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Abstract

One of the most striking features of the world economy is that wealthy countries are clustered together. This paper theoretically and empirically explains a mechanism for this clustering by extending the Acemoglu and Ventura model so that it takes real geography into account. Countries close to fast growing economies experience faster growth in aggregate demand for their exports, stimulating faster domestic growth. As a result, a poor country that is surrounded by other poor countries finds it more difficult to grow because its terms of trade shift against it. When this model is estimated on data for 1965 to 1985, we find statistically and economically significant effects. If the typical European country were located in Africa, these terms of trade effects would have lowered its growth rate by almost 1 percentage point per year. The results strongly suggest that it is very difficult to raise income in poor countries without dealing with regional problems.

Keywords: Economic growth; Economic geography; International trade; Terms of trade; Empirical.

JEL Classification: F12, F15, F43, O11, O19.

1 Introduction

The geographic distribution of world income is far from uniform. Wealthy countries tend to be located close to other wealthy countries and the same can be said about fast growing economies, which also tend to be geographically clustered. This geographical concentration of economic growth is partly responsible for the success of regional dummies in many empirical growth studies which consistently, and even after controlling for other factors, find a negative coefficient for the African dummy.[1] There exists an ongoing debate in the literature on the origins and causes of Africa's poor performance. While institutions (or the lack of appropriate ones) definitely play a significant role, Sachs and his co-authors argue that poor geography has prevented these countries from participating in international markets while, at the same time, exposing them to tropical diseases.[2]

This paper suggests a mechanism through which geography can actually have an effect on a country's growth performance. Geography introduces transportation costs to international trade so that each country trades more intensively with other close and neighboring countries. In this respect, international trade causes the growth rate of a country to depend on that of its trading partners through supply and demand linkages. Thus, our model introduces the possibility for the creation of "good" (high) and "bad" (low) growth clusters. In other words, the typical African country finds it more difficult to expand its production and its exports due to the lack of a sufficiently large and dynamic demand by its main trading partners. When taking our model to the data, we find that it can account for about a 1 percentage point in the differential growth rates between the typical European and the typical African country.

The starting point for this analysis is the work by Acemoglu and Ventura (2002) who theoretically show how these demand linkages can translate into international growth spillovers via terms of trade effects. The terms of trade effect refers to the decline in a country's relative price of exports as a result of a relative increase in the country's exports. In their model, capital accumulation depends on the value of its marginal product which, in turn,

[1] Doppelhofer, Miller, and Sala-i-Martin (2000) find that the dummy for a country being located in Sub-Saharan Africa has an average coefficient of - 0.7% and is significant in 85% of the 2 million regressions they run. The equivalent dummy for Latin America has an average coefficient of -0.58% and is significant in 62% of their regressions.

[2] See Sachs and Warner (1997) and Gallup, Sachs, and Mellinger (1999). For an argument on the importance of institutions, see Acemoglu, Johnson, and Robinson (2001) and for a rebuttal of their arguments, see McArthur and Sachs (2000).

depends on the value of the country's exports in the world markets. Thus, a country which grows at above average rates experiences adverse terms of trade effects that dampens its growth but fosters that of the rest of countries in the world, who experience a terms of trade improvement. Acemoglu and Ventura build on the extensive theoretical literature on the effect that changing terms of trade have for a country's welfare and growth prospects. A seminal paper by Bhagwati (1958a) shows how an increase in welfare due to an increase in domestic production can be partially offset by a decline in the country's terms of trade. Furthermore, Bhagwati (1958b) gives the conditions for immiserizing growth, the situation in which an increase in domestic production can actually reduce welfare in the home country because of adverse terms of trade effects. Despite this and other early empirical studies[3] on the actual relevance of the terms of trade effects have been sparse, with the most significant one being the aforementioned work by Acemoglu and Ventura, who are able to estimate the elasticity of terms of trade with respect to GDP growth for a cross-section of countries.[4]

Another strand of literature has focused on the importance that geography plays for a country's growth performance. Redding and Venables (2003) perform an analysis which is very similar in spirit to the one we conduct in this paper. They develop a theoretical model that allows for the decomposition of the growth rate of a country's exports into two components: one due to changes in the demand for the country's goods and another due to changes in the country's internal supply of its goods. They find that a substantial part of the differences in export growth rates can be explained by differences in the growth rate of demand for a country's goods. The presence of trade costs in their model causes this effect to be much larger for neighboring countries than for more distant ones.

In this paper, we put these two strands of literature together and show that the evolution of a country's terms of trade (which is closely related to the evolution of its GDP growth rate) depends on the evolution of aggregate demand for its exports. Given that there are transportation costs associated with international trade, its volume falls off rapidly with distance and other transportation costs. Thus, aggregate demand for a country's exports is not global but depends on a trade-cost-weighted measure of its trading partners' economic size. Following some of the earlier literature, we refer to this measure as market potential and to its effect on the terms of trade

[3]See, for instance, Corden (1956)

[4]In a related study, Debaere and Lee (2003) use a richer data set with panel data for the period 1970-88 to estimate the presence of terms of trade effects.

as the market potential effect. This market potential effect (or rather its geographical concentration) is what effectively causes the terms-of-trade-induced growth spillovers to have a limited geographical scope.[5]

Using country-level and bilateral trade data from 1965 to 1985, we construct a theoretically-sound measure of market potential growth which we include into a regression for terms of trade growth. Our findings are in line with the previous literature and indicate that an increase in a country's GDP does indeed lead to a decline in its terms of trade. We find an estimate for the elasticity of terms of trade with respect to GDP growth of about - 0.8, which is a larger estimate than that of Acemoglu and Ventura. This difference could be attributed to the presence of omitted variable bias in their regression since the growth rate of market potential is correlated with the growth rate of a country's exports. When we estimate the same regression using export growth instead of GDP growth, we find estimates that are consistent with those of Debaere and Lee (2004). That is, a 1% increase in exports is associated with a decline in terms of trade of between 0.25% and 0.30%. In both cases, market potential effects have a positive and significant effect on the evolution of a country's terms of trade.[6]

After our econometric study on the determinants of the evolution of a country's terms of trade, we turn to the economic significance of our results. We perform a counterfactual exercise by computing the growth rate that each country would have achieved if it had the same fundamentals but was located elsewhere. Recall that, in our model, a country benefits from its location by being close to large and dynamic sources of demand for its exports which allow the country to expand exports and production without experiencing declines in its terms of trade. By repeating this exercise over every possible location and comparing the counterfactual growth rate to the actual growth rate a country has achieved, we are able to make a statement about whether (and by how much) a given country has benefited (or suffered) from being in its actual location.

[5]Note that, despite the qualitative similarities, our results do not lend direct support to the Prebisch-Singer hypothesis. Prebisch (1950) and Singer (1950) suggest that the relative prices of primary products would decline in the long run diminishing the growth prospects of developing countries who specialize in them because of comparative advantage. In our model, the poor performance of developing countries is not necessarily due to their pattern of specialization but rather to the insufficient demand of their exports by its close trading partners.

[6]Debaere and Lee (2004) also obtain a positive and significant estimate but, since their measure of market potential is constructed differently from ours, the results are non-comparable.

We find that our model can account for almost a one percentage point differential in the growth rate of the average European country compared to the typical African country. How significant is this magnitude? By dividing our model's predictions by the actual growth differentials, we find that we are able to explain around 20% of the observed differential growth experiences across regions. Location has played a specially important role for European and African countries: in our sample, about 30% of their differential growth rate with respect to the rest of the world can be attributed to the effects of poor location.

Our results highlight the importance of taking demand linkages into account when formulating policy for developing countries. First of all, they suggest that policies aimed at raising income in poor countries, can not be formulated only at the national level, but need to be considered at the regional level. Furthermore, our results also lend support to those policies aimed at trade promotion (such as infrastructure development) which would allow a country to reach larger and more dynamic markets for its goods.

The rest of the paper is structured as follows. In section 2, we introduce a theoretical model which allows us to derive a testable estimating equation for the evolution of a country's terms of trade. After discussing our data and addressing the econometric problems in section 3, we present the results of our estimation in section 4. We turn to the economic significance of our results by describing and performing a counterfactual exercise in section 5. Finally, section 6 concludes.

