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Abstract

International trade costs are of vital importance because they determine trade patterns and therefore economic performance. This paper develops a new micro-founded measure of international trade costs. It is based on a multi-country general equilibrium model of trade that incorporates bilateral "iceberg" trade costs. The model results in a gravity equation from which the implied trade costs can be easily computed. The trade cost measure is intuitive, takes multilateral resistance into account and yields empirical results that are economically sensible. It is found that during the post-World War II period trade costs have declined markedly. The dispersion of trade costs across countries can best be explained by geographical and historical factors like distance and colonial linkages but also by tariffs and free trade agreements.

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1 Introduction

Barriers to international trade are large and since they impede trade flows, they have a strong impact on countries' overall economic performance and welfare. Some barriers, like tariffs and transportation costs, are directly observable but numerous other barriers are notoriously difficult to measure, for example administrative and communication costs. The aim of this paper is to derive a comprehensive measure of trade costs that can capture all barriers to international trade.

This comprehensive measure of trade barriers is derived by incorporating bilateral "iceberg" trade costs into a multi-country general equilibrium model of trade. Iceberg trade costs mean that for each good that is exported a certain fraction melts away during the trading process as if an iceberg were shipped across the ocean. The model yields a simple micro-founded gravity equation from which the implied international trade costs can be inferred. This indirect approach results in a comprehensive measure of trade barriers that is both intuitive and easy to compute.

Empirical bilateral trade costs are thus obtained for a sample of 29 mostly OECD countries during the post-World War II period. For the G7 subsample trade costs fell by 26.5 percent between 1960 and 2002. Similarly, for European Union countries trade costs declined by 17.7 percent between 1977 and 2002. For both subsamples the 2002 tariff equivalent of trade costs is about 40 percent. More specifically, trade costs have fallen most dramatically for nearby trading partners, implying an increase in regional economic integration that is consistent with the emergence of regional free trade agreements such as NAFTA and the European Common Market.

Apart from providing snapshots of trade costs over time, the paper also seeks to explain the dispersion of trade costs across country pairs. The most important determinants of trade costs are found to be geographical factors like distance and being landlocked as well as historical linkages such as a common colonial history and the use of a common language. In particular, sharing a common colonial history on average cuts the tariff equivalent of trade costs by 16 percentage points and using a common language reduces trade barriers by 10 percentage points. Both these effects have diminished over time, however, as the impact of colonial history has subsided and as the learning of foreign languages has become more widespread. Perhaps more surprisingly, institutional factors like tariffs and nominal exchange rate volatility play a smaller role in explaining the dispersion of trade costs.

Trade costs have recently attracted wide attention in the literature. James Anderson and Eric van Wincoop (2004) present an in-depth survey of trade costs and argue that the representative tariff equivalent of international trade costs is around 74 percent, which is consistent with the range found in the present paper. David Hummels (2001) measures some components of trade costs *directly* such as transportation costs. His measures, however, are usually specific to particular goods or transportation modes and therefore not necessarily representative of overall trade costs in an economy.

The traditional way of accounting for trade costs is by *ex ante* assuming trade costs to consist of certain components and then including these components into a gravity equation. Two well-known applications of this strand are John McCallum's (1995) and Andrew Rose's (2000) papers. McCallum (1995) examines the effect of the U.S.-Canadian border as a very general form of a trade costs, whereas Rose (2000) focuses on common currencies. However, as pointed out by Anderson and van Wincoop (2003), such atheoretical inclusion of trade cost components can lead to an omitted variable bias and therefore invalid comparative statics. In contrast, this paper follows a different approach by measuring trade costs *indirectly and comprehensively* through inference from aggregate trade flows on the basis of a theoretically derived gravity equation. In this two-step procedure a micro-founded measure of bilateral trade costs is computed first and then the trade cost components are identified *ex post*.

Scott Baier and Jeffrey Bergstrand (2001) also derive a gravity equation that includes trade costs but they restrict trade costs to transportation costs and tariffs and do not consider other geographical, historical or institutional determinants. More recently, Anderson and van Wincoop (2003) introduce a micro-founded gravity equation with trade costs based on a general equilibrium framework that is *conditional* on a certain allocation of production and consumption. The drawback of this framework is that it does not allow for valid comparative statics. For example, a change in trade barriers will not only have an effect on trade flows but also on the allocation of production and consumption within countries. To account for such effects I develop a general equilibrium framework in which the allocation of production and consumption is determined endogenously.

In addition, the gravity equations developed by Baier and Bergstrand (2001) and Anderson and van Wincoop (2004) include price indices that are unobservable because they are theoretical constructs. But the gravity equation I derive in the present paper is more practical since it consists of observable variables only and therefore provides an easy and intuitive way of computing trade costs.

The results on the factors that drive the dispersion of trade costs are generally consistent with previous findings in the literature, which is surveyed by Anderson and van Wincoop (2004). For example, the language barrier estimates by Hummels (2001) and Jonathan Eaton and Samuel Kortum (2002) lie in the same range as mine. Similar to my results, Jeffrey Frankel and Andrew Rose (2002) find evidence that a common colonial history significantly facilitates trade. Furthermore, Anderson and van Wincoop (2004) point out that nowadays most developed countries have low tariffs and that tariffs therefore only represent a small fraction of overall trade costs. This observation is reflected in my finding that tariffs only play a minor role in explaining the dispersion of trade costs.

The paper is organized as follows. Section 2 develops the general equilibrium model with iceberg trade costs, resulting in the essential gravity equation. Section 3 presents the historical evolution of trade costs with special emphasis on the G7 and European Union countries, showing that economic integration has progressed fastest on a regional level. Section 4 identifies the factors that determine trade costs and provides a discussion of the results, also comparing them to evidence from the late 19th century trade boom. Section 5 concludes.

2 A Model with Iceberg Trade Costs

This section develops a micro-founded general equilibrium model that is similar to the framework typically encountered in the New Open Economy Macroeconomics literature, as for example in Obstfeld and Rogoff (1995), with the exception that the model abstracts from price stickiness as it does not focus on the short run. The model augments the standard framework in three distinct ways. First, it extends it to multiple countries. Second, it adds nontradable goods and third, as its central ingredient the model incorporates iceberg trade costs of the kind introduced by Samuelson (1954) and first included in a monopolistic competition model by Krugman (1980).

Optimizing consumers and firms inhabit J countries with $j = 1, 2,..., J$ and $J \geq 2$. The range of all consumers and of all goods produced in the world is the continuum $[0, 1]$. Country j comprises the consumer range $[n_{j-1}, n_j]$ and country-j monopolistic firms each produce one differentiated good on the same range, where $n_0 = 0$ and $n_J = 1$. It is assumed that the exogenous fraction s_j of goods is tradable so that $[n_{j-1}, n_{j-1} + s_j(n_j - n_{j-1})]$ is the range of all tradable goods produced by country j $(0 < s_j \leq 1)$.[1] These can be purchased by all consumers in the world. The remaining range $[n_{j-1} + s_j(n_j - n_{j-1}), n_j]$ represents country j's nontradable goods. The latter are available for purchase to country-j consumers only.

Exogenous bilateral "iceberg" trade costs $\tau_{j,k}$ are incurred when goods are shipped from country j to country k where

$$\tau_{j,k} \begin{cases} \geq 0 & \text{for} \quad j \neq k \\ = 0 & \text{for} \quad j = k \end{cases}$$

Iceberg trade costs mean that for each unit of goods that is shipped from j to k the fraction $\tau_{j,k}$ melts away as if an iceberg were shipped across the ocean ($\tau_{j,k} < 1$ for $j \neq k$). Note that bilateral trade costs can be asymmetric such that $\tau_{j,k} \neq \tau_{k,j}$. The assumption of zero intranational trade costs is a normalization which can also be found in Baier and Bergstrand (2001).

[1] For an empirical motivation of this assumption see Section 2.4.

2.1 Consumers

All consumers within one country are identical. They like consumption and dislike work such that their utility can be described as

$$U_j = \ln C_j + \eta \ln (1 - L_j) \tag{1}$$

where C_j and L_j denote per-capita consumption and labor input in country j. The parameter η is assumed to be identical across countries. C_j is a CES composite consumption index defined as

$$C_j \equiv \left[\sum_{k=1}^{J} \int_{n_{k-1}}^{n_{k-1}+s_k(n_k-n_{k-1})} (c_{ji})^{\frac{\rho-1}{\rho}} \,\mathrm{d}\, i + \int_{n_{j-1}+s_j(n_j-n_{j-1})}^{n_j} (c_{ji})^{\frac{\rho-1}{\rho}} \,\mathrm{d}\, i \right]^{\frac{\rho}{\rho-1}} \tag{2}$$

where c_{ji} denotes the per-capita consumption of good i in country j. The country-j consumption index (2) is defined over all tradable goods produced in the world, which is the left term within the brackets of (2), plus all nontradable goods produced by country j, which are given by the right term within the brackets. The parameter $\rho > 1$ is the elasticity of substitution and it is assumed to be identical across countries.

The consumption-based price index is defined as the minimum expenditure for one unit of C_j and can be derived from (2) as

$$P_j = \left[\sum_{k=1}^{J} \int_{n_{k-1}}^{n_{k-1}+s_k(n_k-n_{k-1})} (\xi_{ji})^{1-\rho} \,\mathrm{d}\, i + \int_{n_{j-1}+s_j(n_j-n_{j-1})}^{n_j} (\xi_{ji})^{1-\rho} \,\mathrm{d}\, i \right]^{\frac{1}{1-\rho}} \tag{3}$$

where ξ_{ji} denotes the prices of the individual goods as follows

$$\xi_{ji} = \begin{cases} \frac{1}{1-\tau_{k,j}} p_{ki}^{T} & \text{for} \quad n_{k-1} \leq i \leq n_{k-1} + s_k(n_k - n_{k-1}) \quad \forall \quad j, k \\ p_{ji}^{NT} & \text{for} \quad n_{j-1} + s_j(n_j - n_{j-1}) \leq i \leq n_j \end{cases} \tag{4}$$

p_{ki}^{T} denotes the f.o.b. (free on board) price of the tradable good produced by country-k firm i and $p_{ki}^{T}/(1 - \tau_{k,j})$ is the c.i.f. (cost, insurance, freight) price of the same good when traded with country j. p_{ji}^{NT} is the price of the nontradable good produced by country-j firm i. All prices are denominated in one world currency.

