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Essays on International Trade

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ESSAYS ON INTERNATIONAL TRADE

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ABSTRACT

This dissertation is composed of two essays. The first uses the gravity equation and data on bilateral trade to investigate colonial patterns. The second also uses bilateral trade and the gravity model. The inquiry in the second essay concerns the causal relation between trade and government expenditures. In addition to bilateral trading pattern, data on tariffs and trade tax revenues is also examined.

DEDICATION

To all that loved and supported me through each step of this process: my parents, my brother and A. I owe each more than I can ever say in words and am thankful every day to have such strong wind filling my sails and propelling me ever forward.

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Thanks to Professor Scott Baier who introduced me to the power of the gravity equation. His insights shaped this paper from the beginning. Thanks also to Michael Maloney, who helped me through each iteration of this paper and kept me on track. Thanks to all my readers who offered comments.

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WORLD TRADE AND COLONIAL ORIGINS

Introduction

Few countries are in need of greater understanding than those once controlled by European powers. Former colonies constitute some of the most prosperous and the most bereft countries on the planet. The disparity between rich and poor can be attributed to any number of variables, but popular perception inevitably drives the discussion toward a referendum on colonization. Parent countries are either extolled for establishing institutions, property rights and the rule of law or demonized for ravaging local ecologies and yoking the population toward their ends.

But the success of a post-colonial country often has more to do with its ability to develop strong trade relations after its independence. Trade, through the mechanism of comparative advantage and specialization, can help lift a country from poverty. Understanding how former colonies adapt to trade illuminates the wealth disparities that are becoming an increasing concern in our modern world.

Our research shows that newly-independent countries trade more with their sister colonies and parent country than with others but that this linkage dissipates over time. It takes decades for former colonies to develop trading partners and increase their volume of trade to a meaningful level—evolution away from a parent country can be attenuated by the nature of the colonization and the disposition of the parent.

We have laid out a review of the pertinent literature, a theoretical model for addressing the quantitative and qualitative nature of colonial trade effects and a description of the data we used in the following pages. We also discuss the results, their sensitivity and our conclusions.

Literature Review

Our research aims to use the gravity model to quantify, qualify and extrapolate the influence of colonialism on international trade.

The gravity equation is one of the most successful and widely used models in international trade. Anderson (1979) and Bergstrand (1985) first developed the model from physics and found it showed excellent estimation properties for bilateral trade volumes. Bilateral trade volumes are related to the distance and to the product of each of the trading country's GDP as Eaton and Kortum (2002) pointed out.

Various researchers have plumbed the gravity model. They introduced the concept of trade barriers, attempting to explain the costs that are implied by crossing international borders. Such costs arise from the fact that countries may have different currencies, ethno-linguistic characteristics, political institutions, histories, cultures and behavioral norms between trading agents. Anderson and Wincoop (2004) describe trade barriers as a list of observable variables used in the trade cost function. These variables include distance, common language, preferential trade membership, adjacency (common land border), and a host of others. Some of these variables, such as distance and adjacency, have become mainstays of the gravity model. Other variables, such as whether a country is a former colony and whether trading partners speak the same language, were introduced recently.

Wei (1996) first reported a strong language effect in the gravity equation. Other researchers soon corroborated. Eaton and Kortum (2002), Rose and Wincoop (2001) and Hummels (2001) each find that countries that speak the same language tend to trade more.

Rose and Wincoop (2001) were among the first who considered the relation between colonies in the gravity equation. Estevadeoradal et. al (2003) and Felbermayr and Kohler (2006) later confirmed a positive tie between the colonial dummy and trade.

Rose and Wincoop (2001) examine trade patterns between countries within a larger study on currency unions. They include variables that track trade between sister colonies and trade between a colony and its parent country. They find that colonies tend to trade more between themselves and with their colonial parent.

Estevadeoradal et. al (2003) investigates the boom of international trade between 1870 and 1939. They use the gravity equation approach for their study and consider a unique colonial dummy to identify if the countries shared a colonial relationship during that period.

Eichengreen and Irwin (1996) investigate trade between 1949 and 1964, considering colonial dummies for British colonies, British Commonwealth, US-Philippines and Netherlands-Indonesia. Their findings suggest that former British colonies traded disproportional more with one another in 1949. They also found that former British colonies tended to trade less with one another and less with the rest of the world than predicted by the standard gravity model after they added lagged trade data. Trade peaked in 1949 for the British Commonwealth but the effect disappeared in the period from 1954 to 1964 when the researchers included lagged trade data. The researchers reported larger than expected trade flows between the US-Philippines and Netherlands-Indonesia during the time considered.

These investigations into the effect of colonial ties focus on the application of the gravity equation model. They represent a small subset of studies in the area of colonial development. Early studies of colonial trade, such as Kleiman (1976) did not use the gravity model approach.

Kleiman (1976) investigates the negative effect of bilateralism—a trade bias introduced by colonial rule—on the future economic development of African countries. The author focuses on the relationship between France and its former colonies, and the UK and its former colonies. His main finding is that colonization had a greater effect on former French colonies. He postulated that colonial influence on Africa should decrease over time and end after a decade of independence (or till the 1970s).

Literature on colonial effect is not limited to trade considerations. Individual country growth and prosperity is also a common topic of inquiry. Most of those studies focus on the effect each different parent country has on its former colonies. Lange et al. (2006) analyze the economies of former Spanish and British colonies, for example. They claim that Spanish colonization had negative consequences. Countries that had been colonized by the British did much better after becoming independent.

Landes (1998) compared French and British colonies. The researcher argued that former British colonies have greater prosperity compared to the French colonies due to the British propensity to create better cultural and political institutions. He also attributes modern post-colonial poverty to a failed institution building by the European elite during the colonial years.

Bertocchi and Fabio (1996) investigate the impact of European colonization on African countries. The authors find that dependencies experience more positive economic outcomes than colonies. They find former French and British colonies are better off than countries that were once controlled by Belgium, Italy or Portugal. They also discover that, on average, growth accelerates after independence.

We explore the effect of colonialism on international trade during 1962-2000 in this research. We follow Rose and Wincoop (2001) and introduce two colonial dummies: common colonizer and ex-colony/colonizer. We will quantify the effect of colonialism on trade flows, consider the extent to which trade is influenced by the number of years a country has been independent and estimate how long the colonial effect may be expected to last.

We will asses the extent trade is influenced by a country's colonial past. Unlike previous studies, we consider four colonial origins (France, Spain, Netherlands and United Kingdom). We follow Bertocchi and Fabio (1996) to assess the extent to which the number of years a country has been independent impacts its trade by comparing colonies that received independence before and after 1945. We pursue Kleiman (1976) to estimate when the effects of colonialism may be expected to abate by considering the colonial effect on trade from 1962 to 1983 and then from 1984 to 2000.

Theoretical Model

A classical approach for investigating the pattern of international trade is the gravity equation. Baier and Bergstrand (2001) give the following definition:" The gravity equation is a log-linear cross-sectional specification, relating the nominal bilateral trade flow from exporter *i* to importer *j* in any year (X_{ij}) to the exporting and importing countries' nominal gross domestic products (Y_i and Y_j, respectively), distance between their economic centers (d_{ij}), and typically an array of dummy variables …and a common land border". In simple words gravity equation relates the bilateral trade flows between two countries to their GDP and distance. Its well-known formulation is the following:

$$X_{ij} = \beta_0 Y_i^{\beta_1} Y_j^{\beta_2} d_{ij}^{\beta_3} \tag{1}$$

Where X_{ij} is the volume of bilateral trade between countries *i* and *j*, *Y* is country's real GDP and d_{ij} is the distance between them. Variable Y_i determines the potential capacity of trade of country *i*, since it reflects its economic capacity. The signs of β_1 and β_2 are predicted to be positive and β_3 negative. The implication of basic gravity theory is that trade is a result of attraction and resistance from geographical distance. Geographical trade resistance is composed of transportation costs and transport time, and in the basic gravity model d_{ij} acts as a proxy variable for the trade resistance.

The gravity model has been widely used and offers an excellent performance since the original work of Tinbergen (1962). The gravity model is often used to estimate the effects of trade costs on bilateral trade flows *j* such as, transport costs, tariffs, border effects, language and ethnic effects.

Thus the gravity equation will look in the following way:

$$X_{ij} = \beta_0 Y_i^{\beta_1} Y_j^{\beta_2} d_{ij}^{\beta_3} e^{\beta_4 A_{ij}} e^{\beta_5 l_{ij}} \varepsilon_{ij} \qquad (2)$$

where A_{ij} is an adjacency (common land border), l_{ij} is a dummy for common language and e is natural logarithm base and ε_{ij} is a log-normally distributed error term.

Neighboring countries (A_{ij}) can be expected to have additional stimulus to trade because they have similar tastes and common interests. A common language l_{ij} tend to increase the trade flows between countries. It provides evidence of common cultural roots, shared literature radio and television communications, and even educational exchanges, and with all of these come greater knowledge of institutions, networks and individuals which makes it likely to forge tighter economic ties (see Helliwell (1997, p.10)). So coefficients on β_4 and β_5 are expected to be positive.

Using existing literature we formalize our model in a multi-country framework where $i, j= 1, \ldots, N$ denotes countries. We base our model on Anderson and Wincoop (2003), Lochard and Sousa (2003) and Baier and Bergstrand (2006). Our justification for gravity equation rests on Armington model[1] assuming that each country is specialized in a production of single good. The more substitutable are goods from different countries, the higher will be the sensitivity of trade to production costs and geographic barriers.

We start our model from a standard consumer maximization problem and use constant elasticity of substitution (CES) utility function. The choice of this type of function was based on theoretical result by Anderson (1979): if elasticity of demand for product varieties is constant, then firm scale will not change at all due to tariffs or trade

[1] While we use here the simple Armington assumption, it can be easily extended to a model with monopolistic competition.

liberalization. So the utility function of representative consumer in country i is the following:

$$U_i = \left(\sum_j \beta_j^{\frac{1-\sigma}{\sigma}} c_j^{\frac{\sigma-1}{\sigma}} \right)^{\frac{\sigma}{\sigma-1}} \tag{3}$$

where σ elasticity of substitution between products is equal to σ>1, which also equals the elasticity of demand η, when number of products is large, and c_{ij} is consumption by country i consumers of goods from country j .

The consumers in country i will maximize their utility function subject to total expenditures equal to total income so their budget constraint will be :

$$Y_i = \sum_j c_{ij} p_{ij} \tag{4}$$

where p_{ij} is the price that consumers in country i pay for good j and Y_i is the GDP of country i. Then the solution of constrained utility maximization is:

$$c_{ij} = \left(Y_i / p_{ij} \right) \left(\beta_j p_{ij} / P_i \right)^{1-\sigma} \tag{5}$$

where,

$$P_i = \left(\sum_j (\beta_j p_{ij})^{(1-\sigma)} \right)^{\frac{1}{1-\sigma}} \tag{6}$$

As it is customary in the gravity equation literature, we follow Samuelson (1952) and assume "iceberg" transportation costs factor for an imported goods T_{ij}. We assume that country i sells its good to country j for the price p_{ij}. This price includes all transportation costs from country i to j, on c.i.f. (cost, insurance, freight) basis. At the same time p_i, local price of good produced in country *i* is net of any transportation costs, on a f.o.b. (free on board) basis. Then $p_{ij} = p_j T_{ij}$, notice that if good stays in country then $T_{jj}=1$ and $T_{ij}>1$ which means that we need to ship T_{ij} units of product in order for one unit of good to reach the final destination. Fraction (T_{ij}-1) of each product "falls into the ocean" while being transported from country *j* to country *i*. Taking the "iceberg" costs into consideration we can calculate the prices that buyers in country *i* pay and payments that sellers of country *j* receive[2] as $p_j = \frac{p_{ij}}{T_{ij}}$.

Now we can use the equations above to find the import demand function of country *i* for the good from country *j*:

$$X_{ij} = Y_i \left(\frac{\beta_j p_j T_{ij}}{P_i} \right)^{(1-\sigma)} \tag{7}$$

In equilibrium markets clear and exporter *j* GDP should be exactly equal to importer *i* expenditures so if we sum over all countries we would receive a balanced trade equation:

$$Y_j = \sum_i X_{ij} \tag{8}$$

thus giving us the GDP for country *j* as a function of GDP of country *i* :

$$Y_j == \sum_i Y_i \left(\frac{\beta_j p_j T_{ij}}{P_i} \right)^{(1-\sigma)} \tag{9}$$

From this we can calculate the equilibrium prices and plug them back into demand function (7). Then using this new equation for demand function and assuming symmetric

[2] Maintaining the assumption that all of the "iceberg" costs are paid by the seller.

trade costs between countries and after some algebra we will receive the final version of the import of country *j* for good of country *i*:

$$X_{ij} = \frac{Y_i Y_j}{\overline{Y}} \left(\frac{T_{ij}}{P_i P_j} \right)^{(1-\sigma)} \tag{10}$$

with
$$P_i^{1-\sigma} = \sum_j S^j \left({T_{ij}}/{P_j} \right)^{(1-\sigma)} \tag{11}$$

and $S^j = {Y_j}/{\overline{Y}}$

where $\overline{Y}$ is the world GDP and S^j is the country *j* share of world expenditures, and assuming balanced trade in each country S^j is also country *j* share of world GDP.

The last step left is to model the transportation cost T_{ij}. There are going to be three components in the cost function. The first three are adjacency (A_{ij}), distance (d_{ij}) and language (l_{ij}) which are included in conventional literature. The fourth element of the cost factor is a set of colonial dummies (*C*). Thus our trade costs factor is:

$$T_{ij} = A_{ij}^{\alpha} d_{ij}^{\rho} l_{ij}^{\gamma} C \tag{12}$$

where A_{ij}=exp(α*adj_i) and adj_{ij} =1 when countries *i* and *j* share common land border and 0 otherwise, d_{ij} is the distance between countries *i* and *j*, l_{ij}=1 if countries *i* and *j* speak the same language and C represents the vector of dummy variables that we include in the trade costs formulation.

First, we follow Rose and Wincoop (2001) so that our vector *C* contains two variables for colonial control. The two variables capture the effect of bilateralism, or colonial trade bias. The first variable, cc_{ij}, captures colony-to-colony trade and equals one if countries *i* and *j* share a common colonizer and zero otherwise. The second colonial variable, cm_{ij}, captures the biased trade between colonies and their former masters. This dummy equals one if trading countries *i* and *j* are former colony and colonizer and zero otherwise. We extend Rose and Wincoop (2001) by specifying the colonial origins when considering trade between colonies and trade between a colony and its parent country. We consider four origins: French, Spanish, Dutch and British.