2 Theory

2.1 Demand

The setup of our theoretical model is similar to the one presented in Fujita, Krugman, and Venables (1999) and Redding and Venables (2003). There is a finite number of countries indexed by the subscript $c = 1, ..., \mathcal{C}$ or c' when needed to avoid confusion. Consumers in country c derive utility from the consumption of a non-traded good (C_c^{NT}) and a traded composite (C_c^T). The utility function is Cobb-Douglas:

$$U_c = \left(C_c^{NT}\right)^{1-\alpha_c} \cdot \left(C_c^T\right)^{\alpha_c}. \tag{1}$$

In turn, the traded good composite is a combination of the varieties (z) of traded goods produced in each country aggregated according to:

$$C_c^T = \left(\sum_{c'=1}^{\mathcal{C}} \int_{n'_c} c_{cc'}(z)^\rho dz \right)^{\frac{1}{\rho}},$$

where $c_{cc'}(z)$ represents country c's demand of variety z produced in country c' and ρ $(0 < \rho < 1)$ captures the substitutability across varieties.[7] Since, in equilibrium, all goods produced in country c' are demanded in equal quantity (and have the same price) in country c, the previous equation simplifies to:

$$C_c^T = \left(\sum_{c'=1}^{\mathcal{C}} n_{c'} \cdot c_{cc'}^\rho \right)^{\frac{1}{\rho}}. \tag{2}$$

Total expenditure in country c, represented by E_c, is divided between the expenditure on tradable goods and the expenditure on the non-traded domestic good according to the following budget restriction:

$$E_c = P_c^{NT} \cdot C_c^{NT} + \sum_{c'=1}^{\mathcal{C}} n_{cc'} \cdot p_{cc'} \cdot c_{cc'}. \tag{3}$$

We solve this problem in two stages: first, we solve for the division of the country's total expenditure (E_c) between tradable and non-tradable goods and, secondly, we compute the optimal division of the expenditure on tradable among the different varieties available. Given that the Cobb-Douglas division between non-traded goods and the traded good composite, demand for the non-traded good is given by:

$$C_c^{NT} = \frac{(1-\alpha_c) \cdot E_c}{P_c^{NT}}. \tag{4}$$

At the same time, expenditure on tradable goods is equal to $E^T = \alpha_c \cdot E_c$. Since we know total expenditure on traded goods, we can now move to finding demand in country c for each variety produced in country c' which is given by:

$$c_{cc'} = p_{cc'}^{-\sigma} \cdot E_c^T \cdot \left(P_c^T\right)^{\sigma-1} \qquad \text{where } \sigma = \frac{1}{1-\rho}, \tag{5}$$

[7] $\rho = 0$ would indicate no substitutability, while $\rho = 1$ would point towards perfect substitutability.

and P_c^T corresponds to the price index of traded goods given by

$$P_c^T = \left(\sum_{c'=1}^{\mathcal{C}} n_{c'} \cdot p_{cc'}^{1-\sigma} \right)^{\frac{1}{1-\sigma}} . \tag{6}$$

Note that, by symmetry, demand for each of the traded varieties produced in country c in the rest of countries c' is given by:

$$c_{c'c} = p_{c'c}^{-\sigma} \cdot E_{c'}^T \cdot \left(P_{c'}^T \right)^{\sigma-1} , \tag{7}$$

where the price index $(P_{c'}^T)$ is defined symmetrically.

We assume the existence of transportation costs between countries. Following the literature, and for analytical convenience, we assume these costs to be of the *iceberg* type.[8] When shipping a good from country c to country c', $\tau_{c'c} \geq 1$ units of good need to be shipped from country c in order for one unit of good to reach country c'. We assume that there are no internal transportation costs which implies that our formulation for transportation costs is such that:[9]

$$\tau_{c'c} \begin{cases} = 1 & \text{if c' = c} \\ > 1 & \text{if } c' \neq c \end{cases}$$

Furthermore, we also assume that transportation costs between any two countries are symmetric so that $\tau_{cc'} = \tau_{c'c}$. In this setting, transportation costs introduce a wedge between the domestic and foreign price of any variety produced in country c:

$$p_{c'c} = p_{cc} \cdot \tau_{c'c}. \tag{8}$$

Using equation (8), one can rewrite equation (7) as:

$$c_{c'c} = p_{cc}^{-\sigma} \cdot \tau_{c'c}^{-\sigma} \cdot E_{c'}^T \cdot \left(P_{c'}^T \right)^{\sigma-1} . \tag{9}$$

Total demand, and total exports, by country c' of goods from country c taking into account the value of shipments and the amount lost in shipping will, therefore, be given by:

$$X_{c'c} = n_c \cdot p_{cc} \cdot \tau_{c'c} \cdot c_{c'c} = n_c \cdot p_{cc}^{1-\sigma} \cdot \tau_{c'c}^{-\sigma} \cdot E_{c'}^T \cdot \left(P_{c'}^T \right)^{\sigma-1} . \tag{10}$$

[8]The name represents the hypothetical costs that would be associated with the transportation of an iceberg where the main cost would result from its melting as it was being moved. This formulation was first introduced by Samuelson (1954) and its convenience is two-fold. First, it allows the cost of transportation to be paid in terms of the shipped good and, secondly it allows us not to need to model a shipping sector explicitly.

[9]Actually, this is equivalent to imposing a normalization of the value of international transportation costs

By aggregating over every possible export destination, we find that total demand of tradables from country c is given by:

$$X_c^T = n_c \cdot \sum_{c'} p_{c'c} \cdot \tau_{c'c} \cdot c_{c'c},$$

$$X_c^T = n_c \cdot p_{cc}^{1-\sigma} \cdot \sum_{c'} \tau_{c'c}^{1-\sigma} \cdot E_{c'}^T \cdot \left(P_d^T\right)^{\sigma-1}. \tag{11}$$

2.2 Production

The non-traded good is produced domestically using a constant returns to scale technology which employs labor, the only factor in the economy. Thus, the price of the non-traded good in country c is equal to the labor cost of producing it. Without loss of generality, we normalize the productivity of labor in the non-traded sector to 1 which implies that:

$$P_c^{NT} = w_c.$$

Each of the domestically-produced traded varieties are produced using a technology that involves a fixed cost of production (F) and, therefore, increasing returns to scale. When the representative firm in the traded-goods sector in country c maximizes its profits, it sets a price which is a constant mark-up over the marginal cost:

$$p_{cc} = \frac{\sigma}{\sigma-1} \cdot A_c \cdot w_c, \tag{12}$$

where A_c is labor productivity in the traded-goods sector (relative to productivity in the non-traded sector). Because the pricing is the same for all varieties produced in country c, output of each variety is going to be the same as that of any other variety. By imposing a free entry condition (recall that they need to pay a fixed cost), we find that total output for each variety ($\overline{X}_c^T$) is equal to:

$$\overline{X}_c^T = F \cdot (\sigma - 1). \tag{13}$$

Every country, c, has a labor force of size L_c that is devoted to the production of traded (L_c^T) and non-traded (L_c^{NT}) goods. Given our assumptions, production in the non-traded sector will be given by $X_c^{NT} = L_c^{NT}$. Total labor demand by the traded-goods sectors is given by the number of varieties produced times the labor requirement of each variety produced:

$$L_c^T = n_c \cdot \left(F + \frac{1}{A_c} \cdot \overline{X}_c^T\right). \tag{14}$$

Using equation (13), we obtain that $L_c^T = n_c \cdot F \cdot \sigma$. This result, already found in Fujita et al. (1999), states that the scale at which firms operate is independent of the size of the market in which they operate i.e. all scale effects occur via changes in the number of varieties produced by the relevant economy. The wage in this economy will adjust to help determine the relative size of the tradable and non-traded sector in the economy.

2.3 Equilibrium: Terms of trade

While most authors at this point focus on the so-called wage equation, we turn our attention to the determination of country c's terms of trade, understood as the ratio between country c's exports (p_{cc}) and imports (P_c^*) price:

$$ToT_c = \frac{p_{cc}}{P_c^*}, \tag{15}$$

which, in terms of growth rates, can be written as:

$$\widehat{ToT_c} = \widehat{p_{cc}} - \widehat{P_c^*}, \tag{16}$$

where the hat symbol is used to indicate the growth rate of the corresponding variable. This equation tells us that the evolution of a country's terms of trade is the difference between the growth rate of its exports price and the growth rate of its imports price. In order to obtain an expression for the price of exports, we re-write equation (11) as:

$$X_c^T = n_c \cdot p_{cc}^{1-\sigma} \cdot MP_c \quad \text{where } MP_c = \sum_{c'} \tau_{c'c}^{1-\sigma} \cdot E_{c'}^T \cdot \left(P_{c'}^T\right)^{\sigma-1}. \tag{17}$$

Market potential (MP_c) in the previous equation is a weighted average of the expenditure on tradables of every country in the world where the weights depend on the transportation costs between each country pair. Taking logarithms and derivatives on this equation and rearranging terms, we obtain and expression for the evolution of country c's export price:

$$\widehat{p_{cc}} = \frac{1}{1-\sigma} \cdot \widehat{X_c^T} - \frac{1}{1-\sigma} \cdot \widehat{n_c} - \frac{1}{1-\sigma} \cdot \widehat{MP_c}. \tag{18}$$

We also need to characterize the evolution of country c's market potential:

$$\widehat{MP_c} = \sum_d \omega_{c'c} \left[(\sigma - 1) \widehat{P_c^T} + \widehat{E_{c'}^T} \right] \quad \text{where } \omega_{c'c} = \frac{\tau_{c'c}^{1-\sigma} \cdot E_{c'}^T \cdot \left(P_{c'}^T\right)^{\sigma-1}}{\sum_{c'} \tau_{c'c}^{1-\sigma} \cdot E_{c'}^T \cdot \left(P_{c'}^T\right)^{\sigma-1}}. \tag{19}$$

Note that in deriving this equation, we have assumed that transportation costs between any two countries remain constant over time. Equation (19) reveals that the growth rate of market potential is a weighted average of the growth rate of expenditure on tradables and the change in the price index of tradables in every country. The weight for every country depends on the size of its every market (E_d^T), its price index for tradables (P_d^T)[10], and the bilateral trade cost ($\tau_{cd}^{1-\sigma}$.)