The c.i.f. price is $1/(1-\tau_{k,j})$ times the f.o.b. price because when one unit of a tradable good produced by a country-k firm is shipped to country j, only the fraction $(1 - \tau_{k,j})$ arrives at the destination. The tariff equivalent $\theta_{k,j}$ of iceberg trade costs can be expressed as

$$\theta_{k,j} = \frac{1}{1 - \tau_{k,j}} - 1 = \frac{\tau_{k,j}}{1 - \tau_{k,j}} \tag{5}$$

Maximizing consumption (2) subject to the minimum expenditure (3) yields the individual demand function

$$c_{ji} = \left(\frac{\xi_{ji}}{P_j}\right)^{-\rho} C_j \tag{6}$$

Finally, the per-capita budget constraint in country j is given by

$$P_j C_j = W_j L_j + \pi_j \tag{7}$$

where W_j is the nominal wage and π_j denotes per-capita nominal profits made by country-j firms, which are fully redistributed to country-j consumers.

2.2 Firms

There is monopolistic competition such that each firm is the single producer of one differentiated good and sets the profit-maximizing price. Not all firms within one country are symmetric since in country j the fraction s_j of firms produces tradable goods, whereas the fraction $(1 - s_j)$ produces nontradable goods. Let y_{ji}^T denote the output produced by country-j tradable firm i and y_{ji}^{NT} the output produced by country-j nontradable firm i. In addition, let $y_{ji,k}^T$ be the tradable output of firm i produced for country k so that

$$y_{ji}^T \equiv \sum_{k=1}^{J} y_{ji,k}^T \tag{8}$$

All firms face a linear production function that has constant returns to scale and that operates with labor as the only input

$$y_{ji,k}^T = A_j L_{ji,k}^T \tag{9}$$
$$y_{ji}^{NT} = A_j L_{ji}^{NT} \tag{10}$$

where A_j is an exogenous and country-specific technology level that is assumed to be the same across the tradable and nontradable sectors. $L_{ji,k}^T$ and L_{ji}^{NT} denote the amount of labor used to produce $y_{ji,k}^T$ and y_{ji}^{NT} with

$$L_{ji}^T \equiv \sum_{k=1}^{J} L_{ji,k}^T \tag{11}$$

Note that since all consumers within one country are identical, they each spread their labor over all domestic firms according to how much labor input each firm needs. Since labor is assumed to be internationally immobile, domestic consumers do not work for foreign firms.

With clearing markets it follows from demand function (6) for the tradable good produced by country-j firm i

$$(1-\tau_{j,k})\, y_{ji,k}^T = \left(\frac{\frac{1}{1-\tau_{j,k}} p_{ji}^T}{P_k} \right)^{-\rho} (n_k - n_{k-1}) C_k \tag{12}$$

The right-hand side of (12) represents the amount of the tradable good i that the $(n_k - n_{k-1})$ consumers in country k demand. The left-hand side is the amount of the same good that arrives in country k after being shipped there from country j. Accordingly, it follows for a country-j nontradable good

$$y_{ji}^{NT} = \left(\frac{p_{ji}^{NT}}{P_j} \right)^{-\rho} (n_j - n_{j-1}) C_j \tag{13}$$

The profit function for tradable firm i in country j is

$$\pi_{ji}^T = \sum_{k=1}^{J} \left(p_{ji}^T y_{ji,k}^T - W_j L_{ji,k}^T \right) \tag{14}$$

where W_j is the nominal wage that is assumed to be same in the tradable and nontradable sectors. Plugging the production function (9) and the market-clearing condition (12) into (14) and maximizing with respect to p_{ji}^T yields

$$p_{ji}^T = \frac{\rho}{\rho - 1} \frac{W_j}{A_j} \tag{15}$$

For nontradable firms the same procedure leads to

$$p_{ji}^{NT} = \frac{\rho}{\rho - 1} \frac{W_j}{A_j} \tag{16}$$

so that

$$p_{ji}^T = p_{ji}^{NT} \equiv p_j \tag{17}$$

Thus, all country-j firms set the same price p_j, irrespective of whether they produce tradable or nontradable goods.

2.3 A Gravity Equation with Trade Costs

Appendix A.1 shows that the model outlined above has a unique equilibrium solution. As one might expect, in equilibrium trade costs reduce the real wage, consumption and real profits.[2]

Since all country-j firms producing tradable goods are symmetric and since $s_j(n_j -$

[2] See equations (31)-(33) and (37) in Appendix A.1.

n_{j-1}) is the overall number of these firms, all goods that leave country j for destination country k are given by

$$EXP_{j,k} = s_j(n_j - n_{j-1})y^T_{ji,k} \tag{18}$$

where $EXP_{j,k}$ denotes real exports from j to k. Appendix A.2 shows that by using market-clearing condition (12) and plugging in the equilibrium solutions for prices and consumption, one can derive a micro-founded gravity equation that incorporates trade costs

$$EXP_{j,k}EXP_{k,j} = s_j\left(GDP_j - EXP_j\right)s_k\left(GDP_k - EXP_k\right)\left(1-\tau_{j,k}\right)^{\rho-1}\left(1-\tau_{k,j}\right)^{\rho-1} \tag{19}$$

where GDP_j is real output of country j and $EXP_j \equiv \sum\limits_{k\neq j} EXP_{j,k}$ are total real exports from j.

Of course, bilateral trade $EXP_{j,k}EXP_{k,j}$ in (19) decreases if bilateral trade costs $\tau_{j,k}$ and $\tau_{k,j}$ are higher. It also decreases if there are fewer firms that produce tradable goods, i.e. if the shares s_j and s_k are lower. Given these variables, bilateral trade is not solely determined by GDP as in traditional gravity equations, but by the terms $(GDP_j - EXP_j)$ and $(GDP_k - EXP_k)$. These terms can be interpreted as 'market potential' terms in the sense that $(GDP_j - EXP_j)$ is country-j output which is potentially tradable but not yet traded. For example, if GDP_j increases with total exports EXP_j and everything else constant, then the market potential and thus bilateral trade will increase. Vice versa, if total exports EXP_j increase with GDP_j and everything else constant, then market potential and thus bilateral trade will drop. The reason is the general equilibrium effect that in order for an increase in EXP_j to occur, trade costs with third countries must have dropped, for instance $\tau_{j,l}$ with $l \neq k$, making trade between j and k relatively more costly. Market potential takes trade into account that is conducted with third countries and that will not be diverted to country k for given trade costs.

Gravity equation (19) therefore captures what Anderson and van Wincoop (2003) call '*multilateral resistance*,' i.e. the idea that trade flows are determined by two countries' bilateral trade barriers (i.e. $\tau_{j,k}$ and $\tau_{k,j}$) relative to their average trade barriers. For example, imagine that all trade barriers $\tau_{j,l}$ between j and all countries l with $l \neq k$ go down with everything else constant including $\tau_{j,k}$. Then total exports EXP_j increase and trade between j and k drops. The total export terms EXP_j and EXP_k in (19) can therefore be referred to as multilateral resistance variables because they implicitly capture average trade barriers.

Alternatively, one can think of multilateral resistance in terms of trade destruction and trade diversion. For example, if bilateral trade barriers go up everywhere in the world except between countries j and k (i.e. $\tau_{j,k}$ and $\tau_{k,j}$ are constant), then total trade flows in the world are diminished, i.e. there is trade destruction. But j and k will redirect some of the 'destroyed' trade towards each other because the relative trade barriers between these two countries have dropped, i.e. there is trade diversion.

Baier and Bergstrand (2001) and Anderson and van Wincoop (2003) derive gravity equations which capture multilateral resistance by price indices that are difficult to observe because they are theoretical constructs. Gravity equation (19), however, captures multilateral resistance by directly observable variables and is therefore more practical.

Another advantage of gravity equation (19) is that it allows for an easy computation of the bilateral trade costs that are implied by observable trade flows. In order to identify trade costs, it is assumed that bilateral trade costs are symmetric ($\tau_{j,k} = \tau_{k,j}$), an assumption which is standard in the literature, for instance in Anderson and van Wincoop (2003). It is also assumed that the fraction of firms producing tradable goods is the same across countries ($s_j = s_k = s$).[3] Gravity equation (19) can then be rewritten as

$$\tau_{j,k} = \tau_{k,j} = 1 - \left(\frac{EXP_{j,k} EXP_{k,j}}{\left(GDP_j - EXP_j\right)\left(GDP_k - EXP_k\right) s^2} \right)^{\frac{1}{2\rho - 2}} \tag{20}$$

Intuitively, if bilateral trade flows between j and k rise all else being equal, then trade must have become less difficult between these two countries and trade costs must have gone down. Conversely, if output in either country increases without simultaneously leading to an increase in bilateral trade, then the implied trade costs must have gone up.[4] Appendix A.3 shows that expression (20) still holds even when countries run trade deficits or surpluses.[5]

Given the equilibrium solution of the model, a micro-founded single gravity equation with $EXP_{j,k}$ as the only dependent trade flow variable can be derived as

$$\begin{aligned} EXP_{j,k} = \; & \left(1 - \tau_{j,k}\right)^{\frac{(\rho-1)^2}{2\rho-1}} \left(1 - \tau_{k,j}\right)^{\frac{\rho(\rho-1)}{2\rho-1}} \left(s_j\right)^{\frac{\rho-1}{2\rho-1}} \left(s_k\right)^{\frac{\rho}{2\rho-1}} \times \\ & \left(GDP_j - EXP_j\right)^{\frac{\rho}{2\rho-1}} \left(GDP_k - EXP_k\right)^{\frac{\rho-1}{2\rho-1}} \left(\frac{POP_k}{POP_j}\right)^{\frac{1}{2\rho-1}} \end{aligned} \tag{21}$$

where POP_j is the population of country j. As a special feature of gravity equation (21), the relative population of country k is a determinant of exports from j to k. Intuitively, the

[3] See Section 2.4 for a discussion of s.