Second, we go beyond Rose and Wincoop (2001) to consider trade not just between colonies but also the trade between colonies and the rest of the world. To do this, we consider two dummies based on whether an exporter or importer is a former colony, $c\text{-}e_i$ and $c\text{-}i_i$, where $c\text{-}e_i$, is equal one if exporter *i* is a former colony and zero otherwise and $c\text{-}i_i$ is equal one if importer *i* is a former colony and zero otherwise. Then we denote those dummies by their four colonial masters. The first letter of the variable identifies which country was the colonial parent. The second letter indicates whether the country is a net exporter (*e*) or importer (*i*). For example, "*f_i*=1 if a country is former French colony and importer" and "*s_e*=1 if country is former Spanish colony and exporter" and etc. There are eight such dummies, one for each of the four parent countries as an exporter and another four for the countries as an importer.

All the trade barriers described above form a trade cost factor in equation (12). We can plug equation (12) back into equation (10) and receive the gravity equation model which now includes the colonial effects:

$$\ln(X_{ij}) = \beta_0 + \beta_1 \ln(Y_i) + \beta_2 \ln(Y_j) + \beta_3 \ln(d_{ij}) + \beta_4 \ln(A_{ij}) + \beta_5 \ln(l_{ij}) -$$

$$-(1-\sigma)\ln(P_i) - (1-\sigma)\ln(P_j) + \varphi C_n \qquad (13)$$

where $\ln(P_j)$ are price indices and φC_n is a vector of colonial dummies described above:

Colony to colony and colony to colonizer (cc_{ij}, cm_{ij},)

- Colony to colony and colony to colonizer separated into four colonial origins (f_cc_{ij} ,s_cc_{ij}, d_cc_{ij}, u_cc_{ij}, f_cm_{ij}, s_cm_{ij}, d_cm_{ij}, u_cm_{ij})
- Colonial exports and Colonial imports ($c\text{-}e_i$, $c\text{-}i_i$)
- Colonial exports and Colonial imports by origins (*f_i, s_i, d_i, u_i, f_e, s_e, d_e, u_i*)

The gravity equation says the trade flow between two countries are directly proportional to the product of the exporting and importing countries nominal GDPs, the cost of trade and the price indices for both countries. Anderson and Wincoop (2003) call those indices "multilateral resistance" variables. Multilateral resistance variables P_i and P_j are not prices, they are not observable, since we do not have statistics on all the prices, taxes, trade barriers and other costs in all the countries. These indices depend on bilateral resistance $\{T_{ij}\}$, including those not directly involving i. Multilateral resistance indices are simple summary measures of trade costs for a particular region i with all its trading partners (see Anderson and Wincoop (2004, p. 72).

Earlier gravity model literature such as Anderson (1979) and Bergstrand (1985) attempted to omit multilateral resistance variables. McCallum (1995) investigated US-Canada trade patterns and found that the international border has an enormous negative effect on their trade. It became questionable to the literature that this colossal border effect maybe due to omitted price terms. After McCallum (1995) there were several attempts to approximate the multilateral resistance variables. Wei (1996) estimated the gravity equation using remoteness variables, calculated as the ratio of distances to GDPs.

But the fundamental contribution to the gravity equation model was done by Anderson and Wincoop (2003) who claim that omitting the multilateral resistance variables introduces the upward bias on the estimates and that the remoteness variables used are atheoretical. The key implication of their study is that the trade is determined by relative trade barriers and including multilateral resistance variables is crucial for consistent and efficient estimates. Anderson and Wincoop (2003) assume a symmetry of costs and estimate the structural equation with nonlinear least squares after solving for the multilateral resistance indices as a function of observables trade barriers (distance and the international border dummy).

The nonlinear least square estimation of the gravity model imposes a problem, since it is not as easy to perform as OLS. Both Anderson and Wincoop (2003) and Feenstra (2004) note that fixed effect approach which includes a single set of region specific dummies will be identical nonlinear estimation. However as pointed out by Baier and Bergstrand (2006) fixed-effects dummy variables can account for multilateral resistance variables but without the structural system of equations one still can not generate region- or pair-specific comparative statics. Baier and Bergstrand (2006) suggest a solution for the complicated nonlinear estimation problem, called BV-OLS. They perform the first-order log-linear Taylor series expansion of the price indices equation and find equations that identify the exogenous factors determining the multilateral price terms in gravity model. Thus,

$$MWRZ_{ij} = \left[\frac{1}{N}\sum_{j=1}^{N}\ln Z_{ij} + \frac{1}{N}\sum_{i=1}^{N}\ln Z_{ij} - \frac{1}{N^2}\sum_{i=1}^{N}\ \sum_{j=1}^{N}\ln Z_{ij} \right]$$

where Z_{ij} is any of the variables from the trade costs factor specified in the equation (12) and $MWRZ_{ij}$ is the estimated multilateral resistance variable for the trade cost variable Z_{ij}. Each equation contains two terms. The first one is a GDP weighted (geometric) average of the gross trade costs facing country across all regions. The second term is the influence of the world resistance and thus is identical to all countries. Those equations are used as the proxies for the multilateral resistance variables, which not only make it possible to estimate the gravity model with OLS but also allow us to find the comparative statics and thus the source of multilateral resistance. It is important to notice that inclusion of approximated multilateral resistance variables requires estimation of the constrained OLS model, where the coefficient estimates of the variables are forced to have an opposite sign with the corresponding estimates of the multilateral resistance variables. In order to run the constrained regression we need to constrain the coefficients on GDPs to their theoretically implied value, therefore we construct:

$$trade\_share = \ln(X_{ij}) - \ln(Y_i) - \ln(Y_j)$$

Then equation (13) is modified to account for the constraints and to include the multilateral resistance variables proxies:

$$trade\_share = \beta_0 + \beta_1 \ln(d_{ij}) + \beta_2 \ln(A_{ij}) + \beta_3 \ln(l_{ij}) + \varphi C + \theta MWRZ \qquad (14)$$

where as before d_{ij} is distance between countries i and j, A_{ij} is an adjacency, l_{ij} is a dummy for common language, φC is a vector of colonial dummies (cc_{ij}, cm_{ij}, f_cc_i, s_cc_{ij}, d_cc_{ij}, u_cc_{ij}, f_cm_{ij}, s_cm_{ij}, d_cm_{ij}, u_cm_{ij}, $c\text{-}e_i$, $c\text{-}i_i$, f_i, s_i, d_i, u_i, f_e, s_e, d_e, u_i) and *MWRZ* is a vector of proxies for all multilateral resistance variables included in the regression.

Equation (14) is the model that we are going to use to find answers for our research questions. First, how much does colonialism influences countries trade flows? Second, does it matter when the colonies received the independence? And third, how long does the colonial effect last? That formulation of gravity equation will enable us to estimate the presence of bilateralism, the colonial trade bias, when former colonies trade more between themselves and with former colonizer rather then with other countries in the world. It will also allow us to estimate the impact of different colonial origins on bilateral trade flows and see whether the colonial influence vanishes with the time.

We use the vector of colonial relationship specified by Rose and Wincoop (2001) and expand it by colonial origins to identify the presence of bilateralism. Also we will use another specification to identify the effect of colonial origins on bilateral trade. Both models are based on equation (14), the difference between the two is the specification of the colonial vector. For the first case we include only colony to colony trade and colony to master trade general and by origins, while for the second specification we include colonial export and colonial import for all colonies and by their origins.

Both models will be applied to a different set of settings. First, we consider pooled sample of former colonies, no matter when they received independence. Second, we divide a set of colonies into those that received their independence before 1945 and after 1945. And finally third, we investigate those colonies that received independence after 1945, by dividing the dataset into two parts time spans, a decade after the colonization has ended (1962-1983) and time after that (1984-2000). Our choice of time period is mainly based on Kleiman (1976) who claimed that the colonial effect should last for a decade after the independence. According to Kleiman (1976) until the end of 1970s, we expand the time span until 1983, instead of 1980, the reason for that is a change in the trade dataset, which happened in 1984, that excluded small observations of trade from the sample.[3]

If bilateralism is present then estimated coefficients on the dummies cc_{ij}, cm_{ij}, f_cc_{ij} ,s_cc_{ij}, d_cc_{ij}, u_cc_{ij}, f_cm_{ij}, s_cm_{ij}, d_cm_{ij}, u_cm_{ij}, would have a positive sign. The coefficients on the dummies $c\text{-}e_i$, $c\text{-}i_i$ would show an influence of colonial origins on trade and coefficients *f_i, s_i, d_i, u_i, f_e, s_e, d_e, u_e* would show that influence by origin. Those coefficients can have either negative or positive signs. Negative coefficient would mean that country *i* has a disadvantage in trade due to the fact it was a colony of *X* (where *X* is *France, Spain, Netherlands* and *UK*) while positive coefficient on those dummies would claim that being a colony of *X* (where *X* is *France, Spain, Netherlands* and *UK*) has a positive impact on country *i* trade. This part of our study will support/decline the numerous investigations in current literature that are trying to find the "best" colonizer, for instance, whether Britain was better than France or vice versa.

[3] See details in Data Description section of this paper.

Data Description

The data for this project come from four sources: National Bureau of Economic Research (NBER), Central Intelligence Agency (CIA), Center for International Comparisons at the University of Pennsylvania and the Department of Economics at Macalester College.

Our primary data on bilateral trade flow come from the NBER. Robert Feenstra and Robert Lipsey constructed this unique data set from United Nations under a grant from the National Science Foundation to the NBER.[4] Feenstra and Lipsey (2004) revised some of the UN country codes to aggregate small countries and adjust for countries that no longer exist. The researchers combined Belgium and Luxemburg into a single coded-entity for example. They also recoded some countries that were former Soviet Republics but no longer exist.

Both importers and exporters report the data. Importers report CIF (cost, insurance, freight) and exporters report FOB (free on board). Import data are usually more reliable than export data since they constitute a tax base, as pointed by Felbermayr and Kohler (2006). Constructing data from importers alone gives more accurate reporting and reflects a larger number of country pairs with positive trade. Feenstra and Lipsey (2004) also give primacy to the importers' reports whenever they are available, but use exporter data when they are not available.

The number of trade observation is charted for each year between 1962 and 2000 in Appendix C. The graph shows an obvious difference in the number of trade observations

[4] This dataset covers the years 1962-2000 and is available at: http://www.nber.org/data/.

made before 1984 and after that year. The difference comes from a change in the way the United Nations recorded its data. Before 1984, it included all the trade data, no matter how small. But starting in 1984, the UN only recorded data that exceeded USD$100,000 for each bilateral flow. Feenstra and Lipsey (2004) revised the data by adding smaller-valued trade to the UN dataset, but only for certain countries.

There are 203 countries and or territories listed in the dataset but there are only 72 countries listed during 1984-2000. Those 72 countries accounted for 98% of the world's exports in the last five years. We present the list of all the countries in the database in Appendix A and the list of post-1984 countries in Appendix B. The World Trade Flows dataset includes data on country *i's* imports from country *j*, $X_{i,j\ t}$, where *t* stands for the year. The data are reported in nominal thousands of US dollars and each observation is unique, reported only once in the database. A majority of the countries are included in the database, despite the UN data collection change. The UN still tracked each trade one of the 72-listed countries did with one of the un-listed countries. The only data that is lost is from one unlisted country trading with another unlisted country. We transform the trade data into real terms with the base year =2000.

GDP data come from the Center for International Comparisons at the University of Pennsylvania and are called the "Penn World Tables." They provide data on GDP per capita and population for 188 countries for some, or all, of the years 1950-2004. We use the real GDP per capita in constant prices (Chain) with the base year=2000 and multiply that by population to receive the country *i* GDP in millions of US dollars.

We use the CIA Factbook[5] to obtain data on distance, adjacency (common land border) and colonial history. The CIA Factbook has information on 266 countries, territories and uninhabited islands. We use several tables from CIA Factbook: the geographic coordinates table to calculate distance, the land boundaries table to create adjacency dummy and the independence table to create colonial dummies. The table with geographic coordinates includes rounded latitude and longitude figures and based on the Gazetteer of Conventional Names, Third Edition, August 1988, US Board on Geographic Names and other sources.

We obtain data on latitude and longitude for country *i* and calculate its distance from country *j* using spherical geometry and trigonometric math functions. The near-spherical shape of the earth dictates the following formula for approximating the distance between countries:

Distance=3962.6*acos(sin(latrad_*i*)*sin(latrad_*j*)+cos(latrad_*i*)*cos(latrad_*j*)*cos(longrad_*i*-longrad_*j*))

The table with land boundaries contains the total length of all land boundaries and the individual lengths for each of the contiguous border countries. We, however, do not use the total length of all boundaries. We only obtain data for country *i*, and then create a dummy variable which is equal to one if country *i* has a common land border with country *j* and zero otherwise.

The independence table gives the date that each country achieved sovereignty from its nation, empire, or trusteeship and links the former colonial country to its parent. This

[5] https://www.cia.gov/cia/publications/factbook/index.html

posed the toughest obstacles of the data collection. Some of the countries have different colonial masters in different periods of time or had several colonizers simultaneously. The Dominican Republic, for example, received independence from Haiti while Haiti itself was colonized by France, according to the CIA Factbook. Somalia is also difficult to categorize since it was merged from two colonizers: the UK and Italy. We consider four colonial masters in our study and create a colonial dummy variable for each: France, Spain, UK and the Netherlands. The list of colonies by colonizers with the independence date is present in Table 1.8.

The data on languages are from Western Hemispheric Research Resources at the Department of Economics at Macalester College.[6] The dataset lists 176 countries and separates them by the origin of their language into 15 different groups (Arabic, Burmese, Chinese, Dutch, English, French, German, Greek, Korean, Malay, Persian, Portuguese, Spanish, Swedish and Other).

We changed the language dataset from its original version by recoding the data and expanding it to include more countries. The original dataset divided countries into 15 language categories. The first 14 groups each described a different set of related languages. The 15th group, which was coded as “99,” included all the countries that speak languages that do not easily fall into one of the first 14 categories. The language spoken in a country coded “99” was not spoken anywhere else in the world.

The original dataset did not include countries that emerged in the early 1990s after the break up of the former Soviet Union empire.

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[6] http://www.macalester.edu/research/economics/PAGE/HAVEMAN/Trade.Resources/Data/Gravity/language.txt

We revised the dataset in two major ways:

1. We split the "99" code language designation into separate languages. We gave each of the 35 countries that fell into this catch-all its own code. We change languages codes of those countries to their own unique code ranging from 101 to 135. Having the same language code for countries that have different languages was inappropriate for our research.
2. We added countries formed at the beginning of the 1990s that had been missing from the original dataset. These countries were the product of the break up of the Soviet Union, Yugoslavia and Czechoslovakia. Countries formed from Yugoslavia and Czechoslovakia retained their languages. The Slovakian and Czech languages are very similar. The Serbian, Yugoslavian, Croatian, Bosnia and Herzegovinan and Macedonian languages all belong to South Slavic language group.

