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New Zealand's Trade Prospects in an Uncertain Trans-Pacific Partnership (TPP) Environment: Results from Gravity Model

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New Zealand's Trade Prospects in an Uncertain Trans-Pacific Partnership (TPP) Environment: Results from Gravity Model

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Abstract: This paper applies a modified gravity model to assess trade patterns between New Zealand and its major trading partners, including potential TPP members using annual pre-agreement data for the period 2000-2015. Although the Agreement, in its current form, cannot enter into force without the US participation, the remaining members have reaffirmed their commitment to TPP. The assumptions of the traditional gravity model that economic size would positively affect bilateral trade flows between countries while distance would negatively affect this outcome was tested. Results from this research suggest that New Zealand tends to trade more with larger countries and having free trade agreement with major Asia-Pacific countries will enhance New Zealand's merchandise trade, especially exports of agricultural products.

At another level, trade intensity index (TII) and the revealed comparative advantage (RCA) between New Zealand and potential TPP members were also calculated in this research. When applied to potential TPP countries, calculated TIIs show that there is not enough evidence to suggest that TPP would necessarily improve New Zealand's trading relationship with member countries, yet it would reinforce the existing trade patterns. Calculated RCAs in this research indicate that the trade creation effects are likely to be larger than trade diversion effects. Generally speaking, the TPP countries are sharing different RCA in different product groups. Although the status of TPP remains uncertain at this time, this study could provide some useful predictions about the likely trade effects on New Zealand merchandise trade after some variant of the TPP become a reality.

Keywords: Trans-Pacific Partnership (TPP), Gravity Model, New Zealand

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1. INTRODUCTION

FTAs have become an important trade policy vehicle in New Zealand. Currently, New Zealand has free trade agreements (FTAs) in force with Australia, Brunei Darussalam, Chile, China, Hong Kong, Malaysia, Singapore, South Korea, Thailand, Vietnam and the ASEAN nations. Also, New Zealand has two multilateral trade agreements, the AANZFTA and the Trans-Pacific Strategic Economic Partnership which has also known as P4. Currently, New Zealand

is actively negotiating on a number of FTAs. It is expected that signing of FTAs would increase export opportunities and promote economic growth.

The TPP originally started in 2005 among four countries, namely New Zealand, Brunei, Chile and Singapore under the name of "Trans-Pacific Strategic Economic Partnership" which was also known as "TPSEP" or "P4". The partnership agreement entered into force in 2006. In 2008, more countries such as the United States, Australia, Peru and Vietnam joined the discussion of the newly purposed agreement and it was presented to the public as the Trans-Pacific Partnership (TPP). Japan was the last country to take part in the negotiations and brought the membership to 12 Asia-Pacific countries. The 12 countries signed the final agreement on 4th February 2016.

The TP proposes to cut tariffs, improve market access for exporters that are additional to New Zealand's existing free trade agreements. Other objectives of TPP but not explored in this research include setting common grounds on labour and environmental standards and protection of intellectual property. Through the TPP, it aims to liberalise trade and investment among the 12 participating countries and provides New Zealand's exporters with a better access to global markets. While some of the TPP partners have already had FTA with New Zealand, (Australia, Brunei Darussalam, Chile, Malaysia, Singapore and Vietnam), several other countries such as Canada, Japan, Mexico, Peru and the United States do not currently have FTA with New Zealand. Within the past eighteen months, several studies have been conducted to estimate the economic impact of the TPP agreement (e.g., Petri & Plummer, 2016; Lawrence & Moran, 2016; Cheong & Takayama, 2016; Capaldo, Azurites & Sundaram, 2016). Most of these studies were focusing on macroeconomic impacts towards specific country or industry sectors. For example, a report by Petri and Plummer (2016) used the computable general equilibrium (CGE) model to assess the impact of TPP to conclude that TPP would significantly benefit its members. For United States (US), they estimated annual exports to increase by 9.1% (equalling $357 billion) by the year of 2030.

Cheong and Takayama (2016) in their study towards trade and welfare analysis of tariff changes within the TPP countries found that both TPP members and non-TPP members gain from the TPP tariff reductions. The TPP members increase their imports with other TPP countries when compared with non-TPP countries. The authors applied a frontier method to examine the welfare effects of TPP tariff reductions to show that trade creation effect exceeds the trade diversion effect among TPP members. In an earlier research by Petri, Plummer and Zhai (2012), New Zealand's gain from TPP was estimated to be the largest among all partners at a GDP growth rate of 1.3% in 2025 compared with 0.1% GDP growth in the United States and 0% in Canada.

Other studies focused on the employment and income effects of the TPP. According to Riker (2010), there was a significantly positive relationship between exporting and earnings where workers tend to earn more in export-intensive industries. In addition, Riker's finding showed that lower tariff barriers and higher earnings were significantly related. On the same topic, Capaldo et al. (2016) obtained different results on employment effect and income distribution

with the implementation of TPP by using the United Nations Global Policy Model. They found that TPP would lead to a decline in the level of employment and increase inequality at the same time in all participating TPP countries.

The current status of TPP is very contentious such that it is unlikely to come into force in its present form. The new US President signed a memorandum to withdraw from TPP, making its ratification virtually impossible. However, in March 2017, the 11 remaining members affirmed the economic and strategic importance of TPP, particularly as a vehicle for regional economic integration. Participation in some variants of TPP remains an important goal in New Zealand's international trade policy.