[4] Head and Ries (2001) compute a U.S.-Canadian border effect based on relative expenditure ratios but their two-country framework does not consider trade with partners outside North America and thus does not capture multilateral resistance. It does not allow for nontradable goods either. Head and Mayer (2004) derive a measure of "accessibility" of a market or "trade freeness" in the context of the New Economic Geography literature. Their measure is similar to the trade cost function (20) but it applies to specific industries only, whereas (20) holds at a higher level of aggregation. Their measure does not take into account nontradable goods and it is based on exogenous expenditure shares as opposed to general equilibrium. Furthermore, the trade cost measure derived in the current paper allows for trade cost asymmetries and trade imbalances (see equations (22) and (23) and Appendix A.3). In addition, the current paper emphasizes the evolution of empirical trade costs over time and their determinants (see Sections 3 and 4).

[5] Appendix A.3 also demonstrates how to derive a gravity equation that includes imports.

more people inhabit country k, the more imports they demand from country j.[6] Anderson (1979) points out that although most theoretical models do not lead to gravity equations that include population, in empirical applications population is nevertheless frequently used as a regressor and usually found to be significant. The present model provides a theoretical underpinning.

The single gravity equation for $EXP_{k,j}$ is like equation (21) but with the j- and k-indices swapped. Given the two single gravity equations it becomes possible to solve for trade costs as

$$\tau_{j,k} = 1 - \frac{(EXP_{k,j})^{\frac{\rho}{\rho-1}} \left(\frac{POP_k}{POP_j}\right)^{\frac{1}{\rho-1}}}{(EXP_{j,k})\,(GDP_k - EXP_k)^{\frac{1}{\rho-1}}\,(s_j)^{\frac{1}{\rho-1}}} \tag{22}$$

$$\tau_{k,j} = 1 - \frac{(EXP_{j,k})^{\frac{\rho}{\rho-1}} \left(\frac{POP_j}{POP_k}\right)^{\frac{1}{\rho-1}}}{(EXP_{k,j})\,(GDP_j - EXP_j)^{\frac{1}{\rho-1}}\,(s_k)^{\frac{1}{\rho-1}}} \tag{23}$$

Equations (22) and (23) illustrate that bilateral trade costs between two countries can differ depending on the direction of trade. For example, imagine that initially all right-hand side variables in (22) and (23) are symmetric ($EXP_{j,k} = EXP_{k,j}$, $POP_j = POP_k$ etc.) It follows $\tau_{j,k} = \tau_{k,j}$. Then suppose that all else being equal country k's market potential ($GDP_k - EXP_k$) increases, leading to $\tau_{j,k} > \tau_{k,j}$. Intuitively, if country k absorbs more goods domestically without simultaneously demanding more goods from j, then trade costs from j to k must have gone up.

But computing empirical trade costs on the basis of (22) and (23) yields implausibly volatile time series of τ because the single export series $EXP_{j,k}$ (reported by country j) and $EXP_{k,j}$ (reported by country k) often diverge erratically from year to year.[7] Empirical bilateral trade costs are therefore computed with expression (20) that makes use of the symmetry assumption $\tau_{j,k} = \tau_{k,j}$.

2.4 Data and Parameter Assumptions

Trade costs are computed on the basis of equation (20). The required export data, denominated in U.S. dollars, are taken from the IMF Direction of Trade Statistics (DOTS), and the required GDP data come from the IMF International Financial Statistics (IFS). The data are annual for a sample of 29 countries, consisting of 23 OECD countries plus six important South American and Asian countries (Argentina, Brazil, Chile, Hong Kong, India and Indonesia).[8] For some countries data are available from 1960 until 2002, for

[6] If an additional country-k consumer is born, the marginal utility she derives from her first unit of a country-j good will be higher than for an existing country-j consumer, resulting in an increase in $EXP_{j,k}$.

[7] Appendix A.3 explains the inconsistency problems that arise when trade flow data are reported by different countries. See Hummels and Lugovskyy (2006) for a discussion.

[8] The OECD countries include all current 30 OECD countries exclusive of Belgium/Luxembourg and the Czech Republic/Slovak Republic who only report jointly. Poland, Portugal and Turkey are not included

most countries only more recent data are reported. The data appendix provides details.

Computing bilateral trade costs on the basis of gravity equation (20) requires two parameter assumptions. The first is $\rho = 11$ for the elasticity of substitution, which via the optimal prices (15) and (16) corresponds to a markup of 10 percent. The elasticity of substitution is typically estimated to lie near 7 or 8 but many studies find higher values.[9] For example, under the assumption of homogeneity across industries Head and Ries (2001) obtain an estimate of 11.4 for the elasticity of substitution. Eaton and Kortum (2002) estimate ρ to be 9.28.

Intuitively, a lower ρ means that consumers are less sensitive to prices and trade costs. They should therefore be expected to trade more. To reconcile the lower price elasticity with observed trade flows, a lower ρ tends to shift the level of trade costs upwards. Fortunately, the percentage change of trade costs over time, a main focus of this paper, is considerably less dependent on ρ. For example, under $\rho = 11$ the tariff equivalent of U.S.-Canadian trade costs between 1960 and 2002 declined by 39.2 percent from 40.8 to 24.8 percent. Cutting the elasticity of substitution to $\rho = 8$ would result in a decline of 40.7 percent from 63.1 to 37.4 percent.[10]

The second assumed parameter is the fraction s of the range of firms that produce tradable goods. Stockman and Tesar (1990) say that this fraction is "difficult to estimate directly from the data" but report evidence that the expenditure on nontradable goods as a share of private final consumption ranges from 18.9 to 44.3 percent for five large OECD countries (France, Italy, Japan, United Kingdom and United States) between 1960 and 1988. As my sample includes many smaller countries, the appropriate share of nontradable goods is likely to be closer to the lower end of this range. I therefore choose $s = 0.8$, implying that the fraction of the range of goods that are nontradable is 20 percent across all economies.

Given the general decrease in trade costs over the last decades, one might expect that more goods have become tradable, as suggested in the literature on endogenous tradability, for instance by Bergin and Glick (2006). However, the IMF finds in a recent empirical analysis of globalization that based on sectoral input-output tables "unlike in many emerging market countries, the tradables sector share output in most industrial countries has actually fallen slightly in recent years because of the rapid expansion of service sectors" (IMF 2005, p. 131). Since my sample includes both industrial countries and some emerging market economies, the overall effect on s is unclear. But even if there has been a slight downward trend in s, the resulting additional decrease in trade costs would be small. For example, cutting s from 0.8 to 0.75 would merely reduce the 2002

because of limited data availability.

[9] See the survey given in Anderson and van Wincoop (2004, Section 3.6).

[10] The regression results in Section 4 are not qualitatively affected when trade costs are computed with $\rho = 5$ instead of $\rho = 11$, see the discussion in Section 4.3.

tariff equivalent of U.S.-Canadian trade costs from 24.8 to 24.1 percent.

3 Trade Costs over Time

Most empirical studies estimate trade costs for a given period only.[11] Using annual data for 1960-2002, this section examines how bilateral trade costs have evolved over time. Its guiding question is 'By how much and how quickly have trade costs fallen (if at all) for which country pairs?' Comprehensive iceberg trade costs are computed on the basis of equation (20) and then converted into the tariff equivalent through (5).

3.1 Bilateral Trade Costs in the U.S. and UK

This subsection scrutinizes bilateral trade costs for the United States and for the United Kingdom as two eminent examples. The UK is picked as the second biggest European economy after Germany whose data show a structural break in the wake of reunification.

Table 1 gives a snapshot of U.S. bilateral trade costs for the years 1960 and 2002. U.S. bilateral trade costs have fallen with almost all trading partners in the sample except for slight increases in the cases of Chile and Iceland. The decline in trade costs has been most dramatic for the two adjacent countries Canada and Mexico but also for Ireland and Korea which have experienced strong economic growth relative to other countries in the sample.

The levels of the tariff equivalents across countries vary substantially from 24.8 percent for Canada up to 171 percent for Greece in 2002. The average magnitude is consistent with values typically put forward in the literature. For example, Anderson and van Wincoop (2004, p. 692) find that the representative tariff equivalent of international trade costs is 74 percent.

Table 2 is the UK counterpart to Table 1. Unlike the United States the UK displays a number of remarkable increases in trade costs between 1960 and 2002, mostly with former colonies that are far away such as Australia, Canada, India and New Zealand. The increases seem less staggering if one takes into account that the initial 1960 tariff equivalents for these countries are comparatively low. What the U.S. and the UK have in common is that except for Korea the most dramatic declines in trade costs have occurred with nearby countries, in this case France, Germany, Ireland, the Netherlands and Spain. These countries also exhibit the lowest levels of trade costs.

[11] Amongst others, exceptions are Hummels (1999) who considers transportation costs, Head and Mayer (2000) who investigate border effects within the European Union from 1976 to 1995 and Coulombe (2005) who investigates the U.S.-Canadian border effect between 1981 and 2000.

