Oxford Business and Economics Conference **Australia's Global Trade Potential: Evidence from the Gravity Model Analysis**

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Abstract: This paper attempts to investigate trade potential for Australia using the augmented gravity models and cross section data of 50 countries. OLS has been used as an estimation technique for 2001 and 2005 data. The estimated coefficients from the gravity models are then used to predict Australia's trade potential. Theoretical justification for using the gravity model to analyse bilateral trade flows is also re-affirmed. Our results reveal that Australia's bilateral trade is affected positively by economic size, per capita GDP, openness and common language, and negatively by the distance between the trading partners. The estimated results also show that Australia has tremendous trade potential with Singapore, Argentina, the Russian Federation, Portugal, Greece, Chile, the Philippines, Norway, Brazil and Bangladesh.

Against the backdrop of Australia's historic trade deficit and lower and unimpressive share in the world trade, this study is crucial and will play a contributory role for the policy makers in particular and for the economies of Australia and its trading partners in general.

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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 slide 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 shares in world's exports, imports and trade are still very low and look unimpressive when compared with other countries including its Asian neighbours. In 2007, Australia's exports, imports and trade shares in the world were 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. 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 generalised gravity model. This model is a widely used popular empirical tool for analysing bilateral trade flows. We have used the gravity model to first analyse the Australia's trade flows globally for the

year 2001 and 2005[a]. 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 gravity model extensively against the backdrop of Australia's historic trade deficit and lower and unimpressive share in the world trade. The study covers 97 percent of Australia's global trade. Thus this study will play a contributory role for the 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.

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

[a] These two years have been selected randomly. Estimations are made based on cross-section data of two years, instead of one year, to confirm the outcomes.

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

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

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:

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

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. When estimated, the model gives relatively good results. 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:

$$\text{Log}\,(\text{Trade}_{ij}) = \alpha + \beta \log\,(\text{YiYj}) + \delta \log\,(D_{ij}) + \sum_{s=1}^{p} \lambda s Gs \qquad (3)$$

Theoretical Justification

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 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. Also 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 (2001) 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[b]. 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) examines the determinants Bangladesh 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 augmented gravity model to estimate India's trade potential. The model is based on cross-section data of 2000. Hassan (2000, 2001 and 2002) examines the effects of regional trade block on bilateral trade of 27 countries using cross-section data. Taking cross- section data from 1996-99 and using ordinary least square, Christie (2002) analyses trade potential for

[b] see Bergstrand 1985 and 1989, Oguledo and Macphee 1994, Frankel 1997, Karemera *et al.* 1999, Mathur 1999, Sharma and Chua 2000, Paas 2000, Hassan 2000 and 2001, 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.

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.

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

Data and Sample Size

Our study covers Australia's trade with 49 countries around the globe. In 2005, Australia's trade with these countries together comprises 96.77 percent of its total world trade. Export to these countries together comprises 95.27 percent of its total world exports, and import from these countries together comprises 98.1 percent of its total world import. For 2001 data, these trade statistics are also, more or less, similar. The countries are chosen on the basis of importance of trading partnership with Australia and availability of required data. Twenty countries from Asia, eighteen countries from Europe, three countries from North America, three countries from South America, two countries from Africa and three countries from Australasia are included in the sample as Australia's trading partners. Table 14 provides the list of countries.

The data are collected for the period of 2001 and 2005. All observations are annual. Data on GDP, GDP per capita, total exports and total imports are obtained from the *World Development Indicators (WDI*) database of the World Bank. 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* (2007) of IMF. Data on the distance (in kilometer) between Canberra (capital of Australia) and other capital cities of country j (as the crow flies) are obtained from an Indonesian Website: *www.indo.com/distance*.

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

Although panel data have certain advantages (e.g. panels can capture the relevant relationships among variables over time, and panels can monitor unobservable trading-partner-pairs' individual effects), classical gravity model generally uses cross-section data to estimate trade effects and trade relationships for a particular time period, for example one year. Empirical literature of the gravity model using cross-section data is also huge. Further, Batra (2006) observe that aggregation over time does not really add any value to the

estimations. We have therefore followed the classical tradition of estimation of gravity model with cross-section data for the years 2001 and 2005.

