Exploring Australia's global trade potential: a gravity approach with panel data

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Abstract: This paper investigates Australia's global trade potential taking data of Australia and its 57 trading partners for the period of 1972-2006. Gravity model approach and panel data estimation techniques have been used. Providing a theoretical justification for using the gravity model the paper first estimates the augmented gravity models of trade. The estimated coefficients are then used to predict Australia's trade potential. Our results reveal that Australia's bilateral trade is affected positively by income, openness of trading partners, common language and free trade agreement, and negatively by the per capita income differential and distance between Australia and trading partners. The results indicate Australia has notable trade potential with Mexico, Argentina, Uruguay, Austria, Peru, India, the Philippines, Brazil, Chile, the USA, New Zealand, Greece, Japan, Turkey, Nepal, Kenya, Spain, Hungary, Brunei, Hong Kong, South Africa, Pakistan and Canada.

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I. INTRODUCTION

Foreign trade plays a vital role in the process of economic development in any country. Both export and import trades are equally important. A country must import required raw materials, intermediate and capital goods to enlarge its production base and to foster export growth if these goods are not domestically available. Imports of consumer goods are also essential to meet the growing domestic demand. On the other hand, export trade is crucial to meet the 'foreign exchange gap', to increase the import capacity of the country concerned and to reduce dependence on foreign aid. An increase in import capacity boosts industrialisation and overall economic activities, which, in turn, can ensure economic growth. Therefore, increased participation in world trade is considered as the single most important key to rapid economic growth and development.

The foreign trade sector of Australia constitutes an important part of its economy. The trade-GDP ratio increased to 42.09 percent in 2006 from 32.90 percent in 1980. However, despite the gradual importance, this sector has been suffering from a deficit over the period of 1980-2007 with the only exception of 1991 when this sector experienced a slight trade surplus (WDI, World Bank). Furthermore, the growth rate in the volume of Australian merchandise export trade is also lower compared to other countries. In 2006 and 2007, the growth rates were 2.0 percent and 2.5 percent, respectively. These figures were 10.5 percent and 7.0 percent for the USA, 22.0 percent and 19.5 percent for China, 11.0 percent and 11.5 percent for India, 10.0 percent and 9.0 percent for Japan, 13.5 percent and 11.5 percent for Asia, and 8.5 percent and 6.0 percent for the world (WTO, 2008).

In addition, Australia's share in world exports, imports and trade is still very low and unimpressive when compared with other countries including its Asian neighbours. In 2007, Australia's export, import and trade share in world trade was 1.0 percent, 1.2 percent and 1.1 percent, respectively. These figures were 9.5 percent, 7.4 percent and 8.5 percent for Germany, 8.7 percent, 6.7 percent and 7.7 percent for China, 8.3 percent, 14.2 percent and 11.3 percent for the USA, 5.1 percent, 4.4 percent and 4.7 percent for Japan, 2.7 percent, 2.5 percent and 2.6 percent for the Republic of Korea, 2.1 percent, 1.8 percent and 2.0 percent for Singapore, and 1.3 percent, 1.0 percent and 1.2 percent for Malaysia (IMF, 2007). Therefore, Australia must increase its trade volume with the rest of the world for the sake of healthy economy. Hence this study – an estimation of Australia's trade potential - is crucial and justified.

In the process of estimation of Australia's trade potential, we have used the generalised gravity model. This model is a widely used empirical tool for analysing bilateral trade flows.

We have used the gravity model to first analyse the Australia's trade flows globally taking data for the period of 1972-2006. The coefficients thus obtained from the estimated gravity models are then used to predict Australia's trade potential.

The main contribution of this study is as follows: To the best of my knowledge, this is the first study that has estimated Australia's global trade potential using the gravity model and panel data against the backdrop of Australia's historic trade deficit and lower and unimpressive share in the world trade. The study covers 92 percent of Australia's global trade based on data of 2007 (IMF, 2009). Thus this study will play a significant role for policy makers in particular, and for the economies of Australia and its trading partners in general.

The remainder of this paper proceeds as follows: Section II provides the introduction and theoretical justification of the gravity model; this section also briefly reviews the existing literature on the application of gravity model to international trade flows. Section III describes the data, methodology and model selection, model estimation, and econometric issues. Section IV analyses the results. Section V discusses Australia's trade potential around the globe. Finally, section VI concludes with policy implications.

II. THE GRAVITY MODEL

The gravity model has been applied to a wide variety of goods and factors of production moving across regional and national boundaries under different circumstances since the early 1940s (Oguledo and Macphee, 1994). This model originates from the Newtonian physics notion. Newton's gravity law in mechanics states that two bodies attract each other proportionally to the product of each body's mass (in kilograms) divided by the square of the distance between their respective centres of gravity (in meters).

The gravity model for trade is analogous to this law. The analogy is as follows: the trade flow between two countries is proportional to the product of each country's 'economic mass', generally measured by GDP (national income) and inversely proportional to the distance between the countries' respective 'economic centres of gravity', generally their capitals. This formulation can be generalized to

$$Trade_{ij} = \alpha \; Y_i Y_j / D_{ij} \qquad (1)$$

where $Trade_{ij}$ is the value of the bilateral trade between country i and j , Y_i and Y_j are country i's and country j's GDPs, D_{ij} is the geographical distance between the countries' capitals and α is a constant of proportionality.