We omit trade observations on former Soviet satellite countries. The data were inconsistent and limited only to years after 1991. We kept observations of the Soviet Union between 1962 and 1990 which were consistent with the quality of the rest of our data. After all the changes described above, we had 50 different language codes. A value of one is assigned as a language variable for any bilateral trade flow between two countries sharing a common language.

The summary statistics for all of the variables described above are represented in Appendix E.

Results

We use constrained ordinary least squares to estimate our model of interest with trade share as the endogenous variable for the period 1962-2000. We estimate the model using proxies for multilateral resistance variables. We also include a year-fixed effect because the number of trade observations is different before 1984 than after. The results of the regressions are given in Table 1.1 and Table 1.4. In these tables, we report only variables of interest and do not report the estimates of the year effect, though every regression from those tables included year dummies in the estimation. The coefficients on the year effects are very similar for all the regressions, so we report them separately in Table 1.7.

We find a positive impact of common land border and common language on trade for all of the regressions. This is consistent with theoretical expectations and previous studies. The exponent on distance in those regressions is negative with an absolute value between 1.11 and 1.21. It is higher than the value predicted by the actual gravity model used to account for the physical attraction between two bodies, but it is consistent with the estimates reported by other researchers.

Further discussion of results is divided into two sections: one is concerned with findings of the bilateralism and the other is dedicated to the colonial effect on export and import.

Presence of Bilateralism

The results of our investigation for the presence of bilateralism may be found in Table 1.1. Regressions 1 and 2 use all the trade data for years between 1962 and 2000 and include as colonies all the countries that were colonized in the past. Both regression 1 and 2 are pooled regressions, they consider a country a colony if it was ever colonized, even if it received independence two hundred years ago, as was the case for many Spanish colonies, such as Argentina (1811) and Mexico (1810). For the list of colonies by origin as well as by year of independence see Table 1.8.

In regression 1, we confirm finding by Rose and Wincoop (2001) and report a positive coefficient on common colonizer equal to 0.26 and a coefficient on ex-colony/colonizer 1.44. Our coefficients are of a smaller magnitude than those found by Rose and Wincoop (2001) who reported the former equal to 0.68 and the later equal to 1.74. The difference between the estimates may be due to the fact that Rose and Wincoop (2001) used the trade data for years 1970 to 1995, while we use a wider time span including years from 1962 to 2000. Thus we capture the earlier years of a country's history, when the colonial relationship may have had a greater effect.

Regression 2 includes a different set of colonial dummies. Dummies from regression 1 are now specified by colonial origin so that we can investigate the effect of different origins on a colony's trade with its colonial sisters and its parent. All four origin coefficients on trade between colonies and their parent are positive. But coefficients on trade between colonies and their sisters are positive for French, Dutch, and British colonies and are negative for Spanish colonies. All except one Spanish of the colonies received independence before 1945.[7] So in regressions 3 through 6 we break out the pooled sample of colonies into those that received independence before 1945 and after

[7] it is Equatorial Guinea that received independence in 1968

1945. Regressions 3 and 4 consider colonies as only those countries that received independence before 1945, while regressions 5 and 6 include colonies that received independence after 1945.

Regressions 3 and 5 compare the presence of colonial bias for the different sets of colonies. The estimated coefficient on trade between former colony and colonizer is positive in both regressions, it is 0.73 for countries that received their independence before 1945, and is half of the estimated coefficient for those colonies that received independence after 1945 (the coefficient value for those colonies is 1.44). Both coefficients are significant at a 1% level of significance. The coefficients on trade between former colonies are even more dramatically different for the two sets of colonies. Those that receive independence after 1945 had a positive coefficient of 0.40, while those that received independence before 1945 had a negative coefficient of 0.23. This implies that the bilateral trade flows between former colonies of the pre-1945 group are smaller than those with other countries. This leads us to say that earlier independence causes countries to trade less with their colonial masters and trade even less with other colonies.

Regressions 3 and 5 look at the aggregate level without specifying colonial origins, so we can not tell which origin is driving the results. So we consider regressions 4 and 6. One is for colonies with independence before 1945 and the other is for those that received it after 1945. Both regressions consider the effect of colonial origins on bilateralism, so they are simply a more detailed version of regressions 3 and 5. All the Dutch colonies received independence after 1945, so they are only included in regression 6 but not in regression 4. The results of those regressions reveal the decrease in colony to colony trade in the pre-1945 group was chiefly set by the Spanish subset of colonies, which had a negative 0.37 coefficient on trade between colonies. The decrease in the colonies' trade with their parents in that group was driven more by British colonies and less by the Spanish.

Dividing the set of colonies into those that gained independence before and after 1945 allowed us to say there is some evidence of bilateralism which declines after independence was received. This leads us to conclude that the colonial impact is declining. We consider only the set of post 1945 countries next. These countries still may have the residuals of the colonial effect on their trade. We run regression for those countries only, but we count for two time periods, 1962-1983 and 1984-2000. The decision on how to divide the trade was based on the structure of our trade dataset and Kleiman (1976) who said that the colonial effect on trade should remain a factor for a decade after a country gains independence.[8] If Kleiman's (1976) hypothesis was correct, then the colonial effect should vanish after a decade of independence, or by the end of 1970s for most countries.

Regression 7 and 10 present the findings for the two time periods. Regressions 7 and 9 show that a colony's trade with its sisters almost falls by half. It is 0.45 for the 1962-1983 time period and only 0.25 for the years between 1984 and 2000. The trade between a colony and its parent is also declining, with coefficients of 1.76 and 1.23 respectively.

[8] The trade dataset has different sources for data before 1984 and after. Data before 1983 contain more country pairs and record smaller values of trade that after 1984. We conduct sensitivity tests of the dataset composition in the next section.

Regressions 8 and 10 show that the decline in a colony's trade with its sister is largely driven by the French group, while a decline in trade with its parent is represented by all colonial groups. This leads us to conclude that the effect of colonial past is decreasing with the time, but it has not vanished, as was suggested by Kleiman (1976). The colonial effect may take decades to disappear.

Colonial Effects on Export and Import

We continue our investigation by exploring the influence of colonialism on a country's total trade. We do not limit our concern to the country's specific trading partners. Before, we were only interested in a colony's trade with its sisters and with its colonial parent. Now we consider a colony's trade with all the countries in the world. The results of this research are presented in Table 1.4.

In regression 1 the estimates on dummies for colonial exporter and colonial importer are negative 2.05 and negative 1.50, respectively, both significant at 1% level of significance. Regression 2 breaks our estimates into four colonial origins – French, Spanish, Dutch and British. This detailed specification allows us to explore the effect of different colonial masters on the trade flows of the colonies. Regression 2 suggests that the negative coefficient on colonial exporter is caused by French and British exporters, and the negative coefficient on colonial importer seems to be driven by all the colonies except Dutch.[9]

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[9] We found high sensitivity of Spanish colonial exporter coefficient, depending on other variables included in regression 2.

Breaking the pooled data into colonies that gained independence before 1945 and those that gained their independence after 1945 is instructive. It shows that those with earlier independence have switched signs of their coefficients on colonial exporter and colonial importer, which are 2.80 and 2.74 respectively. Those results are exactly opposite for the group that gained independence after 1945. There, the same estimates are found to be negative 2.82 and negative 3.38. The dramatic negative impact in the post-1945 group is primarily caused by the French and British. Remarkably, the coefficients on Dutch colonies both for exporter and importer are positive despite the fact that all of them belong to the post-1945 independence subset of colonies.

We consider the subset of colonies that received independence after 1945 next. Regressions 7 through 10 represent the subset of those colonies, inspected for two time periods: 1962-1983 and 1984-2000. There is evidence of decreased colonial influence on countries' trade. The estimated coefficient on colonial exporter is negative 4.10 during 1962-1983 and is negative 1.67 during 1984-2000. The estimates on colonial importer for the same time periods are negative 4.39 and negative 2.44 respectively. Regressions 9 and 10 show that the increase in those coefficients is driven by all the colonial origins—French, Spanish, Dutch and British. All coefficients both for exporter and importer have increased during that time. It is worth pointing out that all the coefficients in Table 1.4, regression 1 through 10, are highly significant at 1% level of significance.

Sensitivity Analysis

For the regressions reported in Table 1.1, we present the sensitivity analysis in Tables 1.2 and Table 1.3. The sensitivity analysis for the regression in Table 1.4 is shown in Table 1.5 and Table 1.6. In all the sensitivity-analysis tables, we keep the regressions numbered in exactly the same way as they were numbered in the original tables. Regressions in Table 1.2 and Table 1.3 are listed under the same numbers as they are in Table 1.1. Regressions in Table 1.5 and Table 1.6 are listed under the same number as they are in Table 1.4.

Tables 1.2 and 1.5 address the truncation problem we have with the trade data. Before 1984, the dataset included all the trade data for all countries. But starting in 1984, the UN only recorded data that exceeded USD$100,000 for 72 countries.[10] Tables 1.2 and 1.5 repeat many of the regressions from Table 1.1 and Table 1.4 and include a restricted version of those regressions next to them. The restricted regressions use the time period 1962-1983 and only those pairs of trade countries that are present in post 1984 period. The limited regressions have the same column number as the original, but a letter "a" is added to their column label. For example, regression 1 is the original regression and regression 1a is the regression which used a limited sample of countries.

We do not find any significant change in our results after limiting the data in this way. All the regressions in Table 1.2 are remarkably unaffected. Coefficients on common colonizer have decreased a little, but most of the coefficients hardly change.

[10] See detailed explanation in Data Description section

Results in Table 1.5 are more sensitive to the limitation of the sample. The two worth noticing are the coefficient on the British colonial exporter, which becomes insignificant in the 1962-1983 time period under the limited sample, and the coefficient on Spanish colonial importer, which changes sign in regression 1.4.

Table 1.3 and 1.6 make changes to the list of British colonies. Both Canada and the US received independence before 1900 and both are among the world's largest economies. In our original regressions, we considered the US and Canada as former colonies of the UK. Now we remove them from the list of colonies. Table 1.3 and Table 1.6 present results where the US and Canada are counted as if they where never colonized. Table 1.3 shows that most of the estimates found in Table 1.1 remain identical. There are a few that have changed. The first is the coefficient on the British-colony trade with sisters (regression 4a) that became insignificant in pre-1945 group (the coefficient in column 4 is 0.16 compared to the coefficient in column 4a which is 0.02). There is also a minor change in the coefficients on the common colonizer and ex-colony trade with the parent in regression 3a, both of which decreased relative to their counterparts in column 3.

Table 1.6 had more changes compared to the original estimates in Table 1.4, but none of them changed our interpretation of the results. The only thing that we witness is a big decrease on the British colony as exporter and British colony as importer in the pre-1945 group.

Thus the results presented in Tables 1.1 and 1.4 do not appear to be overly sensitive to data construction issues. Neither the change in the sampling methods used by the

United Nations nor the colonial definition that we adopted has substantial overall impacts on the estimated coefficients.

Conclusion

Our research aimed to quantify, qualify and extrapolate the influence of colonialism on international trade.

The literature suggests that former colonies trade more with each other and with their colonial master than with non-related countries. Rose and Wincoop (2001) find a presence of bilateralism and we confirm their findings. Our dataset, however, included observations over a greater time period than previous studies and added information about the parent country of each colony. Taking a wider swath of time under consideration diluted the importance of colonial ties on trade. It became evident that further qualification of the data was necessary to better understand these trade relations.

Cutting the post-colonial countries into two groups based on when they received independence helped clarify the residual influence of colonialism on trade. We found that the earlier a country received independence, the less it traded with its colonial sisters and its colonial parent. This effect was particularly noticeable for Spanish and British colonies, many of which received independence before 1945. The results were not conclusive for Dutch and French colonies, which typically split from their parent countries after 1945.

Independent countries evolve new economic relations and trade ties over time. Kleiman (1976) predicted that colonial trade ties last at least a decade after a country gains its independence and we corroborate that. We studied the trade patterns of countries that became independent after 1945 and found statistically significant trade linkages to their sister colonies and parent country declined over time but persisted through the 1990s. We observed the decline in trade dependence with the parent country for each colony we considered, but French colonies drove the decline in trading between sister countries and with the parent.

We also investigated the influence of a colonial past on a country's exports and imports to the rest of the world. We find results similar to those from our inquiry into bilateralism: countries that received independence before 1945 trade with the rest of the world more than colonies that received their independence after 1945. This evidence holds for the French, Spanish and British. The Dutch colonies, which all received independence after 1945, don't act like the other colonies considered. They trade more with the rest of the world than their colonial counterparts. Still, we see the colonial influence decreasing over time for all the countries considered.

Further research in this area might include a consideration of the types of goods traded. Colonies tend to shape their entire national product based on the needs of their parent country. This can lead to a myopic lack of agricultural or industrial diversification. The international demand and price of certain commodities and finished goods, and the unique demands of parent countries fluctuate over time, causing bumps in the trade data. Colonies with a history of specialization can be hit particularly hard. Some correction or consideration for the nature of the national exports and imports might help clarify colonial trade relations.

Table 1.1 Bilateralism

							After 1945 by periods		After 1945 by periods	
	All colonies		BEFORE 1945		AFTER 1945		1962-1983	1984-2000	1962-1983	1984-2000
Model	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Log distance	-1.19	-1.20	-1.18	-1.19	-1.18	-1.18	-1.19	-1.17	-1.19	-1.17
	(-185.23)	(-184.81)	(-182.74)	(-182.56)	(-184.99)	(-185.15)	(-125.23)	(-145.55)	(-125.27)	(-145.63)
Adjacency	0.56	0.50	0.55	0.54	0.54	0.50	0.60	0.46	0.54	0.44
	(19.49)	(17.57)	(19.04)	(18.90)	(18.99)	(17.39)	(14.20)	(12.51)	(12.78)	(12.02)
Common-language	0.41	0.46	0.69	0.71	0.54	0.52	0.65	0.37	0.61	0.36
	(24.93)	(27.82)	(44.99)	(45.47)	(36.99)	(35.38)	(30.34)	(19.36)	(28.41)	(19.27)
Common colonizer	0.26		-0.23		0.40		0.45	0.25		
	(15.76)		(-7.73)		(18.99)		(15.38)	(8.35)		
Ex-colony/colonizer	1.44		0.73		1.49		1.76	1.23		
	(43.38)		(13.51)		(39.13)		(29.60)	(27.01)		
French colony-colony		1.26		n/a		1.27			1.43	0.74
		(31.54)				(31.69)			(26.79)	(11.65)
Spanish colony-colony		-0.21		-0.37		n/a			n/a	n/a
		(-5.92)		(-10.49)						
Dutch colony-colony		0.44*		n/a		0.41*			-0.02*	1.03
		(1.97)				(1.82)			(-0.05)	(3.49)
UK colony-colony		0.15		0.16		0.06			0.03*	0.10
		(7.34)		(2.66)		(2.26)			(0.72)	(2.84)
French colony master		1.64		0.14*		1.66			2.05	1.25
		(26.92)		(0.49)		(26.84)			(21.41)	(16.86)
Spanish colony master		1.01		0.72		2.72			3.63	1.96
		(15.33)		(10.81)		(9.67)			(7.91)	(6.13)
Dutch colony master		1.71		n/a		1.67			1.62	1.77
		(11.02)				(10.72)			(6.53)	(9.76)
UK colony master		1.44		0.74		1.34			1.55	1.13
		(29.78)		(7.99)		(26.24)			(19.47)	(18.57)
Root MSE	2.158	2.122	2.164	2.164	2.159	2.157	2.432	1.778	2.429	1.778
# of observations	303,442	303,442	303,442	303,442	303,442	303,442	164,766	138,676	164,766	138,676

Notes: Dependent variable: trade share, t-statistics in parentheses. All the coefficients, except *, are significant at 1% level. Table does not include estimated coefficient on year effect though they are included in all regressions.