In order to fully characterize the evolution of country c's terms of trade, we only need the evolution of country c's price of tradables ($\widehat{P_c^T}$). Towards this end, recall our expression for the price index of tradable goods in country c, given by equation (6). Taking logarithms and derivatives in that equation, we obtain that:

$$\widehat{P_c^T} = \frac{1}{1-\sigma} \cdot \sum_{c'} \frac{\tau_{c'c}^{1-\sigma} \cdot p_{c'c'}^{1-\sigma} \cdot n_{c'}}{\sum_d Tc'c^{1-\sigma} \cdot p_{c'c'}^{1-\sigma} \cdot n_c'} \left[(1-\sigma) \cdot \widehat{p_{c'c'}} + \widehat{n_{c'}}\right].$$

This expression can be combined with equation (18) to obtain:

$$\widehat{P_c^T} = \frac{1}{1-\sigma} \cdot \sum_{c'} \theta_{c'c} \left[\widehat{X_{c'}^T} - \widehat{MP_{c'}}\right] \quad \text{where } \theta_{c'c} = \frac{\tau_{c'c}^{1-\sigma} \cdot p_{c'c'}^{1-\sigma} \cdot n_{c'}}{\sum_{c'} \tau_{c'c}^{1-\sigma} \cdot p_{c'c'}^{1-\sigma} \cdot n_{c'}}. \tag{20}$$

Substituting equation (20) into equation (19) and the resulting equation into (18), we obtain an expression for the evolution of the exports price of a given country as a function of the growth rate of its exports, the growth rate of its market potential, and the expansion in the number of varieties:

$$\widehat{p_{cc}} = \frac{1}{1-\sigma} \cdot \widehat{X_c^T} - \frac{1}{1-\sigma} \cdot \widehat{n_c} - \frac{1}{1-\sigma} \sum_{c'} \left[\widehat{E_{c'}^T} + \sum_{c''} \theta_{c'c''} \left(\widehat{MP_{c'}} - \widehat{X_{c'}^T}\right)\right]. \tag{21}$$

In order to get an expression for the evolution of the terms of trade, we only need to construct an expression for the evolution of the price of imports. To this end, we define the import price index (P_c^*) analogously to P_c^T by excluding goods produced in the home country and compute its dynamic version as:

$$\widehat{P_c^*} = \frac{1}{1-\sigma} \cdot \sum_{c' \neq c} \theta_{c'c}^* \left[\widehat{X_{c'}^T} - \widehat{MP_{c'}}\right] \quad \text{where } \theta_{c'c}^* = \frac{\tau_{c'c}^{1-\sigma} \cdot p_{c'c'}^{1-\sigma} \cdot n_{c'}}{\sum_{c' \neq c} \tau_{c'c}^{1-\sigma} \cdot p_{c'c'}^{1-\sigma} \cdot n_{c'}}. \tag{22}$$

[10] Since this price index is higher for those countries located further away from the rest of the world, this term has often been referred to remoteness or multilateral resistance as in Anderson and van Wincoop (2003).

By combining equation (21) and (22) with our definition for the evolution of terms of trade, equation (16), we would obtain our estimating equation. Unfortunately, the recursive nature of the former equations due to the presence of the tradable goods price indices makes it hard to find a closed form solution. However, the use of matrix algebra allows us to find the transformation we need to apply to each variable in order to solve this problem. The reader is referred to Appendix A for the derivation of the closed form.

2.4 Estimating Equation

Based on the previous section, the regression we estimate is:

$$\Delta ToT_c = \beta_0 + \beta_1 \cdot \Delta X_c^T + \beta_2 \cdot \Delta MP_c + \gamma \cdot z_c + \epsilon_c, \tag{23}$$

where ΔToT_c represents the percentage change in the terms of trade of country c over the whole sample. ΔX_c and ΔMP_c represent, respectively, the transformation of the growth rate of exports and of market potential as outlined in Appendix A. It is worthwhile noting that lack of data forces us to omit technological progress in the form of growth in the number of varieties which is, therefore, included in the error term. In our empirical estimation, z_c will be a set of controls that we discuss later on.

Our theoretical model predicts that $\beta_1 < 0$, i.e., an increase in exports by c (relative to its trading partners) should worsen its terms of trade while $\beta_2 > 0$, i.e., an increase in country c's market potential should improve country c's terms of trade. However, our model goes even further: it predicts that $\beta_1 = -\beta_2$, a hypothesis that we test in our empirical estimation. This means that a 1% increase in a country's exports coupled with a 1% increase in its market potential should have no effect on its terms of trade. In other words, a proportional increase in the supply and demand of a country's exports should leave its relative price (the terms of trade) unaltered.[11]

3 Estimation

3.1 Data Sources

In order to perform our empirical analysis, we pool data from a variety of sources. We use country level data on GDP growth, terms of trade growth and other country characteristics from the Barro-Lee data set. These data are the same as those used by Acemoglu and Ventura.

[11]This result is a direct implication of the common elasticity of substitution (σ) that we assume across varieties.

To construct the market potential variables, we use bilateral trade volume data from the World Trade Database (WTDB) constructed by Statistics Canada and presented by Feenstra, Lipsey, and Bowen (1997). Geographical data such as bilateral distance, and dummies for border, currency union, common language, landlocked countries and island nations were obtained from Noguer and Siscart (2004).

3.2 Data Description

Country level data on GDP and terms of trade growth corresponds to the period 1965-1985. Initially, we have data for about 94 countries. However, missing data for some variables causes the number of observations to fall to 79 (which is the same number of observations used by Acemoglu and Ventura). When combining the country-level data with the trade data, two of the countries in our sample (Botswana and Lesotho) are dropped due the lack of availability of international trade data. Therefore, our final data set consists of 77 countries.

Table 1 shows the summary statistics for all the country-level variables that are used at some point in our estimation. The average annual GDP growth rate of countries in our sample is about 1.8% with a standard deviation of 1.86%. The average growth rate of exports is higher (with an average of 3.1%) and more volatile (it has a standard deviation of 3.8%) than the growth rate of GDP. The average country in our sample experienced a -0.7% annual decline in its terms of trade. There are 5 OPEC countries in our sample which, over our sample period, experience an average annual terms of trade improvement of about 7.8%. The Barro-Lee data set provides these data for 5 year periods. The reported values are the geometric mean of the corresponding variables for the periods 1965-1969, 1970-74, 1975-79 and 1980-84.

Table 2 shows the sample statistics for the bilateral trade variables as well as for other geographical/cultural characteristics of each country pair.[12] The variable Log(Value) gives the value of shipments between each country pair, whereas Log(Distance) gives the great-arch distance between the capital cities of the two countries. The border, common language, and currency union take a value of 1 if both countries share a border, an official language or are part of the same currency union, respectively. The variables Number Landlocked and Number Island represent the number of countries in the pair

[12]Note that the high number of observations is due to the fact that each observation represents a country pair.

that are landlocked and that are an island, respectively. Thus, the range of these two variables is between 0 and 2.

3.3 Econometric Issues

There are several issues that need to be taken into account when taking our econometric specification to the data. We address each of them individually.

3.3.1 Endogeneity

As we have mentioned earlier, and has already been pointed out by Acemoglu and Ventura, technological progress might bias the coefficient on the growth rate of exports in equation (23). For instance, technological progress resulting in an expansion in the number of varieties produced in country c could result in an increase in exports and, simultaneously, an improvement in the terms of trade.

The solution to this problem is to use a two stage procedure to instrument for country c's export (or GDP) growth. An instrument is needed that satisfies two requirements: it should be highly correlated with the growth rate of exports or GDP and uncorrelated with the error term which includes the technological progress component.

Following Acemoglu and Ventura, we instrument GDP growth with a standard growth regressio i.e. in the first stage, we regress GDP growth on the logarithm of the initial level of GDP (in 1965), the average number of years of education and the logarithm of life expectancy. There are two requirements for this to be a good instrument: it should be highly correlated with the growth rate of exports or GDP and uncorrelated with the error term. The first condition is met since standard growth theory tells us that the initial level of GDP and measures of distance to the steady state are the determinants of a country's growth rate.[13] For the second condition we require that the initial level of GDP be uncorrelated with the terms of trade growth rate. It is easy to verify that both conditions are met.[14]

As a robustness check we later add other control variables into our instrumenting equation which do not significantly alter any of our results.[15]

[13] In this case, the average number years of education and the logarithm of life expectancy.

[14] The correlation between our instrument and the growth rate of GDP is over 0.5 and the correlation with terms of trade growth is around 0.05.

[15] Variables in our robustness checks include the logarithm of the black market premium, a dummy for the presence of a war in our sample period and a measure of political instability.

3.3.2 Estimating $\omega_{c'c}$ and $\theta_{c'c}$: Gravity Equation Estimation

The parameters $\omega_{c'c}$ and $\theta_{c'c}$ are crucial in estimating the growth rate of a country's market potential and transforming the variables to prepare them for the estimation. Recall their formulas:

$$\omega_{c'c} = \frac{\tau_{c'c}^{1-\sigma} \cdot E_{c'}^{T} \cdot \left(P_{c'}^{T}\right)^{\sigma-1}}{\sum_{c'} \tau_{c'c}^{1-\sigma} \cdot E_{c'}^{T} \cdot \left(P_{c'}^{T}\right)^{\sigma-1}},$$

$$\theta_{c'c} = \frac{\tau_{c'c}^{1-\sigma} \cdot p_{c'c'}^{1-\sigma} \cdot n_{c'}}{\sum_{d} \tau_{c'c}^{1-\sigma} \cdot p_{c'c'}^{1-\sigma} \cdot n_{c'}}.$$

Thus, we need to estimate $\tau_{c'c}^{1-\sigma}$ as well as $E_{c'}^{T} \cdot P_{c'}^{T}$ and $p_{c'c'}^{1-\sigma} \cdot n_{c'}$. Towards this end, we consider equation (10) which predicts the volume of bilateral trade flows between every country pair. By taking logarithms on this equation we obtain:

$$log\left(X_{c'c}\right) = log\left(n_{cc} \cdot p_{cc}^{1-\sigma}\right) + log\left(\tau_{c'c}^{1-\sigma}\right) + log\left(E_{c'}^{T} \cdot \left(P_{c'}^{T}\right)^{\sigma-1}\right). \qquad (24)$$

