

# **TRADE OPENNESS: AN AUSTRALIAN PERSPECTIVE**

Simon Guttman and Anthony Richards

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## **Abstract**

Australia's external trade is relatively low compared with the size of its economy. Indeed, Australia's openness ratio (exports plus imports as a proportion of GDP) in 2002 was the third-lowest among the 30 OECD countries. This paper seeks to understand Australia's low openness by analysing the empirical determinants of aggregate country trade. We begin by estimating a standard gravity model of bilateral trade. Although the model appears to fit the bilateral data very well, it does a relatively poor job at fitting countries' aggregate trade levels, with different methodologies sometimes providing highly conflicting results.

The focus of the paper is an equation for country openness. Our equation explains a substantial amount of the variation in how much countries trade using a small number of explanatory variables. We find that the most important determinants of openness are population and a measure of distance to potential trade partners. Countries with larger populations trade less, as do countries that are relatively more remote. Furthermore, after controlling for trade policy there is little evidence of a positive correlation between openness and economic development.

While gravity models suggest Australia trades much more than expected, the openness equation suggests that its level of trade is relatively close to what would be expected. The most important factors in explaining Australia's low openness ratio are its distance to the rest of the world, and to a lesser extent its large geographic size.

JEL Classification Numbers: F10, F13, O1

Keywords: trade, outward orientation, economic geography, trade liberalisation

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# TRADE OPENNESS: AN AUSTRALIAN PERSPECTIVE

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## 1. Introduction

Consumers in other countries may know Australia best for its beer, dairy and wool products, but Australia's economy relies very little on exports. Of the 30 members of the Organization for Economic Cooperation and Development, only 3 are less export-dependent – Greece, the United States and Japan (*New York Times*, 7 March 2003, p W1).

There is substantial interest among academics and policy-makers in the role of external trade in macroeconomic outcomes. For example, there is a vigorous debate among economists as to whether trade openness influences either the level or growth of output (see, for example, Frankel and Romer 1999, and Rodriguez and Rodrik 2001). In the Australian case, trade is considered an integral part of economic activity and, among Australians at least, it is widely perceived that Australia is a very open economy. Yet, as shown in Figure 1, Australian trade (exports plus imports, a broader measure than used in our opening quote) as a proportion of GDP (henceforth termed **openness**) is relatively small compared to other industrialised countries.<sup>1</sup> With exports and imports of goods and services each equivalent to around 21–22 per cent of GDP, Australia's 2002 openness ratio of 43 per cent was substantially below the median for OECD countries of 69 per cent. In addition, of the 136 countries and territories for which the Penn World Tables have data for 2000, Australia was the 20<sup>th</sup> least open economy.

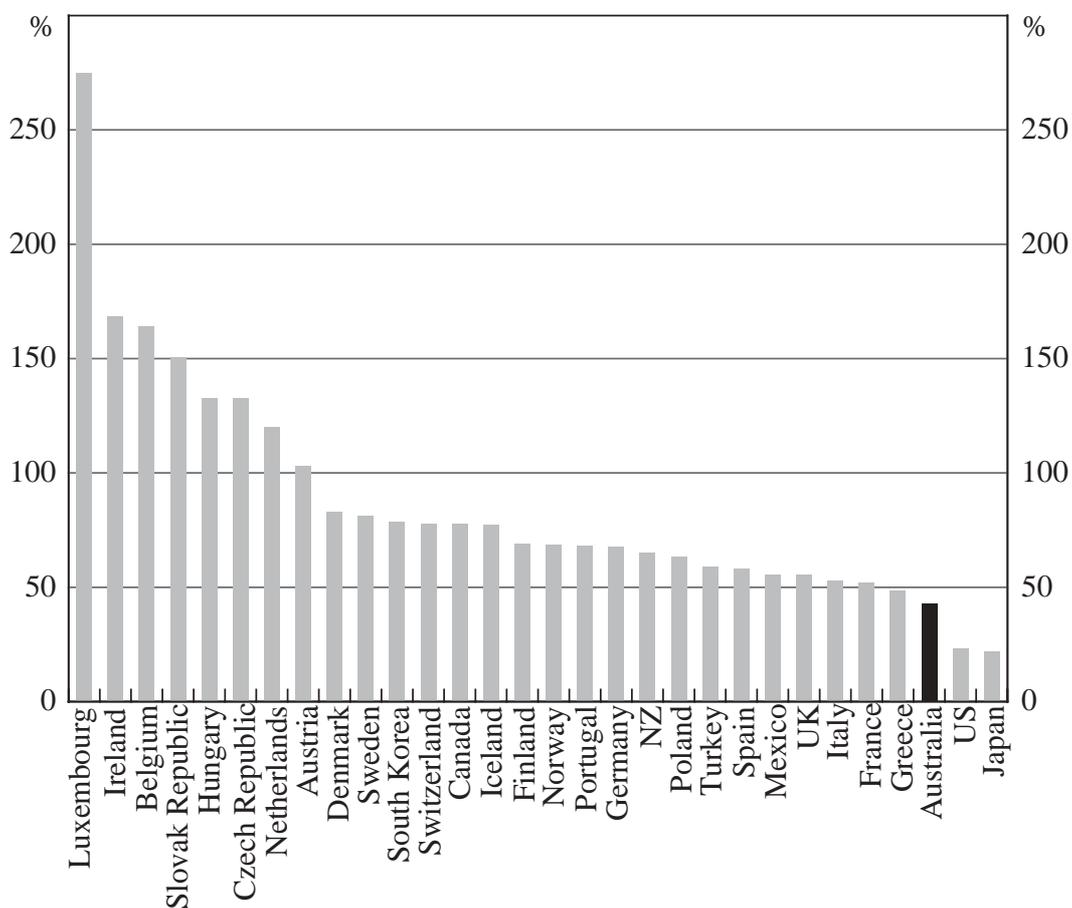
The fact that Australia trades less than other countries does not necessarily imply that Australia trades less than would be expected. There could be good reasons for its relatively low openness. For example, it might reflect Australia's geographic isolation, especially from the economic mass of North America and western

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<sup>1</sup> We focus on trade outcomes as our measure of openness, rather than the presence or absence of barriers to trade, the degree of capital account liberalisation or the size of capital flows.

Europe.<sup>2</sup> Another plausible factor might be Australia's geographic size. Geographically larger countries will typically have more diversified endowments, allowing them to produce a wider range of agricultural and resource products, which means they may have less need to trade than smaller countries. Thus, although Australia trades much less than most other OECD countries, it might actually be the case that it trades more than would be expected given its geographic attributes.

**Figure 1: Trade as a Proportion of GDP – OECD Countries**  
2002



Source: authors' calculations based on IMF *Direction of Trade Statistics*

<sup>2</sup> In related work, Battersby and Ewing (2003) have examined the impact of remoteness on Australia's trade using the gravity model and conclude that Australia's level of total trade is low because of its relatively remote location. The analysis in the current paper differs from Battersby and Ewing in that our focus is mainly on equations for total trade rather than on the gravity model and bilateral trading patterns. In addition, our analysis includes a wider range of possible economic determinants of trade and a larger sample of countries.

There is relatively little theoretical or empirical analysis looking at the determinants of the openness of countries, or at least at the variables that can explain openness.<sup>3</sup> This paper takes up that task with an empirical study of openness and the economic and geographic variables that are able to explain cross-country differences in openness.

To provide greater perspective for our results, we first examine a gravity model of **bilateral** trade. This model has been used extensively to estimate the effect on bilateral trade of factors such as the use of a common currency or common membership in a free trade agreement (FTA). Our approach is somewhat different in that we take the estimates from a gravity model and use different methods to extract information about countries' **total** trade. We show that the different methods can yield conflicting results. For Australia, one approach suggests that total trade is about 50 per cent more than predicted whereas another suggests that Australia trades fully 2.8 times the prediction of the gravity model. We interpret these results as providing substantial justification for our analysis focusing on openness and the total trade of countries.<sup>4</sup> Given that models of bilateral trade do not seem to provide good predictions of aggregate trade, we estimate a model for total trade as a proportion of GDP.

