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ON MODELING AND MEASURING POTENTIAL TRADE

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Abstract

The methodology suggested in this paper to estimate exports potential in bilateral trade between countries draws on the procedures developed for estimating stochastic frontier production functions. The workability of the methodology is demonstrated using bilateral trade data from 2006 to 2008 between Australia and its key trading partners. The empirical analysis indicates that Australia is able to achieve strong export potential in Mineral and Manufactured products with East Asia and South Asia.

1. Introduction

Trade potential is defined as the trade that could be achieved at an optimum trade frontier with open and frictionless trade possible given the current level of trade, transport and institutional technologies or it is the maximum level of trade given the current level of determinants of trade as well as the least level of restrictions within the economic system. Earlier studies have estimated the differences between observed values and the estimated predicted values by using the gravity equation through OLS estimates as potential trade (For example, Baldwin, 1994; and Nilsson, 2000) between a pair of countries. The OLS estimation procedure produces estimates that represent the centered values of the data set. But, potential trade refers to free trade with no restrictions to trade. Thus, for policy purposes, it is rational to define potential trade as the maximum possible trade that can occur between any two countries, which have liberalized trade restrictions the most, given the determinants of trade. This means that the estimation of potential trade requires a procedure that represents the upper limits of the data and not the centered values of the data set (Kalirajan, 2000, 2007). Drawing on the procedures developed for estimating stochastic frontier production functions, the objective of this paper is to model and estimating export potential of a country with respect to its trade partner using the gravity model.

However, the realized actual trade is given by the current level of determinants of trade with existing level of restriction and institutions. Thus, there exists a gap between potential and actual trade, which is directly related to various socio-political and institutional factors that are hindering the actual trade to grow to the upper limit of the production frontier. By knowing the trade potential, countries could engage in bilateral and multilateral processes to make efforts to minimize or at least mitigate the effect of existing restrictive measures to trade growth. Therefore the objective of the every country is to try to achieve its full trade potential through the engagement process or even through unilateral reforms.

Given these potential gains, countries are interested to liberalize their economies to enjoy the benefits of trade and globalization through bilateral and multilateral process. It is of significant importance that each country may know its full trade potential with other countries or other regions in order to get the engagement process started. Australia also needs to know its full trade potential with other countries or regions. This paper examines the trade potential of

Australia at single digit Standard Industrial Classification (SIC) of products by using the trade gravity stochastic frontier model. In particular, the paper estimates the trade potential of Australia from 2006 to 2008 based on nearly 65 trading partners. The trade gravity stochastic frontier model allows us to identify (a) the biasness from "behind border measures" that traditional gravity model does not address, (b) the potential trade and technical efficiency by each sector for each of its trading partners, and (c) potential trade from regional trade with South Asian Association of Regional Countries (SAARC).

The organization of the paper is as follows. In the first section, introduction of the paper has been given while the section 2 provides a brief overview of the Australia's bilateral trade flows. Section 3 deals with a brief discussion of the inherent bias that exists in estimating potential trade in empirical research by using gravity equation analysis of trade. Furthermore, section 4 presents the data and the suggested methodology of the stochastic frontier approach to gravity equation while results from the estimation are discussed in the section 5. Lastly, section 6 which is the final section brings out the overall conclusions of this paper.

2. Trends of Australian Trade

During 1996-2006, Australia's economy has grown by 81 percent starting from US$ 417.35 billion and reaching at US$ 756 billion in 2006. During the same period, total trade (exports plus imports) have also grown from US$ 121.72 billion to US$254.323 billion. However, the major boost in total trade occurred after 2001, when the total trade was valued at US $ 124 billion, and it reached US $254.323 billion in 2006. The recent data indicates that Australia's exports to the World is growing at around 24 percent in 2006-2008, with agriculture and minerals export accounting for nearly 54 percent of Australia's export (see Table 1). In contrast, the manufactured exports (both manufactured and other manufactured goods not identified by kind) only accounts for around 46 percent of Australia's total exports.

Table 1: Australia's Nominal Major Exports to World (US$ Million)

Products Division	SIC Code	Australia's Exports to World			Mean Exports
		2006	2007	2008	2006-08
Agricultural, forestry, and fishery	0	8619.72	7438.59	10061.82	8706.71
Mineral Commodities	1	48120.97	53847.16	94044.06	65337.40
Manufactured Commodities	2	24378.96	27519.50	29548.84	27149.10
Manufactured Commodities not identified by kind	3	32344.10	39639.73	43933.13	38638.99
Other Commodities	9	1213.16	1497.50	1712.06	1474.24
Total		114676.90	129942.48	179299.92	

The bilateral trade of Australia with the SAARC is given in Table 2. Australia's trade with the SAARC has increased significantly over the past decade, increasing by 4 times since 1996. In particular, India and Pakistan are the key trading partners with Australia accounting for more than 80 percent of the trade between SAARC and Australia.

