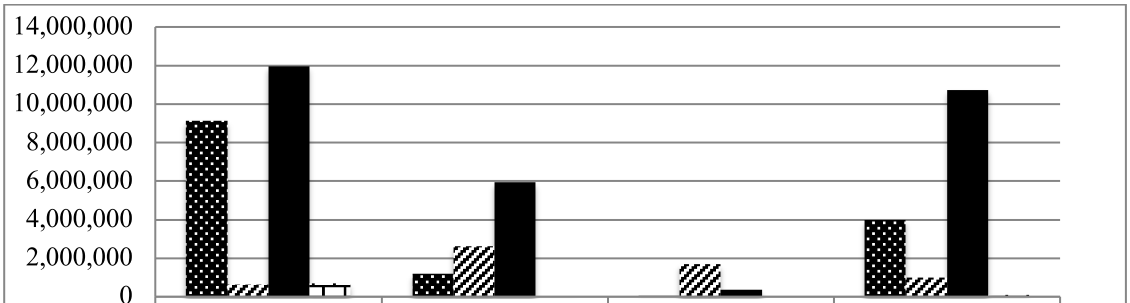


Figure 4. Volume of production of mango in metric tons, the Philippines, 2013–2017

Source: Philippine Statistics Authority

The Philippines' participation in the global value chain is limited in its trade of fresh fruits and in processed forms. The majority of processed mango in dried, airtight and juice goes to US and puree goes to Hongkong (Figure 5).



	US	HONGKONG	REPUBLIC OF KOREA	JAPAN
Dried	9,138,665	1,189,072	72,020	3,992,540
Puree	642,935	2,621,173	1,679,503	1,003,485
Airtight	11,941,214	5,928,919	350,994	10,727,905
Juice	692,517	37,314		106,529

Figure 5. Processed mango exports value in US$ millions, FOB, 2013–2017, by type, by export destination Philippines

Source: Philippine Statistics Authority

4.2. Philippine Mango Global Value Chain – A gravity approach

The examination is based on the econometric analysis of panel regression model using dataset of gross value added, gross exports, gross domestic product, and global competitiveness of the four mango producing regions namely Region 1, 6, 7 and 11 with the leading exporter's provinces such as Pangasinan in Luzon, Western and Central Visayas, Davao and Cotabato in the latest two years data. For some variables that are not quantifiable in nature such as distance, contiguity, remoteness, and landlocked, imputed values were used for these variables. Table 1 shows the descriptive statistics of the variables used.

Table 1.

Descriptive Statistics of Data

Variables	Calculations (Taking natural logarithm of)	Sources	Obs	Mean	Std.Dev.	Min.	Max.
lnDrc	The bilateral distance of the region to the destination country c	Based on the CEP II table by Mayer and Zignago (2006).	88	10640.690	14514.750	4169.540	19772.340
LL_r	Dummy variable whose value is one when region *r* is landlocked.	Constructed based on the UNCTAD[4] data	88	0.500	0.577	0	1
LL_c	Dummy variable whose value is one when country *c* is landlocked.	Constructed based on the UNCTAD data	88	0.818	0.405	0	1
lnR_{rc}	Remoteness of the region from the rest of the world. This is measured based in the study of Head (2003): $R_{rc} = 1/\Sigma(GDP_m/D_{rm})$; GDP_m is GDP of importer country and D_{rm} is distance of region to importer country	Constructed based on the IMF[5] and World Bank[6]	88	9.670	0.276	8.670	9.870
$lnEx_{rc}$	Gross exports from mango exporter region *r* to destination country *c*.	Philippine Statistics Authority Reports	88	24.500	2.187	17.980	29.000

[4] Data retrieved from https://unctad.org/en/Pages/Home.aspx
[5] Data retrieved from https://www.imf.org/en/Data
[6] Data retrieved from https://data.worldbank.org/

lnV_{rc}	Value added produced and exported from mango exporter region *r* to destination country *c*.	Philippine Statistics Authority Reports	88	14.200	3.420	8.200	19.207
$lnGDP_r$	The natural logarithm of the gross domestic product of the regions	Philippine Statistics Authority Reports	88	24.300	2.870	19.200	30.400
$lnGGI_{rc}$	Global competitiveness index of the region to the rest of the world.	Philippine Statistics Authority Reports, World Economic Forum[7] and Cities and Municipalities Index of Department of Trade and Industry Philippines[8]	88	61.330	8.310	62.1	70.500

[7] Data retrieved from https://www.weforum.org/
[8] Data retrieved from https://www.dti.gov.ph/

Subsequently, it discusses the econometric results on the relationships between mango global value chain as represented by value- added and gross exports and the identified explanatory variables.