Taking logarithms of the equation (1), we get the following linear form of the model:

$$Log(Trade_{ij}) = \alpha + \beta \log (YiYj) + \delta \log (D_{ij}) \qquad (2)$$

Where α, β and δ are coefficients to be estimated. Equation (2) is the baseline model where bilateral trade flows are expected to be a positive function of income and negative function of distance. However we know that there are other factors that influence trade levels.

Most estimates of gravity models add a certain number of dummy variables to (2) that test for specific effects, for example being a member of a trade agreement, sharing a common land border, speaking the same language and so on.

Assuming that we wish to test for p distinct effects, the model then becomes:

$$\text{Log}\ (\text{Trade}_{ij}) = \alpha + \beta \log (YiYj) + \delta \log (D_{ij}) + \sum_{s=i}^{p} \lambda sGs \qquad (3)$$

Theoretical justification of using gravity model

The justification for the gravity equation can be analysed in the light of a partial equilibrium model of export supply and import demand as developed by Linneman (1966). Based on some simplifying assumptions the gravity equation turns out, as Linneman argues, to be a reduced form of this model.

Using a trade share expenditure system Anderson (1979) also derives the gravity model which postulates identical Cobb-Douglas or constant elasticity of substitution (CES) preference functions for all countries as well as weakly separable utility functions between *traded* and *non-traded* goods. The author shows that utility maximization with respect to income constraint gives *traded goods* shares that are functions of *traded goods* prices only. Prices are constant in cross-sections; so using the share relationships along with trade balance / imbalance identity, country j's imports of country i's goods are obtained. Then assuming log linear functions in income and population for traded goods shares, the gravity equation for aggregate imports is obtained.

Further justification for the gravity model approach is based on the Walrasian general equilibrium model, with each country having its own supply and demand functions for all goods. Aggregate income determines the level of demand in the importing country and the level of supply in the exporting country (Oguledo and Macphee, 1994). While Anderson's (ibid.) analysis is at the aggregate level, Bergstrand (1985, 1989) develops a microeconomic foundation to the gravity model. He opines that a gravity model is a reduced form equation of a general equilibrium of demand and supply systems. In such a model the equation of trade demand for each country is derived by maximizing a constant elasticity of substitution (CES) utility function subject to income constraints in importing countries. On the other hand, the equation of trade supply is derived from the firm's profit maximization procedure in the exporting country, with resource allocation determined by the constant elasticity of transformation (CET). The gravity model of trade flows, proxied by value, is then obtained under market equilibrium conditions, where demand for and supply of trade flows are equal(Karemera *et al.,* 1999). Bergstrand argues that since the reduced form eliminates all endogenous variables out of the explanatory part of each equation, income and prices can also be used as explanatory variables of bilateral trade. Thus instead of substituting out all endogenous variables, Bergstrand (ibid.) treats income and certain price terms as exogenous and solves the general equilibrium system retaining these variables as explanatory variables. The resulting model is termed a “generalized” gravity equation (Krishnakumar 2002).

Eaton and Kortum (1997) also derive the gravity equation from a Ricardian framework, while Deardorff (1998) derives it from a Heckscher-Ohlin (H-O) perspective. Deardorff opines that the H-O model is consistent with the gravity equations. As shown by Evenett and Keller (1998), the standard gravity equation can be obtained from the H-O model with both perfect and imperfect product specialization.

To test for the relevance of monopolistic competition in international trade Hummels and Levinsohn (1993) use intra-industry trade data. Their results show that much intra-industry trade is specific to country pairings. So their work supports a model of trade with monopolistic competition (Jakab *et al.*, 2001).

Therefore, the gravity equation can be derived assuming either perfect competition or a monopolistic market structure. Neither increasing returns nor monopolistic competition is a necessary condition for its use if certain assumptions regarding the structure of both product and factor market hold (Jakab *et al*., 2001).

Further, Anderson and van Win Coop (2003) also derive import gravity equation as a function of income and trade cost. Trade cost is mainly transport cost in this kind of model which is related to distance.

Trade theories just explain why countries trade in different products but do not explain why some countries' trade links are stronger than others and why the level of trade between countries tends to increase or decrease over time. This is the limitation of trade theories in explaining the size of trade flows. Therefore, while traditional trade theories cannot explain the extent of trade, the gravity model is successful in this regard. It allows more factors to be taken into account to explain the extent of trade as an aspect of international trade flows (Paas, 2000).

Literature survey

There are wide ranges of applied research where the gravity model is used to examine the bilateral trade patterns and trade relationships[1]. These studies use the gravity model both for the aggregate bilateral trade and also for product level trade. Both the cross -section and panel data approaches have been used by these studies.