Table 2:Australia's bilateral Trade with SAARC Countries: 1996-2006 in Million US$

	Maldives	Nepal	Bhutan	Bangladesh	Sri Lanka	Pakistan	India	Total trade to SAARC
1996	2.849	5.56	0.156	192.47	221.65	314.93	1391.964	2129.579
1997	2.819	6.743	0.977	223.851	185.681	498.358	1726.931	2645.36
1998	3.709	7.659	0.055	219.637	182.805	292.337	1763.494	2469.696
1999	3.729	8.248	0.012	197.209	182.907	517.039	1434.413	2343.557
2000	4.512	6.044	0.025	231.964	212.967	323.023	1481.159	2259.694
2001	8.638	6.847	0.009	207.196	220.943	318.799	1652.02	2414.452
2002	13.476	7.237	0.053	196.936	209.268	341.023	1864.47	2632.463
2003	9.889	7.182	0.234	175.236	162.192	350.182	2832.94	3537.855
2004	14.816	10.639	0.498	227.535	214.396	493.97	4818.213	5780.067
2005	15.068	7.745	0.082	213.19	202.448	466.537	6194.434	7099.504
2006	17.879	7.779	0.008	169.231	196.836	350.548	7700.29	8442.571
2007	20.942	30.354	0.047	201.218	195.919	487.608	8999.86	9935.948

3. Inherent Bias that exists in Gravity Equations

The traditional gravity model was first introduced by Tinbergen (1962) to explain the bilateral trade flow between countries. The basic model is based on the formulation that trade volume between two countries is proportional to the product of their GDPs and inversely proportional to

the distance between the countries. We can provide a simple illustration of the gravity model. Let the dependent variable be $M_{ijk}\,(\tau_{ijk})$ aggregated over all commodity class *k* goods from country *i* (where $M_{ijk}\,(\sum_k \tau_{ijk}) = \sum_k M_{ijk}(\tau_{ijk})$). The term $M_{ijk}\,(\tau_{ijk})$ represents the landed value at country *j* of commodity class *k* goods produced in country *i*. The term τ_{ijk} represents the transit costs, including all tariffs associated with moving commodity class *k* goods from country *i* to country *j*. The term M_{ijk} is the foreign port value of commodity class *k* good in country *j*. Thus $M_{ijk}\left(\sum_k \tau_{ijk}\right)$, the new dependent variable is the value of country *j*'s imports including all transport costs, from country *i*.

Now, there are more than one traded good from each country *i*. Within each commodity class of traded goods, goods are considered to be differentiated by place of origin. Further, as there are identical homothetic preferences for traded goods across all countries, the traded goods expenditure shares are also identical across all countries. Thus, following Anderson (1979), τ_j is considered to be the expenditure share in all countries *j* for commodity class *k* goods from county *i*. The term τ_j is a vector of the τ_{ijk}'s for country *j*.

$$M_{ij} = \sum_k M_{ijk} = \emptyset_j Y_j \sum_k \left(\frac{1}{\tau_{ijk}}\right) \varphi_{ik}(\tau_j), \qquad (1)$$

and the balance of trade constraint, assuming exogenous values for the *Y*'s (or at least corrected values) is

$$m_i Y_i \emptyset_i = \sum_j M_{ij} = \sum_j \emptyset_j Y_j \sum_k \left(\frac{1}{\tau_{ijk}}\right) \varphi_{ik}(\tau_j) \qquad (2)$$

Before proceeding, it is important to note that the above relationships are all in the aggregate form. This is the only valid form of the gravity equation. Gravity equations derived for individual commodity class *k* goods are invalid. The term $\sum_k \left(\frac{1}{\tau_{ijk}}\right) \emptyset_{ij}(\tau_j)$ is a weighted average of expenditure share across all countries *j*. Using the term $\sum_k \left(\frac{1}{\tau_{ijk}}\right) \emptyset_{ij}(\tau_j)$ in the estimation process will lead to biasness in the direction in trade. In order to partially overcome this biasness, the transit costs (τ_{ijk}) are expressed as a function of distance, such that $\tau_{ijk} = f(d_{ij})$ with $f(0) = 0$ and $f' > 0$. This leads to the above system of equations becoming

$$M_{ij} = \left[(\sum_k \varphi_{ik})\emptyset_j Y_j * \{1/f(d_{ij})\}U_{ij}\right], \quad (3)$$

$$m_i Y_i \emptyset_i = \left[(\sum_k \varphi_{ik})\sum_j \emptyset_j Y_j \{1/f(d_{ij})\}\right]. \quad (4)$$

The gravity equation derived from the above system of equations is as follows

$$M_{ij} = \left(m_i Y_j \emptyset_i Y_j \emptyset_j / \sum_j Y_j \emptyset_j\right)\left\{1/f(d_{ij})\right\} * \left[\sum_j Y_j \emptyset_j / \left(\sum_j Y_j \emptyset_j * \{1/f(d_{ij})\}\right)\right]^{-1} U_{ij} \quad (5)$$

With the log-linear forms assigned to *m* and *Φ*, equation (5) can be rewritten as follows:

$$M_{ij} = (K_m K_F{}^2) Y_i^{m+F+2} N_i^{m+F} Y_j^{F+1} N_j^F \left\{1/f(d_{ij})\right\} * \left[S_j Y_j F_j / \left(S_j Y_j F_j * \{1/f(d_{ij})\}\right)\right]^{-1} U_{ij} \quad (6)$$

However, there are a few differences between the model presented in equation (6) and the standard gravity equation, which would be given as:

$$T_{ij} = \alpha Y_i^{\beta 1} Y_j^{\beta 2} N_i^{\beta 3} N_j^{\beta 4} D_{ij}^{\beta 5} U_{ij}, \quad (7)$$

where T_{ij} refers to trade between countries *i* and *j*; GDP of the respective countries are given as Y_i and Y_j, the population of the countries are given as N_j and N_i, *D* represents their separation, and the parameters to be estimated are given as $\alpha, \beta 1, \beta 2, \beta 3, \beta 4$, and $\beta 5$. The last term, U_{ij}represent a random disturbance showing the influence of omitted variables and statistical errors. The term U_{ij} is such that *ln*(U_{ij}) has normal distribution with *E(ln* U_{ij}) = 0. The models usually are estimated using the Ordinary Least Squares (OLS) methods.