Table 1.2 Sensitivity of Bilateralism with limited sample

					After 1945 by periods		After 1945 by periods	
	All colonies				1962-1983	1962-1983	1962-1983	1962-1983
Model	(1)	(1a)	(2)	(2a)	(7)	(7a)	(9)	(9a)
Log distance	-1.19	-1.19	-1.20	-1.21	-1.19	-1.20	-1.19	-1.20
	(-185.23)	(-178.41)	(-184.81)	(-178.11)	(-125.23)	(-113.09)	(-125.27)	(-113.06)
Adjacency	0.56	0.41	0.50	0.37	0.60	0.33	0.54	0.28
	(19.49)	(12.99)	(17.57)	(11.76)	(14.20)	(6.39)	(12.78)	(5.37)
Common-language	0.41	0.34	0.46	0.43	0.65	0.58	0.61	0.58
	(24.93)	(19.52)	(27.82)	(24.28)	(30.34)	(24.05)	(28.41)	(23.89)
Common colonizer	0.26	0.18			0.45	0.35		
	(15.76)	(10.34)			(15.38)	(9.26)		
Ex-colony/colonizer	1.44	1.48			1.76	1.80		
	(43.38)	(45.62)			(29.60)	(30.86)		
French colony-colony			1.26	1.17			1.43	1.61
			(31.54)	(23.65)			(26.79)	(21.28)
Spanish colony-colony			-0.21	-0.33			n/a	n/a
			(-5.92)	(-9.16)				
Dutch colony-colony			0.44*	0.27*			-0.02*	-0.48*
			(1.97)	(1.13)			(-0.05)	(-1.30)
UK colony-colony			0.15	0.15			0.03*	-0.07*
			(7.34)	(6.97)			(0.72)	(-1.68)
French colony master			1.64	1.67			2.05	2.09
			(26.92)	(27.69)			(21.41)	(22.18)
Spanish colony master			1.01	1.02			3.63	3.69
			(15.33)	(15.80)			(7.91)	(8.13)
Dutch colony master			1.71	1.78			1.62	1.71
			(11.02)	(11.75)			(6.53)	(7.06)
UK colony master			1.44	1.46			1.55	1.56
			(29.78)	(30.98)			(19.47)	(19.99)
Root MSE	2.158	2.095	2.122	2.093	2.432	2.371	2.429	2.367
# of observations	303,442	277,838	303,442	277,838	164,766	139,162	164,766	139,162

Notes: Dependent variable: trade share, t-statistics in parentheses. All the coefficients, except *, are significant at 1% level. Table does not include estimated coefficient on year effect though they are included in all regressions. (a) regressions use limited sample of trade pairs for 1962-1983.

Table 1.3 Bilateralism without US and Canada

	All colonies				BEFORE 1945			
Model	(1)	(1a)	(2)	(2a)	(3)	(3a)	(4)	(4a)
Log distance	-1.19	-1.18	-1.20	-1.20	-1.18	-1.18	-1.19	-1.19
	(-185.23)	(-184.21)	(-184.81)	(-184.61)	(-182.74)	(-182.73)	(-182.56)	(-182.56)
Adjacency	0.56	0.56	0.50	0.50	0.55	0.54	0.54	0.54
	(19.49)	(19.51)	(17.57)	(17.54)	(19.04)	(18.92)	(18.90)	(18.91)
Common-language	0.41	0.43	0.46	0.48	0.69	0.70	0.71	0.71
	(24.93)	(27.40)	(27.82)	(29.69)	(44.99)	(45.58)	(45.47)	(45.86)
Common colonizer	0.26	0.26			-0.23	-0.31		
	(15.76)	(15.91)			(-7.73)	(-9.64)		
Ex-colony/colonizer	1.44	1.44			0.73	0.82		
	(43.38)	(43.64)			(13.51)	(14.59)		
French colony-colony			1.26	1.26			n/a	n/a
			(31.54)	(31.50)				
Spanish colony-colony			-0.21	-0.22			-0.37	-0.37
			(-5.92)	(-6.21)			(-10.49)	(-10.58)
Dutch colony-colony			0.44*	0.44*			n/a	n/a
			(1.97)	(1.96)				
UK colony-colony			0.15	0.14			0.16	0.02*
			(7.34)	(6.66)			(2.66)	(0.23)
French colony master			1.64	1.63			0.14*	0.14*
			(26.92)	(26.80)			(0.49)	(0.48)
Spanish colony master			1.01	0.99			0.72	0.72
			(15.33)	(15.12)			(10.81)	(10.77)
Dutch colony master			1.71	1.70			n/a	n/a
			(11.02)	(10.95)				
UK colony master			1.44	1.49			0.74	1.13
			(29.78)	(30.52)			(7.99)	(10.53)
Root MSE	2.158	2.158	2.122	2.155	2.164	2.164	2.164	2.164
# of observations	303,442	303,442	303,442	303,442	303,442	303,442	303,442	303,442

Notes: Dependent variable: trade share, t-statistics in parentheses. All the coefficients, except *, are significant at 1% level. Table does not include estimated coefficient on year effect though they are included in all regressions. (a) regressions do not include US and Canada as former colonies.

Table 1.4 Colonial effects on export and import

							After 1945 by periods		After 1945 by periods	
	All colonies		BEFORE 1945		AFTER 1945		1962-1983	1984-2000	1962-1983	1984-2000
Model	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Log distance	-1.11	-1.13	-1.21	-1.19	-1.11	-1.13	-1.12	-1.10	-1.14	-1.11
	(-171.04)	(-175.64)	(-188.78)	(-186.95)	(-175.4)	(-178.53)	(-119.63)	(-137.63)	(-121.53)	(-139.66)
Adjacency	0.63	0.60	0.48	0.49	0.63	0.60	0.73	0.49	0.70	0.47
	(21.98)	(21.20)	(16.65)	(17.28)	(21.98)	(21.06)	(17.66)	(13.38)	(16.89)	(12.86)
Common-language	0.76	0.78	0.67	0.69	0.79	0.78	0.93	0.57	0.92	0.57
	(53.57)	(55.28)	(47.4)	(49.18)	(56.06)	(55.59)	(45.65)	(31.15)	(45.22)	(31.10)
Colony exporter	-2.05		2.80		-2.82		-4.10	-1.67		
	(-44.99)		(33.56)		(-61.29)		(-52.28)	(-32.54)		
Colony importer	-1.50		2.74		-3.38		-4.39	-2.44		
	(-31.31)		(34.90)		(-76.30)		(-55.74)	(-50.65)		
French colony exporter		-4.25		n/a		-3.86			-4.78	-2.60
		(-50.77)				(-42.49)			(-39.31)	(-17.25)
Spanish colony exporter		0.71		2.86		n/a			n/a	n/a
		(8.09)		(32.94)						
Dutch colony exporter		7.44		n/a		8.31			4.95	11.90
		(16.43)				(18.70)			(7.30)	(21.64)
UK colony exporter		-1.98		6.44		-1.99			-3.28	-1.29
		(-22.36)		(33.83)		(-24.03)			(-25.69)	(-11.04)
French colony importer		-4.12		n/a		-3.16			-3.89	-2.40
		(-50.69)				(-37.09)			(-33.91)	(-16.04)
Spanish colony importer		-0.62		2.29		n/a			n/a	n/a
		(-6.99)		(27.40)						
Dutch colony importer		12.10		n/a		12.64			9.16	15.44
		(27.14)				(29.43)			(13.87)	(29.58)
UK colony importer		-3.57		7.13		-3.87			-4.91	-3.12
		(-45.02)		(40.47)		(-52.74)			(-42.24)	(-29.48)
Root MSE	2.158	2.136	2.156	2.148	2.141	2.135	2.406	1.767	2.402	1.757
# of observations	303,442	303,442	303,442	303,442	303,442	303,442	164,766	138,676	164,766	138,676

Notes: Dependent variable: trade share, t-statistics in parentheses. All the coefficients are significant at 1% level. Table does not include estimated coefficient on year effect though they are included in all regressions.

Table 1..5 Sensitivity of Colonial effects on export and import with limited sample

					After 1945 by periods		After 1945 by periods	
	All colonies				1962-1983	1962-1983	1962-1983	1962-1983
Model	(1)	(1a)	(2)	(2a)	(7)	(7a)	(9)	(9a)
Log distance	-1.11	-1.10	-1.13	-1.11	-1.12	-1.07	-1.14	-1.09
	(-171.04)	(-161.07)	(-175.64)	(-164.54)	(-119.63)	(-100.08)	(-121.53)	(-102.11)
Adjacency	0.63	0.46	0.60	0.42	0.73	0.43	0.70	0.41
	(21.98)	(14.65)	(21.20)	(13.59)	(17.66)	(8.41)	(16.89)	(8.07)
Common-language	0.76	0.71	0.78	0.73	0.93	0.90	0.92	0.90
	(53.57)	(46.97)	(55.28)	(48.81)	(45.65)	(338.41)	(45.22)	(38.57)
Colony exporter	-2.05	-1.32			-4.10	-2.99		
	(-44.99)	(-30.95)			(-52.28)	(-45.60)		
Colony importer	-1.50	-1.80			-4.39	-3.16		
	(-31.31)	(-46.06)			(-55.74)	(-53.01)		
French colony exporter			-4.25	-5.16			-4.78	-6.92
			(-50.77)	(-55.53)			(-39.31)	(-42.62)
Spanish colony exporter			0.71	1.04			n/a	n/a
			(8.09)	(11.14)				
Dutch colony exporter			7.44	7.18			4.95	5.59
			(16.43)	(15.97)			(7.30)	(7.76)
UK colony exporter			-1.98	-0.46			-3.28	-0.14*
			(-22.36)	(-4.69)			(-25.69)	(-0.96)
French colony importer			-4.12	-4.57			-3.89	-4.40
			(-50.69)	(-49.14)			(-33.91)	(-27.36)
Spanish colony importer			-0.62	0.84			n/a	n/a
			(-6.99)	(9.10)				
Dutch colony importer			12.10	14.01			9.16	15.94
			(27.14)	(31.51)			(13.87)	(21.87)
UK colony importer			-3.57	-2.80			-4.91	-3.18
			(-45.02)	(-31.28)			(-42.24)	(-22.78)
Root MSE	2.158	2.095	2.136	2.070	2.406	2.352	2.402	2.338
# of observations	303,442	277,838	303,442	277,838	164,766	139,162	164,766	139,162

Notes: Dependent variable: trade share, t-statistics in parentheses. All the coefficients, except *, are significant at 1% level. Table does not include estimated coefficient on year effect though they are included in all regressions. (a) regressions use aggregated trade for 1962-1983.

Table 1.6 Colonial effects on export and import without US and Canada

	All colonies				BEFORE 1945			
Model	(1)	(1a)	(2)	(2a)	(3)	(3a)	(4)	(4a)
Log distance	-1.11	-1.11	-1.13	-1.13	-1.21	-1.20	-1.19	-1.20
	(-171.04)	(-171.47)	(-175.64)	(-176.46)	(-188.78)	(-187.41)	(-186.95)	(-187.28)
Adjacency	0.63	0.63	0.60	0.60	0.48	0.48	0.49	0.49
	(21.98)	(21.97)	(21.20)	(20.98)	(16.65)	(16.89)	(17.28)	(16.95)
Common-language	0.76	0.76	0.78	0.78	0.67	0.67	0.69	0.67
	(53.57)	(53.80)	(55.28)	(55.23)	(47.4)	(47.02)	(49.18)	(47.23)
Colony exporter	-2.05	-1.42			2.80	2.54		
	(-44.99)	(-33.40)			(33.56)	(31.56)		
Colony importer	-1.50	-1.92			2.74	1.84		
	(-31.31)	(-47.35)			(34.90)	(24.20)		
French colony exporter			-4.25	-4.08			n/a	n/a
			(-50.77)	(-46.76)				
Spanish colony exporter			0.71	0.85			2.86	2.71
			(8.09)	(9.61)			(32.94)	(31.93)
Dutch colony exporter			7.44	7.42			n/a	n/a
			(16.43)	(16.36)				
UK colony exporter			-1.98	-1.72			6.44	3.64
			(-22.36)	(-22.01)			(33.83)	(13.32)
French colony importer			-4.12	-3.61			n/a	n/a
			(-50.69)	(-43.21)				
Spanish colony importer			-0.62	-0.29			2.29	1.84
			(-6.99)	(-3.34)			(27.40)	(22.50)
Dutch colony importer			12.10	12.39			n/a	n/a
			(27.14)	(27.74)				
UK colony importer			-3.57	-3.25			7.13	3.37
			(-45.02)	(-46.45)			(40.47)	(13.02)
Root MSE	2.158	2.157	2.136	2.135	2.156	2.159	2.148	2.156
# of observations	303,442	303,442	303,442	303,442	303,442	303,442	303,442	303,442

Notes: Dependent variable: trade share, t-statistics in parentheses. All the coefficients, except *, are significant at 1% level. Table does not include estimated coefficient on year effect though they are included in all regressions. (a) regressions do not include US and Canada as former colonies.