The main objective of this study is to examine bilateral trade flows between New Zealand and its major trading partners, including TPP members and determine the important economic factors that affect New Zealand's total merchandise trade. Thus, this paper will estimate how bilateral trade agreements among countries affect New Zealand's total merchandise trade. It will also analyse the trend and composition of the trading relationship among TPP countries from New Zealand's perspective.

This study is organised as follows. Section 2 illustrates the data and the methodology being used in the empirical analyses and provides a theoretical framework of the gravity model. Section 3 applies the gravity model to estimate the effects of New Zealand's merchandise trade. In addition, trade indicators are examined to further analyse the trading relationship and trade patterns among TPP countries. The final section concludes.

2. DATA AND METHODOLOGY

2.1 Data type and sources

This study covers a total of 16 different countries, including all 12 TPP participating countries. Apart from potential TPP members, four other non-TPP countries (China, the United Kingdom, South Korea and Germany) have been chosen based on the importance to trading with New Zealand but not belonging to TPP. The data used in this study is the annual panel data for all countries during the period 2000-2015. Global trade data are obtained from the UN COMTRADE database measured in US dollars.

The explanatory variables used in the gravity model estimation include respective GDPs and population of both New Zealand and its partner country, geographical distance between New Zealand and its trading partners' capital cities, land area, a collection of dummies such as common language and bilateral trade agreement (BTA) dummy. GDP data is obtained from World Bank database while population data of selected partner countries are collected from the World Development Indicators (WDI) database. The data on geographical distance between New Zealand and its partner countries' capital cities and land size data are obtained from the Centre d'Etudes Prospectives et d'Informations Internationales (CEPII) database and are

measured in kilometres (km). For the common language dummy, the official language of New Zealand and its partner countries are acquired from the CEPII database.

2.2 Trade indicators

Trade indicators are used to access a country's trade structure and patterns. The advantage of using trade indicators is that they are easy to calculate and the data requirement is relatively small since they can be constructed using trade statistics. Nevertheless, the limitation of trade indicators is that they cannot fully explain the effect of free trade agreement in terms of economic welfare or production. In this study, two commonly used indices are employed which are the revealed comparative advantage (RCA) and the trade intensity index (TII) to examine the trade relations and patterns between potential TPP countries from New Zealand's perspective.

2.3 Gravity model

Gravity model originates from Newton's gravity law. When applied to trade, the model states that trade flows between two countries are determined positively by their income and negatively by the distance between them. Since their introduction to trade literature by Tinbergen (1962) and Pöyhönen (1963), gravity models have been widely used to analyse international trade flows and evaluate trade effects of FTAs. In the standard gravity model, the trade flows between two countries is the dependent variable where the independent variables are respective GDP for each country and the geographical distance between them.

The traditional gravity model is represented as follows:

$$F_{ij} = G \frac{M_i^{\beta_1} M_j^{\beta_2}}{D_{ij}^{\beta_3}} \qquad (1)$$

Where

F_{ij} = volume of trade between countries i and j
M_i , M_j = the economic mass or value of GDP of trading partners/ national incomes
D_{ij} = the geographical distance between two countries i and j
G = the constant

Equation (1) can be converted into a linear form by taking the log form of both sides and it becomes:

$$\ln(F_{ij}) = \beta_0 + \beta_1 \ln(M_i) + \beta_2 \ln(M_j) + \beta_3 \ln(D_{ij}) + \varepsilon_{ij} \qquad (2)$$

Where

$\beta_0, \beta_1, \beta_2, \beta_3$ = unknown coefficients
Ln = the log form
ε = the error term / residual of the regression

Anderson (1979) was the first to demonstrate that the gravitational equation helps explain the pattern of international trade. Later, Helpman and Krugman (1985), Bergstrand (1989) and Deardorff (1998) had made contributions to the theoretical foundation for the gravity model leading to its firm acceptance in international trade theory.

Geographic distance in a gravity model is supposed to measure the cost of transport. In trade literature there is an increase in trade flows if transportation cost decreases. For example, Balassa and Bauwens (1987), Clark and Stanley (2003) and Badinger and Breuss (2008) found a negative relation between geographical distance and trade. In a broader sense, distance can be analysed in terms of geography, culture, language and presence/absence of common border. Rauch (1999) and Eichengree and Irwin (1998) emphasised the importance of border and common language. Other studies suggested to include population size variable for both importing and exporting country in the gravity model equation. Matyas (1997) finds that population has a tendency to increase trade by producing gains from specialisation. In contrast, Dell`Ariccia (1999) finds a negative effect population on trade.

All these suggest the need to include additional variables in the standard gravity model to control for differences and effects of geographical factors, A collection of dummy variables was also introduced in the application of the gravity model to analyse bilateral trade flows. These are factors that can affect bilateral trade flows including dummy variables of common official language, common historical background, the common border and if they belong to the same regional trade agreement (RTA) or free trade agreement (FTA). These dummy variables will take a value of 1 for which both countries are members of same trade agreement (Cheng & Wall, 2005). Adding these important variables to the traditional gravity model equation gravity with two core variables, which are GDPs and geographical distance, the extended gravity model becomes:

$$X_{ij} = \beta_0 Y_i^{\beta 1} Y_j^{\beta 2} N_i^{\beta 3} N_j^{\beta 4} D_{ij}^{\beta 5} A_{ij}^{\beta 6} e^{zm} e^{uij} \quad (3)$$