In order to estimate $\tau_{c'c}^{1-\sigma}$, we need to impose a functional form for it. This could, in principle, include as many elements as one could think that affect transportation costs between any two countries such as, but not limited to, distance, the presence of a common border, of a common language, the membership of the two countries in a free trade area or in a currency union and whether the countries are landlocked or islands. While we include all these elements in our estimation of the transportation costs, for the sake of clarity, we show the case in which these transportation are only assumed to depend on distance and on whether countries have a common land border. In this case, we would model transportation costs as $\tau_{c'c}^{1-\sigma} = distance_{c'c}^{\beta_{dist}} \cdot e^{\beta_{border} \cdot border_{c'c}}$ and equation (24) would become:

$$log\left(X_{c'c}\right) = log\left(n_{cc} \cdot p_{cc}^{1-\sigma}\right) + \beta_{dist} \cdot log\left(dist_{c'c}\right) + \beta_{border} \cdot border_{c'c} + log\left(E_{c'}^{T} \cdot \left(P_{d}^{T}\right)^{\sigma-1}\right). \qquad (25)$$

Furthermore, by realizing that the first term of equation (24) is a function of elements that depend only on c and that the last term is a function of elements that only depend on c', we can rewrite the previous equation as:

$$log\left(X_{c'c}\right) = \beta_{dist} \cdot log\left(dist_{cc'}\right) + \beta_{border} \cdot border_{c'c} + D_c + D_{c'}, \qquad (26)$$

where $D_c = log\left(n_{cc} \cdot p_{cc}^{1-\sigma}\right)$ and $D_{c'} = log\left(E_{c'}^{T} \cdot \left(P_{c'}^{T}\right)^{\sigma-1}\right)$. The terms D_c and $D_{c'}$ are estimated as fixed exporter and importer fixed effects in the estimation of equation (26). These fixed effects also allow us to avoid the problem of omitted variable bias from which previous gravity equation studies suffered. As Anderson and van Wincoop (2003) point out, differences in price levels across countries give rise to different levels of what they term as multilateral resistance. Studies that use the product of real GDP as a regressor in the gravity equation fail to take into account the fact that more remote countries tend to have higher price levels. As Feenstra (2002) points out, the use of exporter and importer fixed effects is an easy way to correct for this omitted variable bias and this is what we do. We estimate equation (26) using OLS and using robust standard errors to control for potential heteroskedasticity. The results are presented in Table 3. The coefficients on most of the variables have the standard and expected signs except for the number of countries in the pair which are landlocked which has a significative and positive sign. The coefficients on distance and border are robust to across specifications and suggest that a 1% difference in distance decreases the predicted bilateral volume of trade by around 1.3% whereas sharing a border raises trade by between 30% and 44%depending on the specification.[16]

Following with the previous example, after estimating equation (26), we would construct our estimate of transportation costs as:

$$\widehat{\tau_{cc'}} = distance_{c'c}^{\widehat{\beta}_{dist}} \cdot e^{\widehat{\beta}_{border} \cdot border_{c'c}}$$

and, similarly, we construct our estimate of $\omega_{c'c}$ and $\theta_{c'c}$ as:

$$\widehat{\omega_{c'c}} = \frac{\widehat{\tau_{c'c}} \cdot e^{\widehat{D_{c'}}}}{\sum_d \left(\widehat{\tau_{c'c}} \cdot e^{\widehat{D_{c'}}} \right)} \qquad \text{and} \qquad \widehat{\theta_{c'c}} = \frac{\widehat{\tau_{c'c}} \cdot e^{\widehat{D_c}}}{\sum_d \left(\widehat{\tau_{c'c}} \cdot e^{\widehat{D_c}} \right)}$$

These coefficients allow us to compute ΔX_c^T and ΔMP_c from the our data on the growth rate of exports, and the growth rate of expenditure on tradables for every country.

3.3.3 Export vs. GDP growth

In the model by Acemoglu and Ventura, specialization together with the presence of a continuum of countries causes the export to GDP ratio to be very close to 1. Thus, in their estimation, they proxy export growth with GDP growth. Simple empirical evidence[17] shows that this is not the case

[16] $e^{0.2643} - 1 \approx 30\%$ and $e^{0.3679} - 1 \approx 44\%$, respectively

[17] The average ratio of exports to GDP for the countries in our sample is about 0.153, with median being 0.12.

even if export growth and GDP growth are very highly correlated (with a correlation coefficient of over 0.82). The results of our estimation are different depending on whether we consider GDP or export growth. Initially, and for the sake of comparison with Acemoglu and Ventura, we use GDP growth and later switch to our preferred estimation involving the use of *actual* export growth.

This forces us, however, to rethink our econometric problems. More concretely, the endogeneity problem between the dependent variable and the growth rate of exports still needs to be corrected. Export growth is very highly correlated with GDP growth so we can still use a similar estimation strategy albeit with a modified instrumenting set.

We consider modifying our instrumenting set in two ways. Initially, we consider using the logarithm of the initial level of GDP in 1965 and adding each country's export ratio to the instrumenting set.[18] Alternatively, we can exchange the level of GDP in 1965 with the initial level of exports in 1965 in our instrumenting set. Both strategies produce almost identical results, hence we adopt the latter specification involving the use of the logarithm of exports in 1965, since this allows us to retain one extra degree of freedom.

Regardless of our choice of instruments, both approaches require the use of the export to GDP ratio. Since these data are not available for all countries in our sample, this causes the number of available observations to drop to 71 (from the previous 77).

3.3.4 Other Issues

Finally, since our sample goes from 1965 to 1985, it encompasses both oil shocks of the 1970's. This means that oil-exporting countries in our sample experienced very large (and positive) changes in their terms of trade. To account for this effect, an OPEC dummy is included in our estimation.

4 Results

As we mentioned in section 2.4 and following the previous literature, we first use GDP growth as a proxy for export growth. Recall that because of the combination of our country-level data set with our trade data set, we have 2 fewer observations than Acemoglu and Ventura. The coefficient on GDP growth we obtain is very similar to the one reported by Acemoglu and Ventura under a variety of specifications. The first two columns in

[18] Actually, the average value of the export ratio between 1965 and 1970

Table 4 show a replication of the Acemoglu and Ventura results using the same data set as they do. They obtain a elasticity of about -0.6% in their preferred specification (the first column). In their robustness checks, they use a extended set of instruments for GDP growth, this causes the coefficient on GDP growth to fall to -0.45 in their sample.

The next two columns in Table 4 show a replication of the previous results for our slightly reduced data set. The coefficients of interest are about the same as before with coefficients of -0.72 and -0.51 depending on the instrumenting set. Both coefficients are significant at standard levels.

4.1 GDP Growth

Our estimating equation, unlike that in Acemoglu and Ventura, suggests that the growth rate of market potential needs to be included in the regression for the growth rate of terms of trade. Since this variable is highly correlated with the growth rate of GDP,[19] this could cause previous estimates of the elasticity of terms of trade with respect to GDP growth to be biased upwards (closer to zero) because of omitted variable bias.

Table 5 shows the results of including market potential growth rate in the estimating equation for the growth rate of terms of trade. As predicted, the coefficient on GDP growth becomes more negative, -0.85, when we include market potential growth compared to -0.72 before, and it remains significant at the 5% level. The coefficient on the growth rate of market potential has the predicted positive sign and it is also statistically significant at the 5% significance level. Furthermore, as predicted by our theory, it is very close in magnitude to the negative of β_1. An F-test for the null hypothesis that $\beta_1 = -\beta_2$ fails to reject it at any standard significance level.[20]. This theoretical restriction is imposed in the second column of Table 5 where we obtain a coefficient for $\beta_1 = (-\beta_2)$ of about -0.82 which is in line with our previous results.

The results using an extended set of instruments for GDP growth are qualitatively very similar and they are reported in the last column of Table 5. The only difference is regarding the coefficient of market potential growth rate which is now only significant at the 10% level.

These results indicate that a 1% increase in a country's GDP growth rate leads to a 0.85% deterioration in its terms of trade. On the other hand, a 1% improvement in the country's market potential growth causes its terms of trade to improve by 1.1%. Thus, one might be tempted to assert that a

[19]The correlation between these two variables is about 0.42.

[20]We obtain a p-value of around 0.57

simultaneous 1% increase in a country's GDP and market potential would imply a 0.25% reduction in the country's terms of trade. However, this might not be the relevant comparison since the standard deviation of a country's GDP growth rate is almost 3 times larger than that of its market potential growth rate.[21] Thus, a one standard deviation increase in a country's GDP growth rate coupled with a one standard deviation increase in a country's market potential leads to a worsening of 0.73% in the country's terms of trade.[22]

Summarizing, in our specification the predicted change in the terms of trade of a country depends not only on the growth rate of its GDP but also on the growth rate of its market potential. Countries located in regions with high market potential growth rates are able to increase their exports without experiencing as big a decline in their terms of trade as those countries located elsewhere.

4.2 Export Growth

In this section, we turn to our preferred estimation which uses actual export growth instead of GDP growth to proxy for it. Initially, we simply regress the growth rate of terms of trade on the growth rate of exports (omitting the growth of market potential). Our estimate of the elasticity of terms of trade with respect to export growth becomes 0.25 compared to the value 0.72 we obtained when using GDP growth. This implies that the effect of an increase in exports on the change in the terms of trade is significantly smaller than suggested by previous studies. The coefficient on export growth has a p-value of 0.059 making it significant at the 10% level but not at the 5% level. The first column in Table 6 shows the results using export growth.