The basic openness equation includes some relatively standard variables motivated by the empirical work on the gravity model such as population, area, GDP per capita, and a measure of economic location based on average distance to the rest of the world. However, a more significant addition is the inclusion of a comprehensive measure of trade-policy liberalisation. Also, our robustness tests examine a number of additional variables such as a measure of the efficiency of transport infrastructure, and some resource-related variables. We find some

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<sup>3</sup> We are aware of only a few published papers that examine the determinants of openness. In considering the implications of openness for the size of government, Alesina and Wacziarg (1998) provide a brief empirical analysis of the determinants of openness, using a sample ending in 1989. Pritchett (1996) briefly considers openness in a wider examination of the outward orientation of countries' policies. Rogowski (1987) considers the relationship between openness and government/parliamentary structure. There is also a recent working paper by Jansen and Nordås (2004) that addresses some of the same issues covered in this paper.

<sup>4</sup> The finding of strong country or regional effects in the gravity model – countries in some regions have bilateral trade levels that are consistently higher or lower than predicted (see, for example, Frankel and Wei 1998) – would provide additional justification for our approach.

interesting results, including evidence that the widely accepted positive correlation between the level of economic development and the amount of trade disappears after controlling for countries' trade policies. Overall, our equations are able to explain a substantial proportion of the cross-country variation in openness. And returning to the question that sparked our study, the openness equation suggests that Australia's level of trade is relatively close to what would be expected for a country with its characteristics.

The remainder of the paper is structured as follows. Section 2 presents some analysis with the bilateral gravity model. Estimation with the openness equation is discussed in Section 3. Some Australian extensions of the openness equation are provided in Section 4, and Section 5 concludes.

## 2. The Gravity Model

### 2.1 Background

The most common framework for explaining observed trading patterns is the gravity model (see, for example, Frankel 1997, Rose 2000, and Anderson and van Wincoop 2003). The underlying premise of the gravity model is that bilateral trade is a function of the geographic distance between two countries (which is a proxy for transport costs), and the two countries' combined economic size, measured as the product of the two GDPs. Typically, a number of other variables – to capture geographic features, economic development and policy institutions – are also included as regressors when estimating the model.

The gravity model is a powerful tool for testing a variety of hypotheses, such as the effect of a common currency or membership in a common free trade agreement on bilateral trade (see, for example, Rose 2000). While it is generally used to explain **bilateral** trade between countries, the estimated gravity equation can, in principle, yield implications about **aggregate** country trade. For example, one could ask how well aggregate trade levels are explained by those variables that the gravity literature suggests are empirically important determinants of bilateral trade. Indeed, the goodness of fit of the gravity model at the aggregate country level is arguably an important aspect of the model's overall adequacy.

There are two ways in which the gravity model's goodness of fit for a particular country could be assessed. The first would be to add a country-specific dummy variable to the bilateral model. If the dummy variable is economically and statistically significant, it can be concluded that the model provides a relatively poor fit for the particular country. A second approach would be to take the (de-logged) fitted values of bilateral trade from the model, sum up these values for each country and then compare this with each country's actual trade. We consider both approaches in Section 2.3.

## 2.2 Estimation with the Bilateral Gravity Model

To estimate a gravity model we use the extensive data set compiled by Andrew Rose.<sup>5</sup> This contains data on numerous variables for over 170 countries and territories. We begin by estimating a fairly standard 'empirical' gravity model, as opposed to the 'theoretical' gravity model proposed by Anderson and van Wincoop (2003). The model is similar to Rose (2000), and uses typical economic and geographical variables and also a number of dummy variables. The estimated equation is:

$$\begin{aligned} \log(\text{trade}_{ij}) = & \beta_0 + \beta_1 \log(\text{GDP}_i \cdot \text{GDP}_j) + \beta_2 \log(\text{distance}_{ij}) + \beta_3 \log\left(\frac{\text{GDP}_i}{\text{POP}_i} \cdot \frac{\text{GDP}_j}{\text{POP}_j}\right) \\ & + \beta_4 \log(\text{area}_i \cdot \text{area}_j) + \beta_5 (\text{island both}_{ij}) + \beta_6 (\text{island either}_{ij}) + \beta_7 (\text{landlocked both}_{ij}) \\ & + \beta_8 (\text{landlocked either}_{ij}) + \beta_9 (\text{border}_{ij}) + \beta_{10} (\text{common coloniser}_{ij}) + \beta_{11} (\text{colony}_{ij}) \\ & + \beta_{12} (\text{common language}_{ij}) + \beta_{13} (\text{FTA}) + \beta_{14} (\text{common currency}) + \varepsilon_{ij} \end{aligned} \quad (1)$$

where  $i$  and  $j$  are the two countries in the bilateral trading relationship. The dependent variable  $\text{trade}_{ij}$  is defined as nominal trade in both goods and services, deflated by the US chain price index (see Rose 2000 for more details). We have estimated this equation for six five-year periods going back to 1970, but for brevity present the results for only one cross-section regression with data averaged over 1995–1999, the last five years in the Rose data set. The results are in column (1) in Table 1.

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<sup>5</sup> The data (with definitions) are available at <<http://faculty.haas.berkeley.edu/aroze/RecRes.htm>>.

**Table 1: Parameter Estimates from a Gravity Model of Bilateral Trade  
1995–1999**

	(1)	(2)
Product of total GDP	1.03*** (0.01)	1.05*** (0.01)
Distance	-1.23*** (0.03)	-1.30*** (0.03)
Product of per capita GDP	0.19*** (0.02)	-0.03* (0.02)
Product of area	-0.11*** (0.01)	-0.10*** (0.01)
Island both	0.63*** (0.13)	0.73*** (0.13)
Island either	-0.16*** (0.05)	-0.01*** (0.05)
Landlocked both	0.49*** (0.13)	0.35*** (0.12)
Landlocked either	-0.57*** (0.05)	-0.71*** (0.05)
Common border	0.96*** (0.14)	0.85*** (0.14)
Common coloniser	0.42*** (0.09)	0.53*** (0.09)
Colony	1.36*** (0.13)	1.17*** (0.13)
Common language	0.37*** (0.06)	0.46*** (0.06)
Common FTA membership	0.88*** (0.13)	0.57*** (0.13)
Currency union	1.04*** (0.22)	1.07*** (0.23)
Trade liberalisation index		0.44*** (0.02)
Number of observations	9 637	9 637
Adjusted R <sup>2</sup> with dependent variable defined as $\log(\text{trade}_{ij})$	0.72	0.73
Adjusted R <sup>2</sup> with dependent variable defined as $\log(\text{trade}_{ij}/(\text{GDP}_i \text{GDP}_j))$	0.34	0.37
Memo item:		
Dummy variable for Australia	0.40*** (0.12)	0.20 (0.12)

Notes: Besides the memo item, all the results are for regressions excluding the Australian dummy variable. Robust standard errors are shown in brackets. Significance at the 1, 5 and 10 per cent levels is denoted by \*\*\*, \*\* and \*, respectively. Estimates for the constant are omitted for brevity.

The results in Table 1 are typical of gravity models. The adjusted  $R^2$  of above 0.70 suggests that the overall fit of the model is good for such a large cross-section. All variables are also significant at the 1 per cent level. Bilateral trade, as expected, is strongly positively related to the two countries' economic size (measured by the product of GDPs). After the product of GDPs, the second most significant variable in explaining bilateral trade (in terms of the explanatory power added to the equation, and regardless of ordering), is the distance between two countries, which takes the expected negative sign. This is presumably because trade costs, especially transport costs, increase with distance. Bilateral trade is also estimated to be positively related to the stage of development (proxied by the product of GDPs per capita). Trade is negatively related to combined geographic size, presumably because geographically larger countries are more likely to be self-sufficient (especially in primary products) and thus trade less. (As they are not central to the paper, we do not discuss the coefficients on the dummy variables, although all are significant at the 1 per cent level and most take the expected sign.)

Column (2) of Table 1 shows the results of estimating Equation (1) with an extra variable, which is the average of indices for the 1995 trade-policy regimes of the two trading partners. The trade-policy variable is described in more detail in Section 3, but is calculated so that it is higher for countries with more liberal trade regimes. The main impact of the inclusion of this variable is to change from positive to negative the parameter estimate on the variable for the product of the per capita GDPs. However, we defer further discussion of this finding until Section 3.3.

### **2.3 Assessing the Overall Fit of the Gravity Model**

The results in Table 1 suggest that the gravity model fits the data well. However, two points deserve further attention. First, it is perhaps not surprising that the product of GDP variable is so strongly significant (the  $t$ -statistic in column (1) is above 80), as trade will clearly be greater between bigger economies. Accordingly, it may be of interest to examine the overall fit of the regression absent this scaling effect. Second, while the overall fit of the model for bilateral trade flows is good, it remains to be considered how well the model fits particular countries.