Where

X_{ij} = the total trade flows between country i to country j
Y_i and Y_j = the GDP for exporting and importing country respectively
N_i and N_j = the population size for exporting and importing country respectively
D_{ij} = the geographical distance between two countries
A_{ij} = other determinants that could aid or impede bilateral trade flows
e^{zm} = the dummy variables for specific effects
β = the parameters of the model
e^{uij} = the error term

Many empirical applications of the extended gravity model have been conducted over time. Rahman (2003) used the gravity model to analyse the trade patterns in Bangladesh with its major trading partners and the findings have shown that Bangladesh's trade was positively affected by the economic size, per capita GNP and the openness of the trading countries. Alternatively, the transportation cost had been found to have a negative effect on Bangladesh's trade. Binh, Duong and Cuong (2011) used a gravity model to analyse foreign trade flows

between Vietnam and its partner countries. By applying a gravity model, their estimated results showed that economic size and market size of Vietnam and foreign partners, distance and culture were affecting foreign trade flows in Vietnam significantly. In addition, Binh, Duong and Cuong have also found that Vietnam has trade potential with some new markets such as Africa and Western Asia.

A number of literature (e.g., Aitken, 1973; Frankel, Stein & Wei, 1997; Sohn, 2001; Dlamini, Edriss, Phiri & Masuku, 2016) had included a regional trade agreement dummy variable to estimate the international trade flows. Aitken (1973) found that there were statistically significant effects of the European Economic Community (EEC) on trade flows among members, while Bergstrand (1985) found that the effect of EEC was insignificant on bilateral trade flows. Frankel, Stein and Wei (1997) also found positive effects of regional trade blocs on bilateral trade flows using various factors as the determinants of bilateral trade flows. Moreover, McCallum (1995) estimated a gravity model equation where the dependent variable was bilateral exports to examine the determinants of the Canada-US regional trade patterns with the country's GDP, distance and dummy variable of intra-bloc trade. Results showed that national border had a significant effect on trade and there was a negative relationship between distance and trade.

2.3.1 Model specification

In the original gravity model, there are only two independent variables: GDP and geographical distance. GDP is the most commonly used variable and it is used as a proxy for a country's economic size. The geographical distance is used in the gravity model as a proxy for the transportation costs between countries. The gravity model equation used in this study is enhanced by adding a few more important variables such as population and a collection of dummy variables that may possibly influence New Zealand's total merchandise trade. By introducing these important variables, the augmented gravity model is obtained as follows:

$$\ln(F_{ijt}) = \beta_0 + \beta_1 \ln(GDP_{it}) + \beta_2 \ln(GDP_{jt}) + \beta_3 \ln(pop_{jt}) + \beta_4 ln(pop_{it}) \beta_5 \ln(D_{ijt}) + \beta_6 ln(Area_{jt}) + \beta_7 (Lang_{ij}) + \beta_8 (BTA) + \varepsilon_{ijt} \quad (4)$$

Where

F_{ijt} = value of the merchandise trade (exports plus imports) between New Zealand to importer country j in year t, expressed in US dollars
GDP_{it} = GDP in country i (home country: New Zealand) in year t
GDP_{jt} = GDP in country j (partner country) in year t
pop_{jt} = Population of country j in year t
pop_{it} = Population of New Zealand in year t
D_{ijt} = geographical distance (in kms) between country i and j by each country's capital cities
$Area_{jt}$ = the land size that the trading partner countries covers
$Lang_{ij}$ = common language between country i and j, dummy variable which takes the value 1 if the two countries are sharing the same language (in this case English) and 0 otherwise

BTA = dummy variable which takes the value 1 if two countries have bilateral trade agreement and 0 otherwise
ε_{ijt} = error term
(All variables in the equation are expressed in their natural logarithms forms except for dummy variables)

The dependent variable is the annual total merchandise trade between New Zealand and its trading partners. GDP of both importing and exporting countries are used as a proxy for respective countries' economic size, in terms of production capacity and markets (Sohn, 2001). The coefficients of the GDP variables are expected to be positive to bilateral trade flows. The higher the respective GDPs of two trading countries, the higher trade value is expected between them.

The coefficient of the population variable is used to estimate the market size of both importing and exporting country. The larger the market size, more trade is expected to occur. Also, countries tend to trade more with each other if they have similar markets. According to Dlamini *et al*. (2016), the coefficient of the exporter's population can be positive or negative. An exporting country with a large population size is expected to export more because of the economies of scale. On the other side, due to the higher domestic absorption effect of the large population size, it will also have a chance to export less. For importing country, the coefficient of population variable is expected to be positive.

The distance variable represents the physical distance between the capital cities within two trading partners. Geographical distance is incorporated as a proxy for the trade barriers such as trade-related costs and transportation costs between two countries and other obstacles to trade when engaging trade activities. The coefficient of the geographical distance variable is expected to be negative as distance, the transportation costs and the time-related costs between two trading countries would be proportionally affected. There are three types of costs when engaging business activities at a distance, which are physical shipping costs, time-related costs and costs of cultural unfamiliarity (Rahman, 2003; Frankel, Stein & Wei, 1997). Land area is used as a proxy for resource endowments. Larger countries have more diversified production and tend to be more self-sufficient (Dlamini *et al*., 2016). Therefore, the coefficient of the land area variable is expected to be negative.