Since the data are panel, the estimation of the causal relationship uses common pooled regression, fixed effect model and random effect model. Initially, the panel unit root testing was performed to test if the variables taken collectively were stationary. The obtained annual data of the gross exports, gross value-add, gross domestic product and global competitiveness were first plotted at levels and were observed for the trending patterns that they exhibit. All the data series demonstrated fluctuating trends which characterized non-stationary variables at levels. However, plotting at first difference, all the variables were found to be stationary. Table 2 shows that using the IPS test, at level the variables were all non-stationary as shown in the probabilities which exceeded the 5% level of significance. However, after differencing it exhibited a stationary or stochastic trend. Therefore at this point the variables were integrated at the same order regression was performed on the variables at that form.

Table 2.

Summary of panel unit root test using the IPS technique

Variables	At Level	Probability	At 1st Difference	Probability
Gross exports	–12.233	0.114	–15.958	0.000
Gross value added	–2.342	0.351	–2.033	0.021
Gross domestic product	–14.495	0.420	–14.627	0.000
Global competitiveness	–0.843	0.294	–2.295	0.010

On the one hand, the common pooled regression assumes that the regressors are non-stochastic or, if stochastic, are uncorrelated with the error term. It is also presumed that the error term satisfies the usual classical assumptions (Gujarati, 2011). On the other hand, the fixed effect model is estimated to cross-check the heterogeneity that may exist among all the observations. This model allows each cross section to have its individual intercept value. The term "Fixed effect" is because of the fact that while the intercept may differ across countries/regions, it does not vary over time, that is, it is time invariant. This process is done by introducing differential intercept dummies. To account for the lack of representation and knowledge on the dummy variables; the random effect model (REM) suggests the expression of the said ignorance through the disturbance term, subject to a stochastic random error component. The individual differences of each country are reflected in the error term.

Table 3 presents the panel regression estimation done for functional model (1)

Table 3.

Panel data regression result for functional model (1)

Variables		Panel Data Regression			
		Pooled OLS	FEM	REM	Hausman Test
lnD_{rc}		–0.988	–0.048*	0.008	
	Prob	0.089	0.0478	0.093	
$lnGDP_r$		2.824**	1.440**	0.724**	
	Prob	0.002	0.007	0.005**	
lnR_{rc}		6.496*	6.697*	7.390*	
	Prob	0.045	0.033	0.003	
LL_r		–0.162*	–0.157*	–0.843*	
	Prob	0.042	0.0467	0.024	
GGI_{rc}		1.045**	1.087**	1.820**	
	Prob	0.004	0.005	0.003	
Constant		13.956	25.671	30.227	
	Prob	0.000**	0.000**	0.000**	
R-squared		0.850	0.760	0.720	
Chi-square					3.989
Prob					0.762

Note: *, ** denotes the statistical significance at 5% and 1% level, respectively.

The result shows that bilateral distance using the common pooled and random effects has no significant effect on the gross exports. However, the fixed effect panel regression estimation exhibited a negative significant effect on the gross exports using five percent level of significance. The other explanatory variables such as gross domestic product, remoteness, landlocked and global competitiveness have exhibited significant effect on the gross export using all the estimation method. The result reveals that bilateral distance drives down the gross exports. Remoteness, GDP and global competitiveness have a positive sign while landlocked has a negative sign. Table 4 present the regression result for the functional model (2).

Table 4.
Panel data regression result for functional model (2)

Variables		Panel Data Regression			
		Common Pooled	FEM	REM	Hausman Test
lnD_{rc}		–0.935	–0.041*	0.007	
	Prob	0.079	0.049	0.083	
$lnGDP_{r}$		2.924**	1.570**	0.890**	
	Prob	0.001	0.009	0.005	
lnR_{rc}		6.196*	6.997*	2.290*	
	Prob	0.025	0.037	0.002	
LL_{r}		–0.142*	–0.127*	–0.743*	
	Prob	0.032	0.027	0.034	
GGI_{rc}		1.035**	1.039**	1.027**	
	Prob	0.002	0.003	0.001	
Constant		12.956	35.671	32.976	
	Prob	0.000**	0.000**	0.000**	
R-squared		0.820	0.740	0.670	
Chi-square					3.92
Prob					0.823