When the growth rate of market potential is included into the regression, the coefficient on export growth becomes more negative, -0.308, and statistically significant at the 5% level. The coefficient on market potential growth is 0.77, still positive and with a magnitude similar to the negative of β_1. The F-test for the null hypothesis that $\beta_1 = -\beta_2$ is unable to reject it at any standard significance level.[23] The results for this estimation are shown in the second column of Table 6. In this case, a one standard deviation increase in the growth rate of exports coupled with a one standard

[21] The standard deviations of GDP growth rate and market potential growth are 1.83% and 0.709% respectively.

[22] $\beta_1 \cdot sd\,(\Delta GDP_c) + \beta_2 \cdot sd\,(\Delta MP_c) = -0.8319 * 1.83\% + 1.1203 * 0.709\% = -0.73\%$.

[23] The p-value of this F-test is around 0.2.

deviation increase in the market potential growth lead to a 0.63% decline in the country's terms of trade growth.[24]

We impose the restriction that $\beta_1 = -\beta_2$ in the third column of Table 6 which delivers a coefficient on the term $\Delta EX_c - \Delta MP_c$ of about -0.275. Like in the previous regressions, this coefficient is more negative than the one obtained when omitting the growth rate of market potential. Using an expanded set of instruments for export growth in this setting makes it very hard to obtain statistically significant coefficients as the number of observations drops to 62. Nevertheless all coefficients still have the expected signs and similar magnitudes as before. These results are shown in the last column of Table 6

5 Implications for Growth

We have already shown that the growth rate of market potential is an important determinant of the evolution of a country's terms of trade. This causes terms of trade effects to be localized and the growth spillovers that occur via international trade to have limited geographical scope. In other words, location determines the growth rate of market potential which, in turn, affects the growth rate of a country's terms of trade and, ultimately, the growth rate of its GDP.

The question we want to answer is: how much does location matter for a country's growth performance? Our results in the econometric section allow us to answer a related question: how would the growth rate of a given country have changed if it were located elsewhere? The answer to this question reveals how much each country has benefited/suffered from its actual location.

5.1 A Counterfactual Exercise

To evaluate the economic significance of our results, we perform a simple counterfactual exercise. We compute a counterfactual GDP growth rate, the one a country would have achieved if it had the same fundamentals but was located elsewhere.

To compute this counterfactual GDP growth rate, we first compute the counterfactual terms of trade change that this country would have experienced in a different location. In other words, we find the predicted change in the terms of trade if the country's exports had been the same but its market

[24] $\beta_1 \cdot sd\,(\Delta EX_c) + \beta_2 \cdot sd\,(\Delta MP_c) = -0.3081 \cdot 3.83\% + 0.7714 \cdot 0.709\% = -0.63\%$.

potential growth had been that of another country. Next, we compute the growth of exports that would have been consistent with the counterfactual change in the terms of trade. The difference between this counterfactual and the actual growth rate of exports will be a measure of the importance of location in accounting for the growth rate of a country's exports.

Recall our estimating equation:

$$\Delta ToT_c = \beta_0 + \beta_1 \cdot \Delta X_c + \beta_2 \cdot \Delta MP_c + \gamma \cdot z + \epsilon_c, \tag{27}$$

which we can rewrite for another country, say d:

$$\Delta ToT_{c'} = \beta_0 + \beta_1 \cdot \Delta X_{c'} + \beta_2 \cdot \Delta MP_{c'} + \gamma \cdot z + \epsilon_{c'}. \tag{28}$$

Taking expectations over the two equations and subtracting (28) from (27), we obtain:

$$\Delta ToT_{c'} - \Delta ToT_c = \beta_1 \cdot (\Delta X_{c'} - \Delta X_c) + \beta_2 \cdot (\Delta MP_{c'} - \Delta MP_c). \tag{29}$$

Equation (29) tells us that the differential evolution of the terms of trade between country c and country c' is due to the differential evolution of its export and market potential growth rates.

If we assume that country c' was located where country c is located but it had its own country fundamentals (so that $X_{c'}$ was still the same), we can compute the counterfactual growth rate of terms of trade of country c' in location c:

$$\Delta ToT_{c'}^{cf} - \Delta ToT_d = \beta_2 \cdot (\Delta MP_c - \Delta MP_{c'}). \tag{30}$$

To compute the counterfactual growth rate of exports that would be consistent with the counterfactual terms of trade growth rate, we consider what would have been the exports growth rate consistent with the new terms of trade growth (i.e. if both countries had the same market potential growth):

$$\Delta ToT_{c'}^{cf} - \Delta ToT_{c'} = \beta_1 \cdot \left(\Delta X_{c'}^{cf} - \Delta X_{c'}\right)$$

which can be rewritten as:

$$\Delta X_d^{cf} - \Delta X_{c'} = \frac{1}{\beta_1} \cdot \left(\Delta ToT_{c'}^{cf} - \Delta ToT_{c'}\right). \tag{31}$$

Substituting equation (30) into (31), we get an expression for the predicted export growth rate of country c' if it had been located in c:

$$\Delta X_{c'}^{cf} = \Delta X_{c'} + \frac{\beta_2}{\beta_1} \cdot (\Delta MP_c - \Delta MP_{c'}). \tag{32}$$

In order to translate these differences in export growth rates into GDP growth rates, we multiply them by the export to GDP ratio, α^X:[25]

$$\Delta GDP_{c'}^{cf} = \Delta GDP_d + \alpha_{c'}^X \cdot \frac{\beta_2}{\beta_1} \cdot (\Delta MP_c - \Delta MP_{c'}) . \qquad (33)$$

There is an implicit assumption being made when multiplying across by $\alpha_{c'}^X$ which is that the degree of openness of an economy is a fundamental property of that given country (which might, for instance, be tied to its industrial structure) which is not altered by its location. However, we might also be interested in the case where the degree of openness is not a characteristic of the economy but of its location.[26] Under this assumption, we would need to multiply equation (32) across by the degree of openness of the location, α_c^X (instead of $\alpha_{c'}^X$). This delivers another counterfactual measure of GDP growth:

$$\Delta GDP_d^{cf'} = \Delta GDP_d + \alpha_c^X \cdot \frac{\beta_2}{\beta_1} \cdot (\Delta MP_c - \Delta MP_{c'}) . \qquad (34)$$

5.2 Results of the Counterfactual Exercise

We compute each of the two counterfactual measures for each country pair and set them up in matrix form where each element represents the change in the *row* country's growth if it had been located in the *column* country. However, the 71 countries in our sample imply that there are almost 5000 country pairs,[27] making the matrix with the counterfactual GDP growth rates too large to fit into this paper.[28] Thus, for clarity of presentation, our counterfactual results are aggregated at the regional level. Table 7 shows how the 71 countries in our sample are classified into 7 regions: Africa, North America, South America, South Asia, East Asia, Europe and Oceania.

We define a region's market potential growth rate as a weighted-average of the market potential growth rates of the countries in that region. This implies slightly modifying our question to: how would the growth rate of

[25] It is always the case that the export ratio is positive: $\alpha_{c'}^X > 0$. Recall from footnote 17 that the average export ratio ($\alpha_{c'}^X$) is about 0.153 with a median of 0.12.

[26] Frankel and Romer (1998) use geographical characteristics of countries to instrument for the openness ratio which they use to regress against the income level.

[27] There are 71*70 = 4970 country pairs. Note that the effect of moving country c to c' might be different from that of moving c' to c since the α_c^X will generally be different from $\alpha_{c'}^X$

[28] The complete matrix is available online at `http://www.vilarrubia.com/research.html`

the average country in region R have changed if it were located where the average country in region R' is located?[29]

Table 8 provides the results of our counterfactual exercise. The numbers in each cell represent how much would the GDP growth rate of the average country in the row region have changed if it were located in the column region. For instance, the average European country would have lost about 0.84 percentage points of its annual GDP growth rate if it were located in South America.

The results from Table 8 show that countries in most regions would have had lower GDP growth rates if they were located in South America, Africa or North America; indicating that countries located in those regions have not benefited from their location. Thus, we can say that the regions that have benefited the least have been South America, Africa and, perhaps more surprisingly, North America; whereas those countries who have benefited the most from their location are those in East Asia and Western Europe.

Remember that the benefits from location in our model involve access to more dynamic markets which allow countries to expand their exports without experiencing adverse terms of trade effects. Thus, for North America, the lack of a positive terms of trade effect can be attributed to the fact that, in our sample, the US economy was, in the period of our sample, buffeted by both oil shocks which pushed down its growth rate. In our setup, this causes countries located in or near North America to experience smaller improvements in their market potential than those located close to faster growing economies such as those of East Asia and Western Europe.

The results obtained under the assumption that the degree of openness of an economy depends on its location rather than being a fundamental of each economy are qualitatively very similar. They are reported in Table 9.

5.3 Size Effects

As we remarked earlier, our results so far indicate that the average North American country has not benefited but actually suffered from its location. Recall that, in our model, each country produces a set of goods which are differentiated by place of origin. This has two important implications: each

[29] Note that, alternatively, we could define a region's market potential as the median market potential of countries in that region. All our analysis would still follow through just by changing the word 'average' by the word 'typical' when referring to the representative country in a region. The qualitative and quantitative results are very similar when using either measure and, in this paper, only the results obtained using the weighted average are reported. Results obtained using the median market potential are available upon request from the author.

country is always specialized in the production of one (set) of good(s) and each country has imperfect monopoly power on the production of its good. In this setting, supply of each good always comes from a single country while demand for it comes for the rest of the world. This allows us to separate the effects of countries' own export growth and market potential growth on its terms of trade.