Firstly, in the above standard gravity equation, the distance term is represented in a log-linear form. In equation (6), $f(d_{ij})$is given as an unidentified function of distance. The log-linear from is often used for $f(d_{ij})$ in empirical work due to its ease of computation and application. According to Anderson (1979), assigning the log-linear from to $f(d_{ij})$ does not

lead to any significant estimation errors. However, alternative functional forms could prove to be more efficient. The second difference is a very important issue. It is this difference that motivates one of the objectives of this study. The second difference concerns the term presented in the square brackets in equation (5), that is, $\left[\sum_j Y_j \emptyset_j / \left(\sum_j Y_j \emptyset_j * \{1/f(d_{ij})\}\right)\right]^{-1}$. This term is often omitted in the standard gravity equation used for empirical work. The term represents the "economic distance between *i* and *j* relative to a trade weighted average of the economic distance between *i* and all points in the system", Anderson (1979, p.113). The omission of this term in empirical work does lead to the biasness in the estimation. This is because the term in the square brackets affects the log-normal distribution of the error term. The expected value of the error term is no longer zero. The resulting bias is often overlooked by OLS estimation. Anderson (1979) states that if this bias is substantial, then observed values can be placed in the square brackets, and the function can be estimated using non-linear least squares. However, this procedure does lead to a loss of efficiency. Further, the lack of any measure to account for this bias term in empirical studies of international trade could be insightful.

In simple terms, the above inherent bias leads to heteroskedastic error terms and the log-linearization of the empirical model in the presence of heteroskedasticity leads to inconsistent estimates because the expected value of the logarithm of a random variable depends on higher-order moments of its distribution (Silva and Tenreyro, 2003). Also, the bias affects the normality assumption of the error term. This criticism can also be leveled against the specification used by Anderson and van Wincoop (2003). Fixed effects models proposed to tackle the issue of heterogeneity problem by Glick and Rose (2001), Matyas (1997), and Bayoumi and Eichengreen (1997) are not formulated based on economic theory. It is in this context that an alternative method of contending with this bias is suggested.

In a sense, heteroskedasticity and non-normality are interrelated. Heteroskedasticity is a property of the conditional distribution of the dependent variable in a regression model, and the effect of heteroskedasticity with respect to the variables that move the variances around is generally non-normality (Kalirajan, 2007). In this kind of situation, where the structure of heteroskedasticity is unknown is quite common in many empirical analyses in economics. For example, given a technology and comparable inputs, at a given time, if the production

performances of a sample of firms are examined, there is often a wide variation in their production levels, which not easily explained[1]. This type of deviation from homoskedastic residuals appears to be mainly due to characteristics specific to observations that are not easily quantifiable. In the case of the standard gravity equation, the economic distance variable is not easily quantifiable as discussed by Roemer (1977: 318). In this situation, OLS estimation leads to biased results. Drawing on Kalirajan (2007), this study follows the method of modeling and estimating standard gravity equations taking into account of heteroskedasticity and non-normality, when the researchers do not know the structure of heteroskedasticity.

Thus, the gravity equation for exports can be estimated, for example,

$$LnX_{ij} = Lnf(Z_j,\beta)exp^{(V_i-U_i)}, \qquad (8)$$

where the term X_{ij} represents the actual exports from country *i* to country *j*. The term $f(Z_j,\beta)$ is a function of the determinants of potential bilateral trade (Z_j) and β is a vector of unknown parameters. The single sided error term, $U_i$is the economic distance bias referred by Anderson (1979), which is due to the influence of the 'behind the border measures'. This bias, which is specific to the exporting and importing countries, creates the difference between actual and potential trade between the two countries concerned. U_i takes values between 0 and 1 and it is usually assumed to follow a truncated (at 0) normal distribution, $N(\mu,\sigma_u^2)$. When U_i takes the value 0, this indicates that the bias or country-specific 'behind the border measures' are not important and the actual exports and potential exports are the same, assuming there are no statistical errors. When U_i takes the value other than 0 (but less than or equal to 1), this indicates that the bias or country specific 'behind the border measures' are important and they constrain the actual exports from reaching potential exports. Thus, the term U_i, which is bilateral observation-specific, represents the bias that is a function of the 'behind the border measures' that are within the exporting countries' control. Thus, unlike the conventional approach, the suggested method of estimating the gravity model does not exclude the influence of 'economic' distance bias on trade flows between two countries. The double-sided error term V_i, which is usually assumed to be $N(0,\sigma_V^2)$, captures the influence on trade flows of other left out variables,

[1] In fact, it may be argued that the development of the x-efficiency theory by Leibenstein (1966) might have been significantly influenced by the nature of heteroskedasticity for which the conditioning variables are not known.

including measurement errors that are randomly distributed across observations in the sample. Maximum likelihood methods can be applied on either the cross section or panel data to estimate the above discussed gravity model and to verify how important are the 'behind the border measures' in constraining trade between countries reaching from their potential levels.