To assess the influence of the product of the two countries' GDP as a regressor in the gravity model, we re-estimated the model with the dependent variable divided by the product of the two countries' GDP, with all of the independent variables remaining unchanged. The resulting adjusted  $R^2$  of 0.34 indicates that a substantial proportion of the original goodness of fit is due to the scaling effect of economies' sizes. Another way of illustrating this point is the fact that a regression of bilateral trade on just a constant and the product of GDPs yields an adjusted  $R^2$  of 0.57, so that once one has controlled for the product of GDPs, the additional 13 variables contribute only an additional 0.14 points to the overall adjusted  $R^2$ .

To assess the fit of the model at the aggregate level for each country, two approaches were used. The first involved estimating Equation (1) separately for each country with a country-specific dummy for that country. The coefficients on the dummies provide one gauge of how well the gravity model fits a particular country's bilateral trade: a zero value implies a perfect fit, a positive value implies actual trade is above fitted trade and a negative value implies actual trade is below fitted trade. The second approach involved creating fitted values for bilateral trade between every pair of countries, de-logging the data and then summing up for each country to create a fitted value for aggregate country trade.<sup>6</sup> The computed ratio of actual total trade to fitted total trade provides a further method to see whether countries' aggregate trade is similar to the level that might be expected. Figure 2 presents the two measures in a scatter plot: the ratio from the second method is converted into logs for comparability.

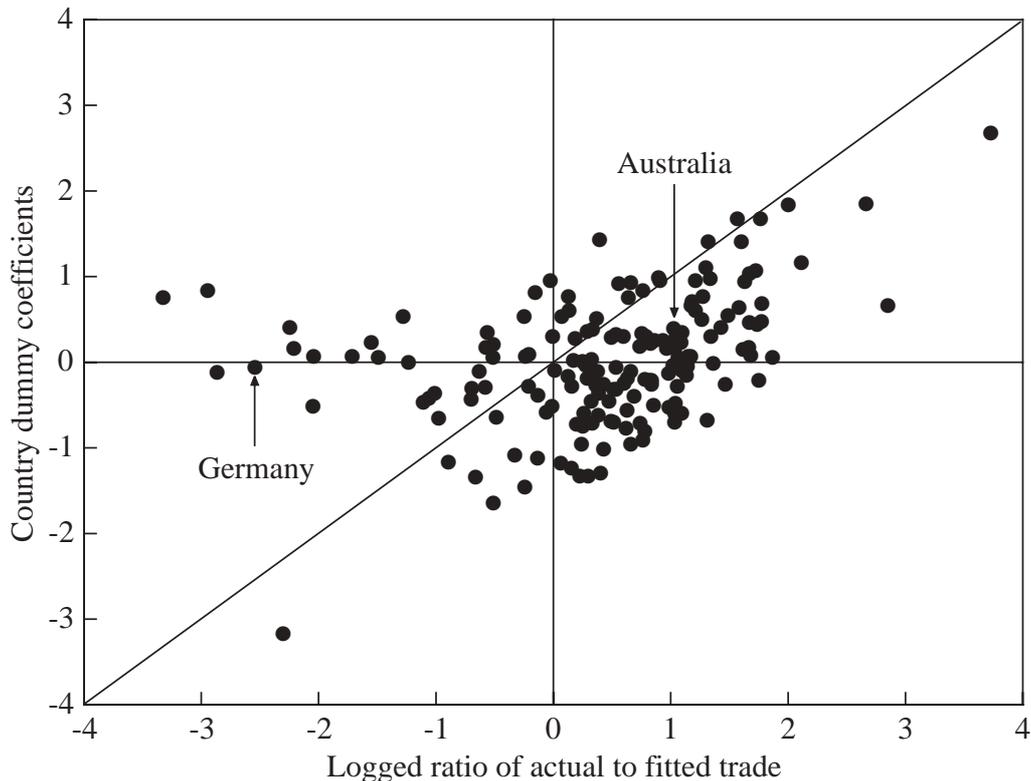
If the gravity model provided accurate predictions of aggregate country trade, the dots would cluster around the origin of Figure 2. Further, if the two methods for assessing the gravity model's goodness of fit at the country level presented similar conclusions, the dots should cluster around the 45 degree line. However, the relationship between the two measures is not that strong, with a correlation coefficient between the two measures of only 0.38. Indeed, for 78 of the 173 countries, the two approaches would suggest different conclusions about whether the total trade of a country is more or less than predicted. In some cases the two approaches provide sharply conflicting results. An extreme example is the case of

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<sup>6</sup> Frankel and Romer (1999) also follow this approach (although based only on geographic variables) to generate fitted values for total trade.

Germany, where actual trade is around  $1/13^{\text{th}}$  of summed fitted trade,<sup>7</sup> while the dummy variable coefficient of  $-0.06$  (which is not significantly different from zero) suggests that Germany's bilateral trade levels were on average only about five per cent smaller than implied by the gravity model results for other countries.

**Figure 2: Assessing the Fit of the Gravity Model for Aggregate Country Trade**



One reason the two approaches frequently yield different answers is that the 'dummy variable' approach places equal weight on a country's trade with all of its trading partners, while the 'fitted values' approach implicitly places more weight on the ability of the gravity model to explain a country's trade with larger countries. In the case of Australia, both methods suggest that Australia trades substantially more than would be predicted by the gravity model, but by substantially different magnitudes. When a country dummy is added to the gravity model it takes the value of 0.40, suggesting Australia's bilateral trade levels were on average nearly 50 per cent higher than implied by the gravity model results for

<sup>7</sup> The gravity model suggests very high levels of trade between Germany and its immediate neighbours. Indeed it suggests that trade with nine neighbours should account for 84 per cent of Germany's total trade. Germany does trade heavily with these countries, but in reality they account for 'only' 40 per cent of its total trade.

other countries. Alternatively, when all the fitted values for Australia's bilateral trade are summed together, they indicate that Australia's trade is around 2.8 times that predicted by the gravity model. The reason for the latter result is that Australia tends to trade more than predicted with large countries and less than predicted with smaller countries. Indeed, Australia trades more than the gravity model predicts with the 14 largest countries in the database, which account for 82 per cent of rest-of-world GDP. It is tempting to conclude that Australia trades more than predicted by standard empirical models of trade and indeed has had the good fortune to have generated stronger trading links with the world's larger economies. However, before reaching any conclusions on these issues, we consider an alternative approach to the question of how well we can explain the aggregate level of trade undertaken by individual countries.

### **3. The Openness Equation**

The above analysis suggests that the gravity model can yield contrasting answers when used to consider the question of whether countries trade more or less than would be expected, based on a number of economic and geographic variables that are important determinants of trade. These conflicting results suggest that it might be instructive to consider other approaches to the question of explaining the total level of a country's trade. Accordingly, in the remainder of this paper we estimate equations for total trade using data for 1971–2000. However, our interest is not in explaining the nominal value of countries' trade, but the level of their trade relative to their GDP. We therefore estimate an equation for openness – defined as exports plus imports as a proportion of GDP.

#### **3.1 Specification**

Theory provides only very limited guidance as to the type of equation that could be expected to explain the openness of countries: we are aware of no general theoretical model explaining openness. However, individual authors have proposed particular effects that we should expect to find in the data. For example, models of differentiated goods and increasing returns to scale suggest that countries will specialise in particular goods, and the amount of trade they undertake will be inversely proportionate to their size. In a world with no barriers to trade and where all goods are both final and tradable, a country which represents  $x$  per cent

of world production would have imports and exports each equivalent to  $100-x$  per cent of GDP (see, for example, Haveman and Hummels 2004). Alternatively, in a highly stylised Heckscher-Ohlin world (with constant returns to scale), Leamer (1988) shows that in the absence of barriers to trade, openness ratios should be a function of ‘resource distinctiveness’ or the ‘peculiarity of the resource supply vector’. Given data limitations, it is not clear that this notion can be seriously tested. More generally, problems of data availability preclude us from including some of the resource endowment variables that might be suggested by trade theory, but we make some modest attempts to include such variables in our robustness tests.