However, in a more realistic setting with incomplete specialization, the level (as well as the growth rate) of market potential might be a determinant of the evolution of a country's terms of trade. With incomplete specialization, the supply of each good need not be given by production in a given country. In this respect, countries located close to large markets might be able to expand their production and exports without suffering as big declines in their terms of trade.

To take these size effects into account, we modify our estimating equation accordingly. Thus, our previous estimating equation,

$$\Delta ToT_c = \beta_0 + \beta_1 \cdot \Delta X_c + \beta_2 \cdot \Delta MP_c + \epsilon_c, \tag{35}$$

is modified to include an interaction term between the growth rate of exports and the level of market potential ($\Delta X_c \cdot MP_c$). This is meant to capture the fact that countries with a higher *level* of market potential experience a smaller decline in terms of trade as a consequence of an increase in exports. We would, therefore, expect this extra term to enter with the opposite sign of ΔX_c. Our estimating equation thus becomes:

$$\Delta ToT_c = \beta_0 + \beta_1 \cdot \Delta X_c + \beta_2 \cdot \Delta MP_c + \beta_3 \cdot \Delta X_c \cdot MP_c + \epsilon_c. \tag{36}$$

The inclusion of this extra term creates new econometric issues that need to be addressed. The main one is again one of endogeneity, we construct the third term as $MP_c \cdot \Delta X_c$ and add $MP_c \cdot \widehat{\Delta X_c}$ to our set of instruments where $\widehat{\Delta X_c}$ is our instrument for export growth. Thus, in the first stage, we run a double instrumentation of ΔX_c and $MP_c \cdot \Delta X_c$ on our previous set of instruments and $MP_c \cdot \widehat{\Delta X_c}$.

The results of the regressions under this new specification are reported in Table 10. They are in line with our expectations, the coefficient on export growth (β_1) has become -0.23 which is similar to the one from the previous estimation, negative and statistically significant at the 10% level. The coefficient on the interaction term between export growth and the level of market potential is positive and highly statistically significant. The magnitude on this coefficient is somewhat hard to understand but its importance will be highlighted by the counterfactual exercise in the next section. The coefficient on market potential growth (β_2) has the expected sign (positive) and magnitude ($-\beta_1$) but it is statistically insignificant at any standard level.

Our theoretical model predicts that $\beta_1 = -\beta_2$. We impose this in our estimation of equation (36). The results are shown in Table 10. The coefficient on $(\Delta X_c - \Delta MP_c)$ is negative, as expected, and statistically significant at the 10% level. The coefficient on $\Delta X_c \cdot MP_c$ remains highly significant and is very similar to the one obtained in the previous regression.

5.4 Redefining The Counterfactual Exercise

Using an analogous procedure to the one outlined in section 5.1, we can compute a counterfactual GDP growth rate for each country in every possible location. As before, this depends on the export ratio and on the differential evolution of the market potential between the two locations. However, under the new specification, the difference between the counterfactual and the actual GDP growth rates will also depend on the relative difference in the level of market potential.

The counterfactual growth rate of country c' if it had been located where country c is actually located is now given by:

$$\Delta X_{c'}^{cf} = \frac{\beta_1 + \beta_3 \cdot MP_c}{\beta_1 + \beta_3 \cdot MP_{c'}} \cdot \Delta X_{c'} + \frac{\beta_2}{\beta_1 + \beta_3 \cdot MP_d} \cdot (\Delta MP_d - MP_c) \quad (37)$$

which can also be expressed as:

$$\Delta X_d^{cf} = \frac{\widetilde{\beta_{1_c}} \cdot MP_c}{\widetilde{\beta_{1_{c'}}} \cdot MP_{c'}} \cdot \Delta X_{c'} + \frac{\beta_2}{\widetilde{\beta_{1_d}}} \cdot (\Delta MP_{c'} - MP_c), \quad (38)$$

where $\widetilde{\beta_{1_c}} = \beta_1 + \beta_3 \cdot MP_c$. This equation is analogous to (32) but it includes a modified elasticity of the growth rate of exports on terms of trade growth. Countries located close to larger markets (i.e. with a higher level of market potential) have a lower implicit elasticity between export growth and terms of trade growth. In other words,larger markets are able to absorb increases in exports without requiring as big an adjustment in the price the seller charges.

Again, we multiply equation (37) across by the export ratio in order to obtain an expression in terms of GDP growth rates. And, depending on our assumption about the determinants of a country's openness, we get two different expressions. If we assume that the openness depends on a country's industrial structure:

$$\Delta GDP_{c'}^{cf} = \frac{\widetilde{\beta_{1_c}}}{\widetilde{\beta_{1_{c'}}}} \cdot \Delta GDP_{c'} + \alpha_{c'}^{X} \cdot \frac{\beta_2}{\widetilde{\beta_{1_{c'}}}} \cdot \left(\Delta MP_{c'} - \Delta MP_c\right), \qquad (39)$$

whereas, if we assume that it depends on its location:

$$\Delta GDP_{c'}^{cf'} = \frac{\widetilde{\beta_{1_c}}}{\widetilde{\beta_{1_{c'}}}} \cdot \Delta GDP_{c'} + \tau_{c}^{X} \cdot \frac{\beta_2}{\widetilde{\beta_{1_{c'}}}} \cdot \left(\Delta MP_{c'} - \Delta MP_c\right) \qquad (40)$$

5.5 Results

Using equations (39) and (40), we compute the counterfactual growth rate of country c' in a different location (that of country c). The results under this new specification are in line with our expectations. The countries that benefited the most from their location are those located in Europe, East Asia and North America. Countries in Africa and South America are those who have benefited the least from their location. For instance, if the typical European country had been located where the typical African or South American country is located, its growth rate would have been 0.94 or 1.32 percentage points lower due to the terms of trade effect, respectively.

The reversal of our results for North America can be attributed to the fact that despite its poor growth performance, its enormous level of market potential (the largest in the sample) allows countries in this region to increase their exports without suffering large terms of trade effects. The reverse argument holds true for both South America and Africa which combine poor regional growth performance with low levels of market potential making them more prone to adverse terms of trade effects which hamper their growth. Table 11 shows the difference between the counterfactual and the actual GDP growth rates had the average country in the row region been located where the average country in the column region is located. The results under the assumption that the degree of openness depends on the location (instead of being a fundamental characteristic of each economy) are shown in Table 12.

6 Conclusions

This paper suggests a mechanism through which geography can actually have an impact on the growth prospects of a country. We argue that location determines a country's trading partners and, thus, it also determines the growth rate of aggregate demand for its exports. Countries located close to larger and more dynamic sources of demand are able to increase their exports without being subject to terms of trade declines, which allows them to sustain higher GDP growth rates.

Using data from 1965 to 1985, we find that both the growth rate of a country's exports and the growth rate of the demand for its exports are important determinants of the evolution of its terms of trade. We also find evidence for the presence of size effects. Countries located close to large markets experience smaller declines in their terms of trade as they increase their exports.

We tackle the economic significance of our results by performing a counterfactual exercise which allows us to attribute the importance of location for each country's growth experience. We find that, for instance, about 30% of the differential growth experience of Africa (with respect to other regions) can be attributed to poor geography.

Our results stress the importance of international linkages in the design of policies aimed at raising income in poor countries. Our results also suggest that openness to trade *per se* is not a sufficient condition for growth since it also requires the presence of a sufficiently large and/or dynamic source of demand in order for international trade to be growth-enhancing. As with regards to policy prescriptions, infrastructure investment aimed at reducing trade costs would be growth-enhancing insomuch as it would allow a country to trade with other countries, which would not only increase the level of its market potential but also potentially make it more dynamic.

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A Appendix: Derivation of closed form estimation equation

At this point, we find it convenient to express equations (18)-(20) in matrix notation as:

$$\widehat{p} = (1-\sigma)^{-1} \cdot \widehat{x} - (1-\sigma)^{-1} \cdot \widehat{n} - (1-\sigma)^{-1} \cdot \widehat{mp}$$
$$\widehat{mp} = M \cdot \Omega \cdot \left(\widehat{e} + (\sigma - 1) \cdot \widehat{p^T}\right)$$
$$\widehat{p^T} = (1-\sigma)^{-1} \cdot M \cdot \Theta \cdot (\widehat{x} - \widehat{mp})$$
$$M = \left(I - \frac{1}{\mathcal{C}} \cdot \iota\iota'\right)$$

where I is the identity matrix and ι is a $\mathcal{C} \times 1$ vector of 1's,

$$\widehat{p} = \begin{bmatrix} p_{11} \\ \vdots \\ p_{cc} \\ \vdots \\ p_{\mathcal{C}\mathcal{C}} \end{bmatrix} \quad \widehat{x} = \begin{bmatrix} X_1^T \\ \vdots \\ X_c^T \\ \vdots \\ X_{\mathcal{C}}^T \end{bmatrix} \quad \widehat{n} = \begin{bmatrix} n_1 \\ \vdots \\ n_c \\ \vdots \\ n_{\mathcal{C}} \end{bmatrix}$$

$$\widehat{mp} = \begin{bmatrix} MP_1 \\ \vdots \\ MP_c \\ \vdots \\ MP_{\mathcal{C}} \end{bmatrix} \quad \widehat{p^T} = \begin{bmatrix} P_1^T \\ \vdots \\ P_c^T \\ \vdots \\ P_{\mathcal{C}}^T \end{bmatrix} \quad \widehat{e} = \begin{bmatrix} E_1^T \\ \vdots \\ E_c^T \\ \vdots \\ E_{\mathcal{C}}^T \end{bmatrix}$$

$$\Omega = \begin{bmatrix} \omega_{11} & \dots & \omega_{1c} & \dots & \omega_{1\mathcal{C}} \\ \vdots & & \vdots & & \vdots \\ \omega_{d1} & \dots & \omega_{dc} & \dots & \omega_{d\mathcal{C}} \\ \vdots & & \vdots & & \vdots \\ \omega_{\mathcal{C}1} & \dots & \omega_{\mathcal{C}c} & \dots & \omega_{\mathcal{C}\mathcal{C}} \end{bmatrix} \quad \Theta = \begin{bmatrix} \theta_{11} & \dots & \theta_{1c} & \dots & \theta_{1\mathcal{C}} \\ \vdots & & \vdots & & \vdots \\ \theta_{d1} & \dots & \theta_{dc} & \dots & \theta_{d\mathcal{C}} \\ \vdots & & \vdots & & \vdots \\ \theta_{\mathcal{C}1} & \dots & \theta_{\mathcal{C}c} & \dots & \theta_{\mathcal{C}\mathcal{C}} \end{bmatrix}$$