A collection of dummy variables is included in the augmented gravity model in (4). These are (i) a common official language and, (b) whether the trading country has a bilateral trade agreement with New Zealand. All coefficients of the dummy variables are expected to have a positive sign to New Zealand's merchandise trade. Other things being equal, trade flows between two countries sharing a common language will be larger compared with countries without a common language. The dummy variable of the common official language is also considered as a proxy to the extent of the cultural similarity between New Zealand and its trading partners. The cultural distance and language barriers may cause trade barriers as differences in race and languages will create cultural distance between two countries. A value

of 1 is taken if New Zealand and the partner country share a common language, in this case, English, and zero otherwise.

The bilateral trade agreement (BTA) dummy variable is included in the gravity model equation and it is considered as an FTA dummy. The BTA dummy variable takes a value of 1 if the partner country has an existing free trade agreement with New Zealand and zero otherwise. The coefficient of the BTA dummy variable is expected to have a positive effect towards a country's merchandise trade. A positive value of the BTA dummy implies that the membership of same regional trade agreement or having a bilateral trade agreement between two countries will increase the total volume of trade.

2.3.2 Choice of analytical technique

We considered the alternatives of the fixed effects model (FEM) and the random effects model (REM)to estimate the panel data. Fixed effects model are employed when there is an individual effect between explanatory variables. The model is considered to be more appropriate if the samples can constitute the entire population. Random effects model is more effective if the individual effects are uncorrelated with its explanatory variables. This model is preferred when the samples are randomly selected from a large population. In trade literature, REM is more appropriate when estimating the trade flows between randomly drawn samples of trading partners from a large population. In contrast, FEM would be a better choice when estimating the trade flows between an ex-ante predetermined selection of countries (Dlamini *et al*., 2016; Egger, 2000; Eita & Jordaan, 2007; Martínez-Zarzoso & Nowak-Lehman, 2003). Since this study aims to determine the important factors that affect New Zealand's total merchandise exports among potential TPP members and its main trading partners, the FEM would generally be more appropriate than REM. We also took the additional step to conduct the Hausman test to establish superiority of REM over FEM.

The main problem of the fixed effects model is that it can only estimate coefficients for cross-section variables but does not allow direct estimation of the time-invariant variables (Martínez-Zarzoso & Nowak-Lehman, 2003). As a result, variables such as geographical distance, land area, common language and bilateral trade agreement (BTA) dummy variables will not be estimated in the fixed effects model (FEM). To solve this problem, a number of methods have been developed. Followed by Martínez-Zarzoso and Nowak-Lehman (2003), these time-invariant variables can be estimated in a second step of the two-stage regression procedure from the fixed effects estimation by running another regression with the individual effects (IE) as the dependent variable and the time-invariant variables such as distance, land area as well as the dummy variables as the independent variables.

In summary, although both FEM and REM are appropriate for controlling unobserved individual effects, we believe the REM was more suited for our purposes. Diagnostically, the Hausman test was applied to check for superiority of REM over FEM to our gravity estimation. The null hypothesis of the Hausman test is that there is no correlation between the individual

effects and the regressors. Our test results failed to reject the null hypothesis, indicating REM to be more appropriate and efficient.

3. ESTIMATION RESULTS

3.1 Numerical estimates

3.1.1 Evaluation of trade intensity index

New Zealand's trade intensity index(TII) with TPP countries was calculated to determine if the direction and composition of trade changed significantly during the period of 2010 and 2015. It is a good indicator to measure the strength of trade relation and examine the trade patterns between two countries. According to Yeats (1998), the trade intensity index refers to a tendency for two countries to trade more or less with each other based on factors such as their global importance in world exports and imports. Yeats (1998) also stated that when the trade intensity index is calculated for a single point in time, the measurement is limited since it does not incorporate the influence of factors such as geographical distance and common languages on trade. Calculating and analysing the index over time can show if two countries are experiencing an increased or decreased tendency to trade with each other. These are shown in Figure 1 and Figure 2. Both figures show that New Zealand has a strong trading relationship with most of the TPP countries, especially Australia. Figure 1 shows the trade intensity index between New Zealand and Australia separately where the value of this TII is extremely large compared with other TPP countries. The value of the trade intensity index with Australia has remained above 15 over the period of 2010 to 2015. This indicates that New Zealand and Australia share a very intensive trading relationship.