Instead, our empirical model for openness draws on many of the insights of earlier empirical work with the gravity model. We conjecture that openness will be related to various economic, geographic and policy factors. We do not claim to be estimating a structural model and are aware that causality between the left-hand-side variable and right-hand-side variables may go in both directions, and that there may be causality between the right-hand-side variables.<sup>8</sup> Nor do we test any specific theoretical model of international trade. Instead, the regressions should be interpreted as an attempt to identify which variables are most correlated with the openness of countries. The relative paucity of work explaining the openness of countries suggests that such an exercise may be worthwhile.

We begin by proposing a fairly parsimonious equation with five explanatory variables. The selection of variables is based largely on the availability of data and our desire to maintain as large a sample size as possible. Three of the variables can be viewed as possible economic or geographic determinants of openness: the population and total area of each country, and the level of economic development (using GDP per capita as a proxy). The two other variables are measures of the existence of either natural or policy-induced barriers to trade: we use a measure of the location of each country relative to economic activity in the rest of the world as a proxy for natural barriers to trade and a trade-policy index as a proxy for policy-induced barriers.

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<sup>8</sup> The standard approach to draw out causal effects in these circumstances would be to use instrumental variables, but it is unclear that suitable instruments (for example, variables that influence trade policy but do not influence trade) exist.

Besides the trade-policy measure, all the variables are in logs, and the equation estimated is:

$$\log(\text{openness}_i) = \beta_0 + \beta_1 \log(\text{area}_i) + \beta_2 \log(\text{population}_i) + \beta_3 \log(\text{GDP per capita}_i) + \beta_4 \log(\text{economic location}_i) + \beta_5 (\text{trade policy}_i) + \varepsilon_i \quad (2)$$

The openness, area, population and GDP per capita variables are defined in the usual manner.<sup>9</sup> The economic location and trade-policy variables are specifically constructed and are described in greater detail below.

The most straightforward definition for an economic location variable would be a simple weighted-average of distance to all possible trading partners, termed remoteness:

$$\text{Remoteness}_i = \sum_{j \neq i}^J \text{distance}_{i \rightarrow j} w_j \quad (3)$$

where distance is the Great World Circle distance (the shortest path following the surface of the globe) between the capital cities of two countries,  $J$  is the sample of countries,  $i$  is the home country,  $j$  is the potential trading partner, and  $w_j$  is the weight of country  $j$  in world GDP (excluding the GDP of country  $i$ ).<sup>10</sup> This variable for the average distance to all potential trading partners has a mean value of 8 320 kilometres for the 172 countries for which it can be constructed. It shows western European countries to be the least remote, with weighted-average distance to potential trading partners as low as 5 500 kilometres. By contrast, Australia and

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<sup>9</sup> The use of the log of openness seems appropriate given its distribution – bounded below at zero with no upper bound due to the existence of entrepôt trade. In addition, the Box-Cox test suggests that the log functional form is preferable to the linear form. The data are in current US\$ and taken from Penn World Tables 6.1, as are the data for GDP per capita and population. Area is defined as the total area (land and water) of a country in square kilometres, taken from the Central Intelligence Agency *World Factbook*.

<sup>10</sup> Consistent with common practice in gravity model regressions, Chicago was used as the ‘capital’ for the United States and Shanghai for China. The GDP data used to calculate the various remoteness/economic location measures, measured by market exchange rates, were taken from the IMF World Economic Outlook Database as it has greater coverage than the Penn World Tables.

New Zealand are shown as the most remote countries, with an average distance to potential trading partners of 13 700 and 14 000 kilometres respectively.<sup>11</sup>

However, a transformation of the gravity model (see, for example, Ewing and Battersby 2003) suggests an alternative measure of remoteness, which we term economic location, which is given by:

$$\text{Economic Location}_i = \sum_{j \neq i}^J \frac{w_j}{\text{distance}_{i \rightarrow j}^\alpha} \quad (4)$$

The variable  $\alpha$  in Equation (4) corresponds to the absolute value of the coefficient on the distance term in a gravity model ( $\beta_2$ ). Most empirical estimates put  $\beta_2$  between about  $-0.5$  and  $-1.0$  (Disdier and Head 2003). In preliminary regressions the overall fit of the equation was little different with values for  $\alpha$  of  $0.5$  and  $1.0$ , so for simplicity all the estimated equations use  $\alpha$  equal to  $1.0$ . Given that it uses the reciprocal of distance, countries with a more favourable economic location (that is, closer, on average, to the rest of the world) will have a higher value. As such, we expect this measure of economic location to be positively related to openness.

The trade-policy variable was constructed from the trade-policy component of the Economic Freedom of the World Index produced by the Institute for Economic Freedom (IEF). The IEF's summary measure is based on five separate indicators of countries' openness to trade. However, one of these – the ratio of actual trade to predicted trade (based on a simple openness equation)<sup>12</sup> – is clearly inappropriate for inclusion in our openness regressions, and is accordingly omitted. Therefore, our measure of trade policy is the average of four components – taxes on

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<sup>11</sup> These values are somewhat higher than Ewing and Battersby (2003, p 21) who report remoteness for Australia and New Zealand of 10 183 and 12 312 kilometres, respectively. The difference appears to be due to our use of GDP measured using market exchange rates and their use of GDP measured at purchasing power parities (PPPs), which markedly increase the weight of China and India in world GDP so that Australia appears less remote. Since market exchange rates determine countries' ability to purchase goods and services in international trade, the former is a more relevant weighting system for explaining current levels of trade.

<sup>12</sup> The independent variables in the openness equation used by the IEF are remoteness, population, total area, length of coastline, a dummy for landlocked countries, and time dummies. In the results that follow we include two additional determinants of openness (the trade-policy regime and level of economic development) and a location variable that is theoretically and empirically preferable to a simple remoteness variable.

international trade, the existence of regulatory trade barriers, the difference between the official and black market exchange rates, and the existence of international capital controls.<sup>13</sup> We calculate a simple average (the same method used for the composite index) of these four components. The index is available at five-year intervals from 1970 and scaled from 1 to 10; a higher score indicates a more liberal trade regime.<sup>14</sup>

### 3.2 Empirical Analysis

To simplify the analysis and reduce the noise in annual trade data, the thirty years of data (1971–2000) are averaged over six five-year time periods: 1971–1975, 1976–1980 and so on. We estimated regressions for each of these time periods and also estimated a pooled cross-section regression with the full sample of countries available in each time period.<sup>15</sup> Time dummies were included for the last five time periods. Dummies are also included for Hong Kong and Singapore in each regression. As re-exports are a significant proportion of their total trade, the openness ratios for these countries will be substantially higher than for other countries (315 per cent and 273 per cent for average 1996–2000 respectively, the

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<sup>13</sup> All measures are cardinal and based on quantitative assessment: a detailed discussion of the variables is available at <<http://www.freetheworld.com/2003/1EFW2003ch1.pdf>>.

<sup>14</sup> We include the 1970 value of the trade-policy variable in the 1971–1975 regression, the 1975 value in the 1976–1980 regression, and so on. Some early values of this variable were missing and were imputed using a regression of the index against its value in the next period. The results were robust to a ‘nearest neighbours’ imputation and also to using regional averages. For the 1971–1975 cross-section, 31 of 101 observations were imputed; the number of imputations falls moving forward.

<sup>15</sup> An alternative approach would be to estimate across time with a fixed-effects panel: this effectively involves country-specific dummy variables for every country. However, such an approach is problematic as one of our variables (total area) is constant over time, while the others change only slowly over time. As a result, it is either impossible or difficult to get good parameter estimates for the explanatory variables in a fixed-effects panel. Our compromise is to include dummy variables for only those two countries (Hong Kong and Singapore) which are clearly special cases. However, it should be noted that the coefficient estimates for the variables that can be estimated in a panel regression (population, GDP per capita, economic location and trade policy) are quite similar to the coefficient estimates we obtain from the pooled regression.

two most open countries in our sample).<sup>16</sup> The results of the regression are reported in Table 2.