The advantages of the suggested method of estimation of the gravity model are as follows. Firstly, it does not suffer from a loss of estimation efficiency. Secondly, it corrects for the economic distance bias term, which is creating heteroskedasticity and non-normality, isolating it from the statistical error term. This isolation property will enable us to examine how effective are the 'behind the border measures' as major trade constraints. Thirdly, the suggested approach provides potential trade estimates that are closer to frictionless trade estimates. Because, this approach represents the upper limits of data, which come from, those economies that have liberalized their trade restriction the most. Finally, the suggested method bears strong theoretical and trade policy implications towards finding ways of improving the performance of the 'behind the border measures'. The analysis of the 'behind the border measures' needs to be country-specific, which requires the use of other analytical procedures such as discriminant analysis and game theoretical models, besides the estimation of gravity equations involving countries of interest in this study.

4. Data Sources

The sample consists of around 65 key trading partners of Australia for the period 2006 to 2008. The Gross Domestic Product (GDP), population data as well as GDP deflators' for analysis are obtained from UN COMTRADE database. Given that the GDP data for 2008 is not available at UN COMTRADE, we obtained the 2008 GDP figures from International Monetary Fund (IMF) website. Australia's annual bilateral exports data, based on Standard Industrial Classification (SIC), were obtained using World Integrated Trade Solutions (WITS) from UNCOMTRADE database. For the analysis, trade weighted effective applied rates have been used for five divisions of SIC based classification of products (see Annex A) and the respective tariff rates have been downloaded from the TRAINS by using WITS. The bilateral weighted distances have been used in the analysis that have been downloaded from and are in Kilometers

(www.cepii.fr/francgraph/bdd/distances.pdf). The GDP as well as export figures have been deflated to 2005 prices by using GDP deflators of respective years for each country.

The trade gravity stochastic frontier model is estimated at broad Standard Industrial Classification (SIC) of Agriculture, Forestry, and Fishery Products (code (0)), Mineral Products (code (1)), Manufactured Products (code (2)), Manufactured Products not identified by kind (code (3)), and Other Products (code (9)). All the variables in the model are in natural logs.

5. Results

5.1 Results: Trade Gravity Stochastic Frontier

The results of the trade gravity stochastic frontier model are given in Table 3. The results of the model conform to the gravity model. As expected, the output growth of the trading partners has significant impact on the exports of Australia. In particular, the mineral exports are highly significant and heavily dependent upon the GDP of its trading partners. Agriculture, Forestry and Fishery products are less dependent upon the GDP of its key trading partners relative to Mineral and Manufactured products. Distance also tends to be an important determinant of Australian trade. It is statistically significant and negative as expected from the gravity model. The trade related to Mineral and Other products is very responsive to the distance parameter and countries that are much closer to Australia tend to trade more in these products.

Table 3: Estimation Results of the Trade Gravity Stochastic Frontier Model

Model Dependant Variable Exports	Agriculture, Forestry and Fishery Products	Mineral Products	Manufactured Products	Manufactured Products not identified by kind	Other Products
	SIC 0	SIC 1	SIC 2	SIC 3	SIC 9
Constant	7.14**	9.43***	8.17***	9.26***	12.69**
	(2.79)	(5.52)	(6.51)	(5.58)	(3.46)
GDP	0.67***	1.25***	0.95***	1.10***	1.14***
	(4.55)	(5.75)	(10.31)	(6.76)	(4.29)
Population	0.01*	0.0	-0.21*	-0.18	0.21
	(0.08)	(0.39)	(-2.13)	(-1.16)	(0.99)
Tariff	-0.01	-0.07*	-0.01	-0.01	0.00
	(-0.5)	(-1.8)	(-0.56)	(-0.4)	(-0.19)
Distance	-2.12*	-3.37***	-2.60***	-3.03***	-4.70***
	(-3.11)	(-6.03)	(-7.18)	(5.58)	(-6.96)
sigma_v	0.29	0.31**	0.19**	0.41**	0.81***
	(1.38)	(3.12)	(2.79)	(3.78)	(4.88)
sigma_u	1.03**	0.79***	0.63***	0.65**	0.09
	(3.8)	(4.47)	(5.92)	(3.05)	(0.025)
sigma2	1.16*	0.71**	0.43**	0.59*	0.71
	(2.53)	(2.9)	(3.6)	(2.72)	(1.52)
Log likelihood	-61.51	-29.58	-28.15	-47.01	-65.58
Wald chi2	46.24	113.33	168.79	95.86	97.85
Observations	62	36	55	56	54

Note: *, ** and *** represent significance levels at 10%, 5% and 0% respectively.

Population and tariff are not significant variables determining the trade in Australia. Tariff has a negative and statistically significant impact on the export of Mineral products. Given that trade in Mineral products forms more than 50 percent share of total trade for Australia, greater protection on trade in Mineral products will have significant impact on its overall trade. Population has no impact on the Australian trade except for Agricultural and Manufactured products. There is positive but a small impact of population growth on the exports of Agriculture, Forestry and Fishery products. However, as opposed to positive, we do observe a negative and statistically significant impact of population on the export of manufactured products. It is highly likely that trade in Manufactured products for Australia is mostly in final

goods. The negative impact of population reflects that the Australian manufactured goods might be substituted for manufactured goods from other countries as the population and standard of living of its trading partners improves.