Many of these works also try to examine the trade potential, trade determinants, trade direction and trade enhancing impacts. For example, Rahman (2003, 2010a) examines the determinants Bangladesh's trade using panel data estimation technique and generalised gravity model. The author considers both economic and natural factors when estimating the gravity model. The study covers data of 35 countries for 28 years (1972-99). Batra (2006) considers the augmented gravity model to estimate India's trade potential. The model is based on cross-section data of 2000. Taking cross- section data from 1996-99 and using ordinary

[1] see Bergstrand 1985 and 1989, Oguledo and Macphee 1994, Frankel 1997, Karemera *et al.* 1999, Mathur 1999, Sharma and Chua 2000, Paas 2000, Rahman 2003, Batra 2006, Jakab *et al.* 2001, Kalbasi 2001, Christie 2002, Mátyás *et al*. 2000, Feenstra et al 2001, and Frankel and Wei 1993, for example.

least square (OLS), Christie (2002) analyses trade potential for Southeast Europe. In a sample of 76 countries, Kalbasi (2001) examines the volume and direction of trade for Iran dividing the countries into developing and industrial countries. The impact of the stage of development on bilateral trade is analysed in this study. Using cross-section and panel data Frankel (1997) also applies the gravity model to examine roles of trading blocs, currency links, etc. Analysing the bilateral trade patterns worldwide Frankel and Wei (1993) examine the impact of currency blocs and exchange rate stability on trade. Anderson and Wincoop (2003), Baier and Bergstrand (2003), and Feenstra (2003) analyse the impact of multilateral factors on bilateral trade flows. Rahman (2010b) also attempts to explore the trade potential of Australia based on cross section data of 2001 and 2005. However, real picture of trade potential may not be reflected based on 2 years of data only.

III. DATA, METHODOLOGY AND MODEL SELECTION, ESTIMATION, AND ECONOMETRIC ISSUES

Data and sample size

Our study covers Australia's trade with 57 countries around the globe. In 2007, Australia's trade with these countries together comprises 91.70 percent of its total world trade. Export to these countries together comprises 91 percent of its total world exports, and import from these countries together comprises 92.32 percent of its total world import (IMF, 2009). The countries are chosen on the basis of importance of trading partnership with Australia and availability of required data. Twenty two countries from Asia, eighteen countries from Europe, four countries from North America, five countries from South America, four countries from Africa and four countries from Oceania are included in the sample as Australia's trading partners. Table 9 provides the list of countries.

The data are collected for the period of 1972-2006. Every attempt has been made to contain as many trade partners as possible. Sample size is affected by the availability of data of the dependent and explanatory variables. Data for all variables are taken on a yearly basis. However because of many missing observations in the data series it has been necessary to estimate missing values from the data set. As there is no *priori* information, missing observations were estimated using simple average for one missing value and moving average method for more than one missing values.

Data on GDP, GDP per capita, population, total exports and total imports are obtained from the *World Development Indicators (WDI*) database of the World Bank 2008 and 2009. However, data for total exports and total imports of Bahrain, Jordan and Singapore are collected from International Financial Statistics (IFS) of IMF as these data are not available in WDI. Data on Australia's exports of goods and services (country i's exports) to all other countries (country j), Australia's imports of goods and services (country i's imports) from all other countries (country j) and Australia's total trade of goods and services (exports plus imports) with all other countries included in the sample are obtained from the *Direction of Trade Statistics Yearbook* (various issues) of IMF. Data on the distance (in nautical miles) between Canberra (capital of Australia) and other capital cities of country j are obtained from *http://www.happyzebra.com*. Data on Australia's regional/free trade agreement[2] and common language[3] are obtained from different websites.

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[2]Data sources for FTA/RTA: http://www.dfat.gov.au/trade/ftas.html

GDP, GDP per capita are in constant 2000 US dollars. GDP, total exports, total imports, Australia's exports, Australia's imports and Australia's total trade are measured in million US dollars.

Methodology and Selected Model

Classical gravity models generally use cross-section data to estimate trade effects and trade relationships for a particular time period, for example one year. In reality, however, cross-section data observed over several time periods (panel data methodology) result in more useful information than cross-section data alone. The advantages of this method are: first, panels can capture the relevant relationships among variables over time; second, panels can monitor unobservable trading-partner-pairs' individual effects. If individual effects are correlated with the regressors, OLS estimates omitting individual effects will be biased. Therefore, we have used panel data methodology for our empirical gravity model of trade.

We have used unbalanced panel strategy as data for some variables for some years for some countries are not available. Hausman test is performed to compare fixed- effects and random-effects estimations; the test suggests that fixed effect model is the appropriate model. However, as the distance, regional trade agreements / free trade agreement and common

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http://www.dfat.gov.au/trade/

http://www.trademinister.gov.au/releases/2009/sc_017.html

http://www.trademinister.gov.au/releases/2009/sc_021.html

[3] Data source for common language: http://en.wikipedia.org

language variables cannot be estimated with fixed effect model as they do not change overtime; we have estimated separate least square models for these variables, where the dependent variable is the individual country effects taken from the fixed effect estimations[4].