Note: *, ** denotes the statistical significance at 5% and 1% level, respectively

The resulting estimation suggests that bilateral distance still has significant negative effect on gross value added. The distance variable that is represented by bilateral distance drives down both the gross exports of mango and gross value- added. This means that final goods and intermediate goods that is either fresh or processed mango was negatively affected by the distance of the Philippines to its exporting countries (Hong Kong (China), Japan, Singapore, Switzerland, UK and the USA). This negative effect means the nearness or farness of the regions of the country to its exporting countries. In contrast, gross domestic product increases the country's integration in terms of mango chain to the world as depicted by increase on its gross exports and gross value-add. Remoteness has a positive effect as expected similar to gross value- added and gross exports. The result is the same with the global competitiveness that each country has. Conversely, landlocked has negative effect in the mango global value chain. Hence, in forecasting the Philippine mango global chain integration, bilateral distance, gross domestic product, remoteness, landlocked and global competitiveness must be considered. Policies direted toward these factors must be considered.

We use the Hausman Test to determine the robustness of the model to be used for policy formulation. The null hypothesis of the Hausman test is that FEM and REM do not differ substantially. The result of the Hausman test strongly accepts the REM model for the p-value of the estimated chi-square statistic as high. However, it did not indicate a significant difference and did not necessarily suggest that random effect estimates are free from bias and are more preferred than fixed effect estimates.

The results of the panel regression suggest that FEM is the appropriate model for policy formulation. Thus, the resulted mango global value chain models are:

$$lnEx_{rc} = 25.671 - 0.048\, lnD_{rc} + 1.440\, lnGDP_r + 6.697\, lnR_{rc} - 0.157LL_r + 1.087GGI_{rc}$$

$$lnV_{rc} = 35.671 - 0.041\, lnD_{rc} + 1.570\, lnGDP_r + 6.997\, lnR_{rc} - 0.127LL_r + 1.039GGI_{rc}$$

The first functional model implies that an increase by 1% each would tend to increase growth in gross exports by 1.44% (Gross Domestic Product), 6.697% (Remoteness) and 1.087 % (Global Competitiveness). On the contrary, an increase by 1% of landlocked and bilateral distance will decrease gross exports by 0.157% and 0.048% respectively.

Additionally, the second functional model reflects the same effect with the gross value-added but in different levels. Landlocked and remoteness brings down gross value added by 0.127 and 0.041 percent. Gross domestic product, remoteness and global competitiveness positively affect gross value-added by 1.570%, 6.997% and 1.039% respectively.

Both functional models that explains Philippine global value chain integration is affected by the determinants, bilateral distance, gross domestic product, remoteness, landlocked and global competitiveness which suggests that all of the identified explanatory variables has significant effect on the country's global value chain integration. Therefore, for the country to increase its integration, policy directing towards these variables must be directed. The results indicated that gravity model proves its significance not only in trading but also to its integration to the mango chain.

5. Conclusion

The Philippines' participation in the mango global value chain is limited to its exports of fresh and processed mango and is threatened by the decreasing pattern of its volume of production. Using the gravity model approach, our work found out that both exports and the intermediate factors presented by value added found out to be affected by bilateral distance, landlocked, GDP, remoteness and global competitiveness. Measuring exports in value-added terms might be more appropriate for gravity model estimates and can be extended as a control for the measurement. The coefficients for distance, landlocked and global competitiveness are smaller when their effect is estimated for export value-added. This reflects the intermediate trade between two countries, which increases the size and the productivity of the third or fourth country and declines in each of the two trading countries. Thus when a country participates in the global chain of mangoes the third country involved in the connections of the chain will be in a competitive edge. This is the "gravity" of the third country in which has the comparative advantage since they were able to integrate in most of the processes in the chain.

The Philippines for such is majority present and specialized in the primary goods that is the supply of fresh mangoes in the world that explains the similarity and small differences in the result of the two export values used in the analysis of global integration. This does not mean that Philippines are not concerned in Global Value Chain Integration, but processing activities involved in the chain are mainly oriented to the supply of fresh mangoes to the foreign markets because of its low competitive nature. Since the Philippines is only present in the production stage and is limited to the final stage which is processed products, its global integration is threatened by its competitor countries■

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