One of the key objectives of estimating the trade gravity stochastic model is to determine the "behind the border measures", which is reflected by value of U_i. The value of U_i close to 0 reflects that the bias or country-specific "behind the border measures" are not important. If U_i takes a value other than 0 reflects that country specific "behind the border measures" are important. The estimated value of U_i is given in Table 3. The value of U_i is statistically significant for all the different product categories except for Other Products. It is more than one for Agriculture, Forestry and Fishery products, indicating that there is very high behind the border restriction for this product category. We also observe a value of 0.8 for Mineral products and around 0.6 for manufactured goods highlighting the importance of "behind the border measures" for trade in these products. It is important to highlight that the conventional gravity model will be biased if does not account for the "behind the border measures" in its estimation.

5.2 Results: Potential Trade

The estimation of potential trade based on the trade gravity stochastic model for Australia's key trading partners is given in Tables A1-A5 in the Annexure. In Table A1, the actual and potential trade by key trading partners in Agriculture, Forestry, and Fishery products (SIC 0) is given. The estimation results for Agriculture, Forestry, and Fishery products show that considerable potential exists on individual country basis compared to regional estimates. Australia's trade potential is higher than actual trade for several developed countries such as France, Canada, Germany, New Zealand, Switzerland and United Kingdom. There is also greater potential for Australia to increase its trade with key ASEAN and East Asian countries. The estimated potential export is much higher than actual trade for Hong Kong, Indonesia, Japan, Korea, Malaysia, Philippines, Singapore, Thailand and Vietnam. It is quite interesting to observe that the actual trade is much higher than potential trade with China for Agricultural, Forestry, and Fishing products. The same reasoning also applies to SAARC region when we analyze the potential in a regional basis as compared to individual countries. In SAARC region, the key countries of India and Pakistan provide the key trade potential for Agriculture, Forestry, and

Fishery products for Australian export. The results also shows that the unexplored markets such as Maldives and Nepal also provide potential for trade in Agriculture, Forestry, and Fishery products.

The potential trade for Mineral products (SIC 1) is given in Table 2A. China and Japan are the key major trading partners that also provide substantial potential for Australia's trade in Mineral products. The potential export for both countries is much higher than the actual export. Given that the trade in Mineral products is very important for the Australian trade, the growth of China and Japan will be very crucial for the export growth of Australia. The exports in Mineral products could also be enhanced in Korea, Hong Kong, Thailand, and Singapore. Table 2A of Mineral products (SIC 1) also shows that there is little trade potential for the SAARC region. Again, the emerging countries of India and Pakistan tend to provide key trade potential for Australia in Mineral products in the SAARC region.

The potential trade for Manufactured products (SIC 2), Manufactured products not identified by kind (SIC 3) and Other products (SIC 9) are given in Tables A3-A5. As compared to Mineral products, Manufactured products (SIC 2) tend to have less export potential for Australia. Some European countries for example France, Italy, Spain, Switzerland, Germany etc as well as Latin American countries such as Argentina, Brazil, and Mexico tend to have potential for trade in Australian's Manufactured products. The potential exports for Manufactured products not identified by kind (SIC 3) show an interesting result as East Asian countries tend to have strong potential for export growth for Australia's exports. China, Hong Kong, Korea, Japan, Malaysia, Singapore and Philippines have strong potential for export growth with Australia in this category. United States also provides strong export potential for Australia in this category. In the SAARC region, India tends to provide the most potential for trade for Australia. Furthermore, the results indicates that Australia does not have much trade potential in Other products category as indicated in Table A5 in the Annex.

6. Policy Conclusion

This paper examined the trade potential of Australia using the trade gravity stochastic frontier model and estimated the trade potential for nearly 65 trading partners. In particular, the

paper corrected for the biasness from “behind border measures”, which the traditional gravity model will not be able to address. The results indicate that the measure for biasness is statistically significant and it is high for Agriculture, Forestry, and Fishing products and Mineral products. Thus, gravity model that did not control for the “behind border measures” will provide bias results on the measured trade potential. The estimation results for all products classifications show that considerable potential exists on individual country basis compared to collective estimates. In Agriculture, Forestry, and Fishery products (SIC 0) products, there is also considerable potential for Australia to increase its trade with key ASEAN and East Asian countries. In SAARC region, the key trading partners of India and Pakistan provides the most trade potential for Australia.

Additionally, the results also indicate that trade in Mineral products (SIC 1) is very important for the Australian trade and the growth of China and Japan will be very crucial for the export growth of Australia. As compared to Mineral products, Manufactured products (SIC 2) tend to have less export potential for Australia. Apart from the existing level of trade, Australia also needs to focus on trade from emerging countries that are liberalizing their markets for economic growth, which could form important avenue for its exports.