For estimation of the gravity model, we have followed Frankel (1997), Sharma and Chua (2000), Rahman (2003) 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 GNP/GDP and the product of per capita GNP/ 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:

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

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.

To distinguish the dominant influences on bilateral trade flows we have reconsider 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/GNP, the larger the number of varieties of goods offered for trade. The more similar the countries are in terms of GDP/ GNP, 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/GNP (Paas 2000). For our estimated model, we have used constant GDP (in 2000 US dollars).

Per Capita GDP: While we are taking GNP as a variable, the reason for taking 'per capita GNP' 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. Further, the process of development may be led by the innovation or invention of new products that are then demanded as exports by other countries. 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. Also the volume of trade should increase with increasingly equal distribution of national income (Helpman-Krugman sort of theory). This theory predicts that per capita GDP will have a positive effect on trade. We have used constant per capita GDP (in 2000 US dollars) for our estimated model.

Per capita GDP differential: This variable has been included in an alternative model to explore which hypothesis – Heckscher-Ohlin hypothesis or 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 with cross-section data, this variable is considered for country j only. Australia's trade-GDP ratio is not considered as there is no variation of this variable when estimation is performed.

Distance: Transportation cost is an important factor of trade. Production of the same good in two or more countries in the presence of transport costs is inconsistent with factor price equalization. Moreover, different trade models might behave differently in the presence of transport cost and differences in demand across countries (Paas 2000, quoted from Davis and Weinstein 1996).

Transport costs are proxied by the distance. So distance between a pair of countries naturally determines the volume of trade between them. Three kinds of costs are associated with doing business at a distance: (i) physical shipping costs, (ii) time-related costs and (iii) costs of (cultural) unfamiliarity. Among these costs, shipping costs are obvious (Frankel 1997 quoted from Linnemann 1966).

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 (RTA): 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 or cultural heritages and patterns of consumption and production are likely to be similar. We consider 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 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 two step estimation strategies to explore Australia's global trade potential. In the first stage we have estimated equation (4) and equation (5) using OLS estimation technique with cross section data for the year 2001 and 2005 covering 50 countries including Australia. 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.

The coefficients thus obtained in the first stage have been used in the second stage to calculate the predicted bilateral trade of Australia with its 49 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[c]. 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 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[d].

Heteroscadasticity

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

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 Table 3 present the OLS estimates of the augmented gravity models for 2005 and 2001 data. Table 2 shows the estimated results of model 4 where per capita GDP variable is considered as an explanatory variable, and Table 3 exhibits 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)

From Table 2 it is observed that the gravity models for both 2005 and 2001 fit the data well and explain 75 percent and 76 percent of the variation in bilateral trade across our sample of countries, respectively. As mentioned above, the results are hetero-corrected, and the models do not have any multicollinearity and auto correlation problems.

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 by 0.81% as the size of the country (GDP/output) is increased by 1%. Per capita GDP also affects Australia's bilateral trade positively and significantly though this variable was not found significant for 2001 data. The coefficient of this variable is 0.17 for 2005 data indicating that 1 percent increase of per capita income of trading pair increases bilateral trade by 0.17 percent. The openness variable also affect Australia's bilateral trade

positively and more than proportionately [exp(.1)= 1.11] . This variable is found statistically significant.

The estimated coefficient on distance variable has the anticipated negative sign and it is -2.15 and -2.01 for 2005 and 2001 data, respectively. 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 2.15 percent and 2.01 percent respectively. The dummy variable, RTA, is not found significant; however the common language variable is found significant for 2005 data and its effects on bilateral trade is positive and substantial. Two countries that share a common language are estimated to engage in 54 percent more trade than two otherwise similar countries.