Table 1.7 Year effects

Year	Coefficient	Year	Coefficient	Year	Coefficient
1963	-0.08*	1976	-0.57	1989	-0.46
	(-1.85)		(-14.60)		(-11.10)
1964	-0.10*	1977	-0.51	1990	-0.54
	(-2.16)		(-13.05)		(-13.18)
1965	-0.23	1978	-0.30	1991	-1.26
	(-5.28)		(-7.39)		(-31.20)
1966	-0.34	1979	-0.62	1992	-1.49
	(-7.80)		(-15.89)		(-37.22)
1967	-0.42	1980	-0.49	1993	-1.67
	(-9.60)		(-12.64)		(-42.03)
1968	-0.55	1981	-0.70	1994	-1.72
	(-12.59)		(-17.86)		(-43.35)
1969	-0.67	1982	-0.79	1995	-1.68
	(-15.65)		(-19.69)		(-42.59)
1970	-0.52	1983	-0.60	1996	-1.74
	(-13.13)		(-14.55)		(-44.28)
1971	-0.63	1984	0.00*	1997	-1.82
	(-16.05)		(-0.07)		(-46.45)
1972	-0.65	1985	-0.14	1998	-1.94
	(-16.47)		(-3.24)		(-49.47)
1973	-0.56	1986	-0.24	1999	-2.00
	(-14.30)		(-5.80)		(-51.20)
1974	-0.40	1987	-0.28	2000	-2.03
	(-10.17)		(-6.77)		(-51.73)
1975	-0.48	1988	-0.42		
	(-12.34)		(-10.23)		
Root MSE	2.158				
# of observations	303,442				

Notes: Dependent variable: logarithm of trade share, t-statistics in parentheses. All the coefficients, except *, are significant at 1% level. Dummy for year 1962 is omitted. Year effects here are from regression 1 in Table 1. Year effects from other regressions are almost identical.

Table 1.8. Colonial Origins and year of independence (where applicable)

Colonies of UK	Year		Year	Colonies of France	Year	Colonies of Spain	Year	Colonies of Netherlands	Year
Afghanistan	1919	Malawi	1964	Algeria	1962	Argentina	1816	Aruba	n/a
Anguilla	n/a	Malaysia	1957	Benin	1960	Bolivia	1825	Indonesia	1945
Antigua and Barbuda	1981	Maldives	1965	Burkina Faso	1960	Chile	1810	Netherlands Antilles	n/a
Australia	1901	Malta	1964	Cambodia	1953	Colombia	1810	Suriname	1975
Bahamas, The	1973	Mauritius	1968	Central African Republic	1960	Costa Rica	1821		
Bahrain	1971	Montserrat	n/a	Chad	1960	Cuba	1902		
Barbados	1966	Nauru	1968	Comoros	1975	Ecuador	1822		
Belize	1981	New Zealand	1907	Congo, Republic of	1960	El Salvador	1821		
Bermuda	n/a	Nigeria	1960	Cote d'Ivoire	1960	Equatorial Guinea	1968		
Botswana	1966	Pakistan	1947	Djibouti	1977	Guatemala	1821		
British Virgin Islands	n/a	Pitcairn Islands	n/a	French Guiana	n/a	Honduras	1821		
Brunei	1984	Qatar	1971	French Polynesia	n/a	Mexico	1810		
Burma	1948	Saint Helena	n/a	Gabon	1960	Nicaragua	1821		
Canada	1867	Saint Kitts and Nevis	1983	Guadeloupe	n/a	Panama	1903		
Cayman Islands	n/a	Saint Lucia	1979	Guinea	1958	Paraguay	1811		
Cyprus	1960	St Vincent and Grenadines	1979	Haiti	1804	Peru	1821		
Dominica	1978	Seychelles	1976	Laos	1949	Philippines	1898		
Egypt	1922	Sierra Leone	1961	Madagascar	1960	Venezuela	1811		
Falkland Islands (Islas Malvinas)	n/a	Solomon Islands	1978	Mali	1960				
Fiji	1970	Somalia	1960	Martinique	n/a				
Gambia, The	1965	South Africa	1910	Mauritania	1960				
Ghana	1957	Sri Lanka	1948	Mayotte	n/a				
Gibraltar	n/a	Sudan	1956	Morocco	1956				
Grenada	1974	Swaziland	1968	New Caledonia	n/a				
Guernsey	n/a	Tanzania	1964	Niger	1960				
Guyana	1966	Tonga	1970	Reunion	n/a				
India	1947	Trinidad and Tobago	1962	Saint Pierre and Miquelon	n/a				
Iraq	1932	Turks and Caicos Islands	n/a	Senegal	1960				
Israel	1948	Tuvalu	1978	Tunisia	1956				
Jamaica	1962	Uganda	1962	Vanuatu	1980				
Jersey	n/a	United Arab Emirates	1971	Vietnam	1945				
Jordan	1946	United States	1776	Wallis and Futuna	n/a				
Kenya	1963	Vanuatu	1980						
Kiribati	1979	Zambia	1964						
Kuwait	1961	Zimbabwe	1980						
Lesotho	1966								

Appendix A. List of countries and territories in NBER-UN World Trade Flows Dataset

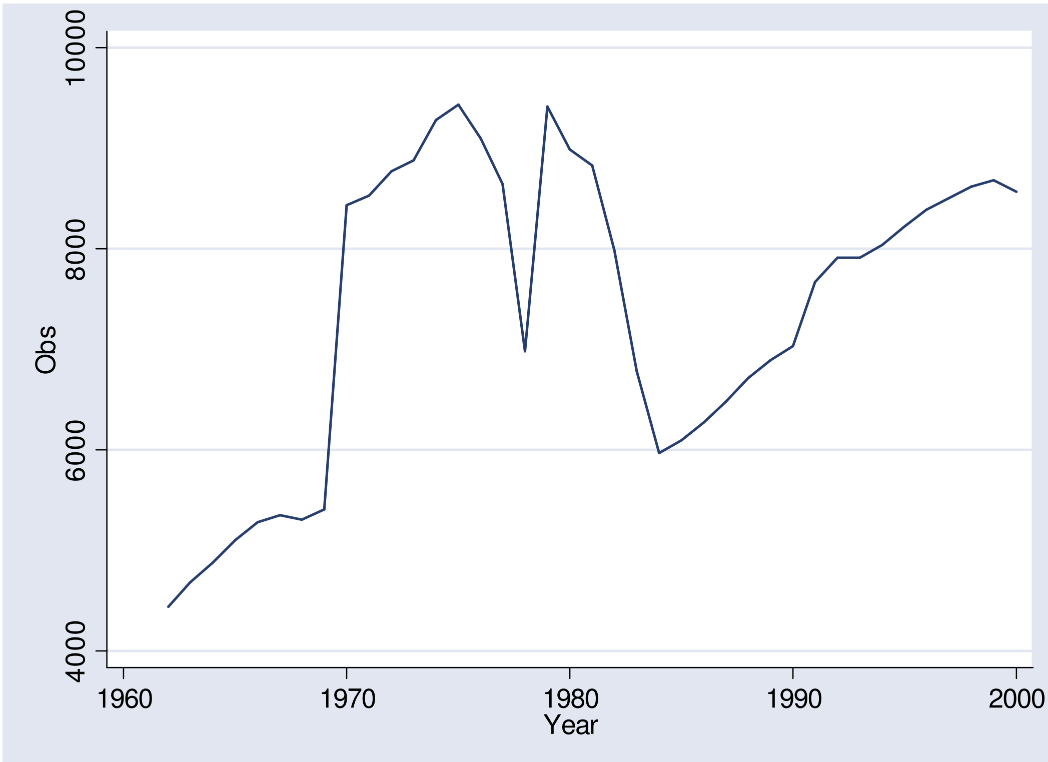
Afghanistan	Dem.Rp.Congo	Italy	Qatar
Afr.Other NS	Denmark	Jamaica	Rep Moldova
Africa N.NES	Djibouti	Japan	Romania
Albania	Dominican Rp	Jordan	Russian Fed
Algeria	E Europe NES	Kazakhstan	Rwanda
Angola	EEC NES	Kenya	Samoa
Areas NES	Ecuador	Kiribati	Saudi Arabia
Argentina	Egypt	Korea D P Rp	Senegal
Armenia	El Salvador	Korea Rep.	Seychelles
Asia NES	Eq.Guinea	Kuwait	Sierra Leone
Asia West NS	Estonia	Kyrgyzstan	Singapore
Australia	Ethiopia	LAIA NES	Slovakia
Austria	Eur. EFTA NS	Lao P.Dem.R	Slovenia
Azerbaijan	Eur.Other NE	Latvia	Somalia
Bahamas	Falkland Is	Lebanon	South Africa
Bahrain	Fiji	Liberia	Spain
Bangladesh	Finland	Libya	Sri Lanka
Barbados	Fm German DR	Lithuania	St.Helena
Belarus	Fm German FR	Madagascar	St.Kt-Nev-An
Belgium-Lux	Fm USSR	Malawi	St.Pierre Mq
Belize	Fm Yemen Ar	Malaysia	Sudan
Benin	Fm Yemen AR	Mali	Suriname
Bermuda	Fm Yemen Dm	Malta	Sweden
Bolivia	Fm Yugoslav	Mauritania	Switz.Liecht
Bosnia Herzg	Fr Ind O	Mauritius	Syria
Br.Antr.Terr	Fr.Guiana	Mexico	Taiwan
Brazil	France,Monac	Mongolia	Tajikistan
Bulgaria	Gabon	Morocco	Tanzania
Burkina Faso	Gambia	Mozambique	TFYR Macedna
Burundi	Georgia	Myanmar	Thailand
CACM NES	Germany	Nepal	Togo
Cambodia	Ghana	Neth.Ant.Aru	Trinidad Tbg
Cameroon	Gibraltar	Netherlands	Tunisia
Canada	Greece	Neutral Zone	Turkey
Carib. NES	Greenland	New Calednia	Turkmenistan
Cent.Afr.Rep	Guadeloupe	New Zealand	Uganda
Chad	Guatemala	Nicaragua	UK
Chile	Guinea	Niger	Ukraine
China	GuineaBissau	Nigeria	Untd Arab Em
China HK SAR	Guyana	Norway	Uruguay
China MC SAR	Haiti	Occ.Pal.Terr	US NES
China SC	Honduras	Oman	USA
Colombia	Hungary	Oth.Oceania	Uzbekistan
Congo	Iceland	Pakistan	Venezuela
Costa Rica	India	Panama	Viet Nam
Cote Divoire	Indonesia	Papua N.Guin	World
Croatia	Int Org	Paraguay	Yemen
Cuba	Iran	Peru	Yugoslavia
Cyprus	Iraq	Philippines	Zambia

Appendix B. List of 72 countries that account for 98% of world trade for the last 5 years[11]

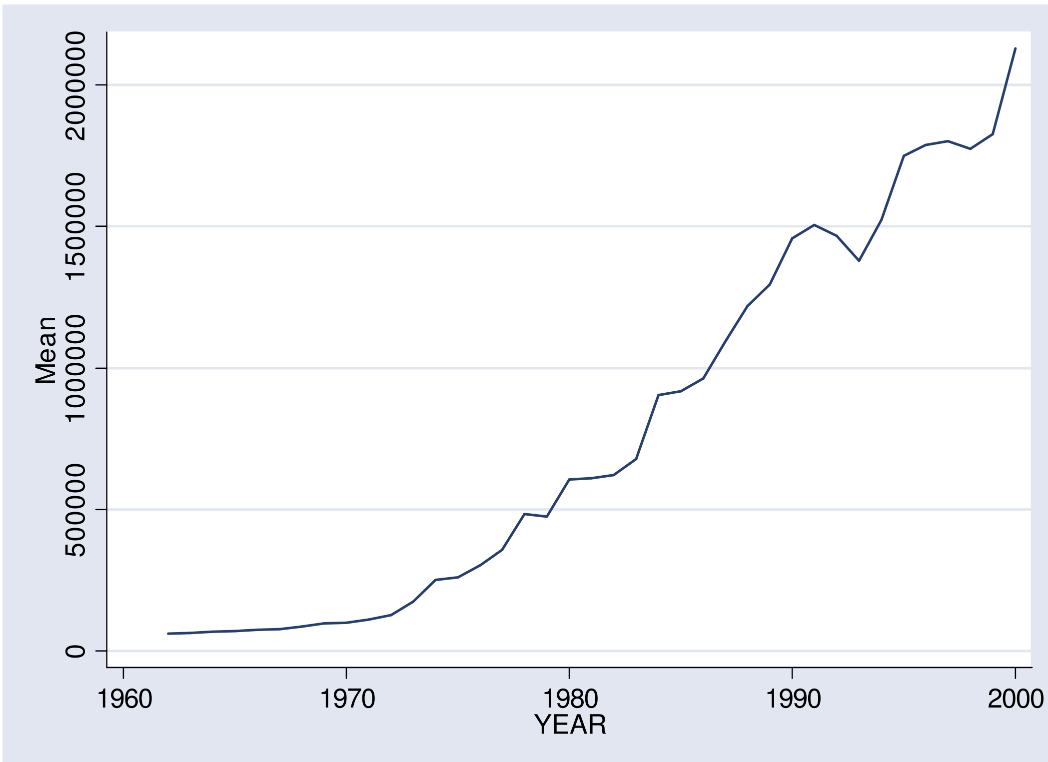
Algeria	Kuwait
Angola	Libya
Argentina	Luxemburg
Australia	Malaysia
Austria	Mexico
Belgium	Morocco
Belgium-Luxembourg	Netherlands
Brazil	New Zealand
Bulgaria	Nigeria
Canada	Norway
Chile	Oman
China	Pakistan
Colombia	Peru
Czech Republic	Philippines
Denmark	Poland
Dominican Republic	Portugal
Ecuador	Qatar
Finland	Romania
Fm Czechoslovakia	Russian Federation
Fm Fed Germany	Saudi Arabia
Fm USSR	Singapore
Fm Yugoslavia	Slovakia
France	Slovenia
Germany	South Afr. Cus. Union
Greece	South Africa
Hong Kong	Spain
Hungary	Sweden
India	Switzerland
Indonesia	Thailand
Iran	Tunisia
Ireland	Turkey
Israel	United Arab Emirates
Italy	United Kingdom
Japan	USA
Kazakhstan	Venezuela
Korea Republic	Vietnam

[11] This table is taken from Feenstra et.al (2004). Belgium and Luxemburg are listed here as separated countries, but in the bilateral trade dataset they are pooled together.

Appendix C. Number of trade observations 1962-2000



Appendix D. Mean of trade 1962-2000



Appendix E. Summary Statistics

Variable	Obs	Mean	Std. Dev.	Min	Max
Economic variables					
Year	303442	1982	11	1962	2000
Trade	303442	3093	26127	0.01	232699
Log trade	303442	4	3	-5	15
GDP exporter	303442	325	858	0	9850
GDP importer	303442	307	856	0	9850
Log GDP exporter	303442	17.82	1.98	12.32	23.01
Log GDP importer	303442	18.01	1.90	12.32	23.01
Geographic variables					
Population exporter	303442	49096	144450	53	1262474
Population importer	303442	42670	130460	53	1262474
Distance	303442	4658	2728	49	12382
Log distance	303442	8	1	4	9
Common dummy variables					
Adjacency	303442	0.02	0.15	0	1
Common language	303442	0.12	0.33	0	1
Common colonizer	303442	0.10	0.30	0	1
Ex-colony/colonizer	303442	0.02	0.13	0	1
Importer colony	303442	0.54	0.50	0	1
Exporter colony	303442	0.52	0.50	0	1
Colonial origin variables					
French colony with sister	303442	0.01	0.12	0	1
Spanish colony with sister	303442	0.02	0.15	0	1
Dutch colony with sister	303442	0.00	0.02	0	1
UK colony with sister	303442	0.09	0.28	0	1
French colony with parent	303442	0.01	0.07	0	1
Spanish colony with parent	303442	0.00	0.07	0	1
Dutch colony with parent	303442	0.00	0.03	0	1
UK colony with parent	303442	0.01	0.10	0	1
French colony importer	303442	0.11	0.32	0	1
Spanish colony importer	303442	0.13	0.33	0	1
Dutch colony importer	303442	0.01	0.10	0	1
UK colony importer	303442	0.25	0.42	0	1
French colony exporter	303442	0.09	0.29	0	1
Spanish colony exporter	303442	0.13	0.34	0	1
Dutch colony exporter	303442	0.01	0.09	0	1
UK colony exporter	303442	0.25	0.42	0	1

Notes: Trade is in millions of US dollars, GDP is in billions of US dollars, Population in thousands.