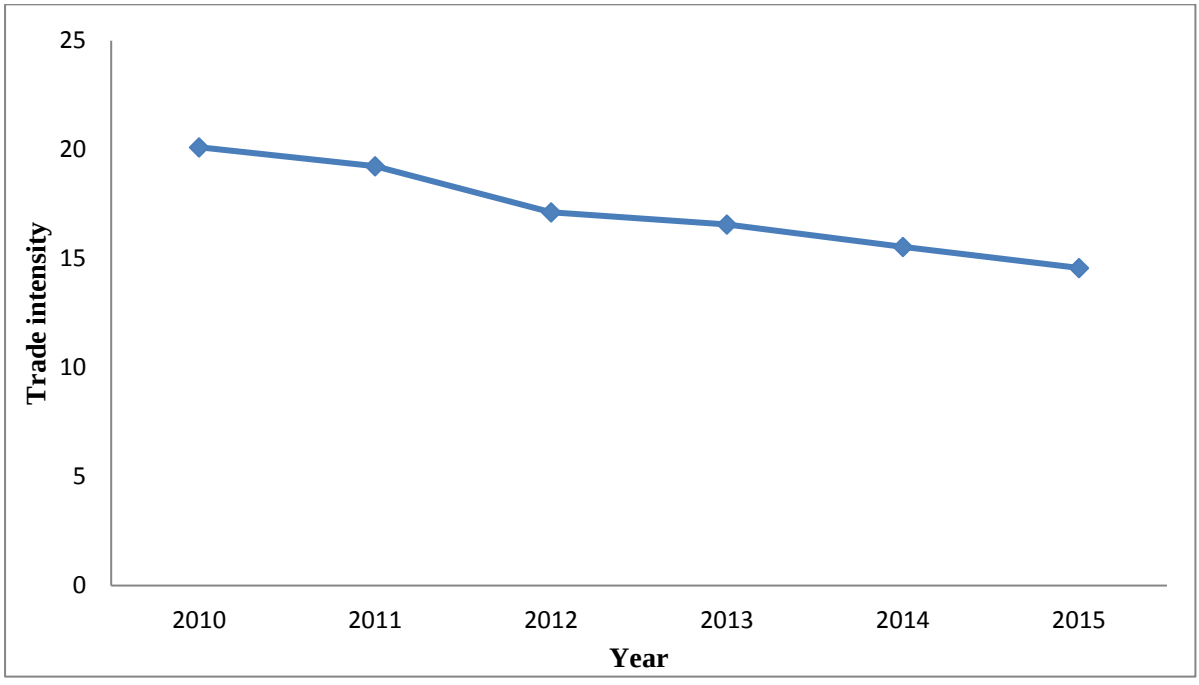

***Figure 1*. New Zealand's trade intensity with Australia (2010-2015)**
Source: Own calculations from UNCOMTRADE database

Figure 2 goes on to illustrate TIIs for remainder of the TPP countries. As shown in figure 2, New Zealand's TII with Japan and Malaysia has retained at a value of 1.5 or above over the entire period of 2010 and 2015, suggesting that there is a strong trading relationship between New Zealand and those two nations. The trade intensity index for New Zealand with Japan has been decreasing over the period of 2010 to 2014, but then increased back in 2015.

Figure 2 also shows that New Zealand has had a moderate trade trading relationship with Chile, Brunei Darussalam, Canada and Mexico. From 2010 to 2015, trading relationship between New Zealand and both Chile and Peru has been improving. Trade intensity of New Zealand with Chile shows an upward trend, especially with a large increase in 2013 in terms of the value of the trade intensity between 2010 and 2015. Among all TPP members, New Zealand's TII with Peru has shown the highest variability. While New Zealand has an upward trend of the trade intensity index with most of the TPP participating countries over the period of 2010 and 2015, Vietnam is the only country among TPP countries that showed a decline in value of this index. In 2015, the value of trade intensity index for New Zealand with Vietnam is below 1 (0.89), suggesting that the trading relationship between them is lower than expected. For those countries which do not have existing FTAs with New Zealand, for example, the United States, TII was found to increase steadily from 1.02 in 2010 to 1.26 in 2015.

Overall, according to the results of the trade intensity index, there is no strong evidence to show that having a free trade agreement will necessarily improve trading relationship of New Zealand with other potential TPP members. However, an FTA could potentially reinforce the existing trade pattern.