Gravity Model Estimation Results Using Per Capita GDP Differential Variable (Model 5)

The estimated coefficients in this model also give very similar results as are given in model 4 (see Table 3). Again the model is free from multicollinearity, and autocorrelation problems, and hetero-corrected results are presented. The per capita GDP differential has negative and statistically significant effect on bilateral trade flows for both 2005 and 2001 data. So our estimated results support the Linder hypothesis, i.e. similar countries trade more than dissimilar ones. The coefficients of this variable are -0.17 and -0.23 for 2005 data and 2001 data, respectively. The implication is that 1 percent increase of per capita income differential between pair of countries results in 0.17 percent and 0.23 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 model 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 Tables 4 -11 on the basis of 2005 and 2001 data and inclusion of per capita GDP / per capita GDP differential variable. Table 12 and 13 present the summary results of Table 4-11 where countries of trade potential and overtraded countries are noted.

Results based on 2005 data and with per capita GDP variable (Table 4) exhibit that Australia has the highest trade potential with countries like Singapore, Argentina, Portugal, Greece, Chile, the Philippines, the Russian Federation, Norway, Bangladesh, etc. Australia can potentially attain eight times more trade with Singapore, five times more trade with

Argentina, four times more trade with Portugal, three times more trade with Greece, Chile, the Philippines and the Russian Federation, and two times more trade with Norway and Bangladesh. Similar results, more or less, are observed for Singapore, Argentina, the Philippines, the Russian Federation, Chile, Greece and Bangladesh while estimating the trade potential with per capita GDP differential for 2005 data (see Table 8).

While estimating for 2001 data with per capita GDP variable (see Table 6), Australia has the highest trade potential with Argentina (6.15 times), the Russian Federation (5.14 times), Chile (3.25 times), Mexico (2.5 times), Norway (2.29 times), Brazil (2.03 times) and Greece (2.01 times). The estimates with per capita GDP differential variable for 2001 data give, more or less, the similar results for these countries (see Table 10). This Table also shows that Australia has substantial trade potential with Hong Kong, New Zealand, Singapore and Turkey.

From Table 12 we get an indication about the Australian trading partners with which the country has definite potential for trade expansion. If trade potential with trading partners is confirmed by both models (model with per capita GDP variable and model with per capita GDP differential variables) for both 2005 and 2001 data sets, Australia definitely has potential for trade expansion with those countries. This is indicated by '4 yes' in Table 12. Accordingly, Australia has definite trade potential with Argentina, Austria, Bangladesh, Brazil, Chile, Greece, Israel, New Zealand, Norway, Pakistan, the Philippines, Portugal, the Russian Federation, Singapore and Turkey. Canada can also be mentioned as a potential country for Australia's trade expansion.

Australia's Trade Potential / Overtrade by Regions

Among the Asian trading partners, Australia has definite potential for trade expansion with Singapore, the Philippines, Bangladesh, Israel and Pakistan. On the other hand, Australia has already exceeded its trade potential with China, Vietnam, Thailand, Indonesia, Malaysia, Republic of Korea, Kuwait, Qatar and Saudi Arabia. Among the European trading partners, definite trade potential exists for the Russian Federation, Portugal, Norway, Greece, Turkey and Austria. However, Australia trades more than its potential with Finland, Germany, Ireland, Italy, UK, Sweden, Switzerland and the Netherlands. With regard to North American countries, Australia has potential for trade expansion with Canada while the country exceeds trade potential with the USA. Among the South American countries, Australia has definite trade potential with Argentina, Chile and Brazil. In Australasia, Australia has definite trade potential with New Zealand, while the country has overtraded with Fiji and Papua New Guinea. Australia has also overtraded with South Africa (see Tables 12 1nd 13).

VI. CONCLUSIONS

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 cross section data for the year 2005 and 2001 of 50 countries including Australia. Trade with these 49 trading partners constitute about 97 percent of Australia's total

world trade. Hence our analysis is based on maximum possible coverage of Australia's trade. OLS has been used as an estimation technique.