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TRADE AND GOVERNMENT: THE CAUSALITY CASE

Introduction

There is evidence of the relationship between the size of government and the size of international trade the cause of which may be of particular interest to both policy makers and trade experts. Prior work by Rodrik (1996) argues that expansion of trade causes government to grow in order to provide social insurance against the external economic fluctuation.

However, as even Rodrik points out, the causality could go the other way. For many reasons the size of government and the size of trade in an economy could be positively related and, indeed, growth in the size of government could precede expansion of trade.

We propose to examine the causal relation between trade and government size in several ways. First we replicate Rodrik's analysis using an extended dataset. We also collect data on tariff rates and on trade tax revenues and explore the time series patterns in these. In addition, we use disaggregated data on trade by examining bilateral trading patterns across country pairs. These disaggregated data are exploited in two ways. One uses an augmented form of the classic gravity equation by including government spending as a gravity factor like income. The other uses bilateral trading patterns to define trade volatility as an attempt at a direct test of Rodrik's social insurance hypothesis, that is, does trade volatility create income volatility, and does government then step in.

Literature Review

A large body of economic literature concerns the economic determinants of government size, the determinants of international trade and the relationship linking these two variables.

One of the most influential papers in the theory of government and trade is famous paper by Rodrik (1996). He explores the relationship between increase in government and increase in trade. He finds a positive correlation between economy's exposure to foreign trade and size of its government. Rodrik believes that the explanation for this relationship is that government expenditures are used to provide social insurance against external risk. He also finds the share of trade in GDP in early 1960's is a statistically significant predictor of the expansion of the government consumption over the subsequent three decades. The author assumes that the causality should run from exposure to external risk to government spending.

Recent studies of the economics of government and trade, by Adsera and Boix (2002), Alesina and Wacziarg (1998) and Alesina et al. (2004) offer different hypothesis to explain the link between government size and trade openness.

Adsera and Boix (2002) perform the study of the correlation between country's openness to trade and size of government. They attempt to include politics as a possible explanation for this relationship. Alesina et al. (2004) explore another aspect of the development in international trade. They claim size of countries is crucial for understanding of increase in international trade. They review the impact of market size on growth and endogenous determinant of country size. They show that size of countries influence country's preferences for international trade.

Alesina and Wacziarg (1998) argue that the size of government correlates negatively with country size and positively with trade openness. They show that smaller countries have a larger share of public consumption in GDP, and are also more open to trade. They claim that these empirical observations may account for the observed positive empirical relationship between trade openness and government size. Their research is done in two steps. The authors first show that government consumption, as a share of GDP, is smaller in larger countries. In the next step they confirm the observation that small countries tend to be more open to international trade. They claim that these two facts, taken together, may account for the observation that open countries have larger governments. They suggest a different link between trade openness and government size than suggested by Rodrik (1996). Their research implies a different but not mutually exclusive explanation for the positive empirical relationship between openness and government size. Specifically, they argue that positive link between the two is mediated by country size. In this way they put some doubts on the direct link between openness and the share of government consumption. At the same time they find evidence of a direct relationship between openness to trade and the size of government transfers, which is in the spirit of Rodrik (1996).

Our research is also aimed to explore the link between size of government and international trade. Our research investigates the issue of reverse causality which concerned Rodrik (1996) as well. We consider the body of literature which points toward a negative relationship between international trade and taxes.

Kenny and Winer (2006) perform the study on the structure of taxation. They suggest that no government would choose a point on the backward bending part of any rate-revenue Laffer curve, since it would lead to a marginal cost that is higher than those implied by the lower tax rate that raises the same revenue. They also claim that since the total marginal costs associated with any level of total revenue decline as tax base expands, the equilibrium size of government increases. They show an importance of trade as a tax base and find that countries with large international trade sector rely more on taxes on exports and imports. The claim is that share of trade to GDP has a highly significant positive impact on the share of revenue that comes from trade taxes. Although they say that the effect of the expansion of trade on the trade tax is not straightforward. They believe that with the large potential trade tax base, the same trade revenue can be raised with a lower tax rate or with more extensive loopholes. But the larger tax base makes trade taxation more attractive. Despite the theoretical uncertainty on the direction of the two effects their empirical findings suggest that the trade base has a negative but insignificant effect on the trade tax rate. They also find that countries in which international trade is important rely more on trade taxes.

Fisher (2006) raises the question about anxiety of developing countries that lowering trade tariffs will reduce government revenues. He demonstrates that dependence on tariff revenue is diminishing and trade liberalization need not result in lower total tax revenues or even lower customs revenues. Moreover he claims that much depends on a country's current tariff and trade regime, its tax structure and that at some point, a country needs to broaden its tax base.

Recent IMF report1 on links between trade liberalization and tax revenue states that:

"As is now widely recognized, trade liberalization does not necessarily reduce revenue from trade taxes. This is most likely to be the case when liberalization involves…cutting tariffs that are initially set, for protective reasons, at such high levels that a reduction will cause trade volumes to increase by more than enough to offset the direct revenue loss from lower rates. … (Lower tax rate) leads to an expansion of trade and trade tax revenue will increase".

This research is based on the hypothesis that points toward a relationship between size of government and the degree of international trade. Our research takes as a starting point a paper by Rodrik (1996) who argues that open countries are more subject to external shocks, and therefore need a larger public sector to provide a stabilizing role. However, we consider a reverse causality than claimed by Rodrik (1996) we suggest that the relationship runs the other way, i.e. it is increase in government that leads to the increase in trade. Our reasoning is based on Kenny and Winer (2006). We claim that government needs additional recourses as it grows and in order to provide those recourses it lowers the taxes on international trade. The later pulls the trigger and leads to an increase in the international trade.

[1] Dealing with the Revenue Consequences of Trade Reform(Background Paper for Review of Fund Work on Trade)
IMF February 15, 2005

Theoretical Model

As noted in the introduction, we will test the Rodrik hypothesis several different ways. The main idea is to examine the causal relation between trade and government size in a time series context. Does the growth of government follow or precede the expansion of trade.

The conventional approach is to explore the relationship between the share of government expenditures in GDP to "openness," or the share of trade (measured as exports plus imports) in GDP. We undertake this analysis as well using an expanded dataset of international trade.

In addition, we apply the classic trade theory gravity equation augmented in a way to further investigation of this relationship. In the past, the gravity equation has been used to make conclusions about trade between countries by looking at their relative distances and GDPs. We add government expenditures of trading pairs to the classic model. Just as the size of an economy acts as a force on trade, we postulate that government expenditure exerts a similar force. Tweaking the classic gravity equation in this way allows us to evaluate the empirical robustness of the theory employed by Rodrik.

The classic gravity equation is a cross-sectional specification relating the nominal bilateral trade flow from exporter *i* to importer *j* in any year (X_{ij}) to the exporting and importing countries' nominal gross domestic products (Y_i and Y_j, respectively).

$$X_{ij} = Y_i^{\alpha} Y_j^{\beta} Z_{ij} \qquad (1)$$

where Z_{ij} stands for all of the additional elements usually included in the gravity model, such as, distance, adjacency, language, and colonial effects.

In this paper we augment the gravity equation by including the size of government expenditures in the model. We use a standard structure of gravity equation and add government size (as measured by government expenditures) as a component to the equation in the same way other researches have included adjacency, language and colonialism to the gravity equation. The basic idea of the gravity model is that trade between two countries responds to the weight of their combined incomes. We postulate a similar force will exist in response to the weight of their government sizes.

Inclusion of the government expenditures is not substantively different than inclusion of colony, language, adjacency or other variables. We include the total government expenditures, not the shares of expenditures to GDP in keeping with the classic formulation of the gravity equation, which uses absolute GDP rather than a normalized variable. Including the total government expenditures of both exporter and importer is baked into our assumption that it is the combined size of expenditures that drives the trade effect.

We also employ the disaggregated data on trade by using observations on pairs of countries. This comes from the simple gravity equation trade model. Trade between a pair of countries is driven by many factors. By combining and using the data in this way follows the gravity equation methodology—a methodology which has proven its usefulness for empirically evaluating other aspects of trade.[2] So our new gravity model can be written as:

[2] The possible counter-argument against using the trade observations on the pairs of countries may be that since government size is the same for the same country's trade observations it may deflate the standard errors. While this may be true, it is essentially the same as including other dummies in the model, and the literature has not raised/addressed that question.

$$X_{ij} = Y_i^{\alpha} Y_j^{\beta} Z_{ij} G_i^{\lambda} G_j^{\mu} \quad (2)$$

Our interest is in exploring the causal relation between trade and government spending. We do this using a Granger-style time series analysis in which we look at the first difference of the logs, and time shifts of these variables going in both directions. Our motivation is to see how changes in government spending are correlated to changes in trade.

Our study is concerned with the presence of causality between government size and the size of international trade and we define two models to estimate this causation. The first model deals with the possibility that government expands first, and that this is followed by the expansion of trade. If so, there should be a time lag between the increase in government and increase in trade.

To simplify the notation, let's express the difference in the logs of trade through time as:

$$\dot{X}_{ijt} = \ln X_{ijt} - \ln X_{ijt-1} \quad (3)$$

and use similar notation for the other variables. Our gravity equation now becomes:

$$\dot{X}_{ijt} = A + \alpha \dot{Y}_{it} + \beta \dot{Y}_{jt} + \lambda \dot{G}_{it} + \mu \dot{G}_{jt} \quad (4)$$

First differencing the log form of the gravity model eliminates all the variables included in Z_{ij}, i.e., distance, adjacency, language and colony, since those variables do not vary with time.

The Granger causality approach includes leads and lags of the right-hand side variable on the hypothesis that if government is causing trade but not the reverse, future values of the change government spending should be correlated with current values of trade. If the increase in government size causes increase in trade, we will have positive coefficients on the lagged values of government spending. If the opposite holds true, the coefficients will be negative.

We flip equation (4) to look for causation going in the other direction and to test the idea that increases in trade lead to expansion in the size of a country's government: Rodrik's theory. In this flip test we must make an assumption about the values of λ and μ. For simplicity, we assume that they are both the same. Thus, we have

$$G_i G_j = (X_{ij} Y_i^{-\alpha} Y_j^{-\beta} Z_{ij}^{-1})^{\Gamma} \tag{5}$$

Then let:

$$\dot{g}_{ijt} = \ln(G_{it} G_{jt}) - \ln(G_{it-1} G_{jt-1}) \tag{6}$$

so that we capture this inverse gravity effect in terms of percentage changes. Again we include leads and lags of the right-hand side variables. If an increase in trade causes an increase in government, we will have positive coefficients on the lagged RHS values of trade.

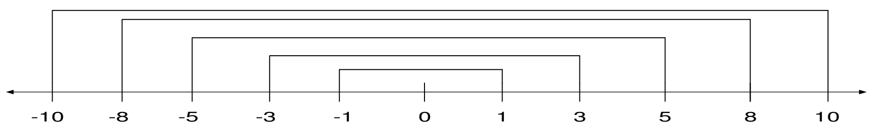
In the event that we find that the causality runs opposite to the way that Rodrik asserts, it is interesting to consider what might be going on. It might be possible that government is financing increased government spending by increased trade tax revenues. So we collect data on these and examine the time series patterns with government spending. Also, we collect data on tariff rates and rank countries as high, middle, and low. We then examine the sensitivity of the relations between trade and government size for these groups.

There are some factors not accounted for in this empirical analysis. Tariffs and non-tariff barriers reduce trade. Because of this, trade volume may be a measure of how "open" a country is, regardless of country's specific tariff rates. An alternative way of investigating a country's "openness" to trade is to observe country's level of trade in the years after a country joins the GATT or other tariff and non-tariff barrier reducing body.[3]

We look at the entry to the GATT as a point of reference of countries willingness to accept trade. We explore the growth rate of a country's trade and government expenditures before and after the country joins the GATT. We consider the simplest possible specification and regress the average yearly growth of country's trade N years after entering the GATT on the average yearly growth of this country N years before entering the GATT. Figure 2.1 below shows graphically the intervals of time that we choose for the analysis, with N=1, 3, 5, 8 and 10 years before and after entering the GATT.

[3] The reason why chose the GATT is that until 1995 (the year when WTO was created) it was the world's major agreement on reduced tariff barriers. We consider GATT and not WTO because our data set is covering the years 1962-2000, and the GATT was signed in 1948 and continued until the end of 1994. WTO was signed in 1995 and continues until today. So we chose GATT because it covers more of the period of time that we have the data available for.

Figure 2.1. The GATT Entrance Time Span.



Note: The 0 in the center of the scale represents the year a country enters the GATT.

Data Description

The trade data for this project come from four sources: National Bureau of Economic Research (NBER), Center for International Comparisons at the University of Pennsylvania, UNCTAD - TRAINS (Trade Analysis and Information System) and WTO[4]. Robert Feenstra and Robert Lipsey constructed this unique data set from United Nations under a grant from the National Science Foundation to the NBER.[5] Feenstra and Lipsey (2004) revised some of the UN country codes to aggregate small countries and adjust for countries that no longer exist. The researchers combined Belgium and Luxemburg into a single coded-entity for example. They also recoded some countries that were former Soviet Republics but no longer exist.

Both importers and exporters report the data. Importers report CIF (cost, insurance, freight) and exporters report FOB (free on board). Import data are usually more reliable

[4] Data on the GATT membership and the year of entrance to the GATT is available at : http://www.wto.org/
5 This dataset covers the years 1962-2000 and is available at: http://www.nber.org/data/.

than export data since they constitute a tax base, as pointed by Felbermayr and Kohler (2006). Constructing data from importers alone gives more accurate reporting and reflects a larger number of country pairs with positive trade. Feenstra and Lipsey (2004) also give primacy to the importers' reports whenever they are available, but use exporter data when they are not available.