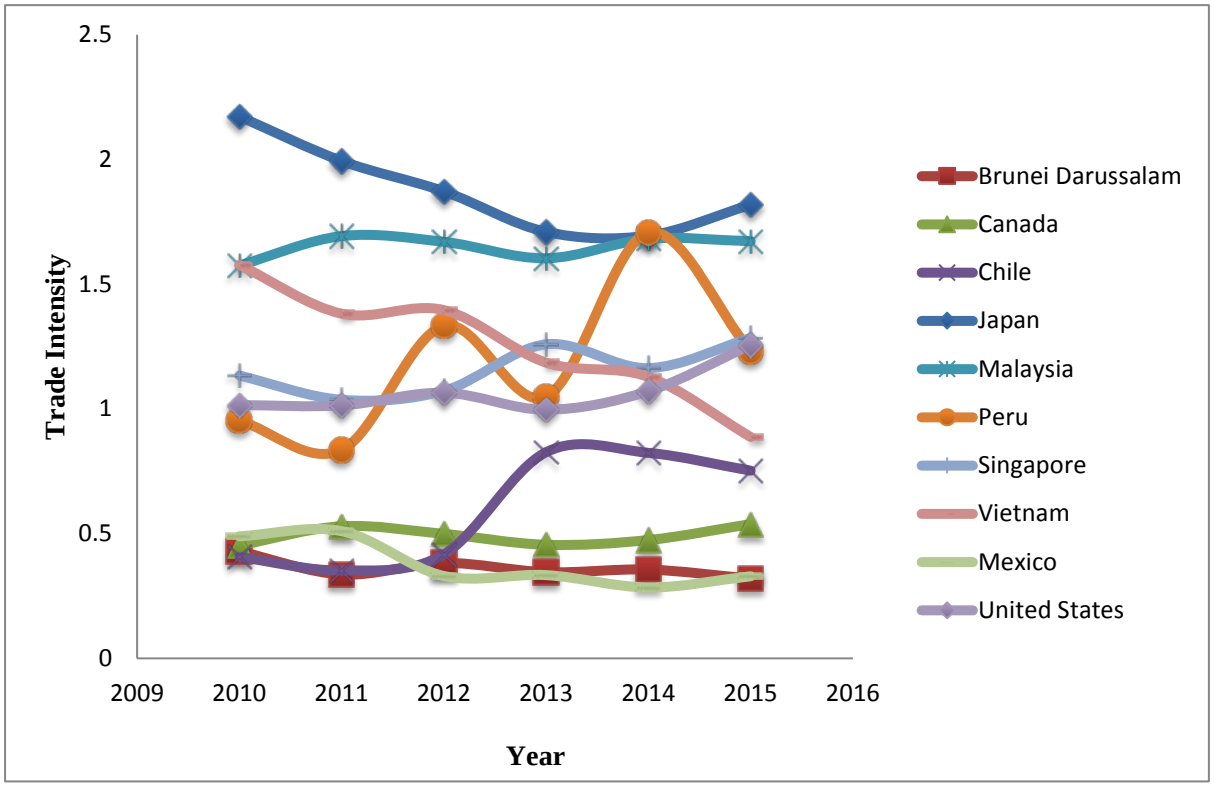

***Figure 2*. New Zealand's trade intensity with potential TPP members (2010-2015)**
Source: Own calculations from UNCOMTRADE database

3.1.2 Evaluation of revealed comparative advantage (RCA)

The measure of the revealed comparative advantage (RCA) was introduced by Balassa (1965) that has been used to assess a country's export structure. RCA identifies the products or sectors in which a country has a comparative advantage in producing or is relatively efficient. Under its standard assumption, a country does not both import and export the same products. These RCAs according to their product groupings for the year 2015 was estimated and the results reported in Table 1. In general, New Zealand has a strong RCA in animal and agricultural products such as meat and dairy as well as fruit and vegetable. Wood products are also one of the commodities in which New Zealand has a strong RCA with the value index at 4.56. RCA value of these product groups are far above the cut-off value of one, suggesting New Zealand enjoys high levels of comparative advantage in these commodities.

New Zealand has shown low RCAs on products such as machinery and equipment, transport, fuels, chemicals and textiles and clothing. All of these are major imports of New Zealand. Manufactured products such as machinery and transportation equipment are the major imports for New Zealand. The RCA results shows that Japan, Canada, US, Malaysia, Mexico and Singapore, all have the comparative advantage in producing these. These indicate that New Zealand faces a very small possibility of losing from trade diversion. After implementation of TPP, trade creation is likely to occur between New Zealand and TPP country members.

In terms of footwear, textiles and clothing that are considered important imported products for New Zealand, Vietnam is the most efficient producers of these commodities grouping across all potential TPP members. This indicates that Vietnam would potentially gain the most from trade creation after TPP is implemented. For chemicals, only Singapore and the United States are having revealed comparative advantage that means they are competitive world producers of chemical products. Trade diversion is less likely to occur with the formation of TPP since New Zealand will not shift its chemicals imports from a more efficient supplier to an inefficient source that may cause a reduction in national welfare.

Based on these RCA numbers, one can say that if TPP agreement comes in to force, trade diversion effect would be minimum. The reason New Zealand has a strong exporting relationship with Japan and the United States even though they do not have existing FTAs is that they are enjoying different RCA on different commodity groups.

Countries that have different RCA on different commodity groups provide potential gains from trade creation as they have the opportunities for specialisation. In contrast, countries, which have the same or similar revealed comparative advantage on particular product, indicate that they are less likely to trade and becoming trading partners as their comparative advantage are overlapping. Among TPP members, since they have different revealed comparative advantage in different commodity groups, it implies that the trade creation effects are potentially larger than the trade diversion effects with the possible formation of the trading bloc. With regional integration, New Zealand is likely to increase the volume of merchandise trade within the countries that participated in the trade agreement.

Table 1: RCA indices for New Zealand and TPP countries (2015)

Product group	RCA indices											
	New Zealand	Australia	Brunei	Canada	Chile	Japan	Malaysia	Mexico	Peru	Singapore	US	Vietnam
Animal	21.73	3.64	0.02	1.39	4.63	0.14	0.22	0.49	1.28	0.09	0.93	1.34
Wood	4.56	0.57	0.03	3.41	3.15	0.36	0.88	0.3	0.41	0.37	1.19	0.74
Food Products	3.56	0.87	0.01	0.79	2.35	0.13	0.56	0.94	2.73	0.7	1.02	0.59
Raw materials	2.98	5.01	3.27	1.05	2.96	0.11	0.45	0.92	3.75	0.08	0.78	0.8
Vegetable	2.17	1.53	0.01	1.07	3.94	0.04	1.65	1.1	4.34	0.08	1.4	1.6
Hides and Skins	1.84	0.74	0.01	0.33	0.13	0.07	0.06	0.22	0.24	0.11	0.47	3.23
Intermediate goods	1.49	0.73	0.14	1.19	2.28	1.01	0.69	0.45	1.75	1.14	1.05	0.41
Chemicals	0.75	0.49	0.21	0.62	0.53	0.87	0.34	0.28	0.24	1.74	1.41	0.14
Consumer goods	0.64	0.45	1.82	1.11	0.34	0.85	0.78	0.83	0.52	0.81	0.87	1.27
Textiles and Clothing	0.58	0.4	0.05	0.24	0.1	0.28	0.27	0.41	0.99	0.06	0.35	3.89
Metals	0.53	0.98	0.04	1.03	4.15	1.33	0.51	0.54	1.38	0.31	0.73	0.37
Stone and Glass	0.43	1.01	0.24	0.58	0.43	0.66	0.32	0.62	4.39	0.92	0.85	0.3
Minerals	0.29	19.75	0	1.26	20.49	0.13	0.46	0.82	21.14	0.04	0.43	0.39
Plastic or Rubber	0.24	0.12	0	1	0.25	1.26	1.1	0.56	0.34	1.11	1.2	0.61
Fuels	0.24	2.29	8.36	1.4	0.14	0.15	1.24	0.52	0.52	1.27	0.61	0.2
Capital goods	0.22	0.12	0.02	0.7	0.05	1.51	1.63	1.45	0.02	1.44	1.19	1.25
Mach and Elec	0.2	0.09	0.03	0.46	0.04	1.41	1.99	1.33	0.02	1.55	0.93	1.55
Transportation	0.07	0.18	0.01	2.04	0.06	2.12	0.11	2.41	0.01	0.22	1.5	0.11
Footwear	0.06	0.03	0	0.06	0.04	0.04	0.07	0.21	0.11	0.04	0.09	10.52