For estimation of the gravity model, we have followed Frankel (1997), Sharma and Chua (2000), Rahman (2003, 2010) and Batra (2006). Since the dependent variable in the gravity model is bilateral trade (sum of exports and imports) between the pairs of countries, the product of GDP and the product of per capita GDP have been used as independent variables. We have added some additional independent variables in our model. The model is therefore "augmented" in the sense that several conditioning variables that may affect trade have been included. Thus the gravity model of trade in this study is:

$$\log (Trade_{ij}) = \alpha_0 + \alpha_1 \log (GDP_i{*}GDP_j) + \alpha_2 \log (PCGDP_i{*}PCGDP_j) + \alpha_3 (TR/GDP_j) + \alpha_4 \log(Distance_{ij}) + \alpha_5(RTA/FTA) + \alpha_6(Com.Lang) + U_{ij} \quad (4)$$

where, $Trade_{ij}$ = Value of total trade between Australia (country i) and country j, GDP_i (GDP_j) = Gross Domestic Product of country i (j), $PCGDP_i$ ($PCGDP_j$) = Per capita GDP of Country i (j), TR/GDP_j = Trade- GDP ratio of country j, $Distance_{ij}$ = Distance between country i and country j, RTA = Regional trading agreement (dummy variable), Com.Lang= Common language (dummy variable), U_{ij} = error term, α_s = parameters. We expect positive signs for α_1, α_2, α_3, α_5 and α_6 and a negative sign for α_4.

[4] Filippinic and Molini, 2003, Zarzoso and Lchmann, 2003, Egger and Pfaffermayr, 2003 followed this procedure.

To distinguish the dominant influences on bilateral trade flows we have reconsidered the above model taking per capita GDP differential as a variable instead of per capita GDP. The alternative model is as follows:

$$\log (Trade_{ij}) = \alpha_0 + \alpha_1 \log (GDP_i * GDP_j) + \alpha_2 \log (PCGDPD_{ij}) + \alpha_3 (TR/GDP_j) + \alpha_4 \log (Distance_{ij}) + \alpha_5 (RTA) + \alpha_6 (Com.Lang) + U_{ij} \quad (5)$$

Where, PCGDPDij = per capita GDP differential between country i and j. A positive sign of this variable would support the Hecksher - Ohlin hypothesis (influences of factor endowments differences), while a negative sign would support the Linder hypothesis (influences of style taste differences).

Rationale and explanation of explanatory variables

GDP: The larger the country is in terms of its GDP, the larger the number of varieties of goods offered for trade. The more similar the countries are in terms of GDP, the larger is the volume of this bilateral trade. Thus with economies of scale and differentiated products, the volume of trade depends in an important way on country size in terms of its GDP (Paas 2000).

Per Capita GDP: While we are taking GDP as a variable, the reason for taking 'per capita GDP' as a separate independent variable is that it indicates the level of development. If a country develops, the consumers demand more exotic foreign varieties that are considered superior goods. Also it is true that more developed countries have more advanced transportation infrastructures which facilitate trade. Moreover, per capita GDP, as a separate independent variable, is widely used to analyse bilateral trade flows as the standard gravity model predicts that countries with similar levels of output per capita will trade more than countries with dissimilar levels.

Per capita GDP differential: This variable has been included in an alternative model to explore which hypothesis – the H-O hypothesis or the Linder hypothesis – dominates Australian bilateral trade. The Heckscher-Ohlin hypothesis predicts that countries with dissimilar levels of per capita income will trade more than countries with similar levels. On the contrary, the Linder hypothesis predicts that countries with similar levels of per capita income will trade more with each other, as they will have similar preferences for differentiated products. Thus the Linder hypothesis is associated with a negative effect of Per capita GDP differential between country i and j on bilateral trade. A positive effect of this variable is associated with the Heckscher-Ohlin hypothesis.

Trade-GDP ratio: Trade-GDP ratio variable indicates the openness of the country. The more open the countries are, the greater would be the trade between them. So a positive sign for this variable is expected. Since we are estimating our gravity model of trade for Australia, this variable is considered for country j only.

Distance: Transportation costs affect trade negatively. Transport costs are proxied by the distance. So distance between a pair of countries naturally determines the volume of trade between them.

The following two dummy variables are also included to capture the impact of historical and cultural ties between the fair of countries on bilateral trade. These are explained below.

Regional Trading Agreement/Free Trade Agreement (RTA/FTA): To facilitate trade, countries often enter into regional trading agreements. Preferential arrangements are found to be trade enhancing and statistically significant (Oguledo and Macphee, 1994). The reason is that trade group member countries are more likely to have incentives for trade with each other as their cultures, cultural heritages or patterns of consumption and production are likely to be similar. We posit the dummy variable is equal to one when both trading partners in a given pair belong to the same regional group and zero otherwise. A special regional effect on bilateral trade flows will be known from the estimated coefficient of this variable. On an average positive RTA/FTA effect is expected on trade flows.

Common Language: If trading partners share a common language, transaction costs of trading is expected to be reduced, because speaking the same language helps facilitate and expedite trade negotiations. Thus trade is expected to increase between them. If both trading countries in a group have common official language, the dummy variable is equal to one and zero otherwise. This variable should have positive effect on trade.