The number of trade observations changes in the middle of the dataset as UN changed the way that data were collected. Before 1984, it included all the trade data, no matter how small. But starting in 1984, the UN only recorded data that exceeded USD$100,000 for each bilateral flow. Feenstra and Lipsey (2004) revised the data by adding smaller-valued trade to the UN dataset, but only for certain countries. There are 203 countries and or territories listed in the dataset for the period 1962-1983 but there are only 72 countries listed during 1984-2000. Those 72 countries accounted for 98% of the world's exports in the last five years. We confine our analysis largely to the period 1984-2000 because of the issues of the dataset composition over the entire period.

The World Trade Flows dataset includes data on country *i's* imports from country *j*, $X_{i,j\,t}$, where *t* stands for the year. The data are reported in nominal thousands of US dollars and each observation is unique, reported only once in the database. We transform the trade data into real terms with the base year =2000.

GDP and Government expenditures data come from the Center for International Comparisons at the University of Pennsylvania and are called the "Penn World Tables." They provide data on GDP per capita and population for 188 countries for some, or all, of the years 1950-2004. We use the real GDP per capita in constant prices (Chain) with the base year=2000 and multiply that by population to receive the country i GDP in millions of US dollars. Penn World Tables offer data on Government Share of GDP. In order to generate Government expenditures we multiply the Government Share on GDP. Government expenditures are in constant prices in millions of US dollars.

The data on tariffs come from the UNCTAD - TRAINS[6] database which ranges from 1988-2000. The dataset includes most favored nation rates and effectively applied rates for 120 countries. For the earlier years 1988-1992 the data are available for the very few countries. More data are available in the later years. For our research we use the most favored nation rates. The mean tariff rate is 14 percent with the standard deviation equal to 10 percent. We calculate the average of the tariff rates over the period 1993-2000 and divide the sample into high, low and medium tariff rates countries. We use half a standard deviation from the mean as the rule to divide the countries into different groups. Thus the low tariff group consists of 46 countries that have tariffs less than 9 percent. The high tariff rates group has 26 countries with the tariffs higher than 19 percent. And the rest of the 48 countries fall into medium tariff rate group with the tariff rates ranging between 9 and 19 percent.

The summary statistics for all of the variables described above are represented in Table 2.1.

[6] Dataset is available at http://r0.unctad.org/trains_new/index.shtm

Table 2.1 Summary Statistics

Variable	Mean	Std. Dev.	Min	Max
Bilateral trade variables				
Year	1992	3	1988	1996
Volume of Trade	5,248	33,477	0	160,000
GDP exporter	541	1,160	0	8,260
GDP importer	489	1,160	0	8,260
Gov. Expenditures exporter	9.77	188	0	98,000
Gov. Expenditures importer	8.51	177	0	98,000
Aggregate Trade variables				
Year	1992	5	1984	2000
Trade	7,420	25,400	0	425,000
Government	422	126	0	151,000
GDP	225	751	0	9,850
Dependency	41	7	10	55
Urbanization	53	24	5	100
Dummy variables				
High tariff	0.21			
Low tariff	0.38			
Soviet	0.05			
Sub-Saharan Africa	0.26			
East Asia	0.14			
Latin America	0.18			
OECD	0.19			

Notes: Number of bilateral observations=53,502 and number of aggregate trade observations=2,419. Data on tariffs have 1,791 observations. Trade is in millions of US dollars, GDP is in billions of US dollars, Government Expenditures in millions. Dependency and Urbanization are measured as a ratio of total population.

There are high standard deviations in trade, both in the bilateral trade dataset and the aggregate trade dataset. There is a high variation from the mean of trade from countries which we observe in both datasets. On average, country urbanization rate is equal to 53 percent and ranges from 5 percent to 100 percent. The mean of the dependency ratio is 41 percent but it ranges from 10 to 55, which means that 55 percent of the population is not of working age. We also see that approximately 21 percent of the countries have high tariff rates and 38 percent of the countries in our sample have low tariff rates. OECD countries constitute 19 percent of the sample and only 5 percent of the countries are former Soviet. Sub-Saharan and East Asian countries account for almost 40 percent of the sample.

Analysis

Our first effort is to examine the general trends in the level of government and the level of trade relative to GDP across time for the countries in our sample. The average over countries is shown in Figure 2.2 over the period 1962-2000.

Figure 2.2 Yearly averages of trade share and government share during 1962-2000.

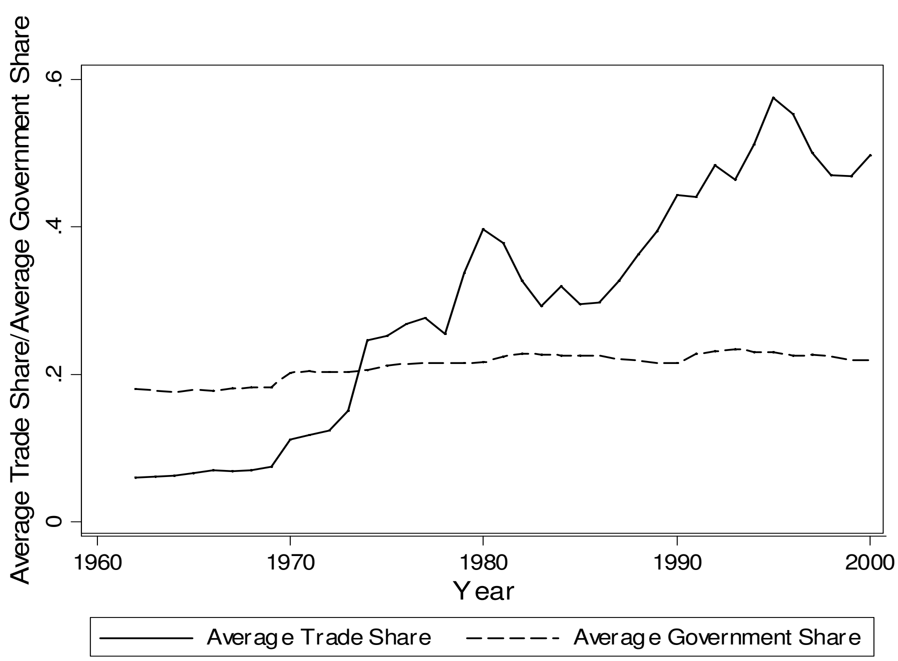


Table 2.2 shows the average of the trade and government as share of GDP over time and countries. The average for Government share is 21 percent with the standard deviation of 0.02 and minimum and maximum 18 percent to 23 percent, so that Government share is fairly tightly bound. On the other hand trade varies rather markedly with the mean of 30 percent and varies between 6 percent and 58. We can also see from the graph that trade in our data has been growing substantively.

Table 2.2 Averages of Trade share and Government share over 1962-2000

Variable	Mean	Std. Dev.	Min	Max
Trade	0.30	0.16	0.06	0.58
Government	0.21	0.02	0.18	0.23

Notes: Number of observations=6,516. Trade is as share of GDP, Government Expenditures as share of GDP.

From the graph it is hard to see the relationship between the two variables. However it does not seem that the trends in growth of government and growth of trade coincide for the same period of time.

Rodrik Replication

Our first step is to replicate Rodrik's specification as closely as possible with the dataset that we have at our disposal. Rodrik's benchmark regression includes as dependent variable the log of the share of government expenditures in GDP average for years 1990-92. His independent variables include: log of per capita GDP[7], log of urbanization in year 1990, log of dependency ratio[8] in year 1990, log of openness (calculated as exports plus imports divided by GDP, also called as a trade share) averaged over years 1980-1989, and a set of dummy variables, such as socialist countries, OECD, Latin America, East Asia and Sub-Saharan Africa.

Table 2.3 presents results of the Rodrik's specification of the model for the relationship between trade and government with some small modifications. We use the data for years 1984-2000 which extends the period of observation beyond that examined by Rodrik.

Also Rodrik included socialist dummy and found that the coefficient on it was insignificant. We instead include soviet dummy, i.e. former Soviet Union and countries which were formed after USSR collapsed, since our data range covers period when those countries became independent and entered the world markets as separate entities.

As a dependent variable we consider the log of the share of government expenditures average for years 1993-2000, and as independent variable we include log of openness (exports plus imports divided by income) averaged over years 1984-1992, log of GDP in 1993, log of dependency in year 1993 and log of urbanization in year 1993 as well as all the dummies included in Rodrik's original regression. Regression 1 is the direct replication of Rodrik's results (but for the different time period and including soviet dummy instead of socialist).

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[7] It is not clear which year if log of GDP Rodrik uses in his benchmark regression. I assume it is 1990, same year that he uses for dependency and urbanization.

[8] Rodrik is not clear in his definition of the dependency ratio in population. I calculate the dependency ratio as the ratio of population which is aged <15 and over 64 divided by total population.

Rodrik's benchmark regression had negative insignificant coefficients on all dummies except dummy on socialist which was positive. Our replication of the model shows the same signs of the coefficients but more of them are significant. For instance, coefficient for East Asia and for Sub Saharan Africa which are statistically significant at 5 percent level, and are equal to -0.24 and -0.48 accordingly. Also the coefficient on Soviet is positive and highly significant at 5 percent level equal to 0.58.

Rodrik reports coefficient on openness that is significant and positive with the coefficient value of 0.223. However, our replication shows that coefficient on openness is equal to 0.07 and is not significant. Also we find that though coefficients on GDP, dependency, and urbanization have the same sign in our replication as in Rodrik's the results are the opposite in significance: Rodrik reports insignificant coefficient on the first and significant on the others, while we find the significant coefficient on GDP and insignificant on dependency and urbanization.

Regression 2 uses modified version of Rodrik's model and includes all the independent variables except openness calculated as averages over period 1993-2000. We find in this case that coefficient on openness significant at 5 percent level but the value of it does not change compared to regression 1. All other coefficients in Regression 2 are almost identical to the coefficients in regression 1 both in statistical significance and in magnitude.

Table 2.3 Rodrik's specification

	Dependent variable					
	Rodrik			Alternative		
	Log of Gov't share avrage1993-2000			Log of Trade share average 1993-2000		
Model	(1)	(2)	(3)	(4)	(5)	(6)
Log of GDP per capita		-0.19	-0.16*		0.30*	0.46
		(-3.15)	(-1.65)		(1.60)	(3.66)
Log of GDP per capita_93	-0.18			0.26*		
	(-3.25)			(1.35)		
Log dependency		-0.10*	-0.04*		-0.05*	0.23*
		(-0.31)	(-0.08)		(-0.08)	(0.31)
Log dependency_93	0.02*			0.08*		
	(0.08)			(0.13)		
Log urbanization		-0.08*	-0.11*		0.78	0.58
		(-0.89)	(-0.93)		(3.04)	(3.50)
Log urbanization_93	-0.08*			0.80		
	(-0.96)			(2.98)		
Soviet	0.58	0.57	0.63	-0.81	-0.80	-0.66
	(4.67)	(4.89)	(3.47)	(-2.20)	(-2.60)	(-1.95)
OECD	-0.04*	-0.06*	0.02*	0.29*	0.25*	-0.00*
	(-0.48)	(-0.61)	(0.18)	(1.54)	(1.38)	(-0.01)
Latin America	-0.12*	-0.13*	-0.10*	0.08*	0.11*	0.01*
	(-1.39)	(-1.51)	(-0.86)	(0.36)	(0.50)	(0.04)
East Asia	-0.24	-0.25	-0.21	0.51	0.60	0.53
	(-2.55)	(-2.55)	(-2.01)	(2.65)	(2.96)	(1.95)
Sub-Sahara	-0.48	-0.46	-0.42	0.66	0.74	0.58
	(-3.62)	(-3.47)	(-2.74)	(3.24)	(3.78)	(2.63)
Log Trade share average 1984-92	0.07*	0.08	0.08*			
	(1.57)	(1.95)	(1.44)			
Log Gov't share average 1984-92				0.20*	0.27	0.22*
				(1.36)	(1.91)	(1.28)
High tariff dummy			-0.09*			0.10*
			(-0.72)			(0.55)
Low tariff dummy			-0.11*			0.22*
			(-1.13)			(1.16)
R-squared	0.24	0.23	0.22	0.44	0.44	0.56
# of observations	142	144	107	143	146	108

Notes: t-statistics in parentheses. All coefficients, except * are significant at 5% level. All regressions have robust standard errors. Regression (1) and (4) are for year 1993 only. All regressions except (1) and (4) have all independent variables as the averages of the corresponding variables over years 1993-2000.

Since we are interested in the question of the causality between openness and government expenditures we perform regression 4 which is in the sprit of Rodrik but is simply the reverse causality regressions in which dependent variable now becomes log of openness averaged over years 1993-2000. Log of the share of government expenditures average for years 1984-92 is now included as an independent variable along with all other variables.

We find that the coefficient on government expenditures is positive equal to 0.20 but is not statistically significant. We also find that GDP per capita has positive but insignificant coefficient, which is reverse of the finding in Rodrik's specification, since it was negative and significant in regression 1. Also we report that coefficient on urbanization is positive and significant equal to 0.80, which is again reverse to the Rodrik's specification where it was insignificant and negative. As for the dummy variables all of them have an opposite signs but have not changed their statistical significance compared to regression 1.

In regressions 5 we use identical specification as in regressions 4 but we are using the averages for all of the independent variables calculated as averages over years 1993-2000. The coefficient on government expenditures becomes statistically significant at 10% level now and is equal to 0.27, values of all other coefficients and their statistical significance in this regression are have not changed compared to regression 4. Thus regression 5 is superior to regression 4, since the coefficients are more significant while their magnitudes do not change. In the reverse causality there is significance from government share in period 1984-92 in trade over period 1993-2000. So our question of the reverse causality deserves farther investigation.

We extend the analysis to see if the level tariffs have a predictive effect either on government spending or trade. Two specifications are re-estimated including dummy variables for high and low tariff countries; tariff levels in the middle range are the omitted class. The results are present in regressions 3 and 6. The coefficient estimates on the tariff dummies are not statistically significant. However, the point estimate for the alternative specifications shows that low tariff countries have a higher level of trade, which is seems reasonable. Also inclusion of the tariff dummies causes the significance level of the effect of government spending on trade to fall.

Gravity Equation

Our next specification exploits the disaggregated, bilateral trade patterns using the gravity model. As discussed in the theory section we will explore the gravity model in the time series fashion by looking at leads and lags of the 1st differences of the logs of the variables. First we explore the Rodrik's hypothesis that trade causes government, in the gravity formulation we would look at the product of the size of the government for the trading countries. This regression is shown in Table 2.4 and 2.5. Table 2.4 contains the coefficients of interest while Table 2.5 reports coefficient on income variables.

We find evidence of correlation between trade and government spending within the narrow time frame within three years is not strong the only statistically significant coefficient is the percentage change in trade three periods in the future effecting government spending today.

Note that the coefficients on income are less then one, which we expected because government spending as the component of income. They are significant between the current government spending and income.

Turning to the reverse causality hypothesis we regress the percentage change in the bilateral trade on leads and lags of government spending. In this specification we can separate government spending into the data for the importer and for the exporter.