Source: World Integrated Trade Solution (WITS) database and own calculations

3.2 Regression estimates

As discussed in section 2.3.2, we believed in the superiority of random effects model (REM) over fixed effects model (FEM) to estimate from the panel data. We then applied the diagnostic tool of Hausman test to validate this claim. The result shows a p-value of above 5% significance level at 1.00. It indicates that the null hypothesis of no correlation between the regressors and the individual effects cannot be rejected. This justifies REM being more appropriate and efficient. As such, our interpretation of the results will focus on REM. Table 2 below presents REM estimation results from equation (4).

Table 2: Estimation results of the gravity model

Variable	Random effects model (REM)
Importer's GDP	0.809 (0.000)***
New Zealand's GDP	0.559 (0.005)***
Importer's population	0.142 (0.428)
New Zealand's population	-2.409 (0.134)
Distance	-1.572 (0.0027)***
Land area	-0.242 (0.0382)**
Common language	0.194 (0.6640)
Bilateral trade agreement (BTA)	0.324 (0.0008)***
Constant	36.189 (0.0761)*
No. of Observation	256
R-squared	0.708

Notes. ***/**/* indicates the significance level at 1%, 5% and 10% respectively. Probabilities are in parenthesis.

The results of REM reveal that all variables except for common language and population are statistically significant for New Zealand's total merchandise trade flows. All of these coefficients have the signs in line with their "a priori" expectations within a gravity model. These are explained below.

GDP is used as a proxy for economic size for both importing and exporting countries and is expected to have a positive effect on bilateral trade flows. The coefficient of the importer's GDP is found to have a positive impact and statistically significant on New Zealand's total merchandise trade flows. An increase of 1% in partner countries' GDP will enhance trade flows by approximately 0.809% and the same increase in New Zealand's GDP will also enhance merchandise trade by 0.559%. This suggests that partner countries' economic size has a bigger influence than New Zealand's own. This finding is consistent with the assumption of the traditional gravity model which states that trade is positively influenced by economic size of participating countries.

Population size is used as a proxy for the market size of a country. The effect of population size of both importing countries and New Zealand are not found to be significant. This implies that population is not an important explanatory variable in explaining New Zealand's total merchandise trade. The coefficient of the population variable on importing countries has a positive value. If the population of the partner country increases by 1%, New Zealand's total merchandise trade would increase by approximately 0.142%. Importing countries with larger market size indicate that they have higher absorption capacity to trade more. The population growth of the importing country creates a larger export market for New Zealand. However, New Zealand's population variable is found to have a negative relationship with its total merchandise trade and the effect is insignificant at a conventional level. This suggests that it is not considered to be an important explanatory variable in explaining New Zealand's merchandise trade flows. New Zealand's total merchandise trade will have 2.409% decline with an increase by 1% in New Zealand's population size.

An increase in geographical distance between countries is expected to have a negative effect on merchandise trade. This is consistent with the assumption of the traditional gravity model. Geographical distance is used as a proxy for trade barriers like transportation costs, time, cultural unfamiliarity and market access (Sohn, 2001). Geographical distance in this research has a negative coefficient and it is statistically significant at 1% level. New Zealand's total merchandise trade would decline 1.572% with a 1% increase in geographical distance. This indicates that transportation cost is an important factor in determining New Zealand's merchandise trade volume with its trading partners. The coefficient of the land size has the expected negative sign with a statistical significance at 5% level. A 1% increase in the trading partner's land size would lead to 0.242% decline in New Zealand total merchandise trade. Larger countries tend to be more self-sufficient, and thus import less. In general, results obtained in this research are consistent with the predictions of the gravity model.

In regard to two of the dummy variables in the model, the coefficient of the common language is expected to have a positive effect on trade flows by reducing communication barriers and increasing information flows between two countries. In case of New Zealand, total merchandise trade would increase by 0.194% if both importing and exporting countries are sharing a common language. However, the influence is not significant at a conventional level that shows a weak linkage between common language and total merchandise trade. This indicates that there are no substantial barriers given the common language of the importing country and the level of common language of New Zealand.