Estimated results reveal that Australia's bilateral trade is positively and significantly affected by higher economic size in terms of GDP, per capita GDP and openness variable (trade-GDP ratio). The magnitude of this effect is the highest for openness variable (more than proportional), nearly proportional for GDP variable, and the lowest for per capita GDP variable. Australia's bilateral trade is also positively and significantly influenced by common language, i.e. Australia tends to trade more with the countries where English is the official language. 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 definite potential for trade expansion with Argentina, Austria, Bangladesh, Brazil, Chile, Greece, Israel, New Zealand, Norway, Pakistan, the Philippines, Portugal, the Russian Federation, Singapore and Turkey. Canada can also be mentioned as a potential country for Australia's trade expansion.

Based on 2005 data our estimate reveal that Australia can potentially attain eight times more trade with Singapore, five times more trade with Argentina, four times more trade with Portugal, three times more trade with Greece, Chile, the Philippines and the Russian Federation, and two times more trade with Norway and Bangladesh.

Estimates based on 2001 data exhibit that Australia has the highest trade potential with Argentina (6.15 times), the Russian Federation (5.14 times), Chile (3.25 times), Norway (2.29 times), Brazil (2.03 times) and Greece (2.01 times).

This research confirms that Australia has exceeded its trade potential with China, Vietnam, Thailand, Indonesia, Malaysia, Republic of Korea, Kuwait, Qatar and Saudi Arabia in *Asia* and Finland, Germany, Ireland, Italy, UK, Sweden, Switzerland and the Netherlands in *Europe.* The country has also overtraded with the USA, Fiji, Papua New Guinea and South Africa.

The policy implication is that Australian government should take correct measures to increase trade volume with the countries where full potential of trade expansion is yet to be exploited. Also attempts should be continued to maintain its high level of trade, particularly export trade, with the countries where Australia has already exceeded its trade potential.

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Table 1: Simple correlations of variables based on 2005 data

	Trade	GDP	PCGDP	PCGDPDiff	TRGDP	Popn	Dist	RTA	Clang
Trade	1								
GDP	0.45	1							

PCGDP	0.15	0.26	1						
PCGDPDiff	-0.14	-0.21	-0.61	1					
TRGDP	0.18	-0.46	0.18	-0.19	1				
Popn	0.35	0.63	-0.5	0.28	-0.39	1			
Dist	-0.23	0.56	0.45	-0.38	-0.28	0.15	1		
RTA	0.06	-0.46	-0.2	0.15	0.03	-0.32	-0.71	1	
Clang	0.33	-0.08	-0.09	0.07	0.25	0.09	-0.27	0.25	1

Table 2: Hetero corrected trade models for 2005 and 2001 with per capita GDP variable. Dependent variable is log (Tradeij)

Variables	Trade Model 05	Trade Model 01
	Coefficients (t-ratios)	Coefficients (t-ratios)
$Log(GDP_i*GDP_j)$	0.81 (7.99)	0.81 (12.24)
Log(PCGDPi*PCGDPj)	0.17 (1.90)	0.08 (0.91)
$(TR/GDP)_j$	0.01 (2.12)	0.01 (2.75)
Log(Distance)	-2.15 (-7.82)	-2.01 (-7.31)
RTA	-0.07 (-0.13)	0.26 (0.58)
Common Language	0.43 (1.98)	0.20 (1.01)
R^2	0.75	0.76
F	21.45 [6, 42]	21.61 [6, 42]
DW	2.22	2.00
Observations	49	49

3: Hetero corrected trade models for 2005 and 2001 with per capita GDP differential variable. Dependent variable is log (Tradeij)

Variables	Trade Model 05	Trade Model 01
	Coefficients (t-ratios)	Coefficients (t-ratios)
$Log(GDP_i*GDP_j)$	0.82 (8.29)	0.81 (13.51)