Also countries with common borders are likely to have more trade than countries without common borders (Karemera, *et al*. 1999). This variable is, however, not considered here as Australia has no land border with other countries. Even its sea border with other trading partners is also not significant.

Estimation

We have followed three step estimation strategies to explore Australia's global trade potential. In the first stage we have estimated equation (4) and equation (5) taking all variables except distance and dummy variables. The dependent variable is the value of total bilateral trade (export value plus import value in US dollar million) of country i (Australia) and country j (Australia's trading partner). This trade value is in log form. In the second stage we have estimated the distance and dummy variables where individual country effects obtained from fixed effect estimations are dependent variable.

The coefficients thus obtained in the first and second stages have been used in the third stage to calculate the predicted bilateral trade of Australia with its 57 trading partners around the globe. These predicted trade values are then analysed and compared with the actual trade values to explore Australia's global trade potential.

Econometric Issues

Endogeneity

As mentioned earlier, Bergstrand (1985, 1989) argues that income (size of the economy) can be treated as an exogenous variable in the gravity model, as a gravity model is a reduced form equation of a general equilibrium of demand and supply systems, and the reduced form eliminates all endogenous variables out of the explanatory part of each equation. However, there is empirical and theoretical support that trade can also affect income. If an endogeneity problem exists, the effect of income on trade may be misleading. To solve this problem alternative instrumental variables (IV) estimations, as suggested by Anderson (1979), were attempted using lagged value of income and population as instruments[5]. This alternative estimation does not change the coefficient of any of the variables to any significant extent. This implies that the endogeneity of income, if exists at all, does not create any significant

[5] Results are not reported here, but may be available on request from the author.

distortion on the initially postulated relationship in the gravity model. Therefore, GDP and GDP per capita are treated as exogenous variables in the estimation.

Multicollinearity

All variables are tested for multicollinearity. Simple correlations as well as Klein's thumb rule have been used to test for multicollinearity in our specification. Simple correlations are small (see Table 1). To apply Klein's thumb rule each independent variable of the model is regressed on the remaining independent variables and R_i^2's are computed. If any of these R_i^2's is greater than the original R^2, then it can be concluded that there is severe multicollinearity in the model. From the results we observe that the model does not have any multicollinearity problem[6].

Heteroscadasticity

To test the heteroscadasticity in the model regression is run considering the heteroscadasticity for every observation and all observations within groups. Regression results reported here are Hetero corrected (see Table 2 and 3).

IV. DISCUSSION OF RESULTS

Table 2 and 3 present the estimated results of the augmented gravity models. Table 2 shows the estimated results of model 4 where per capita GDP variable is considered as an explanatory variable and Table 3 shows the estimated results of model 5 where per capita GDP differential variable is considered as an explanatory variable.

Gravity model estimation results using per capita GDP variable (model 4)

[6] Results are not reported here, but may be available on request from the author.

From Table 2 it is observed that the gravity models of trade fits the data well and explain 95 percent of the variation in bilateral trade across our sample of countries. However, per capita GDP variable is not significant even at 10% probability level. Dropping this variable a separate estimation has been taken. Regression results are reported in Table 2.

The coefficient of product of GDP is positive and highly significant as expected. This implies that Australia tends to trade more with larger economies. Australia's bilateral trade with country j increases proportionately with the size of the country (GDP). The openness variable also affect Australia's bilateral trade positively and more than proportionately [exp (0.16) = 1.17]. This variable is found statistically highly significant. The estimated coefficient on distance variable has the anticipated negative sign and it is -2.05. This variable is found highly statistically significant. The results indicate that for every 1 percent increase in the distance between the trading pairs, bilateral trade falls by 2.05 percent. The dummy variable, RTA/FTA, the common language variable are found significant and their effects on bilateral trade are positive and substantial. Two countries that share a common language are estimated to engage in 46 percent more trade than two otherwise similar countries. Two countries that are in FTA/RTA group are estimated to engage 13% more trade than two otherwise similar countries (see Table 4).

Gravity model estimation results using per capita GDP differential variable (model 5)

This model also fits the data well and explains 95 percent of the variation in bilateral trade across our sample of countries.

The estimated coefficients in this model also give very similar results as are given in model 4 (see Table 3). The per capita GDP differential has negative and statistically significant effect on bilateral trade flows. So our estimated results support the Linder hypothesis, i.e. similar countries trade more than dissimilar ones. The coefficients of this variable are -0.16. The implication is that 1 percent increase of per capita income differential between pair of countries results in 0.16 percent decrease of bilateral trade.

V. AUSTRALIA'S TRADE POTENTIAL

After obtaining the estimated results of the gravity models for bilateral trade flows we proceed to estimate trade potential for Australia. In this section we have used the estimated coefficients obtained in previous section to predict Australia's trade with all the countries in our sample. The ratio of predicted trade (P) obtained by the models and actual trade (A) i.e. (P/A), is then used to analyse the Australia's global trade potential. Australia (country i) has trade potential with country j if the value of (Pij/Aij) is greater than one. Under this situation, attempts for Australia's trade expansion with country j are recommended.