While these results are not overwhelming two things stand out. One is that future values of government spending are not correlated with the current level of trade. Second, there is some correlation between the current level of trade and past levels of government spending for importers. The effect for exporters nets out over three lags.

Since these results suggest that there may be some causal relationship from government spending to trade we explore the relation between trade tax revenues and government spending.

Table 2. 4. Bilateral Trade and Gravity Equation (coefficients of interest)

	Dependent variable	
	% Δ in Government	% Δ in Trade
Model	(1)	(2)
% Δ in Trade at time t+3	0.001	
	(1.65)	
% Δ in Trade at time t+2	0.000*	
	(0.37)	
% Δ in Trade at time t+1	-0.000*	
	(-0.09)	
% Δ in Trade at time t	0.001*	
	(0.70)	
% Δ in Trade at time t-1	0.001*	
	(1.46)	
% Δ in Trade at time t-2	0.000*	
	(0.38)	
% Δ in Trade at time t-3	0.001*	
	(0.27)	
% Δ in Importer's Gov't at time t+3		-0.024*
		(-0.67)
% Δ in Importer's Gov't at time t+2		0.009*
		(0.25)
% Δ in Importer's Gov't at time t+1		0.025*
		(0.69)
% Δ in Importer's Gov't at time t		0.078
		(1.86)
% Δ in Importer's Gov't at time t-1		0.132
		(3.20)
% Δ in Importer's Gov't at time t-2		-0.128*
		(-0.30)
% Δ in Importer's Gov't at time t-3		-0.045*
		(-1.08)
% Δ in Exporter's Gov't at time t+3		-0.007*
		(-0.16)
% Δ in Exporter's Gov't at time t+2		-0.001*
		(-0.03)
% Δ in Exporter's Gov't at time t+1		0.047*
		(1.04)
% Δ in Exporter's Gov't at time t		-0.072*
		(-1.36)
% Δ in Exporter's Gov't at time t-1		-0.173
		(-2.86)
% Δ in Exporter's Gov't at time t-2		0.088*
		(1.57)
% Δ in Exporter's Gov't at time t-3		0.092
		(1.79)
R-squared	0.195	0.019
# of observations	53,502	53,502

Notes: t-statistics in parentheses. All coefficients, except * are significant at 10% level. All regressions have robust standard errors. Both regressions included the percentage change of income for exporter and importer, which are reported in Table 2.5.

Table 2.5 Bilateral Trade and Gravity Equation (income coefficients)

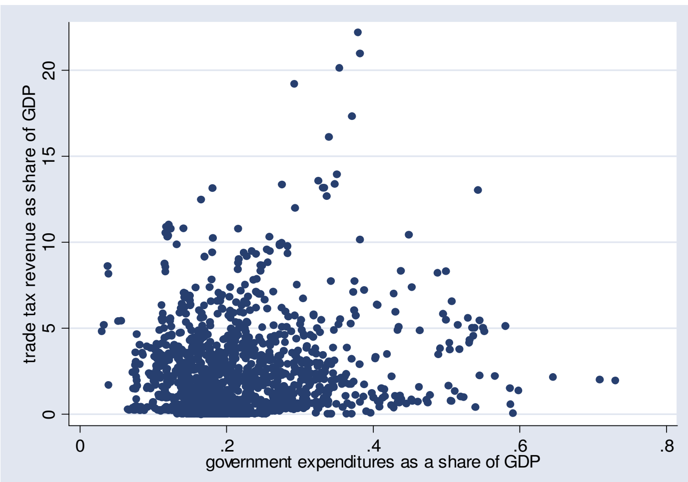
	Dependent variable	
	% Δ in Government	% Δ in Trade
Model	(1)	(2)
% Δ in Importer's income at time t+3	0.134*	0.057*
	(1.08)	(0.83)
% Δ in Importer's income at time t+2	-0.001*	-0.131
	(-0.22)	(-2.14)
% Δ in Importer's income at time t+1	0.019	-0.004*
	(5.96)	(-0.06)
% Δ in Importer's income at time t	0.490	1.190
	(29.70)	(14.30)
% Δ in Importer's income at time t-1	0.123	-0.193
	(4.55)	(-2.99)
% Δ in Importer's income at time t-2	0.045*	-0.138
	(0.65)	(-2.15)
% Δ in Importer's income at time t-3	0.130	-0.077*
	(13.39)	(-1.15)
% Δ in Exporter's income at time t+3	0.056	0.050*
	(4.40)	(0.65)
% Δ in Exporter's income at time t+2	-0.009	-0.026*
	(-1.78)	(-0.35)
% Δ in Exporter's income at time t+1	0.034	0.140
	(3.28)	(1.65)
% Δ in Exporter's income at time t	0.484	1.12
	(25.65)	(9.93)
% Δ in Exporter's income at time t-1	0.113*	0.240
	(1.20)	(2.18)
% Δ in Exporter's income at time t-2	0.061*	-0.224
	(0.47)	(-2.26)
% Δ in Exporter's income at time t-3	0.141	-0.055*
	(13.88)	(-0.66)
Constant	-0.004	0.022
	(-4.01)	(2.84)
R-squared	0.195	0.019
# of observations	53,502	53,502

Notes: t-statistics in parentheses. All coefficients, except * are significant at 10% level. All regressions have robust standard errors. This table reports income coefficients and coefficients on constant from regression in Table 2.4.

Tax Revenues and Government

Next we investigate the relationship between total tax revenues from trade and government expenditures. The graph of the relationship is depicted in Figure 2.3. Visually, there appears to be a positive relation between trade tax revenues and the size of government. Even so, this relation is almost surely strongly affected by heteroskedasticity.

Figure 2.3 Relationship between government and tax revenues.



We undertook a time series analysis of government expenditures and trade tax revenues for short lags. We regressed the percentage change in each on leads and lags of the other for up to three periods. We also estimated these regressions separately for high, medium, and low tariff countries. There was no causal inference to be drawn. The only significant effect was that the current percentage change in government spending is negatively correlated with the current percent change in trade tax revenues.

We next perform an analysis of the long term relationship for causality between government and revenues from trade. In order to do that we calculate the logs of average of government expenditures as a percent of income over years 1993-2000 and the logs of averages of the tax revenues from trade as a percent of income over years 1984-1992. We then regress the average of government on the average of trade. The result is reported in Table 2.6.

Table 2.6 Tax Revenue from Trade and Government in the Long Run

	Government share 1993-2000	Trade Revenue share 1993-2000
Variable	(1)	(2)
Trade Revenue share 1984-92	0.007*	
	(0.34)	
Government share 1984-92		3.421
		(2.35)
Constant	-1.630	-0.503*
	(-30.00)	(-1.30)
R-squared	0.002	0.029
# of observations	90	90

Notes: Revenue from Trade share and Government Expenditures shares are calculated as average over the corresponding period of time. t-statistics in parentheses. All coefficients, except * are significant at 5% level. All regressions have robust standard errors.

Regression 1 investigates if trade revenues in 1984-1992 had any significant influence on government share between 1993 and 2000. We find the coefficient is positive but not significant. The second regression in the table checks for the reverse causality in this relationship. We witness that government expenditures from 1984-1992 are a good predictor of tax revenues from trades for the time between 1993 and 2000. We see the coefficient on government expenditures is statistically significant at the 5 percent level and is equal to 3.42.

Based on all the results reported in Table 2.6 we can conclude that while the short term relation between government expenditures and tax revenues from trade does not seem to be strong there is some evidence of the longer term relation between the two. Based on our results it seems that the causality is running from government to trade but not the other way around.

Volatility

In the last part of our analysis we undertake a more detailed investigation of Rodrik's idea that government acts as a social insurance in the world of uncertainty in trade. To do this we exploit the disaggregation of the bilateral trade data. We create a measure for the volatility of trade from the pair-wise combinations of trading partners. For import volatility we calculate the average of the sum of the squares of the difference in the level of imports for country i and each of its trading partners from one year to the next. The same calculation is performed for exports. Then import and export volatilities are added together. Our idea is that even if the overall level of trade doesn't change from year to year, variation in trading partners is a measure of disruption.

The Rodrik argument is that trade volatility should cause income volatility, so we regress fluctuations in income year to year on our measure of trade volatility. Current and lag values are included. Then we regress the change in government expenditures on these measures of trade and income volatility. Some summary statistics are shown in Table 2.7 and the regressions in Table 2.8.

Table 2.7 Volatility of Trade and Income

Variable	Mean	Std. Dev.	Min	Max
Trade Volatility	1.51	1.33	0.02	40.11
Income Volatility	0.01	0.04	0.00	1.08

Notes: Number of observations=2,767 for Trade Volatility and 2,402 for Income Volatility.

The volatility of income is measured as a square of the percentage change in income. We can see from Table 2.7 Trade volatility has the mean equal to 1.51, with a minimum of 0.02 and maximum of 40.11. At the same time the standard deviation is only 1.33. As for the income volatility the mean here is equal to 0.01 but the standard deviation is four times higher than the mean and is equal to 0.04. Income volatility ranges between the values of 0.00 and 1.08.

Regression 1 in Table 2.8 shows that volatility in trade has a direct negative influence on changes in income. Regression 2 performs a test on the relationship between volatility of trade and volatility of income. We find the two are positively correlated, with the coefficient on the volatility of trade significant at the 5 percent level and equal to 1.98. Finally, Regression 3 looks at changes in GDP, volatility of trade and volatility of income, as well as their lags, as explanatory variables for changes in government expenditures. We consider three variables, and their time shifts, that may affect government expenditure levels: the volatility of trade, the volatility of income and the percentage change in GDP. We find that volatility of trade is statistically significant at the 5 percent level while the volatility of income is not significant.

Table 2.8 Volatility

	Dependent variable		
	% Δ in GDP	Volatility of Income	% Δ in Government
Model	(1)	(2)	(3)
Volatility of Trade	-2.24	1.98	0.84
	(-5.30)	(3.95)	(2.43)
Volatility of Trade at time t-1	0.86	-0.09*	-0.94
	(2.98)	(-0.53)	(-2.26)
Volatility of Trade at time t-2	0.80	0.11*	0.60
	(3.47)	(0.70)	(1.88)
% Δ in GDP			85.48
			(12.44)
% Δ in GDP at time t-1			2.37*
			(0.46)
Volatility of Income			-21.23*
			(-1.40)
Volatility of Income at time t-1			-19.05*
			(-1.45)
Constant	3.82	-2.09	-0.92*
	(5.88)	(-4.25)	(-1.33)
R-squared	0.09	0.31	0.29
# of observations	2,093	2,093	2,086

Notes: t-statistics in parentheses. All coefficients, except * are significant at 10% level. All regressions have robust standard errors. GDP and government variables are in logs. All the coefficients are scaled by 100.

Entry into GATT

Analysis presented in Table 2.9 accounts for some other factors not included in the models we present in our analyses. Our approach in Table 2.9 is to approximate the "openness" of a country by observing the change in trade in the years after a country joins GATT. We consider different intervals of time before and after the entry into this trade agreement. We regress the average yearly growth rates after a country joins the GATT on the average yearly growth rates before joining.

In the analysis, we consider models for the growth of total trade, trade as a share of GDP, government expenditures and government expenditures as a share of GDP. We find highly statistically significant negative coefficients for all the specifications for 1 and 3-year time period spanning before and after entering into GATT. However at the 8 and 10-year time period spanning all of the specifications considered exhibit positive, highly statistically significant coefficients. In other words, in the short run after entering GATT we witness the negative effect on growth of trade and government expenditures and in the long run the effect becomes positive. Trade and government expenditures are growing together in the long run window after entering GATT.

The last two regressions in Table 2.9 explore growth of trade share, N years after a country entered GATT, on the growth of government share before a country's entrance into GATT and the reverse of this relationship. We find that up to N = 8 years, the growth of government before entrance has a highly significant negative effect on growth of trade after the entrance. At the same time, we see the reverse tendency when growth of trade before joining GATT had a positive effect on post-GATT entrance growth of government (with the exception of N = 3 years).

Table 2.9 Regressions of growth of GATT countries

	N=1	N=3	N=5	N=8	N=10
Models	(1)	(2)	(3)	(4)	(5)
Trade Total	-0.233	-0.175	0.018	0.088	0.163
	(-11.28)	(-18.54)	(1.26)	(4.87)	(16.49)
Trade/GDP	-0.137	-0.142	0.005	0.075	0.136
	(-10.15)	(-26.82)	(0.32)	(4.13)	(15.33)
Gov expenditures total	-0.183	-0.026	0.175	0.195	0.166
	(-9.71)	(-1.76)	(9.29)	(21.69)	(20.28)
Gov expenditures/GDP	-0.110	-0.057	0.037	0.152	0.151
	(-5.53)	(-3.16)	(1.61)	(16.38)	(14.73)
Growth of Government/GDP before GATT*	-0.495	-0.679	-0.321	-0.198	0.221
	(-12.02)	(-28.16)	(-10.33)	(-4.34)	(7.08)
Growth of Trade before GATT**	0.011	-0.047	0.008	0.053	0.060
	(1.86)	(-7.77)	(1.44)	(50.79)	(50.24)

Notes: Dependent variables: growths of corresponding variables after entering GATT; independent variables are growths of corresponding variables before entering GATT. t-statistics in parentheses. N is number of years before/after entering GATT.
* regressions have a growth of trade share after GATT as dependent variable and 1,762 observations.
** regressions have a growth of gov't share after GATT as dependent variables and 1,752 observations.

Conclusion

We performed and investigation of the causal relationship between trade and government expenditures, in the attempt to extend the work of Rodrik (1996). Several different tests were conducted. The first is the simple replication of Rodrik's benchmark model on the extended dataset. The results here are not conclusive but suggest that the causation may run from government spending to trade.

Next we use bilateral trade in observations and the augmented form of the classic gravity equation used by trade economists. This analysis uses time series changes in government spending and in trade. Test for Granger style causality are performed. Again little evidence is found for Rodrik's hypothesis that trade causes government spending. And some weak evidence exists for the alternative hypothesis.

Next we extend the analysis to Trade tax revenues under searching for the possible link between government spending and revenues gained from tariffs.

Little evidence is found over short run periods but over the long run there does seem to be an association between the high Trade tax revenues in one period and high government expenditures in the next period.

Finally we look at a more direct test of the Rodrik's hypothesis. Rodrik's story is that trade creates volatility in income which then induces government to provide social insurance in the form of government expenditures. We calculate a measure of trade volatility by looking at bilateral trading partners. And find that trade volatility is associated with income volatility. Then the relationship between income volatility and the government expenditures is exploit the results of this test are ambiguous because changes in government expenditures are negative related to income volatility but at the same time positively related to trade volatility.

Thus at this point the results of the inquiry are not conclusive but certainly suggestive that the Rodrik's hypothesis requires further investigation.

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