	1971– 1975	1976– 1980	1981– 1985	1986– 1990	1991– 1995	1996– 2000	Pooled cross-section
Total area	–0.03 (0.03)	–0.03 (0.02)	–0.04* (0.02)	–0.03 (0.03)	–0.03 (0.03)	–0.04 (0.03)	–0.03*** (0.01)
Population	–0.25*** (0.03)	–0.22*** (0.03)	–0.20*** (0.03)	–0.20*** (0.03)	–0.18*** (0.04)	–0.13*** (0.04)	–0.19*** (0.01)
GDP per capita	–0.02 (0.05)	–0.06** (0.03)	–0.06* (0.04)	–0.08** (0.03)	–0.06* (0.03)	–0.03 (0.03)	–0.05*** (0.01)
Economic location	0.18** (0.07)	0.20*** (0.08)	0.25*** (0.08)	0.20** (0.09)	0.26*** (0.08)	0.27*** (0.08)	0.23*** (0.03)
Trade policy	0.05*** (0.03)	0.07*** (0.02)	0.08*** (0.02)	0.08*** (0.02)	0.04* (0.02)	0.03 (0.02)	0.06*** (0.01)
Adjusted R <sup>2</sup>	0.64	0.67	0.66	0.68	0.57	0.49	0.64
Number of observations	101	102	103	103	116	120	645
Memo item: Dummy variable for Australia	–0.19 (0.16)	–0.10 (0.14)	–0.04 (0.16)	–0.14 (0.16)	–0.04 (0.15)	–0.03 (0.17)	–0.09 (0.06)

Notes: Besides the memo item, all the results are for regressions excluding the Australian dummy variable. All the equations include a constant and dummy variables for Hong Kong and Singapore, and the pooled equation includes five dummy variables for time: these are omitted from the table for brevity. Robust standard errors are in brackets. Significance at the 1, 5 and 10 per cent levels is denoted by \*\*\*, \*\* and \*, respectively.

The results in Table 2 are encouraging. All five variables are significant at the 1 per cent level in the pooled cross-section regression, and most are significant in the individual cross-sections.<sup>17</sup> With the possible exception of the result for GDP per capita (which is considered in detail in Section 3.3), the parameter estimates have the expected sign in the pooled cross-section and all individual cross-sections.

<sup>16</sup> The standard test for identifying outliers, the Welsch and Kuh DFITS test, suggests that Singapore was an outlier in all six of the cross-section regressions and Hong Kong in four. No other country showed up as an outlier in more than two of the cross-sections.

<sup>17</sup> The fact that total area is not strongly significant in any of the cross-sections and that GDP per capita is significant in only some of the cross-sections appears to be the result of the relatively low sample size in the individual cross-sections: it is noteworthy that the parameter estimates for the different cross-sections are fairly similar.

The coefficient values on the time dummies (not shown) are significant and increase over time, consistent with the general increase in openness over time. The Hong Kong and Singapore dummies (not shown) are also consistently significant.

Although the decline in adjusted  $R^2$  over time is puzzling, the overall fit of the regression is quite good.<sup>18</sup> Yet, unlike the case of the gravity model, the goodness of fit of the openness equation is not boosted by a scale effect from nominal GDPs. Indeed, if we reformulate the openness equation with country trade as the dependent variable, and country GDP as one of the independent variables, the adjusted  $R^2$  jumps to around 0.96 in each of the cross-section regressions, which is higher than the normal bilateral gravity model (albeit on a different regressand).

We now discuss the parameter estimates, in order of their marginal significance in the pooled cross-section regression. The most important variable in explaining openness is population. Countries with smaller populations have higher levels of external trade (relative to GDP), presumably because they have fewer opportunities for within-country trade.

The second most important variable is economic location, which has a positive coefficient. Countries which are located closer to the rest of the world tend to trade more and be more open than countries with a less favourable location, presumably for the same reasons that the distance variable in the gravity model has a negative sign.<sup>19</sup> Indeed, Clark, Dollar and Micco (2004) note that, with the decline of regulatory trade barriers such as tariffs, transport costs may in many cases now represent a larger effective rate of protection than trade-policy restrictions. However, it is sometimes argued that as transport costs have declined over time the negative impact of distance on trade should have fallen over time. To test for this, we interacted our economic location variable with time dummies and found that the impact of the location variables fell by 0.04 between 1971–1975 and 1996–2000. These results suggest that an unfavourable economic location is having a smaller detrimental effect on trade over time, which is consistent with

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<sup>18</sup> The adjusted  $R^2$  of our equations is substantially higher than the values of around 0.30–0.40 obtained by Jansen and Nordås (2004): the difference appears to largely reflect our inclusion of variables for economic location and total area.

<sup>19</sup> See Venables (2001) for an overview of the role of location in influencing trade, and Anderson and van Wincoop (2004) for a survey of work on trade costs, broadly defined.

declining transportation costs. On the other hand, the results from the individual cross-sections suggest the opposite conclusion. Similarly, other work investigating the ‘death of distance’ (e.g., Coe *et al* 2002, and Disdier and Head 2003) also finds conflicting results.

The third most important variable is our measure of trade policy. The variable takes the expected sign, and indicates a positive correlation between the degree of liberalisation of a country’s trade-policy regime and how much it trades. It seems reasonable to expect that much of the causality runs from trade policy to trade – that a liberal trade regime stimulates trade. However, it is possible that there is also some reverse causation. For example, countries with high levels of trade may have constituencies pushing for low trade barriers. Alternatively, to the extent that trade is a potential source of budget revenue, countries with low trade levels might levy higher taxes on trade.

The parameter estimates on the per capita GDP variable are always negative, but sometimes not significant in individual cross-sections. The negative sign suggests that countries with larger per capita GDP tend to have a lower level of openness. This is contrary to the conventional wisdom that much trade is intra-industry or in differentiated products, that rich countries do more of such trade, so rich countries trade more. Gravity model researchers typically summarise their finding that per capita GDP has a significant positive sign to the effect that ‘richer economies trade more’ (see, for example, Frankel and Wei 1998, p 193, and Rose 2004, p 103). Our finding is also contrary to the result in the basic gravity model in Table 1. We consider this result further in the next section.

The least significant variable in the regression is total area. Similar to the results of the gravity model, there is a negative relationship between total area and openness, confirming that geographically larger countries are less open. In some respects this may appear somewhat counter-intuitive. In particular, holding population constant, population density falls as area rises, and the costs of internal trade increase. This might be expected to increase the level of external trade: it becomes more likely that people on one side of a country will trade with a neighbouring country rather than their own countrymen. However, this effect is clearly dominated by other factors, and an obvious one is that countries that are geographically larger may have a wider range of resource endowments and climatic variation, and so are able

to produce a more diversified range of products internally and thus have less need for external trade.

### 3.3 The Relationship between GDP Per Capita and Openness

As noted, the finding that GDP per capita has a negative relationship with openness is somewhat unexpected. In this section we examine some possible explanations for why our result differs from the conventional wisdom.

We first consider the possibility that the conventional wisdom is flawed because it ignores one or more important omitted variables. Column (1) of Table 3 shows that the correlation between openness and GDP per capita is significantly positive in a simple regression that also includes the dummy variables for time, Hong Kong and Singapore. However, the explanatory power of GDP per capita for openness is fairly modest: when it is added to a regression already including the dummy variables the adjusted  $R^2$  increases only from 0.17 to 0.20. Furthermore, the coefficient on GDP per capita falls close to zero when population, economic location and total area are added to the regression, as is shown in column (2). And when the trade-policy variable is added to the regression (column (3)), the coefficient on GDP per capita turns negative and significant. These results suggest that after controlling for some other important determinants of openness, notably trade policy, there is no evidence that richer countries tend to trade more than poorer countries.<sup>20</sup>

The results from the gravity model provide further evidence on this point. Column (2) of Table 1 shows the parameter estimates from a standard gravity model which also includes a variable for the average of the trade-policy variables for each country pair.<sup>21</sup> The parameter estimate on this additional variable is positive and significant at the 1 per cent level. Furthermore, the coefficient on the

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<sup>20</sup> This finding is consistent with some other recent research: see, for example, Anderson and Marcouiller (2002) and De Groot *et al* (2004).