The value of (P-A) has also been used to classify countries with potential for expansion of trade with Australia. A positive value implies future possibilities of trade expansion while a negative value indicates Australia has already exceeded its trade potential with the particular trading partner. Depending on the value of (P-A) and (P/A) the Australia's trading partners are divided into two groups: those with which potential for trade expansion is visible and those with which Australia has already exceeded its trade potential. These two groups of countries are presented in Table 5-8.

Table 5 and 6 show the countries where Australia has the trade potential. Both Tables give almost similar results. From the estimated results it is evident that Australia has the highest trade potential with countries like Mexico, Argentina, Uruguay, Austria, Peru, India, the Philippines, Brazil, Chile, the USA, New Zealand, Greece, Japan, Turkey, Nepal, Kenya, Spain, Pakistan, Hungary, Brunei and Canada. Australia can potentially attain almost 6 times more trade with Mexico, 5 times more trade with Argentina, 4 times more trade with Uruguay and Austria, 3 times more trade with the Philippines and Brazil, 2.6 times more trade with the USA and Chile, 2 times more trade with New Zealand, Greece, Japan, Turkey, Spain, Kenya, Hong Kong and Hungary, 1.65 times more trade with South Africa and 1.49 times more trade with Pakistan.

Australia's Trade Potential / Overtrade by Regions

Among the Asian trading partners, Australia has potential for trade expansion with Bangladesh, Brunei, China (not notable), Hong Kong, India, Indonesia, Japan, Nepal, Pakistan, the Philippines and Singapore. On the other hand, Australia has already exceeded its trade potential with Bahrain, Iran, Israel, Jordan, Korea, Kuwait, Malaysia, Saudi Arabia, Sri Lanka, Thailand and United Arab Emirate (UAE). Among the European trading partners, trade potential exists for Austria, Greece, Hungary, Norway, Portugal, Spain, and Turkey. However, Australia trades more than its potential with Belgium, Denmark, Finland, Germany, Ireland, Italy, the Netherlands, Sweden, Switzerland and the UK. Australia has potential for trade expansion with all North and South American countries included in the sample. In Oceania, Australia has trade potential with New Zealand, while the country has overtraded with Fiji, Papua New Guinea and Solomon Islands. Among the African countries Australia has trade potential with South Africa and Kenya, but the country has exceeded its trade potential with Ghana and Egypt (see Tables 5-8).

VI. CONCLUSION AND POLICY IMPLICATIONS

The main purpose of this research was to estimate Australia's trade potential with its trading partners around the globe. We have pursued this research using the generalised / augmented gravity models. Theoretical justification for using the gravity model to analyse bilateral trade flows is also re-affirmed in this paper.

We have used panel data for the period of 1972-2006 of 58 countries including Australia. Trade with these 57 trading partners constitute about 92 percent of Australia's total world trade. Hence our analysis is based on maximum possible coverage of Australia's trade.

Estimated results reveal that Australia's bilateral trade is positively and significantly affected by higher economic size in terms of GDP and openness variable (trade-GDP ratio). The magnitude of this effect is the highest for openness variable (more than proportional), and lowest for GDP variable (proportional). Australia's bilateral trade is also positively and significantly influenced by common language and FTA/RTA. Australia tends to trade more with the countries where English is the official language, and with its trading bloc. As anticipated, distance between trading partners negatively affects Australia's bilateral trade. Our research supports the Linder hypothesis, i.e. similar countries trade more than dissimilar ones.

This study explores that Australia has potential for trade expansion with Mexico, Argentina, Uruguay, Austria, Peru, India, the Philippines, Brazil, Chile, the USA, New Zealand, Greece, Japan, Turkey, Nepal, Kenya, Spain, Pakistan, Hungary, Brunei, Canada, South Africa, Trindad and Tobago, Hong Kong, Bangladesh, Singapore, Portugal, Norway, Indonesia and China.

This research confirms that Australia has exceeded its trade potential with Bahrain, Iran, Israel, Jordan, Korea, Kuwait, Malaysia, Saudi Arabia, Sri Lanka, Thailand, United Arab Emirate (UAE), Belgium, Denmark, Finland, Germany, Ireland, Italy, the Netherlands, Sweden, Switzerland, the UK, Fiji, Papua New Guinea, Solomon Islands, Ghana and Egypt.

The policy implication is that the Australian government should take correct measures to increase trade volume with the countries where full potential of trade expansion is yet to be exploited. Endeavours must be continued to maintain its high level of trade, particularly export trade, with the countries where Australia has already exceeded its trade potential. Efforts must be made to increase growth or national income as GDP is the major determinant of Australia's trade, and GDP increases export supplies and import capacity. Trade negotiations to reduce partner countries' all sorts of trade barriers must continue as the openness variable positively affects Australia's trade. Proper quality of the goods and services must be maintained and the varieties of goods and services must be increased. All partner countries' propensities to export and import must be taken into account sufficiently and adequately when trade policy is set as the Australia's trade is not independent of country specific effects.