Table 1: U.S. Bilateral Trade Costs

	Tariff equivalent θ		
Partner country	1960	2002	Percentage change
Argentina		77.9	
Australia	77.0	66.1	−14.2
Austria		76.7	
Brazil		59.7	
Canada	40.8	24.8	−39.2
Chile	67.8	68.4	+0.9
Denmark		80.5	
Finland	92.3	76.7	−16.9
France	73.6	61.0	−17.1
Germany	62.9	53.4	−15.1
Greece		171.0	
Hungary		85.9	
Iceland	92.3	96.5	+4.6
India	75.4	73.6	−2.4
Indonesia		69.2	
Ireland	88.7	46.8	−47.2
Italy	69.8	65.6	−6.0
Japan	57.7	50.6	−12.3
Korea	103.3	49.9	−51.7
Mexico	58.5	30.9	−47.2
Netherlands	61.3	53.6	−12.6
New Zealand	78.9	74.8	−5.2
Norway		78.9	
Poland		101.6	
Portugal		92.3	
Spain	83.8	79.5	−5.1
Sweden	75.1	68.6	−8.7
Switzerland	70.9	61.0	−14.0
Turkey		79.9	
UK	60.3	54.1	−10.3

All values are percentage values.
Blank cells: data not available.
Computations based on (5) and (20).

Table 2: UK Bilateral Trade Costs

	Tariff equivalent θ		
Partner country	1960	2002	Percentage change
Argentina		98.0	
Australia	44.5	66.9	+50.3
Austria		61.8	
Brazil		79.9	
Canada	47.5	67.8	+42.7
Chile	70.4	87.6	+24.4
Denmark		52.4	
Finland	52.9	56.7	+7.2
France	64.7	41.6	−35.7
Germany	57.7	38.9	−32.6
Greece	79.9	137.5	+72.1
Hungary		61.3	
Iceland	75.1	73.6	−2.0
India	57.0	72.7	+27.5
Indonesia		81.8	
Ireland	36.4	23.0	−36.8
Italy	64.2	50.8	−20.9
Japan	81.8	70.9	−13.3
Korea	124.2	68.4	−44.9
Mexico	95.3	94.6	−0.7
Netherlands	45.3	32.6	−28.0
New Zealand	39.3	79.2	+101.5
Norway		50.2	
Poland		67.2	
Portugal		61.0	
Spain	68.9	49.4	−28.3
Sweden	49.0	51.1	+4.2
Switzerland	62.3	55.3	−11.2
Turkey		66.7	
United States	60.3	54.1	−10.3

All values are percentage values.
Blank cells: data not available.
Computations based on (5) and (20).

3.2 The G7 and European Union Countries

Bilateral trade costs are computed amongst the G7 countries between 1960 and 2002.[12] Figure 1 plots each country's average bilateral tariff equivalent with the other G7 countries, weighted by each trading partner's share of combined G7 exports.

As Figure 1 shows, all seven countries have experienced a steady decline in their average tariff equivalents. The decline is strongest for Canada, resulting in the lowest 2002 tariff equivalent (26.6 percent), and the decline is weakest for Japan, resulting in the highest 2002 tariff equivalent (55.3 percent). In a world of increased regional economic integration it is not surprising that the Japanese decline is the least pronounced, given that geographically Japan is most isolated from the other G7 countries.[13]

The top graph in Figure 2 depicts the average of the graphs in Figure 1, weighted by each country's share of total exports amongst G7 countries. The values of the top graph can be interpreted as the representative intra-G7 tariff equivalent. Between 1960 and 2002 it fell by 26.5 percent from 55 to 40.5 percent, consistent with the 74 percent tariff equivalent of international trade costs suggested by Anderson and van Wincoop (2004) for a broader range of countries. As a comparison, the bottom graph plots the tariff equivalent based on the world c.i.f./f.o.b. ratio that is reported by the IMF as a measure of transportation costs. It dropped from 7.6 percent in 1960 to 3.3 percent in 2002. Anderson and van Wincoop suggest a higher value for transportation costs (10.7 percent) but in either case, transportation costs constitute only a fraction of overall trade costs.[14]

As for the G7 subsample, trade costs are weighted and averaged for a subsample of 13 European Union (EU) countries between 1977 and 2002.[15] The 2002 average tariff equivalent is highest for Greece with 122 percent and lowest for the Netherlands with 33 percent. Between 1977 and 2002 the representative intra-EU tariff equivalent fell by 17.7 percent from 47.5 to 39.1 percent. The corresponding representative G7 values are 45.1 and 40.5 percent so that in comparison, EU trade costs were higher in 1977 but slightly lower in 2002. Over the past 30 years trade costs have therefore fallen more rapidly within the European Union than amongst G7 countries. This finding is consistent with the previous observation that economic integration has increased fastest amongst nearby countries.

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[12] The G7 countries are Canada, France, Germany, Italy, Japan, the UK and the U.S.

[13] Japan is not only geographically the most isolated amongst the G7 countries. Japan does not share a common language, a colonial history nor a free trade agreement with any other G7 country, see Section 4.

[14] See Anderson and van Wincoop (2004, Section 2.2) for a discussion of transportation costs. The c.i.f./f.o.b. tariff equivalent is computed from the world import and export series reported in the IMF Direction of Trade Statistics. These data should be treated with caution though since their quality is questionable, see Hummels and Lugovskyy (2006) for a discussion.

[15] The 13 EU countries are the 15 EU member countries prior to the 2004 Eastern enlargement exclusive of Belgium/Luxembourg who only report jointly. Some data prior to 1977 are missing.

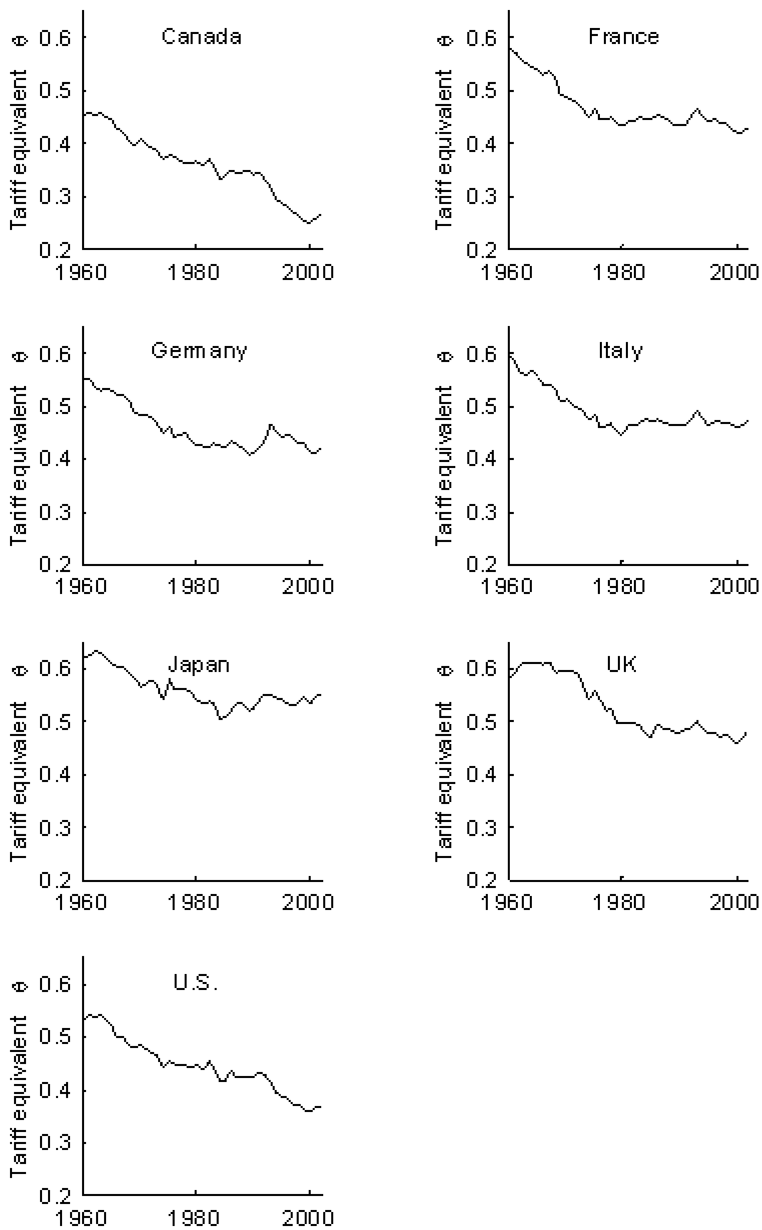

Figure 1: Weighted averages of bilateral trade costs amongst G7 countries (measured as tariff equivalent).

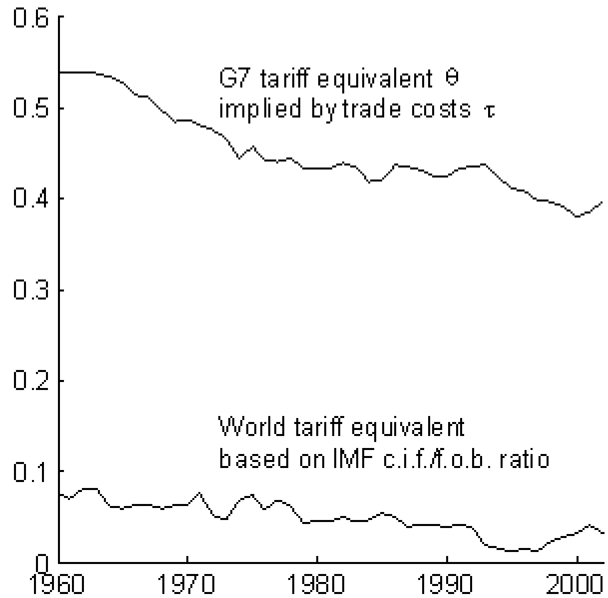

Figure 2: G7 trade costs and the IMF world c.i.f./f.o.b. ratio (both measured as tariff equivalent).