Log(PCGDPDij)	- 0.17 (-2.10)	- 0.23 (-2.06)
$(TR/GDP)_j$	0.01 (2.22)	0.01 (2.07)
Log(Distance)	-2.05 (-6.26)	-2.09 (-7.76)
RTA	0.04 (0.07)	0.23 (0.52)
Common Language	0.42 (1.83)	0.18 (0.99)
R^2	0.75	0.77
F	20.89 [6, 42]	22.93 [6, 42]
DW	2.26	1.94
Observations	49	49

Table 4: Trading partners with trade potential based on 2005 data with per capita GDP variable

Countries	**Trade (P-A) US$ mill.**	**Trade (P/A)**
Australia Argentina	1123.635174	5.131012
Australia Austria	158.9467131	1.20069
Australia Bangladesh	174.5595529	1.819528
Australia Brazil	290.07757	1.24315
Australia Canada	677.0887071	1.242337
Australia Chile	414.8480086	2.714248
Australia Egypt	95.00598208	1.348007
Australia Greece	377.7107064	3.019843
Australia Israel	182.8133559	1.322422
Australia Japan	166.2052349	1.004835
Australia Mexico	794.4273746	1.620646
Australia New Zealand	10093.35345	1.921263
Australia Norway	443.6312587	2.431069

Australia Pakistan	103.8004695	1.222271
Australia Philippines	2100.86882	2.750724
Australia Portugal	223.2005684	3.755563
Australia Russian Federation	530.6365395	2.58399
Australia Singapore	65539.28447	7.727498
Australia Sri Lanka	50.42462601	1.248397
Australia Turkey	338.3442599	1.642019
Australia UAE	364.7305918	1.293901

Note: P = Predicted, A = Actual .

Table 5: Overtraded partners based on 2005 data with per capita GDP variable

Countries	**Trade (P-A) US$ mill.**	**Trade (P/A)**
Australia Belgium	-210.7139033	0.88048
Australia Brunei	-65.42190599	0.880399
Australia China	-18958.86377	0.331634
Australia Denmark	-96.22958209	0.888494
Australia Fiji	-20.08823675	0.95633
Australia Finland	-473.9988773	0.57143
Australia France	-1894.360168	0.592435
Australia Germany	-3336.333855	0.56744
Australia Hongkong	-2020.829081	0.34003
Australia India	-2976.508038	0.519453
Australia Indonesia	-1308.597734	0.76519
Australia Ireland	-466.388094	0.71175
Australia Italy	-2083.983877	0.534929
Australia Korea	-5055.804832	0.585963
Australia Kuwait	-80.98895462	0.850298
Australia Malaysia	-88.85196916	0.986499

Australia Netherlands	-798.6899402	0.694223
Australia PNG	-1064.636415	0.575842
Australia Qatar	-622.5394196	0.445152
Australia Saudi Arabia	-1057.615688	0.549376
Australia South Africa	-1186.810146	0.544236
Australia Spain	-416.9028404	0.76095
Australia Sweden	-724.4582799	0.612796
Australia Switzerland	-357.9595177	0.733859
Australia Thailand	-3212.296391	0.528228
Australia UK	-3577.833824	0.577038
Australia USA	-1237.839551	0.947556
Australia Vietnam	-2199.891797	0.291728

Note: P = Predicted, A = Actual.

Table 6: Trading partners with trade potential based on 2001 data with per capita GDP variable

Countries	Trade (P-A) US$ Mill.	Trade (P/A)
Australia Argentina	644.7918181	6.158335
Australia Austria	209.0462758	1.708631
Australia Bangladesh	70.36598545	1.339932
Australia Brazil	533.175536	2.033286
Australia Brunei	12.44999123	1.051446
Australia Chile	252.6961363	3.256216
Australia Denmark	77.19987037	1.224418
Australia Greece	174.7682851	2.010221
Australia Hong Kong	3423.57636	2.189568
Australia Israel	7.660685494	1.020428
Australia Mexico	793.9826772	2.503755

Australia New Zealand	4985.936701	1.817769
Australia Norway	239.7065587	2.288745
Australia Pakistan	0.109845189	1.000345
Australia Philippines	560.9557912	1.599953
Australia Portugal	91.6942647	1.77054
Australia Russian Federation	443.4713443	5.144592
Australia Singapore	3694.933174	1.766584
Australia Spain	22.31050168	1.027544
Australia Turkey	274.1307449	2.12811

Note: P = Predicted, A = Actual.