Ω and Θ are parameters that, as it will be shown, can be estimated from the data and we define $\overline{\Omega} = M \cdot \Omega$ and $\overline{\Theta} = M \cdot \Theta$. We have data on the evolution of country's terms of trade, exports ($\widehat{x}$), and expenditure on tradables ($\widehat{e}$). Using the equations above, we obtain an expression for the evolution of a country's market potential in terms of known variables:

$$\widehat{mp} = \left(I - \overline{\Omega} \cdot \overline{\Theta}\right)^{-1} \cdot \overline{\Omega} \cdot \left(\widehat{e} - \overline{\Theta}\widehat{x}\right) \tag{41}$$

We can substitute this expression for the evolution of the market potential into our estimating equation:

$$\widehat{p} = (1-\sigma)^{-1} \cdot \widehat{x} - (1-\sigma)^{-1} \cdot \widehat{n} - (1-\sigma)^{-1} \cdot \left[\left(I - \overline{\Omega} \cdot \overline{\Theta}\right)^{-1} \cdot \overline{\Omega} \cdot \left(\widehat{e} - \overline{\Theta}\widehat{x}\right)\right]$$

$$\begin{gathered}\widehat{p} = (1-\sigma)^{-1} \left(I + \kappa \cdot \overline{\Omega} \cdot \overline{\Theta}\right) \cdot \widehat{x} - (1-\sigma)^{-1} \kappa \cdot \overline{\Omega} \cdot \widehat{e} - (1-\sigma)^{-1} \cdot \widehat{n} \\ \text{where } \kappa = \left(I - \overline{\Omega} \cdot \overline{\Theta}\right)^{-1}\end{gathered} \tag{42}$$

which gives us the evolution of every country's export price in terms of observables and parameters we can estimate from data.

Next, we turn our attention to the evolution of the price of imports which can de defined using the evolution of the price index of tradables and excluding own consumption of tradables:

$$\widehat{P_c^*} = \frac{1}{1-\sigma} \cdot \sum_{d \neq c} \overline{\theta^*}_{c'c} \left[\widehat{X_{c'}^T} - \widehat{MP_{c'}}\right]$$

where $\overline{\theta^*}_{c'c} = \frac{\theta^*_{c'c}}{\sum_{c'} \theta^*_{c'c}}$ and $\theta^*_{c'c} = \left(\tau_{c'c}^{1-\sigma} \cdot p_{c'c'}^{1-\sigma} \cdot n_{c'}\right)$ that, in matrix notation, can be expressed as:

$$\widehat{p^*} = (1-\sigma)^{-1} \cdot \Theta^* \cdot (\widehat{x} - \widehat{mp}) \quad \text{where } \Theta^* = M \cdot (\Theta - I \bullet \Theta) \tag{43}$$

where $\bullet$ represents the element-by-element product of matrices. Substituting our expression for the evolution of market potential (41) yields:

$$\widehat{p^*} = (1-\sigma)^{-1} \cdot \Theta^* \left(I + \kappa \cdot \overline{\Omega} \cdot \overline{\Theta}\right) \cdot \widehat{x} - (1-\sigma)^{-1} \cdot \Theta^* \cdot \kappa \cdot \overline{\Omega} \cdot \widehat{e} \tag{44}$$

We define the vector of terms of trade growth rates as $\widehat{t} = \widehat{p} - \widehat{p^*}$ and by substituting equations (42) and (44), we find an expression for the evolution of the terms of trade in terms of parameters and observables:

$$\begin{aligned}\widehat{t} &= \widehat{p} - \widehat{p^*} \\ &= (1-\sigma)^{-1} \left(I + \kappa \cdot \overline{\Omega} \cdot \overline{\Theta}\right) \cdot \widehat{x} - (1-\sigma)^{-1} \kappa \cdot \overline{\Omega} \cdot \widehat{e} - (1-\sigma)^{-1} \cdot \widehat{n} - \\ &\quad (1-\sigma)^{-1} \cdot \Theta^* \left(I + \kappa \cdot \overline{\Omega} \cdot \overline{\Theta}\right) \cdot \widehat{x} + (1-\sigma)^{-1} \cdot \Theta^* \cdot \kappa \cdot \overline{\Omega} \cdot \widehat{e}\end{aligned}$$

$$\widehat{t} = (1-\sigma)^{-1} \left[I + (I - \Theta^*)\, \kappa \cdot \overline{\Omega} \cdot \overline{\Theta}\right] \widehat{x} - (1-\sigma)^{-1} (I - \Theta^*)\, \kappa \cdot \overline{\Omega} \cdot \widehat{e} - (1-\sigma)^{-1} \cdot \widehat{n} \tag{45}$$

If we define $\widehat{m} = M \cdot \Omega \cdot \widehat{e} = \overline{\Omega} \cdot \widehat{e}$ as the growth rate of market potential (not inclusive of changes in the price of tradable goods), we can re-write equation (45) as:

$$\widehat{t} = (1-\sigma)^{-1} \left[I + (I - \Theta^*) \kappa \cdot \overline{\Omega} \cdot \overline{\Theta} \right] \widehat{x} - (1-\sigma)^{-1} (I - \Theta^*) \kappa \cdot \widehat{m} - (1-\sigma)^{-1} \cdot \widehat{n} \tag{46}$$

Table 1: Descriptive Statistics

Variable	Observations	Mean	Std Dev	Min	Max
Terms of Trade growth	77	-0.007198	0.02808	-0.04463	0.09413
GDP growth	77	0.01820	0.01866	-0.02296	0.07072
Export growth	71	0.0312	0.0383	-0.0827	0.152
Years Schooling	77	3.74153	2.51266	0.347	9.54
Log(Life Expectancy)	77	4.0563	0.198	3.509	4.304
OPEC dummy	77	0.06494	0.24803	0	1
Log(Black Mkt Premium)	70	0.20084	0.27097	0	1.310025
War dummy	77	0.40256	0.49364	0	1
Political Instability	74	0.08883	0.11191	0	0.5030

Table 2: Descriptive Statistics

Variable	Observations	Mean	Std Dev	Min	Max
Log(Value)	6547	9.8215	3.2056	1.7417	19.174
Log(Distance)	6547	8.2702	0.7708	4.8455	9.421514
Border dummy	6547	0.0247	0.1554	0	1
Number Landlocked	6547	0.1821	0.4049	0	2
Number Island	6547	0.3927	0.5614	0	2
Common Language	6547	0.1532	0.3602	0	1
Currency Union	6547	0.0046	0.0675	0	1

Table 3: Gravity Equation: Estimating Trade Costs

	(1)	(2)	(3)	(4)	(5)
Log(distance)	-1.417	-1.417	-1.400	-1.330	-1.321
	(44.56)**	(44.56)**	(43.90)**	(41.97)**	(41.53)**
Common Border	0.368	0.368	0.362	0.263	0.264
	(2.63)**	(2.63)**	(2.66)**	(1.91)*	(1.96)
Number Landlocked		7.008			6.376
		(19.77)**			(25.98)**
Number Islands		8.741			8.320
		(38.18)**			(23.97)**
Monetary Union			1.917		1.504
			(5.09)**		(4.17)**
Common Language				0.721	0.681
				(11.48)**	(10.87)**
Exporter Fixed Effects	Yes	Yes	Yes	Yes	Yes
Importer Fixed Effects	Yes	Yes	Yes	Yes	Yes
Number of Observations	6547	6547	6547	6547	6547
R^2	0.98	0.98	0.98	0.98	0.98

Dependent variable is the logarithm of bilateral trade flows. Robust standard error in parentheses. *, **: Significative at the 10% and 5% significance level, respectively.

Table 4: Terms of Trade Growth

	(1)	(2)	(3)	(4)
GDP growth	-0.5952	-0.4582	-0.7274	-0.5054
	(0.2657)*	(0.221)**	(0.3412)**	(0.2565)*
Years Schooling	-0.0012	-0.0016	-0.0013	-0.0017
	(0.0017)	(0.0017)	(0.0018)	(0.0017)
log(Life Expectancy)	0.0432	0..0337	0.0521	0.037
	(0.0241)	(0.022)	(0.0281)*	(0.0238)
Political Instability	.	0.0066	.	0.0068
	.	(0.023)	.	(0.0238)
Log(Black Mkt Prem)	.	-0.0052	.	-0.006
	.	(0.0117)	.	(0.0123)
War dummy	.	-0.0128	.	-0.0126
	.	(0.0052)**	.	(0.0054)**
OPEC Dummy	0.0911	0.0921	0.092	0.0923
	(0.0099)**	(0.0091)**	(0.0106)**	(0.0094)**
Obs.	79	79	79	79
F-statistic	25.1459	17.6423	21.8708	16.3751
R^2	0.4915	0.6315	0.4286	0.614

Dependent variable is the annual average growth rate of terms of trade. Robust standard errors in parentheses. *, **: Significative at the 10% and 5% significance level, respectively.