3.3 An Increase in Regional Economic Integration

Tables 1 and 2 exhibit the pattern that U.S. and UK bilateral trade costs have fallen most dramatically for nearby trading partners. In fact, this pattern applies more generally for the sample of 29 countries described in Section 2.4, suggesting that over the past few decades there has been an increase in regional economic integration.

Table 3 formally demonstrates for a panel of 339 country pairs that regional integration has improved between 1970 and 2000. In a regression of the percentage decline in tariff equivalents, the coefficient of the logarithm of distance is negative and significant. This result holds up even if intra-European trade relations are not included in the sample.[16]

In other words, although absolute trade flows have increased for virtually all country pairs, relative trade flows have been diverted towards nearby countries. Coughlin (2004) comes to the same conclusion from the perspective of individual U.S. states in an analysis of merchandise exports. Bayoumi and Eichengreen (1997) find evidence of relative trade diversion in that the formation of the European Community lowered the growth in trade with other industrial countries by 1.7 percentage points. The results in Table 3 suggest that the diversion of relative trade to nearby countries did not only take place amongst

[16] In results not reported here, in both regressions the fit is even better if the level of distance is used as a regressor.

Table 3: The Decline in Tariff Equivalents θ and Distance

	Percentage decline in θ_{jk}, 1970-2000	
Constant	0.537^{**}	0.306
	(4.20)	(0.58)
ln(Distance)	-0.062^{**}	-0.058^{*}
	(−5.67)	(−2.14)
Country fixed effects	yes	yes
Intra-European pairs included	yes	no
Number of observations	339	224
R^2	0.555	0.527

The dependent variable is the percentage decline in θ_{jk},
defined as $(\theta_{jk,1970} - \theta_{jk,2000})/\theta_{jk,1970}$.
Robust OLS estimation, t-statistics given in parentheses.
** and * indicate significance at the 1 and 5 percent levels.

European nations. Similarly, Frankel, Stein and Wei (1997) identify the Americas, Europe and Pacific Asia as continental trading blocs that have a high degree of internal integration.

As free trade agreements have typically been concluded with nearby countries, they have certainly contributed to the increase in regional economic integration, see Venables (2001) for a discussion. Another reason could be evidence reported by Hummels (1999) that over recent years the cost of overland transport has declined relative to ocean transport, which might have disproportionately favored shorter distances.

4 The Determinants of Trade Costs

Trade costs can vary substantially across country pairs. An obvious question to ask is which factors can explain this variation. For instance, why is the G7 average tariff equivalent so much lower for Canada (26.6 percent) than for Japan (55.3 percent)? A trade cost panel of 339 country pairs for the years 1970, 1980, 1990 and 2000 is used in an attempt to explain this variation.[17]

The factors that have the potential to explain trade costs can be divided into three rough groups. The first group consists of *geographical* factors like distance between two trading partners and contiguity. Both distance and contiguity can be seen as proxies for transportation costs and information costs which tend to be lower for nearby trading partners.

The second group of potential determinants of trade costs is formed by *historical* factors. These include variables that capture whether two countries had a colonial rela-

[17] The trade cost panel includes the following 29 countries (but not all possible country pair combinations): Argentina, Australia, Austria, Brazil, Canada, Chile, Hong Kong, Denmark, Finland, France, Germany, Greece, Hungary, Iceland, India, Indonesia, Ireland, Italy, Japan, Korea, Mexico, the Netherlands, New Zealand, Norway, Spain, Sweden, Switzerland, the UK and the U.S. The 1970 tariff data are incomplete such that only 273 observations can be included for that year.

tionship in the past (e.g. the UK and Australia) and whether they share the same official language. Countries that had a colonial relationship in the past often have strong historical trade linkages and countries with the same official language might find it easier to communicate.

The third group of trade cost determinants consists of *institutional* factors. Two obvious candidates in this group are tariffs and free trade agreements. Another factor that potentially determines trade costs is nominal exchange rate volatility. If exchange rate volatility is reduced, exchange rate risk decreases and trade should become less costly.[18]

Most of the variables just mentioned are common regressors in the gravity literature, for example in Rose (2000) and Fitzgerald (2005). The variables are usually regarded *ex ante* as trade cost components and have therefore been directly included into gravity regressions. If such traditional gravity regressions are estimated with the present data set, the coefficients fall squarely into the range typically suggested in the gravity literature. One can therefore exclude the possibility that the results reported in the following are driven by peculiarities of the particular sample.

4.1 Baseline Results

Trade costs are linked to their determinants by the following baseline regression

$$\begin{aligned}\theta_{jkt} = \; & \beta_0 + \beta_1 \ln(Distance_{jk}) + \beta_2 Common\ Border_{jk} + \beta_3 Colonial_{jk} \\ & + \beta_4 Common\ Language_{jk} + \beta_5 Tariffs_{jkt} \\ & + \beta_6 FTA_{jkt} + \beta_7 ERVolatility_{jkt} + \varepsilon_{jkt}\end{aligned} \tag{24}$$

$\ln(Distance_{jk})$ denotes the natural logarithm of distance in km between countries j and k. $Common\ Border_{jk}$ is a contiguity dummy which takes on the value 1 if the two trading partners share a common border. $Colonial_{jk}$ is a dummy indicating a past colonial relationship between j and k. The $Common\ Language_{jk}$ dummy indicates whether the two countries have the same official language. All these geographical and historical regressors do not change over time.

But the institutional regressors are time-variant. $Tariffs_{jkt}$ is a joint measure of tariffs for countries j and k that is based on country ratings of tariff regimes published by the Fraser Institute in the Freedom of the World Report. The joint measure is constructed by multiplying the single-country ratings and then taking natural logarithms. FTA_{jkt} is a dummy variable for free trade agreements such as NAFTA and the European Common Market. $ERVolatility_{jkt}$ measures the volatility of the nominal exchange rate between j and k over the five years preceding t as the standard deviation of the first differences of the monthly logarithmic nominal exchange rates.[19] ε_{jkt} is the error term. The data

[18] Anderson (2004) surveys the role of informal institutions, for example corruption and predation.

[19] A common currency dummy does not make much sense in this particular sample because it would

Table 4: Baseline Regression (24)

Regressors	Regression: Pooled	1970	1980	1990	2000
Geographical factors					
ln(Distance)	0.109**	0.097**	0.065**	0.113**	0.182**
	(9.38)	(4.28)	(3.03)	(4.40)	(7.86)
Common Border	−0.154**	−0.081	−0.183**	−0.179**	−0.115
	(−5.88)	(−1.39)	(−3.58)	(−3.41)	(−1.81)
Historical factors					
Common Language	−0.189**	−0.262**	−0.190**	−0.188**	−0.204**
	(−10.30)	(−5.62)	(−5.79)	(−5.10)	(−5.57)
Colonial	−0.223**	−0.480**	−0.205**	−0.184**	−0.099
	(−6.41)	(−5.92)	(−3.40)	(−3.55)	(−2.24)
Institutional factors					
Tariffs	0.032**	0.182**	0.031**	0.032**	0.302**
	(6.97)	(3.48)	(4.81)	(4.47)	(5.13)
Free Trade Agreement	0.019	−0.258**	−0.123**	0.122	0.170**
	(0.65)	(−5.03)	(−2.65)	(1.97)	(3.02)
Exchange Rate Volatility	0.007**	−0.016	0.012**	0.012**	−0.020**
	(3.37)	(−1.70)	(2.72)	(4.14)	(−4.60)
1980 dummy	−0.069				
	(−2.47)				
1990 dummy	−0.093**				
	(−3.29)				
2000 dummy	−0.126**				
	(−4.64)				
Constant	0.145	0.921**	0.436	−0.043	0.586
	(1.43)	(3.58)	(2.30)	(−0.19)	(1.73)
Number of observations	1290	273	339	339	399
R^2	0.252	0.255	0.294	0.282	0.307

The dependent variable is the tariff equivalent θ_{jkt}.
Robust OLS estimation, t-statistics given in parentheses.
** indicates significance at the 1 percent level.

appendix explains the variables in more detail and gives the exact data sources.

Note that the dependent variable is the tariff equivalent θ_{jkt}, not iceberg trade costs τ_{jkt}. This choice renders the interpretation of the β coefficients more intuitive. In regression (24) the individual β's represent the percentage point changes in the tariff equivalent in response to marginal changes in the regressors. The choice of the tariff equivalent over iceberg trade costs leaves the statistical significance of the regressors virtually unaffected.[20]

Table 4 reports the results of regression (24), both for pooled data and individual years. In the pooled regression all geographical, historical and institutional variables have the expected signs and are significant at the 1 percent level except for the free trade agreement dummy. The year-specific dummies are negative, reflecting the drop in trade costs over time.

only apply to the eurozone countries for the year 2000. Instead, currency arrangements are reflected in low eurozone exchange rate volatilities for 1995-1999.

[20] The correlation of θ and τ is over 95 percent.

The quantitative effects of the dummy variables are strongest for the historical factors. If two countries had a colonial relationship, their bilateral tariff equivalent is 22 percentage points lower compared to two countries without a mutual colonial relationship. But note from the single-year regressions that this impact of a common colonial history has washed out over time. Sharing the same official language reduces the tariff equivalent by 19 percentage points.

As the institutional variables change over time, their coefficients are more difficult to interpret. Tariffs are significant in all single years. Between 1990 and 2000 there was a marked drop in tariffs, leading to an increase in the magnitude of the 2000 coefficient. Similarly, the number of free trade agreements has increased over time, especially between 1990 and 2000. The unexpected positive coefficients for 1990 and 2000 might arise because the effects of free trade agreements take time to materialize. Indeed, using the 1980 trade agreement values in the regressions for 1990 and 2000 yields the expected negative signs.