Finally, the bilateral trade agreement (BTA) variable is considered to be a FTA dummy variable. The coefficient of the BTA dummy has an expected positive value of 0.324 that is also statistically significant at 1% level. Other things being the same, New Zealand's total merchandise trade would increase by 0.324% if New Zealand and its trading partner country share a free trade agreement. It shows that being a member of a regional trade agreement or having agreement bilateral FTA has a significantly positive impact on trade flows. This can be applied in the case of the TPP as it is, in effect, a regional FTA. The result shows that the existing free trade agreement between New Zealand and its trading partner countries positively impacted New Zealand's total merchandise trade. It is expected that the same would happen to

New Zealand after TPP is implemented. This implies that belonging to a regional trade agreement is a very important factor in enhancing bilateral trade flows.

The estimated results and coefficients obtained from the gravity equation can be used to explain the trade composition and the trade patterns expected from calculated trade indicators. According to the results of the gravity model, an increase in geographical distance will reduce total merchandise trade flows. New Zealand tends to trade more with its neighbouring country like Australia. New Zealand having two FTAs with Australia explains this extremely strong trade relationship between two countries. The positive and significant coefficient of the BTA dummy also corroborates with this. Trade between New Zealand and Brunei predicted by the gravity equation also explain such trade patterns. From the results of the gravity model, New Zealand's trade would increase with countries that have large economic size (GDP) and population but small land area. Since Brunei is a small economy in terms of GDP with a small population compared to other countries, it is the gravity model that explains low trade intensity index for New Zealand with Brunei Darussalam even though they have an FTA in force since 2006.

3. CONCLUSION

The main purpose of this study was to analyse the determinants of New Zealand's bilateral trade flows employing a modified gravity model. With this aim, this research focused on examining the trade patterns between New Zealand and its major trading partners, including potential TPP members using annual pre-agreement data for the period of 2000 and 2015. In addition, four of New Zealand's major trading partners were chosen to include in the gravity model.

Following the traditional gravity model with core variables of GDP of both importing and exporting countries and distance between them, additional variables were added in this research. New Zealand's population, importer's population, importer's land area, dummy variables of common language and bilateral trade agreements were included to make a better explanation of New Zealand's bilateral trade flows. The assumptions of the traditional gravity model state that economic size would positively affect bilateral trade flows between countries while distance would negatively affect this outcome. An expanded gravity equation that was estimated in three variants, pooled regression, fixed effects and random effects. The result of the Hausman test provided that the random effects model is more appropriate and efficient for the gravity model estimation. Accordingly, the results and interpretations focused on random effects model.

Estimated results show that economic size of both importers and exporter have a positive impact on New Zealand's merchandise trade flows as expected in a traditional gravity model. Foreign economic size has a greater positive influence on New Zealand's total merchandise trade. Besides, a positive coefficient of the market size of foreign countries indicates that New Zealand tends to trade more with larger countries than smaller countries. New Zealand's population has a negative effect on merchandise trade, which suggests higher domestic absorption effects. However, neither New Zealand nor its trading partner's population had a

significant effect on merchandise trade. Both geographical distance and importers' land size have negative effects on New Zealand's merchandise trade. Common language dummy variable was estimated to have a positive but insignificant influence on New Zealand's merchandise trade. To investigate the trade effects of regional integration, BTA dummy variable that is considered to be an FTA dummy was included in the gravity estimation and it shows a positive and statistically significant effect on total merchandise trade. The result implies that two countries that have free trade agreement or belong to some regional trade agreements exhibit an enhanced volume of trade.

Another objective of this study was to review the trade intensity index and the revealed comparative advantage between New Zealand and potential TPP members. When applied to potential TPP countries, calculated TIIs show that there is not enough evidence to suggest that TPP would necessarily improve New Zealand's trading relationship with member countries, yet it would reinforce the existing trade patterns. Calculated RCAs in this research indicate that the trade creation effects are likely to be larger than trade diversion effects. Generally speaking, the TPP countries are sharing different RCA in different product groups.

Instead of calculating the gain of TPP in absolute terms, this study focused on the trade effects of TPP using gravity model. Although TPP is unlikely to happen in its present form, this study could provide some useful predictions about the likely trade effects on New Zealand merchandise trade after some variants of the TPP become a reality.

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APPENDICES

Appendix 1: Trade intensity index (TII)

Trade intensity index is to determine the trade relationship between two countries and is defined as the share of the home country's exports to a partner country divided by the share of the world exports to the partner country. The trade intensity index (TII) is calculated as

$$\text{TII} = \frac{\frac{X_{ij}}{X_{it}}}{\frac{X_{wj}}{X_{wt}}}$$

Where
X_{ij} = value of country i's exports to country j
X_{it} = country i's total exports
X_{wj} = world exports to country j
X_{wt} = total world exports

A value of the trade intensity index that is higher than 1 indicates that the trading relationship between two countries is larger than expected. Conversely, a trading relationship between two countries is smaller than expected when the value of trade intensity index is smaller than 1.

Appendix 2: Revealed Comparative Advantage (RCA)

The index is calculated as the ratio of a country's share of a commodity in the country's total exports to the share of world exports of the commodity in total world exports. The formula for the RCA index is

$$\text{Revealed comparative advantage (RCA)} = \frac{\frac{X_{cg}}{X_c}}{\frac{X_{wg}}{X_w}}$$

Where
X_{cg} = country c's exports of commodity g
X_c = country c's total exports
X_{wg}= world exports in commodity g
X_w = total world exports

A country is considered to have a revealed comparative advantage on the product group if the value of the index exceeds 1 and a revealed comparative disadvantage if the value is below 1.