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Table 1: Simple correlations of variables

	TRADEIJ	PGDPIJ	GDPIJ	PGDPDIF	POPIJ	TRGDPJ	DIS	FTA	LANG
TRADEIJ	1								
PGDPIJ	0.420	1							
GDPIJ	0.699	0.535	1						
PGDPDIF	-0.213	-0.546	-0.251	1					
POPIJ	0.429	-0.265	0.671	0.192	1				
TRGDPJ	0.189	0.302	-0.182	-0.250	-0.478	1			
DIS	-0.105	0.308	0.415	-0.236	0.204	-0.221	1		
FTA	0.240	-0.059	-0.076	0.138	-0.035	0.186	-0.544	1	
LANG	0.117	-0.198	-0.214	0.080	-0.070	0.210	-0.306	-0.032	1

Table 2: Hetero corrected trade models with and without per capita GDP variable. Dependent variable is log (Tradeij)

Variables	With PCGDP	Without PCGDP
	Coefficients (t-ratios)	Coefficients (t-ratios)
Log(GDP_i*GDP_j)	1.17 (12.77)	1.09 (21.91)
Log(PCGDPi*PCGDPj)	-0.14 (-1.42)	
$(TR/GDP)_j$	0.17 (4.04)	0.16 (3.58)
R^2	0.95	0.95
F -statistic	601.5	611.12
Observations	1976	1976

Table 3: Hetero corrected trade model with per capita GDP differential variable. Dependent variable is log (Tradeij)

Variables	Coefficients (t-ratios)
Log(GDP_i*GDP_j)	1.10 (23.27)
Log(PCGDPDij)	- 0.04 (-1.77)
$(TR/GDP)_j$	0.16 (3.58)
R^2	0.95
F -statistic	601.71
Observations	1976

Table 4: Estimated results of the distance and dummy variables: dependent variable is country specific effect

Variable	**With PCGDP**	**With PCGDPfiff**
	Coefficients (t-ratios)	Coefficients (t-ratios)
Log (Distance)	-2.05 (-32.99)	-2.09 (33.44)
FTA/RTA	0.12 (4.72)	0.12 (4.63)
Common Language	0.38 (17.22)	0.38 (17.19)
R^2	0.59	0.60

F –statistic	983.90	1000.88
Observations	57	57

Table 5: Trading partners with trade potential based on Model 4

Partner Country	Actual Trade (A) US$ million	Predicted Trade (P) US$ million	P-A (potential) US$ million	P/A
Argentina	90.68	457.78	367.10	5.05
Austria	133.73	489.89	356.15	3.66
Bangladesh	84.62	88.14	3.52	1.04
Brazil	263.92	739.36	475.44	2.80
Brunei Darussalam	37.04	57.43	20.39	1.55
Canada	1185.98	1681.81	495.83	1.42
Chile	44.02	116.31	72.29	2.64
China	2252.29	2309.96	57.67	1.03
Greece	68.19	147.58	79.39	2.16
Hongkong	1411.99	2446.48	1034.50	1.73
Hungary	29.00	53.10	24.10	1.83
India	685.12	2223.71	1538.58	3.25
Indonesia	1185.76	1305.09	119.33	1.10
Japan	13330.73	28451.73	15121.00	2.13
Kenya	21.32	36.95	15.63	1.73
Mexico	127.36	738.52	611.16	5.80
Nepal	3.80	7.25	3.45	1.91

New Zealand	3053.17	6661.29	3608.12	2.18
Norway	121.80	145.82	24.02	1.20
Pakistan	150.71	224.90	74.19	1.49
Peru	25.23	86.30	61.07	3.42
Philippines	427.92	1359.79	931.87	3.18
Portugal	60.14	69.36	9.22	1.15
Singapore	1920.16	2267.82	347.67	1.18
South Africa	401.36	662.77	261.41	1.65
Spain	323.93	603.41	279.48	1.86
Trindad and Tobago	11.65	16.95	5.30	1.45
Turkey	85.33	171.25	85.92	2.01
United States	9777.17	24992.53	15215.36	2.56
Uruguay	6.38	27.09	20.72	4.25

Table 6: Trading partners with trade potential based on Model 5

Partner Country	Actual Trade (A)	Predicted Trade (P)	P-A (potential)	P/A
	US$ million	US$ million	US$ million	
Argentina	90.68	457.66	366.98	5.05
Austria	133.73	527.14	393.40	3.94
Bangladesh	84.62	85.42	0.80	1.01
Brazil	263.92	728.09	464.17	2.76
Brunei Darussalam	37.04	58.71	21.67	1.59
Canada	1185.98	1784.21	598.23	1.50
Chile	44.02	112.32	68.29	2.55