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Annex 1

Table A1: Australia's Mean Exports (2006-08) of Agriculture, Forestry and Fishery Products (US$ Million)

Country	*Exports*	*Potential Exports*	*Technical Efficiency Percent*
United Arab Emirates	80.057	85.611	93.513
Argentina	5.984	15.773	37.938
Belgium	27.759	38.471	72.155
Bangladesh	63.008	70.711	89.107
Bulgaria	6.030	10.463	57.636
Bahrain	32.572	25.663	126.923
Brazil	2.792	15.319	18.226
Brunei	4.675	13.416	34.843
Bhutan	0.001	0.000	668.398
Canada	19.849	36.689	54.100
Switzerland	2.950	12.570	23.470
China	1454.408	1391.587	104.514
Colombia	3.118	11.011	28.319
Czech Republic	60.972	60.674	100.492
Germany	49.783	76.445	65.123
Egypt, Arab Rep.	29.172	35.304	82.632
Spain	16.348	30.727	53.203
Fiji	14.647	22.757	64.365
France	15.990	33.066	48.357
United Kingdom	40.261	62.452	64.467
Greece	4.651	13.674	34.012
Hong Kong, China	451.818	432.581	104.447
Hungary	2.022	11.117	18.189
Indonesia	386.862	454.886	85.046
India	212.600	231.640	91.781
Ireland	1.517	14.840	10.223
Iran, Islamic Rep.	4.048	12.276	32.977
Israel	32.037	40.129	79.835
Italy	196.598	211.676	92.877
Jordan	24.873	19.850	125.303
Japan	776.545	906.134	85.699
Cambodia	4.028	10.293	39.133
Korea, Rep.	95.976	133.326	71.986
Kuwait	59.168	60.666	97.532
Sri Lanka	34.009	38.670	87.947
Macao	1.105	44.702	2.471

Morocco	1.214	20.461	5.932
Maldives	1.348	7.307	18.448
Mexico	16.040	31.490	50.936
Myanmar	12.873	19.870	64.785
Mauritius	5.322	10.008	53.177
Malaysia	148.979	176.004	84.645
Netherlands	64.821	76.949	84.238
Nepal	1.385	13.201	10.495
New Zealand	111.381	180.331	61.765
Oman	29.700	32.565	91.203
Pakistan	58.890	68.489	85.984
Peru	0.431	2.067	20.854
Philippines	21.660	41.013	52.814
Papua New Guinea	18.060	32.754	55.139
Poland	0.440	-2.513	17.509
Portugal	7.591	14.696	51.655
Qatar	16.168	22.761	71.033
Russian Federation	17.227	31.923	53.963
Saudi Arabia	279.463	248.821	112.315
Singapore	78.616	109.809	71.593
Thailand	145.447	173.042	84.053
Turkey	4.963	15.059	32.957
Uruguay	4.079	9.127	44.695
United States	179.544	248.182	72.344
Vietnam	92.339	104.996	87.945
South Africa	17.989	32.043	56.141
Total	5554.205	6401.488	98.380
SAARC			
Bangladesh	63.008	70.711	89.107
Bhutan	0.001	0.000	668.398
India	212.600	231.640	91.781
Sri Lanka	34.009	38.670	87.947
Maldives	1.348	7.307	18.448
Nepal	1.385	13.201	10.495
Pakistan	58.890	68.489	85.984
Total	371.241	430.017	97.576

Table A2: Australia's Mean Exports (2006-08) of Mineral Commodities (US$ Million)

Country	*Exports*	*Potential Exports*	*Technical Efficiency Percent*
United Arab Emirates	3.247	12.295	26.408
Argentina	65.192	85.449	76.293
Belgium	494.310	428.994	115.225
Bangladesh	2.692	13.837	19.458
Brazil	491.587	577.523	85.120
Canada	78.037	125.721	62.071
China	11162.793	12390.478	90.092
Germany	333.340	461.535	72.224
Egypt, Arab Rep.	31.444	38.378	81.931
Spain	471.702	510.708	92.362
Fiji	17.363	20.178	86.050
France	560.058	668.615	83.764
United Kingdom	574.945	683.686	84.095
Hong Kong, China	74.479	123.322	60.394
Indonesia	280.804	458.881	61.193
India	3408.053	3097.793	110.016
Ireland	23.346	32.489	71.859
Iran, Islamic Rep.	37.624	49.964	75.302
Israel	52.740	62.532	84.341
Italy	385.681	482.018	80.014
Japan	18607.615	20688.348	89.942
Korea, Rep.	6883.944	6576.466	104.675
Sri Lanka	0.336	1.016	33.057
Maldives	0.015	0.010	155.291
Mexico	243.016	303.948	79.953
Malaysia	406.568	495.241	82.095
Netherlands	1218.817	1036.245	117.619
New Zealand	743.597	1107.125	67.165
Pakistan	52.478	65.732	79.837
Philippines	243.179	294.862	82.472
Papua New Guinea	317.185	308.058	102.963
Singapore	1629.086	1642.392	99.190
Thailand	804.776	889.135	90.512
Turkey	225.709	248.820	90.712
United States	489.726	802.743	61.007
Vietnam	31.440	50.582	62.157
South Africa	248.109	275.521	90.051

Total	50695.032	55110.640	99.235
SAARC			
Bangladesh	2.692	13.837	19.458
Bhutan	0	N/A	N/A
India	3408.053	3097.793	110.016
Sri Lanka	0.336	1.016	33.057
Maldives	0.015	0.010	155.291
Nepal	0	N/A	N/A
Pakistan	52.478	65.732	79.837
Total	3463.575	3178.387	101.066

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Table A3: Australia's Mean Exports (2006-08) of Manufactured Commodities (US$ Million)