Exchange rate volatility in the panel increased markedly after the collapse of the Bretton Woods system, explaining the positive and significant coefficients for 1980 and 1990, but decreased considerably during the 1990s. As Table 5 demonstrates, however, exchange rate volatility is no longer significant once country fixed effects are included.

4.2 Fixed Effects and Additional Regressors

It might be the case that the baseline results presented in Table 4 are driven by country-specific characteristics that cannot be observed. In order to control for this possibility, country fixed effects are included. Indeed, a likelihood ratio test overwhelmingly rejects the pooled baseline regression in favor of a fixed effects specification. The R^2 is also markedly enhanced by country fixed effects. These results hint at a sizeable degree of heterogeneity across countries.

In addition, trade costs might also be determined by factors that so far have been omitted. I therefore augment baseline regression (24) by six additional variables that are less frequently used in the gravity literature. Three of the additional variables represent geographical features, namely the trading partners' joint surface area, a landlocked variable and an island variable. The landlocked and island variables take on the value 1 if one of the trading partners is landlocked or an island and the value 2 if both partners are landlocked or islands. The remaining three variables indicate institutional features, namely the governments' shares of consumption, inflation rates and the extent of capital controls. These three variables are also based on country ratings published in the Freedom of the World Report. Again, the joint measures are constructed by multiplying the single-country ratings and then taking natural logarithms. The data appendix explains the additional regressors in more detail. Table 5 reports the results of the augmented fixed effects regressions.

Table 5: Fixed Effects and Additional Regressors

	Regression				
Regressors	Pooled	1970	1980	1990	2000
Geographical factors					
ln(Distance)	0.168**	0.159**	0.196**	0.172**	0.162**
	(25.94)	(10.77)	(16.04)	(10.73)	(11.74)
Common Border	0.006	0.034	0.011	0.007	−0.019
	(0.31)	(0.78)	(0.28)	(0.17)	(−0.49)
Area	0.049**	0.051**	−0.009	0.003	0.003
	(15.67)	(6.23)	(−2.35)	(1.25)	(1.38)
Landlocked	0.218**	−0.073	0.196**	0.245**	0.252**
	(7.54)	(−1.53)	(5.74)	(7.61)	(8.65)
Island	−0.196**	−0.365**	−0.040	0.192**	0.332**
	(−6.77)	(−5.61)	(−0.43)	(6.98)	(4.82)
Historical factors					
Common Language	−0.103**	−0.147**	−0.128**	−0.086**	−0.071**
	(−6.82)	(−4.26)	(−3.89)	(−2.85)	(−2.94)
Colonial	−0.160**	−0.237**	−0.182**	−0.143**	−0.085
	(−6.34)	(−5.40)	(−5.94)	(−4.17)	(−2.49)
Institutional factors					
Tariffs	0.007	0.134**	0.033	0.049**	−0.000
	(1.69)	(2.84)	(2.42)	(9.83)	(−0.46)
Free Trade Agreement	−0.054**	−0.135**	0.054	−0.034	−0.044
	(−3.85)	(−3.77)	(1.84)	(−1.09)	(−1.59)
Exchange Rate Volatility	0.001	0.023	−0.020	0.002	0.011
	(0.37)	(1.28)	(−1.42)	(0.16)	(0.78)
Gov. Consumption	0.023	−0.080	0.094**	0.266**	0.225**
	(1.44)	(−0.79)	(5.12)	(12.04)	(10.32)
Inflation	0.000	−0.337**	0.050**	0.015	0.000
	(0.01)	(−2.61)	(4.03)	(1.43)	(0.07)
Capital Controls	0.002	0.002	0.019	0.005	0.002**
	(0.91)	(0.27)	(1.44)	(1.31)	(8.73)
1980 dummy	−0.074**				
	(−4.77)				
1990 dummy	−0.085**				
	(−5.40)				
2000 dummy	−0.150**				
	(−7.72)				
Constant	−1.562**	−2.690**	−0.178	0.049	0.759
	(−12.89)	(−5.54)	(−1.23)	(0.30)	(0.74)
Country fixed effects	yes	yes	yes	yes	yes
Number of observations	1290	273	339	339	339
R^2	0.859	0.848	0.887	0.893	0.895

The dependent variable is the tariff equivalent θ_{jkt}.

Robust OLS estimation, t-statistics given in parentheses.

** indicates significance at the 1 percent level.

As in the baseline specification of Table 4 the distance coefficient is highly significant and similar in magnitude over time, an observation which is consistent with the meta-analysis by Disdier and Head (2005) who consider 1052 distance effects stemming from 78 different studies. Apart from the year 2000 the language and colonial dummies are also highly significant but have become less important over time. In particular, the language estimate is in line with Hummels' (2001) finding and Eaton and Kortum's (2002) estimate for 1990 data. The finding that the language coefficient has subsided over time does not necessarily mean though that speaking the same language is less important nowadays. The lower language barrier might simply reflect the fact that an increasing number of people across the world have learned English as a foreign language.[21]

The area, landlocked and island regressors have the expected signs and are significant in the pooled regression. But it is striking that after 1970 area is no longer a significant impediment to trade. This finding suggests that infrastructure might have been built that helped overcome the difficulties associated with large internal distances. Being an island was an advantage in 1970 but then turned into a disadvantage, possibly because the benefits of having easy access to the sea have faded and the costs of being on the geographical periphery have increased.[22]

If two countries are part of the same free trade agreement, their bilateral trade costs are reduced by about five percentage points. Tariffs are no longer significant for 1980 and 2000. The government consumption variable has a positive and significant coefficient after 1970 when government consumption as a fraction of total GDP was highest. This is likely to reflect the fact that governments spend their budgets disproportionately on domestically produced goods and domestic labor. Inflation was only an impediment to trade in 1980 when its level was generally high. Capital controls show up as an impediment to trade in 2000 only.

More generally, it can be concluded that the effects of institutional factors are less persistent and steady than those of geographical and historical factors. This finding is consistent with the relatively small role that policy related barriers play in determining total trade costs. Anderson and van Wincoop (2004) calculate that policy related barriers including tariffs and trade agreements make up only eight out of the 44 percentage points associated with border related barriers.

4.3 Discussion

The empirical results of Tables 4 and 5 are generally consistent with estimates reported in the literature. However, some special attention is warranted for the border and exchange

[21] For example, see the British Council's report on the English language made available at `http://www.britishcouncil.org/english/pdf/future.pdf`.

[22] There are seven islands in the sample: Australia, Iceland, Indonesia, Ireland, Japan, New Zealand and the UK.

rate volatility variables, the fixed effects as well as the free trade agreement dummy.

In the pooled baseline regression of Table 4 the beneficial effect of sharing a common border is highly significant. Being neighboring countries reduces the tariff equivalent by 15 percentage points. An interesting observation is that once country fixed effects are taken into account in Table 5, the contiguity effect completely disappears. This finding suggests that without fixed effects a border dummy might erroneously pick up country-specific characteristics. Similarly, exchange rate volatility is no longer significant when fixed effects are included, indicating that this variable, too, might otherwise erroneously pick up country-specific features. The same caution should be exercised when making inference about these regressors in traditional gravity equations. Indeed, Anderson and van Wincoop (2003) point out the fixed effects specification as a consistent estimation method for gravity equations.

The country fixed effects themselves carry important information. They are positive and significant for Greece and Iceland but they are negative and significant for Brazil, Canada, Chile, France, Germany, Italy, Sweden, Switzerland and the U.S.[23] It is difficult to give a general explanation for these effects because by construction they capture unobserved characteristics. But at least in the case of Greece the excessive level of trade costs might be related to poor data quality.[24]

It might at first seem surprising that the effects of free trade agreements are so limited. Once country fixed effects are included into the pooled regressions, the tariff equivalent drops by merely five percentage points when two countries conclude a free trade agreement. As mentioned earlier though, using lagged values bolsters the estimated magnitudes because the beneficial effects of free trade agreements need time to materialize. But in general, time series evidence suggests that the effects of trade agreements are moderate. For example, Head and Mayer (2000) are unable to associate the implementation of the 1986 Single European Act with a significant drop in EU trade costs. In the same vein, Rose (2004) finds that WTO membership does not lead to a significant change of trade patterns.

A number of robustness checks have been performed for the results of Tables 4 and 5. Computing trade costs based on an elasticity of substitution $\rho = 5$ instead of $\rho = 11$ leaves the significance and signs of coefficients virtually unchanged. Furthermore, the residuals of the trade cost regressions might be spatially correlated because if a certain country is hit by a shock, its neighbors are more likely affected than remote countries.

[23] It is not possible to include country *random* effects instead of country fixed effects because each observation is associated with two countries. The random effects specification becomes an option though for *country-pair* effects. However, a Hausman test resoundingly rejects country-pair random effects in favor of country-pair fixed effects. When country-pair fixed effects are included, the coefficients reported in Table 5 for the institutional factors are virtually unchanged. But of course, country-pair fixed effects absorb the time-invariant geographical and historical factors and are therefore less informative.

[24] The Greek GDP figures are extraordinarily high relative to trade flows, resulting in high trade costs.

To check for this possibility, I regress the residuals on continental dummies but find only weak correlation for the regressions of Table 4 and no spatial correlation at all for the fixed effects specifications of Table 5.[25] In addition, trade cost regressions that allow for cluster effects associated with individual countries or continents produce results very similar to those in Tables 4 and 5.