China	2252.29	2286.84	34.56	1.02
Greece	68.19	148.86	80.67	2.18
Hongkong	1411.99	2577.01	1165.02	1.83
Hungary	29.00	50.78	21.77	1.75
India	685.12	2188.40	1503.28	3.19
Indonesia	1185.76	1300.51	114.76	1.10
Japan	13330.73	29214.00	15883.27	2.19
Kenya	21.32	35.10	13.77	1.65
Mexico	127.36	731.48	604.12	5.74
Nepal	3.80	6.86	3.06	1.80
New Zealand	3053.17	7245.28	4192.11	2.37
Norway	121.80	141.98	20.18	1.17
Pakistan	150.71	217.85	67.14	1.45
Peru	25.23	82.71	57.48	3.28
Philippines	427.92	1346.12	918.19	3.15
Portugal	60.14	67.48	7.34	1.12
Singapore	1920.16	2405.86	485.70	1.25
South Africa	401.36	652.43	251.07	1.63
Spain	323.93	612.70	288.77	1.89
Trindad and Tobago	11.65	16.14	4.48	1.38
Turkey	85.33	165.73	80.39	1.94
United States	9777.17	25471.93	15694.76	2.61
Uruguay	6.38	26.18	19.80	4.11
France	1270.22	1380.39	110.17	1.09

Table 7: Overtraded partners based on Model 4 with per capita GDP variable

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Partner Country	Actual Trade (A) US$ million	Predicted Trade (P) US$ million	P-A US$ million	P/A
Bahrain	99.29	14.21	-85.08	0.14
Belgium-Luxembourg n.s	537.97	266.36	-271.61	0.50
Denmark	186.49	153.06	-33.43	0.82
Egypt	250.77	78.78	-172.00	0.31
Fiji	230.20	89.03	-141.17	0.39
Finland	257.79	116.61	-141.18	0.45
France	1270.22	1269.32	-0.90	1.00
Germany	2697.75	2133.98	-563.77	0.79
Ghana	20.36	7.36	-12.99	0.36
Iran	255.29	133.05	-122.24	0.52
Ireland	165.82	142.98	-22.84	0.86
Israel	139.72	115.91	-23.80	0.83
Italy	1482.84	1139.61	-343.24	0.77
Jordan	21.88	6.61	-15.27	0.30
Korea	1975.31	1548.74	-426.57	0.78
Kuwait	227.07	77.35	-149.72	0.34
Malaysia	1232.07	526.04	-706.02	0.43
Netherlands	798.89	396.83	-402.06	0.50
Papua New Guinea	796.60	18.73	-777.87	0.02

Saudi Arabia	778.32	409.39	-368.94	0.53
Solomon Islands	29.90	10.15	-19.75	0.34
Sri Lanka	83.16	33.31	-49.85	0.40
Sweden	621.09	258.58	-362.52	0.42
Switzerland	492.46	250.28	-242.18	0.51
Thailand	654.55	495.01	-159.54	0.76
United Arab Emirates	368.81	148.87	-219.94	0.40
United Kingdom	3745.82	3375.84	-369.98	0.90

Table 8: Overtraded partners based on Model 5 with per capita GDP differential variable

Partner Country	Actual Trade (A) US$ million	Predicted Trade (P) US$ million	P-A US$ million	P/A
Bahrain	99.29	14.05	-85.24	0.14
Belgium-Luxembourg n.s	537.97	285.64	-252.33	0.53
Denmark	186.49	151.75	-34.75	0.81
Egypt	250.77	75.35	-175.43	0.30
Fiji	230.20	87.38	-142.81	0.38
Finland	257.79	124.65	-133.14	0.48
Germany	2697.75	2331.19	-366.56	0.86
Ghana	20.36	6.85	-13.50	0.34
Iran	255.29	128.51	-126.78	0.50
Ireland	165.82	144.51	-21.30	0.87
Israel	139.72	121.87	-17.85	0.87

Italy	1482.84	1241.78	-241.06	0.84
Jordan	21.88	6.20	-15.68	0.28
Korea	1975.31	1557.42	-417.89	0.79
Kuwait	227.07	78.29	-148.78	0.34
Malaysia	1232.07	516.37	-715.70	0.42
Netherlands	798.89	418.58	-380.31	0.52
Papua New Guinea	796.60	17.77	-778.84	0.02
Saudi Arabia	778.32	414.31	-364.02	0.53
Solomon Islands	29.90	9.86	-20.04	0.33
Sri Lanka	83.16	31.95	-51.21	0.38
Sweden	621.09	260.29	-360.81	0.42
Switzerland	492.46	241.87	-250.59	0.49
Thailand	654.55	485.21	-169.33	0.74
United Arab Emirates	368.81	147.02	-221.79	0.40
United Kingdom	3745.82	3595.79	-150.03	0.96

Table 9: List of 57 Trading Partners

Argentina	Iran	Solomon Islands
Austria	Ireland	South Africa
Bahrain	Israel	Spain
Bangladesh	Italy	Sri Lanka
Belgium-Luxembourg	Japan	Sweden
Brazil	Jordan	Switzerland
Brunei Darussalam	Kenya	Thailand
Canada	Korea	Trinidad and Tobago
Chile	Kuwait	Turkey
China	New Zealand	United Arab Emirates
Denmark	Malaysia	United Kingdom
Egypt	Mexico	United States
Fiji	Nepal	Uruguay
Finland	Netherlands	
France	Norway	
Germany	Pakistan	
Ghana	Papua New Guinea	
Greece	Peru	
Hong Kong	Philippines	
Hungary	Portugal	
India	Saudi Arabia	
Indonesia	Singapore	