<sup>21</sup> The trade-policy variable is not available for 53 of the 173 countries in the Rose database. To preserve the same sample used in column (1) of Table 1 we interpolate the missing values based on the average value of the trade-policy variable for the region where the country is located. We obtain very similar results – the significance of the per capita GDP variable disappears entirely – when we use a smaller sample of the 120 countries for which our trade-policy variable is available.

product of GDP per capita is now only significant at the 10 per cent level and falls from 0.19 to  $-0.03$ . This strongly suggests that the relative restrictiveness of trade policies is an important variable in explaining bilateral trade outcomes. In addition, after controlling for differences in trade-policy regimes, there is no evidence from the gravity model that countries with higher GDP per capita tend to trade relatively more than countries with lower GDP per capita.<sup>22</sup>

**Table 3: The Relationship between Openness and GDP Per Capita**

	(1)	(2)	(3)	(4)	(5)	(6)
GDP per capita	0.08*** (0.01)	0.00 (0.01)	-0.05*** (0.01)	0.04** (0.02)		0.61*** (0.09)
Population		-0.20*** (0.01)	-0.19*** (0.01)	-0.20*** (0.01)	-0.20*** (0.01)	-0.19*** (0.01)
Economic location		0.27*** (0.03)	0.23*** (0.03)	0.23*** (0.03)	0.26*** (0.03)	0.25*** (0.03)
Total area		-0.02** (0.01)	-0.03*** (0.01)	-0.02*** (0.01)	-0.02** (0.01)	-0.03*** (0.01)
Trade policy			0.06*** (0.01)	0.05*** (0.01)	0.05*** (0.01)	0.06*** (0.01)
Country price level				-0.30*** (0.05)	-0.26*** (0.04)	-0.19*** (0.06)
Country real income level					-0.04* (0.02)	
GDP per capita squared						-0.04*** (0.01)
Adjusted R <sup>2</sup>	0.20	0.61	0.64	0.66	0.66	0.68
Number of observations	645	645	645	645	645	645

Notes: All the equations include a constant, five dummy variables for time, and dummy variables for Hong Kong and Singapore: these are omitted from the table for brevity. All variables except the trade-policy index are in logs. Robust standard errors are in brackets. Significance at the 1, 5 and 10 per cent levels is denoted by \*\*\*, \*\* and \*, respectively.

A second possible explanation is that the result for GDP per capita reflects the use of market exchange rates in calculating the openness ratio. While it is conceivable that the price of tradables across countries will approximately follow the law of one price, there is ample evidence that this does not hold for the price of non-

<sup>22</sup> Jansen and Nordås (2004) find a similar result for gravity models that include a variable for the average bilateral tariff rate.

tradables. In particular, non-tradable prices tend to be substantially lower in developing countries than in developed countries (see, for example, Kravis, Heston and Summers 1982). To illustrate the implications for openness ratios, assume that all economies produced the same proportion of tradable and non-tradable goods. However, the fact that non-tradable prices are lower in developing countries will mean that the value of the non-tradable sector will be lower, which will reduce their GDPs measured at market exchange rates and boost their openness ratios relative to developed countries. This would result in a negative coefficient on per capita GDP.

To test for this, we included a variable in the pooled cross-section regression for each country's price level relative to the US, taken from the Penn World Tables. The results are shown in column (4) of Table 3. As expected, the price level variable takes a negative sign: countries with a higher price level have lower openness, presumably because price level effects boost their measured GDP. Furthermore, after controlling for price levels, the coefficient on GDP per capita becomes positive.

To check the robustness of this result, in column (5) we replace GDP per capita measured at market prices with a purer measure of real incomes from the Penn World Tables, namely real income (measured relative to the US) with all output measured at PPPs. The parameter estimates again show a strong negative coefficient on the price level variable. The coefficient on the alternative income level variable is negative, but only significant at the 10 per cent level. Overall, we conclude that the use of market exchange rates in calculating GDPs and openness ratios is a significant factor in the finding that openness is negatively related to GDP per capita.<sup>23</sup>

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<sup>23</sup> An additional explanation for the negative correlation between GDP per capita and openness might be that the non-traded sector (especially the services sector) is larger in developed economies. Unfortunately, this proposition cannot be tested directly, due to the unavailability of cross-country data on the size of the services sector. However, as government expenditure is predominantly in the non-traded sector (Froot and Rogoff 1991), we attempted to test for the importance of this sector by reformulating the openness ratio excluding government from the calculation of GDP in the denominator. However, the parameter estimate on per capita GDP was little changed. Subject to the caveat of the imperfect proxy for the non-traded sector, we tentatively conclude that this is less of a factor in affecting openness ratios than the other factors identified.

Finally, we investigated the possibility that the negative coefficient for GDP per capita masked the existence of a non-linear relationship by adding a GDP per capita squared term to the basic regression (including the country price level variable). The results from this regression are reported in column (6) of Table 3. Both the linear and squared terms are significant at the 1 per cent level. The positive coefficient on GDP per capita and negative coefficient on GDP per capita squared suggest that the relationship between openness and GDP per capita is indeed non-linear, approximating an inverse U shape.<sup>24</sup>

These results suggest that, to properly understand the relationship between economic development and openness, it is necessary to also allow for the relationship between trade policy and openness, as our initial specification does. In addition, the results suggest that it is important to account for the impact of a country's price level on its measured openness ratio and for possible non-linearity in the relationship between openness and GDP per capita. As such, both of these variables are included in the robustness checks reported in the next section.

### **3.4 Robustness Checks**

To further examine the robustness of the above results, a number of geographical variables and policy variables were added to our basic regression. In addition, we also attempt to test, albeit crudely, for the impact of variables measuring resource endowments.

#### *3.4.1 Geographical variables*

We include several variables to test for the effects of a country's own geography and its position in the world on its level of trade, and also to assess the robustness of the correlations identified in Table 2. The results from these tests are shown in Table 4 and they indicate that the coefficients and significance of our key variables are robust to the inclusion of the additional variables.

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<sup>24</sup> We also tested for the existence of a non-linear relationship between openness and the other explanatory variables, but the evidence is much weaker.

**Table 4: Robustness Checks – Geographical Variables**

	(1)	(2)	(3)	(4)	(5)
Total area	0.03*** (0.01)	-0.01 (0.01)	-0.02** (0.01)	-0.02** (0.01)	-0.03*** (0.01)
Population	-0.19*** (0.01)	-0.23*** (0.01)	-0.20*** (0.01)	-0.18*** (0.01)	-0.19*** (0.01)
GDP per capita	0.61*** (0.09)	0.83*** (0.09)	0.54*** (0.10)	0.60*** (0.09)	0.61*** (0.10)
Economic location	0.25*** (0.03)	0.29*** (0.03)	0.26*** (0.03)	0.33*** (0.04)	0.26*** (0.03)
Trade policy	0.06*** (0.01)	0.06*** (0.01)	0.06*** (0.01)	0.06*** (0.01)	0.06*** (0.01)
Country price level	-0.19*** (0.06)	-0.22*** (0.06)	-0.19*** (0.06)	-0.24*** (0.06)	-0.20*** (0.06)
GDP per capita squared	-0.04*** (0.01)	-0.06*** (0.01)	-0.04*** (0.01)	-0.04*** (0.01)	-0.04*** (0.01)
East Asia		0.33*** (0.06)			
Central and South America		-0.30*** (0.03)			
Landlocked			-0.08** (0.04)		
Proportion of land in the tropics				0.19*** (0.05)	
Trade policy of natural trading partners					-0.08** (0.04)
Adjusted R <sup>2</sup>	0.68	0.74	0.68	0.69	0.68
Number of observations	645	645	645	645	645

Notes: All the equations include a constant, five dummy variables for time, and dummy variables for Hong Kong and Singapore: these are omitted from the table for brevity. Robust standard errors are shown in parentheses. Significance at the 1, 5 and 10 per cent levels is denoted by \*\*\*, \*\* and \*, respectively.

First, since numerous authors (see, for example, the literature on regional trading blocs in Frankel 1998) have argued that there are regional effects in the level of trade, we included separate dummies for the major regions of the world. Column (2) of Table 4 shows the results with the two most significant dummies: east Asia, which has higher than expected openness (even after the inclusion of the dummy variables for Hong Kong and Singapore) and central and South America, which has lower than expected openness. The significance of these regional dummy variables suggests that there are some common factors which are not

captured by the variables in the basic equation. However, the inclusion of the most significant regional dummies increases the adjusted  $R^2$  by only 0.05. Together with the fact that the parameter estimates are mostly little changed following the inclusion of regional dummies, this suggests that the regression based purely on economic, geographic and policy variables is doing a reasonably good job in explaining the openness of countries.

Second, following the tradition of the gravity model, we included a dummy variable for whether a country is landlocked. A number of studies, including Limao and Venables (2001), have shown that the per-kilometre cost of land freight is far higher than the equivalent cost of shipping, implying that landlocked countries face higher transport costs in foreign trade because of their absence of seaport facilities. Hence, the expectation is that the parameter estimate on this variable would be negative, with landlocked countries less open than countries with a coastline. The results show that this dummy was indeed significant and negative, but again, did not disturb the parameter estimates for the core variables (column (3) in Table 4).