Table 7: Overtraded partners based on 2001 data with per capita GDP variable

Countries	**Trade (P-A) US$ Mill.**	**Trade (P/A)**
Australia Belgium	-271.4272754	0.735709
Australia Canada	-168.8821792	0.907157
Australia China	-4867.232902	0.473072
Australia Egypt	-151.0123252	0.602599
Australia Fiji	-116.3887695	0.727427
Australia Finland	-266.6887406	0.564945
Australia France	-212.0547097	0.891919
Australia Germany	-1610.678543	0.617325
Australia India	-85.92489327	0.947987
Australia Indonesia	-941.888859	0.7388
Australia Ireland	-263.2570257	0.651315
Australia Italy	-1314.085757	0.548114
Australia Japan	-1139.261099	0.943292
Australia Korea	-3874.946359	0.47078

Australia Kuwait	-118.1388314	0.623762
Australia Malaysia	-801.364999	0.760644
Australia Netherlands	-405.4381295	0.705136
Australia PNG	-363.8711324	0.688466
Australia Qatar	-126.307674	0.494769
Australia Saudi Arabia	-1308.724541	0.322256
Australia Sri Lanka	-55.99025868	0.745499
Australia South Africa	-412.526617	0.631014
Australia Sweden	-291.5134429	0.676456
Australia Switzerland	-241.2521069	0.698435
Australia Thailand	-1016.135705	0.601672
Australia UAE	-588.23293	0.463291
Australia UK	-3589.218218	0.39207
Australia USA	-6698.633292	0.612348
Australia Vietnam	-934.320213	0.302225

Note: P = Predicted, A = Actual.

Table 8: Trading partners with trade potential based on 2005 data with per capita GDP differential variable

Countries	Trade (P-A) US$ mill.	Trade(P/A)
Australia Argentina	991.9151558	4.646747
Australia Austria	235.2834367	1.297075
Australia Bangladesh	299.4308243	2.405779
Australia Belgium	339.2607542	1.192434
Australia Brazil	297.912925	1.249717
Australia Canada	925.2752984	1.331165
Australia Chile	361.1082785	2.492183
Australia Egypt	137.8012798	1.504767

Australia Greece	343.7440264	2.838203
Australia Israel	189.9382189	1.334988
Australia Mexico	683.2712139	1.533806
Australia New Zealand	6471.307286	1.590663
Australia Norway	212.6324094	1.685911
Australia Pakistan	247.6464327	1.530292
Australia Philippines	2346.531971	2.955443
Australia Portugal	199.4867725	3.4628
Australia Russian Federation	589.2169952	2.758857
Australia Singapore	57166.41288	6.868037
Australia Sri Lanka	80.87122269	1.39838
Australia Turkey	320.2959041	1.607772
Australia UAE	419.9380334	1.338387

Note: P = Predicted, A = Actual.

Table 9: Overtrading partners based on 2005 data with per capita GDP differential variable

Countries	**Trade (P-A) US$ mill.**	**Trade(P/A)**
Australia Brunei	-139.7351128	0.7445428
Australia China	-17800.33296	0.3724765
Australia Denmark	-234.7014468	0.72804
Australia Fiji	-32.62164163	0.9290834
Australia Finland	-478.3191542	0.5675234
Australia France	-654.3819846	0.8592121
Australia Germany	-1626.320693	0.7891455
Australia Hongkong	-2301.031598	0.2485201
Australia India	-2077.835651	0.6645406
Australia Indonesia	-833.5637724	0.8504282