Country	*Exports*	*Potential Exports*	*Technical Efficiency Percent*
United Arab Emirates	169.336	217.991	77.680
Argentina	9.689	22.498	43.064
Belgium	103.959	132.347	78.550
Bangladesh	39.262	49.397	79.482
Bahrain	13.337	32.148	41.486
Brazil	41.691	59.367	70.227
Brunei	8.392	29.335	28.606
Bhutan	0.006	0.006	98.548
Canada	374.159	376.466	99.387
Switzerland	56.056	83.618	67.038
China	1245.509	962.807	129.362
Colombia	4.948	15.779	31.355
Germany	174.789	199.475	87.625
Egypt, Arab Rep.	30.560	39.842	76.702
Spain	42.325	63.328	66.834
Fiji	99.648	162.377	61.368
France	109.353	135.449	80.734
United Kingdom	1103.573	920.928	119.833
Greece	18.521	36.587	50.621
Hong Kong, China	517.371	577.125	89.646
Indonesia	438.621	435.634	100.686
India	206.826	193.485	106.895
Ireland	87.075	117.065	74.382
Iran, Islamic Rep.	13.776	27.503	50.090
Israel	14.957	32.266	46.356
Italy	111.073	136.977	81.089
Jordan	17.952	28.854	62.218
Japan	3857.696	3697.453	104.334
Cambodia	10.355	22.621	45.777
Korea, Rep.	1360.474	1477.444	92.083
Kuwait	36.942	65.320	56.555
Sri Lanka	45.713	65.606	69.679
Macao	6.382	24.022	26.567
Maldives	3.707	15.205	24.377
Mexico	117.010	139.939	83.615
Myanmar	5.370	13.768	39.003
Mauritius	50.833	73.452	69.207
Malaysia	507.511	523.433	96.958

Netherlands	325.153	334.461	97.217
Nepal	1.158	33.740	3.431
New Zealand	2314.925	2596.295	89.163
Oman	33.779	58.780	57.467
Pakistan	83.617	84.983	98.392
Peru	7.728	19.385	39.867
Philippines	294.935	290.186	101.637
Papua New Guinea	145.395	190.771	76.214
Poland	8.481	20.424	41.527
Qatar	22.014	48.808	45.103
Russian Federation	169.612	167.133	101.483
Saudi Arabia	183.770	202.861	90.589
Singapore	635.082	731.410	86.830
Thailand	489.327	479.221	102.109
Turkey	41.861	57.267	73.099
United States	2464.959	1928.085	127.845
Vietnam	153.171	158.876	96.410
South Africa	539.578	452.329	119.289
Total	18969.301	19061.928	99.951
SAARC			
Bangladesh	39.262	49.397	79.482
Bhutan	0.006	0.006	98.548
India	206.826	193.485	106.895
Sri Lanka	45.713	65.606	69.679
Maldives	3.707	15.205	24.377
Nepal	1.158	33.740	3.431
Pakistan	83.617	84.983	98.392
Total	380.288	442.422	97.516

Table A4: Australia's Mean Exports (2006-08) of Manufactured Commodities not identified by kind (US$ Million)

Country	*Exports*	*Potential Exports*	*Technical Efficiency Percent*
United Arab Emirates	1147.923	945.407	121.421
Argentina	17.611	32.881	53.560
Belgium	397.717	385.149	103.263
Bangladesh	26.682	38.765	68.830
Bulgaria	10.118	13.952	72.517
Bahrain	43.397	38.746	112.003
Brazil	94.533	134.751	70.154
Brunei	4.070	15.741	25.857
Bhutan	0.015	0.005	304.737
Canada	261.501	327.815	79.771
Switzerland	569.788	522.846	108.978
China	1486.360	1842.853	80.655
Colombia	15.867	25.626	61.919
Czech Republic	5.749	15.985	35.965
Germany	563.799	681.396	82.742
Egypt, Arab Rep.	46.556	52.286	89.041
Spain	82.897	123.498	67.124
France	236.962	315.632	75.075
United Kingdom	3678.210	3268.461	112.536
Greece	14.538	30.400	47.820
Hong Kong, China	1080.043	1160.658	93.054
Hungary	8.883	18.593	47.778
Indonesia	726.109	931.864	77.920
India	3474.851	3066.731	113.308
Ireland	38.593	54.175	71.238
Iran, Islamic Rep.	35.104	50.057	70.129
Israel	50.071	67.495	74.185
Italy	302.076	381.084	79.268
Jordan	9.869	10.937	90.236
Japan	2452.040	3189.308	76.883
Korea, Rep.	1834.207	2040.446	89.892
Kuwait	178.734	175.148	102.047
Sri Lanka	26.706	36.238	73.695
Macao	33.479	48.306	69.307
Mexico	112.789	154.783	72.869
Mauritius	7.631	13.116	58.177
Malaysia	904.941	997.603	90.712
Netherlands	229.414	264.713	86.665

Nepal	13.785	15.304	90.073
New Zealand	3048.891	3830.412	79.597
Oman	181.217	149.436	121.268
Pakistan	45.204	60.278	74.993
Peru	22.859	32.783	69.728
Philippines	152.618	210.220	72.599
Papua New Guinea	448.466	455.050	98.553
Poland	12.064	27.314	44.166
Portugal	13.592	24.519	55.433
Qatar	67.020	77.164	86.854
Russian Federation	30.816	60.274	51.126
Saudi Arabia	854.270	760.468	112.335
Singapore	1238.825	1375.542	90.061
Thailand	1802.381	1727.552	104.331
Turkey	111.574	137.220	81.310
United States	3452.142	3864.157	89.338
Vietnam	660.042	597.145	110.533
South Africa	318.927	333.506	95.629
Total	32684.526	35211.793	99.289
SAARC			
Bangladesh	26.682	38.765	68.830
Bhutan	0.015	0.005	304.737
India	3474.851	3066.731	113.308
Maldives	0	N/A	N/A
Nepal	13.785	15.304	90.073
Pakistan	45.204	60.278	74.993
Sri Lanka	26.706	36.238	73.695
Total	3587.243	3217.321	101.348