Finally, my results are not sensitive to the exclusion of particular countries like the U.S. or UK from the sample. As long as country fixed effects are taken into account, the results are not even sensitive to the exclusion of all intra-European trade relations. Similarly, the results hold up when the sample is restricted to trade relations between rich countries.[26]

The period after World War II is not unprecedented as a time of enormous trade expansion and forceful international economic integration. The first era of globalization is generally considered to be the trade boom that started in the late 19th century and continued until the beginning of World War I. Using the model developed in the present paper, Jacks, Meissner and Novy (2006) find that the average tariff equivalent of trade costs stood at 72 percent in 1870 and at 61 percent in 1913, implying a drop of 15 percent over four decades. In comparison, the average G7 tariff equivalent declined more rapidly from 55 percent in 1960 to 40.5 percent in 2002, a drop of 26.5 percent over four decades. Apart from distance, important determinants of 19th century trade costs were tariffs, railroad infrastructure, exchange rate regime coordination through the Gold Standard and, similar to the post-World War II period, a common colonial history as well as the use of a common language.

5 Conclusion

This paper develops a new micro-founded measure of international trade costs. It is based on a multi-country general equilibrium model of trade with bilateral iceberg trade costs as its central ingredient. The model results in a gravity equation from which the implied trade costs can be computed as a comprehensive measure of international trade barriers. The measure is intuitive, takes into account multilateral resistance and can easily be computed using directly observable variables only.

The empirical results obtained through the trade cost measure are economically sensible and consistent with the literature. During the post-World War II period trade costs

[25] The dummies are defined as intracontinental binary variables (for North America, South America, Europe, Asia and Oceania), i.e. they only take on the value 1 if both countries in a pair are on the same continent.

[26] Rich countries are defined as those with per-capita income of over US$ 20,000 in 2002 according to UN data. This threshold excludes the South American countries as well as Greece, Hungary, India, Indonesia, Mexico, New Zealand, Korea and Spain. The exclusion of non-rich countries cuts the sample size by more than half (by 690 observations in the pooled data set).

have declined markedly. For the G7 countries they fell by 26.5 percent between 1960 and 2002, and for European Union countries trade costs decreased by 17.7 percent between 1977 and 2002. For both subsamples the 2002 tariff equivalent of trade costs stood at roughly 40 percent. In addition, the paper finds clear evidence that over the past few decades, relative trade flows have been diverted away from remote trading partners towards nearby countries, implying an increase in regional economic integration.

The dispersion of trade costs across country pairs can best be explained by geographical factors like distance but also by historical factors. Sharing a common colonial history cuts the tariff equivalent by 16 percentage points, whereas having the same official language reduces trade barriers by 10 percentage points. Institutional factors such as free trade agreements, tariffs and exchange rate volatility also matter but generally have a smaller impact. For example, entering a free trade agreement on average decreases trade costs by only 5 percentage points.

After controlling for these factors trade costs still vary considerably across countries, indicating a high degree of heterogeneity. Trade costs tend be high for Greece and Iceland but low for Brazil, Canada, Chile, France, Germany, Italy, Sweden, Switzerland and the United States.

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A A Model with Iceberg Trade Costs

This appendix outlines how to derive the theoretical results presented in Section 2. Appendix A.1 focuses on the equilibrium solution of the model. Appendix A.2 derives the results of Section 2.3. Appendix A.3 demonstrates how to derive a gravity equation that includes imports and shows that the trade cost expression (20) holds even when countries run trade deficits or surpluses.

Since within one country all firms producing tradable goods are symmetric and all firms producing nontradable goods are also symmetric, the index i will be dropped in the following.

A.1 Equilibrium of the Model

Each country-j consumer maximizes utility (1) subject to budget constraint (7), leading to the optimal labor supply condition

$$\frac{\eta}{1-L_j} = \frac{W_j}{P_j C_j} \tag{25}$$

In order to solve the model it is useful to define per-capita output, per-capita labor supply and per-capita profits as

$$y_j \equiv s_j y_j^T + (1-s_j) y_j^{NT} \tag{26}$$
$$L_j \equiv s_j L_j^T + (1-s_j) L_j^{NT} \tag{27}$$
$$\pi_j \equiv s_j \pi_j^T + (1-s_j) \pi_j^{NT}$$

where y_j^T is the same as y_{ji}^T from (8), L_j^T is the same L_{ji}^T as from (11) and π_j^T is the same as π_{ji}^T from (14). The remaining right-hand side variables are the corresponding variables for nontradable firm i. Using the production functions (9) and (10) as well as the price markups (15)-(17) it follows

$$\pi_j = p_j y_j - W_j L_j$$

Combined with budget constraint (7) and the optimal labor supply condition (25) this yields the optimal per-capita labor supply

$$L_j = \frac{\rho - 1}{\rho - 1 + \rho\eta} \tag{28}$$

Express nominal wages across countries as

$$\alpha_1 W_1 = \alpha_2 W_2 = ... = \alpha_j W_j = ... = \alpha_J W_J$$

where the α's are auxiliary parameters yet unknown. It follows from the price markups

(15)-(17) that

$$p_k = p_k^T = \frac{\rho}{\rho-1}\frac{W_k}{A_k} = \frac{\rho}{\rho-1}\frac{\alpha_j}{\alpha_k}\frac{W_j}{A_k} \tag{29}$$

Use (29) in price index (3) to derive

$$P_j = \omega_j^{\frac{1}{1-\rho}}\frac{\rho}{\rho-1}W_j$$

where

$$\omega_j \equiv \left(\sum_{k=1}^{J} s_k(n_k-n_{k-1})(A_k\,(1-\tau_{k,j})\,\frac{\alpha_k}{\alpha_j})^{\rho-1}\right) + (1-s_j)\,(n_j-n_{j-1})A_j^{\rho-1} \tag{30}$$

An expression for the real wage follows directly as

$$\frac{W_j}{P_j} = \frac{\rho-1}{\rho}\omega_j^{\frac{1}{\rho-1}} \tag{31}$$

Using budget constraint (7) and the optimal labor supply condition (25), expressions for consumption and real profits follow as

$$C_j = L_j\omega_j^{\frac{1}{\rho-1}} \tag{32}$$

$$\frac{\pi_j}{P_j} = \frac{L_j}{\rho}\omega_j^{\frac{1}{\rho-1}} \tag{33}$$

as well as

$$C_k = C_j\left(\frac{\omega_k}{\omega_j}\right)^{\frac{1}{\rho-1}} \tag{34}$$

To solve for the α's in (30), start off with (26) and plug in the market-clearing conditions (12) and (13). Then substitute in for prices and consumption using (15)-(17), (29), (31) and (34) to yield

$$\begin{aligned}\frac{y_j}{A_j} = \; & C_j\omega_j^{\frac{-\rho}{\rho-1}}\left\{\left(\sum_{k=1}^{J} s_k(n_k-n_{k-1})(A_k\,(1-\tau_{k,j}))^{\rho-1}\left(\frac{\omega_j}{\omega_k}\frac{s_j}{s_k}\left(\frac{A_j}{A_k}\frac{(1-\tau_{j,k})}{(1-\tau_{k,j})}\right)^{\rho-1}\right)\left(\frac{\alpha_k}{\alpha_j}\right)^{-\rho}\right)\right. \\ & \left. + (1-s_j)\,(n_j-n_{j-1})A_j^{\rho-1}\right\}\end{aligned} \tag{35}$$

From the production functions (9) and (10), definitions (26) and (27) and expression (32) it follows

$$L_j = \frac{y_j}{A_j} = C_j\omega_j^{\frac{-1}{\rho-1}}$$

It must therefore be the case that the curly brackets in (35) are equal to ω_j as defined in

(30). Setting the curly brackets equal to ω_j and using (30) yields

$$\frac{\alpha_k}{\alpha_j} = \left(\frac{\omega_j}{\omega_k} \frac{s_j}{s_k} \left(\frac{A_j}{A_k} \frac{(1-\tau_{j,k})}{(1-\tau_{k,j})} \right)^{\rho-1} \right)^{\frac{1}{2\rho-1}} \tag{36}$$

Finally, plug (36) back into (30) to obtain

$$\omega_j = \left(\sum_{k=1}^{J} s_k (n_k - n_{k-1}) (A_k (1-\tau_{k,j}))^{\rho-1} \left(\frac{\omega_j}{\omega_k} \frac{s_j}{s_k} \left(\frac{A_j}{A_k} \frac{(1-\tau_{j,k})}{(1-\tau_{k,j})} \right)^{\rho-1} \right)^{\frac{\rho-1}{2\rho-1}} \right. \\ \left. + (1-s_j)(n_j - n_{j-1}) A_j^{\rho-1} \right) \tag{37}$$

The system of polynomial equations represented by (37) for $j = 1, 2, ..., J$ cannot be solved analytically. However, it can be established numerically by repeated substitution that a unique solution exists for the ω's for all combinations of admissible exogenous parameter values. The admissible parameter values are $0 < n_k - n_{k-1} < 1$, $0 < s_k \leq 1$, $\rho > 1$, $A_k > 0$ and $0 \leq \tau_{k,j} < 1$ for all j, k. The implicit function theorem can be applied to compute the partial effects of changes in exogenous parameters on the ω's.

The ω's give rise to sensible general equilibrium effects for the real wage, consumption and real profits in equations (31)-(33). For example, a technology improvement in A_j increases ω_j and therefore the real wage, consumption and real profits for country-j citizens but, to a smaller extent, it also increases the other ω's and is thus also beneficial to foreign citizens.