Table 5: GDP Growth Results

	(1)	(2)	(3)
ΔGDP_c	-0.853		-0.664
	(0.388)**		(0.316)**
ΔMP_c	1.106		0.931
	(0.546)**		(0.501)*
$\Delta GDP_c - \Delta MP_c$		-0.820	
		(0.382)**	
Years Schooling	-0.002	-0.002	-0.003
	(0.002)	(0.002)	(0.002)
log(Life Expectancy)	0.059	0.057	0.041
	(0.030)**	(0.029)*	(0.025)
Political Instability			0.008
			(0.024)
War dummy			-0.014
			(0.006)**
Log(Black Mkt Prem)			-0.009
			(0.013)
OPEC Dummy	0.085	0.087	0.086
	(0.011)**	(0.011)**	(0.010)**
Observations	77	77	68
F-statistic	17.262	22.184	13.776
R^2	0.424	0.437	0.602

Dependent variable is the annual average growth rate of terms of trade. Robust standard errors in parentheses. *, **: Significative at the 10% and 5% significance level, respectively.

Table 6: Export Growth

	(1)	(2)	(3)	(4)
ΔX_c	-0.257	-0.308		-0.237
	(0.133)*	(0.148)**		(0.134)*
$\Delta X_c - \Delta MP_c$			-0.275	
			(0.142)*	
Years Schooling	-0.0005	-0.001	-0.0007	-0.002
	(0.002)	(0.002)	(0.002)	(0.002)
log(Life Expectancy)	0.036	0.043	0.039	0.031
	(0.022)*	(0.023)*	(0.022)*	(0.021)
Political Instability				0.018
				(0.023)
War dummy				-0.016
				(0.006)**
Log(Black Mkt Prem)				-0.008
				(0.013)
OPEC Dummy	0.089	0.087	0.089	0.083
	(0.012)**	(0.012)**	(0.012)**	(0.011)**
ΔMP_c		0.771		0.661
		(0.417)*		(0.408)
Observations	71	71	71	62
F-statistic	14.485	11.524	14.638	9.028
R^2	0.378	0.369	0.385	0.542

Dependent variable is the annual average growth rate of terms of trade. Robust standard errors in parentheses. *, **: Significative at the 10% and 5% significance level, respectively.

Table 7: Country Classification into Regions

Africa: Algeria, Congo Democratic Republic, Ghana, Kenya, Liberia, Malawi, Mauritius, Niger, Senegal, Sierra Leone South Africa, Tanzania, Togo, Tunisia, Uganda, Zambia, Zimbabwe.

North America: Canada, Mexico, USA.

South America: Argentina, Barbados, Bolivia, Brazil, Chile, Colombia, Costa Rica, Dominican Republic, Ecuador, El Salvador, Guatemala, Guyana, Honduras, Jamaica, Nicaragua, Panama, Paraguay, Peru, Trinidad & Tobago, Uruguay, Venezuela.

Asia: Bangladesh, India, Iran, Iraq, Israel, Jordan, Pakistan, Sri Lanka, Syrian Arab Republic.

East Asia: Indonesia, Japan, Korea Republic (South), Malaysia, Philippines, Taiwan, Thailand.

Europe: Austria, Belgium (including Luxembourg), Cyprus, Denmark, Finland, France, Germany, Greece, Ireland, Italy, Malta, Netherlands, Norway, Spain, Sweden, Switzerland, UK.

Oceania: Australia, New Zealand, Papua New Guinea.

Table 8: Counterfactual Exercise: Using τ_d^{EX} and average regional market potential

	Africa	N America	S America	S Asia	E Asia	W Europe	Oceania
Africa	0.00%	-0.10%	-0.28%	0.25%	0.60%	0.21%	0.30%
N America	0.07%	0.00%	-0.13%	0.24%	0.49%	0.21%	0.27%
S America	0.23%	0.15%	0.00%	0.43%	0.71%	0.39%	0.46%
S Asia	-0.10%	-0.14%	-0.22%	0.00%	0.14%	-0.02%	0.02%
E Asia	-0.39%	-0.45%	-0.57%	-0.23%	0.00%	- 0.25%	-0.20%
Europe	-0.36%	-0.53%	-0.84%	0.07%	0.68%	0.00%	0.15%
Oceania	-0.27%	-0.36%	-0.53%	-0.04%	0.28%	- 0.08%	0.00%

The number in each cell represents how the growth rate of the **average** country in the row region would have changed had it been located in the column region. In this table we assume that the degree of openness depends on the country but not on the location.

Table 9: Counterfactual Exercise: Using τ_c^{EX} and average regional market potential

	Africa	N America	S America	S Asia	E Asia	Europe	Oceania
Africa	0.00%	-0.07%	-0.23%	0.10%	0.39%	0.36%	0.27%
N America	0.10%	0.00%	-0.15%	0.14%	0.45%	0.53%	0.36%
S America	0.28%	0.13%	0.00%	0.22%	0.57%	0.84%	0.53%
S Asia	-0.25%	-0.24%	-0.43%	0.00%	0.23%	-0.07%	0.04%
E Asia	-0.60%	- 0.49%	-0.71%	-0.14%	0.00%	-0.68%	-0.28%
Europe	-0.21%	-0.21%	-0.39%	0.02%	0.25%	0.00%	0.08%
Oceania	-0.30%	- 0.27%	-0.46%	-0.02%	0.20%	-0.15%	0.00%

The number in each cell represents how the growth rate of the **average** country in the row region would have changed had it been located in the column region. In this table we assume that the degree of openness depends on the location but not on the country.

Table 10: Size Effects

	(1)	(2)	(3)	(4)
ΔX_c	-0.226	-0.196		
	(0.119)*	(0.121)		
ΔMP_c	0.406	0.489		
	(0.368)	(0.396)		
$\Delta X_c - \Delta MP_c$			-0.222	-0.178
			(0.118)*	(0.118)
$\Delta X_c \cdot MP_c$	0.355	0.220	0.373	0.243
	(0.136)**	(0.137)	(0.130)**	(0.132)*
Years Schooling	-0.001	-0.002	-0.001	-0.001
	(0.001)	(0.002)	(0.001)	(0.001)
log(Life Expectancy)	0.027	0.024	0.026	0.022
	(0.020)	(0.021)	(0.020)	(0.020)
Political Instability		0.014		0.012
		(0.022)		(0.022)
War dummy		-0.012		-0.012
		(0.006)**		(0.005)**
Log(Black Mkt Prem)		-0.007		-0.005
		(0.012)		(0.012)
OPEC Dummy	0.089	0.085	0.090	0.086
	(0.011)**	(0.011)**	(0.011)**	(0.011)**
Observations	71	62	71	62
F-statistic	12.251	8.786	14.832	9.974
R^2	0.493	0.584	0.492	0.583

Dependent variable is the annual average growth rate of terms of trade. Robust standard errors in parentheses. *, **: Significative at the 10% and 5% significance level, respectively.

Table 11: Counterfactual Exercise: Using MP, τ_d^{EX} and average regional market potential

	Africa	N America	S America	S Asia	E Asia	Europe	Oceania
Africa	0.00%	0.04%	-0.19%	0.18%	0.42%	0.25%	0.25%
N America	-0.29%	0.00%	-0.46%	-0.13%	0.05%	0.07%	-0.01%
S America	0.18%	0.37%	0.00%	0.34%	0.54%	0.49%	0.44%
S Asia	-0.09%	0.07%	-0.20%	0.00%	0.10%	0.11%	0.07%
E Asia	-0.36%	0.21%	-0.56%	-0.17%	0.00%	0.20%	0.01%
Europe	-0.94%	-0.18%	-1.32%	-0.57%	-0.13%	0.00%	-0.27%
Oceania	-0.27%	- 0.14%	-0.45%	-0.09%	0.14%	0.03%	0.00%

The number in each cell represents how the growth rate of the **average** country in the row region would have changed had it been located in the column region. In this table we assume that the degree of openness depends on the country but not on the location.

Table 12: Counterfactual Exercise: Using MP, τ_c^{EX} and average regional market potential

	Africa	N America	S America	S Asia	E Asia	Europe	Oceania
Africa	0.00%	0.03%	-0.15%	0.07%	0.27%	0.47%	0.23%
N America	-0.41%	0.00%	-0.52%	-0.08%	0.04%	0.21%	- 0.02%
S America	0.22%	0.31%	0.00%	0.17%	0.43%	1.20%	0.51%
S Asia	-0.22%	0.13%	-0.37%	0.00%	0.16%	0.57%	0.16%
E Asia	-0.55%	0.23%	-0.69%	-0.11%	0.00%	0.63%	0.02%
Europe	-0.56%	-0.06%	-0.65%	-0.14%	-0.05%	0.00%	-0.14%
Oceania	-0.29%	-0.10%	-0.40%	-0.04%	0.09%	0.05%	0.00%

The number in each cell represents how the growth rate of the **average** country in the row region would have changed had it been located in the column region. In this table we assume that the degree of openness depends on the location but not on the country.

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