Table A5: Australia's Mean Exports (2006-08) of other Commodities (US$ Million)

Country	*Exports*	*Potential Exports*	*Technical Efficiency Percent*
United Arab Emirates	6.737	2.534	265.903
Argentina	0.045	0.006	781.633
Belgium	0.929	12.856	7.225
Bangladesh	16.972	1.675	1013.511
Bulgaria	0.087	0.128	68.320
Bahrain	0.069	0.105	66.033
Brazil	1.514	4.745	31.913
Brunei	0.023	0.006	384.344
Canada	1.167	5.548	21.036
Switzerland	17.211	6.884	250.012
China	469.753	409.230	114.789
Czech Republic	0.006	0.002	264.505
Germany	22.765	12.766	178.325
Egypt, Arab Rep.	0.054	0.028	193.261
Spain	1.277	1.531	83.410
Fiji	2.357	0.598	394.291
France	2.638	3.294	80.105
United Kingdom	49.782	15.232	326.831
Greece	0.210	0.141	148.429
Hong Kong, China	64.652	28.963	223.219
Hungary	0.009	0.004	215.328
Indonesia	116.588	120.149	97.036
India	96.783	69.028	140.209
Ireland	0.111	0.107	103.370
Iran, Islamic Rep.	0.058	0.005	1110.953
Israel	0.179	0.150	119.783
Italy	1.926	3.421	56.291
Jordan	0.080	0.141	56.963
Japan	37.887	58.461	64.807
Cambodia	0.023	0.009	259.086
Korea, Rep.	99.998	73.276	136.467
Kuwait	0.045	0.026	172.582
Sri Lanka	0.338	0.304	111.229
Macao	0.201	0.224	89.840
Maldives	0.010	0.014	76.151
Mexico	0.326	0.312	104.322
Malaysia	161.983	88.220	183.612
Netherlands	21.980	2.462	892.804
Nepal	0.064	0.061	104.203

New Zealand	12.332	28.991	42.537
Oman	0.020	0.013	156.940
Pakistan	7.451	0.474	1572.095
Philippines	13.260	13.489	98.309
Papua New Guinea	5.409	6.018	89.887
Poland	0.017	0.002	716.158
Portugal	0.086	0.079	108.521
Qatar	0.010	0.005	193.477
Russian Federation	0.244	0.222	109.903
Saudi Arabia	0.026	0.000	9280.020
Singapore	16.080	14.015	114.741
Thailand	84.580	46.760	180.880
Turkey	0.300	0.011	2728.666
Uruguay	0.060	0.075	80.239
United States	40.698	44.060	92.368
Vietnam	28.355	10.810	262.303
South Africa	2.840	1.718	165.311
Total	1408.605	1089.385	103.675
SAARC			
Bangladesh	16.972	1.675	1013.511
Bhutan	0	N/A	N/A
India	96.783	69.028	140.209
Sri Lanka	0.338	0.304	111.229
Maldives	0.010	0.014	76.151
Nepal	0.064	0.061	104.203
Pakistan	7.451	0.474	1572.095
Total	121.618	71.555	112.421

Standard Industrial Classification (SIC)

Code	Division	Code	Major Group
0	Agricultural, Forestry and Fishery Products		
		01	Agricultural Products
		02	Livestock and Livestock Products
		08	Forestry Products, nspf
		09	Fish, Fresh, Chilled, or Frozen, and other Marine Products
1	Mineral Commodities		
		10	Metal Ores and Concentrates
		12	Coal and Lignite
		13	Crude Petroleum and Natural Gas
		14	Nonmetallic Minerals, Except Fuels ·
2	Manufactured Commodities		
		20	Food and Kindred Products ·
		21	Tobacco Products ·
		22	Textile Mill Products ·
		23	Apparel and Other Finished Products Made From Fabrics and Similar Materials ·
		24	Lumber and Wood Products, Except Furniture ·
		25	Furniture and Fixtures
		26	Paper and Allied Products ·
		27	Printing, Publishing, and Allied Industries
		28	Chemicals and Allied Products ·
		29	Petroleum Refining and Related Industries
3	Manufactured Commodities not identified by kind Commodities		
		30	Rubber and Miscellaneous Plastics Products
		31	Leather and Leather Products ·
		32	Stone, Clay, Glass, and Concrete Products
		33	Primary Metal Industries
		34	Fabricated Metal Products, Except Machinery and Transportation Equipment
		35	Industrial and Commercial Machinery and Computer Equipment
		36	Electronic and Other Electrical Equipment and Components, Except Computer Equipment ·
		37	Transportation Equipment
		38	Measuring, Analyzing and Controlling Instruments; Photographic, Medical and Optical Goods; Watches and Clocks
		39	Miscellaneous Manufacturing Industries
9	Other Commodities	91	Scrap and Waste
		92	Used or Second-hand Merchandise
		98	Goods returned, and re-imported articles, duty paid on previous importation
		99	Special Classification provisions, nspf