Our third variable is motivated by the fact that Rodriguez and Rodrik (2001) have shown in another context – the relationship between trade and growth – that cross-country empirical results can be extremely sensitive to the inclusion of a variable for the proportion of land in the tropics. The coefficient on this variable was significant, but the coefficients on the other variables were robust to its inclusion (column (4) in Table 4).<sup>25</sup>

Fourth, to further examine the importance of a country's position in the world for its trade, we added a variable for the average trade-policy liberalisation of a country's natural trading partners. The measure is a weighted average of the trade policy of all other countries, with weights that are highest for nearby and large countries. The variable is calculated as:

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<sup>25</sup> The data are from the Centre for International Development at Harvard University, and are available at <http://www.cid.harvard.edu/ciddata/ciddata.html>; a few missing values were filled in. We also separately included a variable capturing a country's distance from the equator: not surprisingly, the coefficient was negative (and significant), although the estimates for our main variables were robust to its inclusion.

$$\text{Trade Policy of Natural Trading Partners}_i = \sum_{j \neq i}^I \text{trade policy}_j \left( \frac{\frac{w_j}{\text{distance}_{i \rightarrow j}}}{\sum_{j \neq i}^J \frac{w_j}{\text{distance}_{i \rightarrow j}}} \right) \quad (5)$$

where  $w_j$  is defined (as in Equations (3) and (4)) as the weight of country  $j$  in world GDP (excluding the GDP of country  $i$ ). Although the expectation is that this variable should show a positive sign – countries should trade more if their larger neighbours have liberal trade regimes – the parameter estimate was negative and significant at the 5 per cent level.<sup>26</sup>

### 3.4.2 Policy variables

Our second set of robustness checks examined the impact of a country's economic and other policies on its trade. The results are reported in Table 5. We first test the possibility that the significance of the trade-policy variable might be acting as a proxy for broader aspects of policies or institutions. Accordingly, we tested the significance of a variable that measures the overall quality of a country's legal and property rights (taken from the IEF's Economic Freedom of the World Index). This variable is indeed quite highly correlated with our trade-policy measure, with a correlation coefficient of 0.64. Column (1) of Table 5 reports the results of our basic pooled cross-section regression. Column (2) reports the results also including the legal and property rights measure, which is found to be positive and significant at the 10 per cent level. In column (3), we drop the trade policy measure and just include the legal and property rights measure. The measure is positive, as expected, and significant at the 10 per cent level. Yet comparing columns (1) and (3) strongly suggests that trade policy has a greater impact on openness than institutional factors such as legal and property rights.

In addition, we tested for a relationship between the quality of a country's transport infrastructure and the level of its trade. Limao and Venables (2001) and Clark *et al* (2004) show that port inefficiency is a major component of transport costs and is accordingly associated with lower levels of bilateral trade in gravity

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<sup>26</sup> We also tested for the significance of the variable for the proportion of world GDP in any free trade agreements to which a country belongs. The parameter estimate was positive, as expected, although not significant.

regressions. The data we use is for the quality of transport infrastructure from the World Economic Forum's Global Competitiveness Report, which provides measures of port and air transport infrastructure quality. The measure takes values from 1 (least efficient) to 7 (most efficient). The prediction is that the parameter on these variables will be positive, with more efficient infrastructure (and low transport costs more generally) being associated with higher trade. The 1998 Report contains data for 51 countries in our sample. We imputed values for a further 29 countries using the data from 2002–2003 Report.

**Table 5: Robustness Checks – Policy Variables**

	Pooled cross-section			1996–2000		
	(1)	(2)	(3)	(4)	(5)	(6)
Total area	0.03*** (0.01)	–0.03*** (0.01)	–0.02* (0.01)	–0.04 (0.03)	–0.04 (0.03)	–0.05 (0.03)
Population	–0.19*** (0.01)	–0.19*** (0.01)	–0.21*** (0.01)	–0.15*** (0.04)	–0.14*** (0.04)	–0.16*** (0.04)
GDP per capita	0.61*** (0.09)	0.63*** (0.10)	0.63*** (0.10)	0.41 (0.56)	0.38 (0.54)	0.50 (0.54)
Economic location	0.25*** (0.03)	0.25*** (0.03)	0.27*** (0.03)	0.33*** (0.08)	0.33*** (0.07)	0.35*** (0.07)
Trade policy	0.06*** (0.01)	0.06*** (0.01)		–0.03 (0.04)	–0.03 (0.04)	–0.02 (0.04)
Country price level	–0.19*** (0.06)	–0.19*** (0.06)	–0.22*** (0.06)	–0.30 (0.27)	–0.25 (0.25)	–0.25 (0.27)
GDP per capita squared	–0.04*** (0.01)	–0.04*** (0.01)	–0.04*** (0.01)	–0.02 (0.03)	–0.02 (0.03)	–0.04 (0.03)
Legal and property rights		0.02* (0.01)	0.04*** (0.01)			
Port infrastructure					0.13*** (0.04)	
Air transport infrastructure						0.15*** (0.05)
Adjusted R <sup>2</sup>	0.68	0.68	0.66	0.58	0.62	0.62
Number of observations	645	645	645	80	80	80

Notes: All the equations include a constant and dummy variables for Hong Kong and Singapore: these are omitted from the table for brevity. Robust standard errors are shown in parentheses. Significance at the 1, 5 and 10 per cent levels is denoted by \*\*\*, \*\* and \*, respectively.

When the two infrastructure measures are added to the basic regression for 1996–2000 (columns (5) and (6)), both measures are significant. This is not surprising: efficient transport infrastructure presumably boosts trade, though the correlation between these variables may go both ways, since countries which trade heavily have greater incentives to improve their infrastructure.

### 3.4.3 *Resource endowment variables*

In the final set of robustness checks, shown in Table 6, we look for any evidence that the openness of countries is influenced by their resource endowments. The rationale for this is the idea noted above that in a Heckscher-Ohlin world, the amount of a country's trade should be related to its 'resource distinctiveness' or the 'peculiarity of the resource supply vector'. For example, countries with 'balanced' resource endowments might be able to meet many of their needs internally and might not trade much. By contrast, countries with resource endowments that are very different from the average may trade intensively, importing to get access to goods that they cannot produce internally, and exporting goods which are intensive in those factors in which they are abundant. To give effect to this, all of our measures of resource endowment are expressed as absolute deviations from the mean. The rationale is that countries with an abundance of a particular resource will trade more (exporting the surplus), as will countries with a relatively small supply of the resource (as they import to offset the particular shortage).

It is clearly difficult to find suitable variables to represent differences in resource endowments, so the variables used are necessarily imperfect.<sup>27</sup> Our first measure of resource endowments is a variable for the amount of land suitable for agriculture on a per capita basis (expressed as the absolute difference in a country's ratio from the mean ratio). While the coefficient is positive as expected, it is not significant.

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<sup>27</sup> The data for the proportion of arable land are from the CIA *World Factbook*; the data for the capital-labour ratio are from Penn World Tables 5.6; the data for human capital per worker are from Hall and Jones (1999); and data for average years of secondary schooling are from the Centre for International Development at Harvard University.