Australia Ireland	-635.4437055	0.6072659
Australia Italy	-1972.234569	0.5598673
Australia Japan	-10575.65674	0.6923356
Australia Korea	-5941.389603	0.5134396
Australia Kuwait	-6.375891396	0.9882146
Australia Malaysia	-744.4981987	0.8868716
Australia Netherlands	-571.3228412	0.78127
Australia PNG	-830.0229043	0.6693136
Australia Qatar	-829.7907811	0.260436
Australia Saudi Arabia	-1187.588185	0.4939974
Australia South Africa	-1234.07965	0.5260831
Australia Spain	-464.3860754	0.7337236
Australia Sweden	-889.1532037	0.5247711
Australia Switzerland	-587.4790883	0.5632126
Australia Thailand	-3259.660605	0.5212718
Australia UK	-3666.967751	0.566501
Australia USA	-6638.384912	0.7187483
Australia Vietnam	-1985.755714	0.3606711

Note: P = Predicted, A = Actual.

Table 10: Trading partners with trade potential based on 2001 data with per capita GDP differential variable

Countries	**Trade (P-A) US$ mill.**	**Trade (P/A)**
Australia Argentina	632.1032705	6.056826
Australia Austria	279.5694516	1.947693
Australia Bangladesh	113.8923303	1.550204
Australia Brazil	502.2303909	1.973315
Australia Brunei	70.77005096	1.292438

Australia Canada	153.6955765	1.084495
Australia Chile	230.5428079	3.058418
Australia Denmark	28.33662617	1.082374
Australia France	446.6670905	1.227659
Australia Greece	180.8881755	2.045596
Australia Hong Kong	3020.298753	2.049444
Australia India	99.63830262	1.060314
Australia Israel	101.2784767	1.270076
Australia Mexico	711.3375419	2.34723
Australia New Zealand	6219.289757	2.020057
Australia Norway	138.0483221	1.742195
Australia Pakistan	29.85045231	1.093869
Australia Philippines	591.037327	1.632125
Australia Portugal	78.8226788	1.662375
Australia Russian Federation	423.9565393	4.962211
Australia Singapore	6620.708735	2.373591
Australia Spain	45.41392928	1.056067
Australia Turkey	244.2983721	2.005343

Note: P = Predicted, A = Actual

Table 11: Overtraded trading partners based on 2001 data with per capita GDP differential variable

Countries	**Trade (P-A) US$ mill.**	**Trade**

		(P/A)
Australia Belgium	-80.67945194	0.921442
Australia China	-4571.911335	0.505044
Australia Egypt	-151.6281234	0.600979
Australia Fiji	-127.0326422	0.7025
Australia Finland	-202.4496059	0.66974
Australia Germany	-892.0608217	0.788059
Australia Indonesia	-679.2143456	0.811643
Australia Ireland	-312.966741	0.585475
Australia Italy	-702.984427	0.758258
Australia Japan	-3492.608078	0.826152
Australia Korea	-3874.395146	0.470856
Australia Kuwait	-99.58584358	0.682848
Australia Malaysia	-1174.791995	0.649106
Australia Netherlands	-323.6877882	0.764591
Australia PNG	-313.7589877	0.731371
Australia Qatar	-127.0579451	0.491768
Australia Saudi Arabia	-1341.492235	0.305286
Australia South Africa	-445.1118925	0.601868
Australia Sri Lanka	-50.1430546	0.772077
Australia Sweden	-310.3639093	0.655534
Australia Switzerland	-353.0495461	0.558688
Australia Thailand	-1092.440969	0.57176
Australia UAE	-358.4298625	0.672965
Australia UK	-3336.366726	0.434897
Australia USA	-8323.94575	0.51829
Australia Vietnam	-905.7182929	0.323586

Note: P = Predicted, A = Actual.

Table12: Countries with potential for Australia's trade expansion by year and variable

	2005		2001	
Countries	**PCGDP***	**PCGDPD****	**PCGDP***	**PCGDPD****
Argentina	Yes	Yes	Yes	Yes
Austria	Yes	Yes	Yes	Yes
Bangladesh	Yes	Yes	Yes	Yes
Belgium	-	Yes	-	-
Brazil	Yes	Yes	Yes	Yes
Brunei	-	-	Yes	Yes
Canada	Yes	Yes	-	Yes
Chile	Yes	Yes	Yes	Yes
Denmark	-	-	Yes	Yes
Egypt	Yes	Yes	-	-
France	-	-	-	Yes
Greece	Yes	Yes	Yes	Yes
Hong Kong	-	-	Yes	Yes
India	-	-	-	Yes
Israel	Yes	Yes	Yes	Yes
Japan	Yes	-	-	-
Mexico	Yes	Yes	Yes	Yes
New Zealand	Yes	Yes	Yes	Yes
Norway	Yes	Yes	Yes	Yes
Pakistan	Yes	Yes	Yes	Yes
Philippine	Yes	Yes	Yes	Yes
Portugal	Yes	Yes	Yes	Yes

Russian Federation	Yes	Yes	Yes	Yes
Singapore	Yes	Yes	Yes	Yes
Sri Lanka	Yes	Yes	-	-
Spain	-	-	Yes	Yes
Turkey	Yes	Yes	Yes	Yes
UAE	Yes	Yes	-	-

* Trade model with per capita GDP variable; ** Trade model with per capita DGP differential variable.

Table 13: Countries where Australia has exceeded its trade potential by year and variable

	2005		2001	
Countries	**PCGDP***	**PCGDPD****	**PCGDP***	**PCGDPD****
Belgium	Yes	-	Yes	Yes
Brunei	Yes	Yes	-	-
Canada	-	-	Yes	-
China	Yes	Yes	Yes	Yes
Denmark	Yes	Yes	-	-
Egypt	-	-	Yes	Yes
Fiji	Yes	Yes	Yes	Yes
Finland	Yes	Yes	Yes	Yes
France	Yes	Yes	Yes	-
Germany	Yes	Yes	Yes	Yes
Hongkong	Yes	Yes	-	-
India	Yes	Yes	Yes	-
Indonesia	Yes	Yes	Yes	Yes
Ireland	Yes	Yes	Yes	Yes
Italy	Yes	Yes	Yes	Yes

Japan	-	Yes	Yes	Yes
Korea, Rep.	Yes	Yes	Yes	Yes
Kuwait	Yes	Yes	Yes	Yes
Malaysia	Yes	Yes	Yes	Yes
Netherlands	Yes	Yes	Yes	Yes
Papua New Gunea	Yes	Yes	Yes	Yes
Qatar	Yes	Yes	Yes	Yes
Saudi Arabia	Yes	Yes	Yes	Yes
South Africa	Yes	Yes	Yes	Yes
Spain	Yes	Yes	-	-
Sri Lanka	-	-	Yes	Yes
Sweden	Yes	Yes	Yes	Yes
Switzerland	Yes	Yes	Yes	Yes
Thailand	Yes	Yes	Yes	Yes
UAE	-	-	Yes	Yes
UK	Yes	Yes	Yes	Yes
USA	Yes	Yes	Yes	Yes
Vietnam	Yes	Yes	Yes	Yes

* Trade model with per capita GDP variable; ** Trade model with per capita DGP differential variable.

Table 14: Australia's trading partners

Argentina	India	Qatar
Austria	Indonesia	Russian Federation
Bangladesh	Ireland	Saudi Arabia

Belgium	Israel	Singapore
Brazil	Italy	South Africa
Brunei	Japan	Spain
Canada	Korea, Rep	Sri Lanka
Chile	Kuwait	Sweden
China	Malaysia	Switzerland
Denmark	Mexico	Thailand
Egypt	Netherlands	Turkey
Fiji	New Zealand	UAE
Finland	Norway	UK
France	Pakistan	USA
Germany	Papua New Guinea	Vietnam
Greece	Philippines	
Hong Kong	Portugal	