**Table 6: Robustness Checks – Resource Endowments**

	Pooled cross-section (full sample)		Pooled cross-section (1971–1976 to 1986–1990)		1986–1990		Pooled cross-section (full sample)	
Total area	0.03*** (0.01)	0.03*** (0.01)	0.08*** (0.02)	0.08*** (0.02)	–0.03 (0.03)	–0.03 (0.03)	–0.03*** (0.01)	–0.03*** (0.01)
Population	–0.19*** (0.01)	–0.19*** (0.01)	–0.19*** (0.02)	–0.19*** (0.02)	–0.19*** (0.03)	–0.19*** (0.03)	–0.20*** (0.01)	–0.20*** (0.01)
GDP per capita	0.61*** (0.09)	0.62*** (0.10)	0.25* (0.20)	0.39** (0.20)	0.85*** (0.26)	0.90*** (0.30)	0.47*** (0.10)	0.41*** (0.12)
Economic location	0.25*** (0.03)	0.26*** (0.03)	0.19*** (0.04)	0.19*** (0.04)	0.29*** (0.08)	0.30*** (0.09)	0.29*** (0.03)	0.29*** (0.03)
Trade policy	0.06*** (0.01)	0.06*** (0.01)	0.08*** (0.01)	0.07*** (0.01)	0.10*** (0.03)	0.10*** (0.03)	0.06*** (0.01)	0.07*** (0.01)
Country price level	–0.19*** (0.06)	–0.18*** (0.06)	0.06 (0.10)	0.04 (0.10)	–0.16 (0.15)	–0.17 (0.15)	–0.30*** (0.06)	–0.30*** (0.06)
GDP per capita squared	–0.04*** (0.01)	–0.04*** (0.01)	–0.02* (0.01)	–0.03** (0.01)	–0.06*** (0.02)	–0.07*** (0.02)	–0.03*** (0.01)	–0.03*** (0.01)
Arable land per capita		4.52 (3.34)						
Capital- labour ratio				0.05*** (0.02)				
Human capital per worker						0.18 (0.40)		
Average years of secondary schooling								–0.03 (0.02)
Adjusted R <sup>2</sup>	0.68	0.68	0.72	0.73	0.75	0.74	0.68	0.69
Number of observations	645	645	233	233	87	87	537	537

Notes: The four resource endowment variables are expressed as absolute deviations from the mean of the sample. All the equations include a constant and dummy variables for Hong Kong and Singapore, and time dummies where applicable: these are omitted from the table for brevity. Robust standard errors are shown in parentheses. Significance at the 1, 5 and 10 per cent levels is denoted by \*\*\*, \*\* and \*, respectively.

Our other resource endowment variables attempt to capture the impact of absolute differences in labour or capital endowments on trade (and are also expressed as deviations from the mean of the sample). We would expect trade to be greater for countries with either a very high capital-labour ratio (which should export capital-intensive goods) or a very low capital-labour ratio (which should export labour-intensive goods). Consistent with this, the estimated coefficient is positive and significant at the 1 per cent level. Similarly, the absolute difference in human

capital per worker (relative to the mean) is also positive, although it is not significant. Surprisingly, the coefficient on the average years of secondary schooling of the population aged over 25 (expressed as the absolute deviation from the mean) was estimated to be negative, although not significant.

Overall, the empirical results provide only limited evidence for a role for resource endowments in influencing openness. Although three of the four parameter estimates take the expected sign, only one is significant. This may reflect the relatively crude nature of the measures of resource distinctiveness, but our results are consistent with a range of earlier work (see, for example, the summary in Davis and Weinstein 2001) showing that the data provide limited support for models of trade that are based on resource differentials.

#### **4. Interpreting Australia's Low Openness Ratio**

The regression results from Section 3 permit one to ask whether countries trade more or less than expected. Our specific interest is Australia. Using the 1996–2000 cross-section regression, the equation predicts an openness ratio for Australia of 41.8 per cent, which is only modestly above the actual ratio of 38.3 per cent.<sup>28</sup> That is, although Australia's openness ratio is relatively low by international standards, the regression results suggest that this ratio is about the level that one might expect. This is consistent with the finding in Table 2 that an Australian dummy variable is always insignificant in the cross-section and pooled openness regressions.

The estimates of the effect of various factors on openness also allow us to shed light on why countries trade as much or as little as they do. To this end, Table 7 reports how Australia compares with the sample average. The first column of data shows the difference between the Australian value and the mean value for the sample, divided by the standard deviation of the sample. Using a common unit, the standard deviation of each variable, this allows us to see whether Australia's difference from the rest of the world for each variable is large or small. The data

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<sup>28</sup> Similarly, the individual cross-section regressions predict Australia's openness to be between 1 and 3 percentage points greater than its actual openness. Note that these regression results are based on the equations with the squared per capita GDP variable and price level variable, and so are not exactly comparable with the results shown at the bottom of Table 2.

show that Australia differs substantially from the sample average in terms of having a much larger land mass and having a less favourable (or more remote) location. In addition, Australia has a substantially higher income level and has a more liberal trade regime than most of the 120 countries in our sample, though its differences with the OECD average on these scores are much smaller. The second column is based on the 1996–2000 cross-section regression in Table 2 and shows whether a unit of one standard deviation of the variable has a relatively large or small effect on openness in the regression. Based on this measure, population is the most important variable for openness, followed by economic location and geographic size.

**Table 7: Understanding Australia's Openness**  
1996–2000

	<b>Australia's difference from average</b>	<b>Parameter estimate for variable</b>	<b>Implied impact on Australia's log(openness)</b>
	Relative to standard deviation of the variable		
Log(total area)	1.82	−0.08	−0.14
Log(population)	0.38	−0.22	−0.08
Log(GDP per capita) <sup>(a)</sup>	0.21	na	0.03
Log(economic location)	−1.68	0.16	−0.24
Trade policy index	0.97	0.07	0.05
Log(country price level)	−1.09	−0.06	−0.07
Total impact	na	na	−0.46

Note: (a) This variable captures the impact of both the unadjusted and the squared GDP per capita terms.

The last column in Table 7 is the product of the first two columns and provides an assessment of which variables are most important in explaining Australia's low openness ratio. The results suggest that an unfavourable economic location and substantial area have the largest effect in reducing Australia's openness, accounting for around three-quarters of the deviation from the sample average. Economic location is the most important variable in this regard, accounting for about half the deviation. For example, a simple counterfactual of imagining Australia near the middle of the North Atlantic Ocean, implying an improvement in our economic location to near the sample mean, would result in Australia's

predicted openness ratio jumping from around 0.42 to around 0.51, or exports and imports rising from around 21 per cent of GDP to around 25–26 per cent.<sup>29</sup>

A final point to note, which is especially relevant for Australia's economic location, is that any measure of location or remoteness will change with shifts in the relative economic size of other countries. The experience of recent years indicates that with its relative proximity to Asia, Australia has benefited strongly from the growth of that region.<sup>30</sup> Looking ahead, the most obvious trend is likely to be the continuing growth of India and China, which in 2002 accounted for 38 per cent of the world's population but only 5 per cent of world GDP at market exchange rates. Australia's relative proximity to these countries suggests that its economic location is likely to improve in coming years as these economies grow.

## 5. Conclusions

Our openness regressions show that it is possible to explain openness well with only a few variables. The most significant variables are not unexpected – countries with small populations tend to trade relatively more and countries that are located closer to potential trade partners also trade more. The significance of these two variables would be consistent with several different models of trade (see Haveman and Hummels 2004), so our results do not really help to discriminate between different models. We find only modest support for some additional variables designed to capture resource differentials, but the significance of population and area in our basic regression can be viewed as partly capturing such effects.

After controlling for other variables related to openness, we find a number of interesting results regarding the relationship between economic development and openness. In our basic openness equation, after controlling for trade policy differences, we found that there is no evidence that richer countries trade relatively more: indeed richer countries appear to trade relatively less. However, after

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<sup>29</sup> Battersby and Ewing (2003) have also noted that if Australia had the same location as the UK, Australian aggregate trade would increase by approximately 40 per cent.

<sup>30</sup> See Macfarlane (2003) for further details of the growth in Australia's trade with east Asia.

including a variable for national price levels to control for differences in the valuation of GDP, we find this negative relationship largely disappears.

Returning to the question that sparked our interest, the openness equation suggests that Australia's level of external trade is close to the level that would be predicted. This stands in contrast with the results from the gravity model which tended to suggest that Australia actually trades much more than expected. The results from the openness equation suggest that the factors that best explain Australia's low level of trade are its remoteness and large size. The first of these can be viewed as a natural disadvantage (see Redding and Venables 2004), while the second can be viewed as an advantage – because of the natural diversity of our large land mass, Australia is able to produce many goods internally and does not need to trade for them externally. However, the implications of our low openness for broader economic outcomes are unclear. While some researchers (for example, Frankel and Romer 1999) argue that economic growth is positively correlated with openness, others (for example, Rodriguez and Rodrik 2001) have questioned this conclusion. In particular, there are good reasons to think that there is no straightforward link, and indeed that natural barriers to trade and policy barriers might have different effects on growth. Finally, it is worth noting that remoteness and economic location are not necessarily static but dependent upon the growth rates of other countries. Australia already has strong trading links with China and India, and as these economies continue to grow relative to other countries, Australia's relative geographic location is likely to be less of a barrier to trade.

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