A.2 A Gravity Equation with Trade Costs

In order to derive gravity equation (21), plug the market-clearing condition (12) into the right-hand side of (18) and use the country-j version of (29), (36) and the country-k versions of (31) and (32). Use production function (9) and rearrange to yield

$$\left(\frac{\omega_j}{\omega_k} \right)^{\frac{\rho-1}{2\rho-1}} = \frac{\omega_j L_{j,k}^T \left(\frac{A_j}{A_k} \frac{(1-\tau_{j,k})}{(1-\tau_{k,j})} \right)^{\frac{\rho(\rho-1)}{2\rho-1}}}{L_k \left(\frac{s_k}{s_j} \right)^{\frac{\rho}{2\rho-1}} (n_k - n_{k-1}) (A_j (1-\tau_{j,k}))^{\rho-1}} \tag{38}$$

Plug the left-hand side of (38) into the right-hand side of (37), noting that $L_j = L_k$ from (28) and using (11) and (27). Also note that $L_{j,j}^T = L_j^{NT}$ as $p_j^T = p_j^{NT}$ through (17). Solve for ω_j to obtain

$$\omega_j = \frac{(n_j - n_{j-1}) A_j^{\rho-1} L_j}{L_{j,j}^T} \tag{39}$$

Plug the country-j and country-k versions of (39) back into the right-hand side of expression (18) and then rearrange to obtain

$$\begin{aligned} EXP_{j,k} = \; & (1-\tau_{j,k})^{\frac{(\rho-1)^2}{2\rho-1}} (1-\tau_{k,j})^{\frac{\rho(\rho-1)}{2\rho-1}} (s_j)^{\frac{\rho-1}{2\rho-1}} (s_k)^{\frac{\rho}{2\rho-1}} \times \\ & \left((n_j - n_{j-1}) y^T_{j,j}\right)^{\frac{\rho}{2\rho-1}} \left((n_k - n_{k-1}) y^T_{k,k}\right)^{\frac{\rho-1}{2\rho-1}} \left(\frac{n_k - n_{k-1}}{n_j - n_{j-1}}\right)^{\frac{1}{2\rho-1}} \end{aligned} \tag{40}$$

Finally, note that $POP_j = (n_j - n_{j-1})$ and $POP_k = (n_k - n_{k-1})$. Also note from (26) that $GDP_j = (n_j - n_{j-1}) y_j$ and

$$(n_j - n_{j-1}) y_j = s_j (n_j - n_{j-1}) y^T_j + (1 - s_j)(n_j - n_{j-1}) y^{NT}_j$$

and by definition (8)

$$s_j (n_j - n_{j-1}) y^T_{j,j} = s_j (n_j - n_{j-1}) y^T_j - s_j (n_j - n_{j-1}) \sum_{k \neq j} y^T_{j,k}$$

Using $y^{NT}_j = y^{NT}_{j,j} = y^T_{j,j}$ as $p^{NT}_j = p^T_j$ it follows

$$(n_j - n_{j-1}) y^T_{j,j} = (n_j - n_{j-1}) y_j - s_j (n_j - n_{j-1}) \sum_{k \neq j} y^T_{j,k} = GDP_j - EXP_j$$

The same applies to $GDP_k - EXP_k$. Gravity equation (21) can now be obtained by plugging POP_j, POP_k, $GDP_j - EXP_j$ and $GDP_k - EXP_k$ into (40). The corresponding gravity equation for $EXP_{k,j}$ follows analogously.

Given the two single gravity equations for $EXP_{j,k}$ and $EXP_{k,j}$, one can easily solve for $\tau_{j,k}$ and $\tau_{k,j}$ separately as in (22) and (23). In order to derive gravity equation (19), solve (22) and (23) for $(1 - \tau_{j,k})$ and $(1 - \tau_{k,j})$ and multiply them by each other.

A.3 Imports and Trade Imbalances

All gravity equations in Section 2.3 are cast in exports but for completeness imports are mentioned here. The relationship between exports and imports is particularly simple, given by

$$IMP_{j,k} = (1 - \tau_{j,k})\, EXP_{j,k} \tag{41}$$

where $IMP_{j,k}$ are real imports from j arriving in k. Although its simple form looks inviting, it is not recommended to compute trade costs on the basis of (41) due to inconsistencies of the export data (reported by country j) and import data (reported by country k). These inconsistencies of the IMF DOTS data come about through differences in classification concepts, time of recording, valuation and coverage of trade flows across countries. See Hummels and Lugovskyy (2006) for a discussion. Using relation (41) the import version of gravity equation (20) follows as

$$\tau_{j,k} = \tau_{k,j} = 1 - \left(\frac{IMP_{j,k} IMP_{k,j}}{(GDP_j - EXP_j)(GDP_k - EXP_k) s^2} \right)^{\frac{1}{2\rho}}$$

But since both import and export variables show up in this expression and given the data inconsistencies, the import version is not used to compute bilateral trade costs.

Many countries run trade deficits or surpluses that are often persistent. Trade imbalances are therefore integrated into the model and it is shown that equation (20) remains unaffected. The per-capita budget constraint (7) is generalized to

$$P_j C_j + \sum_{l=1}^{J} T_{j,l} = W_j L_j + \pi_j \tag{42}$$

where $T_{j,l}$ are nominal per-capita transfers from country j to l. As an accounting identity it follows

$$(n_j - n_{j-1}) T_{j,l} = -(n_l - n_{l-1}) T_{l,j}$$

For analytical convenience it is now assumed that per-capita transfers are a fraction of per-capita consumption spending

$$T_{j,l} = \mu_{j,l} P_j C_j$$

with $\mu_{j,j} = 0$ for all j such that the budget constraint (42) can be rewritten as

$$\left(1 + \sum_{l=1}^{J} \mu_{j,l}\right) P_j C_j = W_j L_j + \pi_j \tag{43}$$

If $\sum_{k=1}^{J} \mu_{j,l} > 0$, then j is a creditor country and runs a trade surplus.

The optimal labor supply condition (25) becomes

$$\frac{\eta}{1 - L_j} = \frac{W_j}{\left(1 + \sum_{l=1}^{J} \mu_{j,l}\right) P_j C_j} \tag{44}$$

and consumption follows as

$$C_j = L_j \omega_j^{\frac{1}{\rho - 1}} \left(1 + \sum_{l=1}^{J} \mu_{j,l}\right)^{-1} \tag{45}$$

The markups (15)-(17), per-capita output (28), real wages (31) and real profits (33) are not affected. If j runs a surplus, this reduces per-capita consumption C_j. Intuitively, due to logarithmic utility in (1), output L_j is constant. If j transfers some of its produced wealth to other countries, then its consumption must fall.

Now use the notation

$$\sum_{l=1}^{J}\mu_{j,l} = \frac{CA_j}{CONS_j}$$

where CA_j denotes the nominal current account of country j and $CONS_j$ denotes the nominal consumption of country j. The equations corresponding to (22) and (23) are

$$\begin{aligned}
\tau_{j,k} &= 1 - \frac{(EXP_{k,j})^{\frac{\rho}{\rho-1}} \left(\frac{POP_k}{POP_j}\right)^{\frac{1}{\rho-1}} \left(1+\frac{CA_j}{CONS_j}\right)}{(EXP_{j,k})\,(GDP_k - EXP_k)^{\frac{1}{\rho-1}}\,(s_j)^{\frac{1}{\rho-1}} \left(1+\frac{CA_k}{CONS_k}\right)} \\
\tau_{k,j} &= 1 - \frac{(EXP_{j,k})^{\frac{\rho}{\rho-1}} \left(\frac{POP_j}{POP_k}\right)^{\frac{1}{\rho-1}} \left(1+\frac{CA_k}{CONS_k}\right)}{(EXP_{k,j})\,(GDP_j - EXP_j)^{\frac{1}{\rho-1}}\,(s_k)^{\frac{1}{\rho-1}} \left(1+\frac{CA_j}{CONS_j}\right)}
\end{aligned}$$

For example, suppose that initially both j and k have a balanced current account ($CA_j = CA_k = 0$). If all else being equal j now becomes a surplus country ($CA_j > 0$), then $\tau_{j,k}$ drops whereas $\tau_{k,j}$ increases. Intuitively, country j would not run a surplus unless trade costs shifted into directions favorable for exports from j to k and disadvantageous for imports from k to j. But gravity equation (20) that make use of trade cost symmetry and from which empirical trade costs are computed is not affected by introducing trade imbalances.

In order to understand the model's implications for *bilateral* trade imbalances, it is useful to look at the ratio $V_{j,k}$ of nominal exports between j and k

$$V_{j,k} \equiv \frac{p_j EXP_{j,k}}{p_k EXP_{k,j}} = \frac{1+\frac{CA_j}{CONS_j}}{1+\frac{CA_k}{CONS_k}}$$

What matters for the ratio $V_{j,k}$ is whether the two countries each run a net total deficit or a net total surplus. For example, even if j transfers money to k ($T_{j,k} > 0$, which might seem like a surplus for j), it can still be the case that k is a net exporter to j ($V_{j,k} < 1$). A country therefore runs either a surplus or a deficit against *all* its trading partners, regardless of the monetary flows from individual trading partners.

B Data Appendix

B.1 Exports and GDP

The export data, denominated in U.S. dollars, are taken from the IMF Direction of Trade Statistics (DOTS), provided by the Economic and Social Data Service (ESDS) at `http://www.esds.ac.uk/`. The GDP data come from the IMF International Financial Statistics (IFS), also provided by the ESDS. The following IFS data lines are used: line 99B..ZF (GDP in national currency), line 99BI.ZF (GDP deflator) and line ..RF.ZF (period average exchange rate in national currency per U.S. dollar). Both the GDP and the export data are deflated with the respective GDP deflators. Export deflators are only available for a small number of countries and were therefore not used.

B.2 Explanatory Variables

The distance data represent great-circle distances between capital cities. They have been collected from the website `http://www.indo.com/distance/`.

The following variables are taken from Andrew Rose's (2000) data set, available at `http://faculty.haas.berkeley.edu/arose/`: the border dummy, the colonial dummy, the language dummy, the free trade agreement dummy, the exchange rate volatility, the surface area variable, the landlocked variable and the island variable. The landlocked and island variables take on the value 1 if one of the trading partners is landlocked or an island and the value 2 if both partners are landlocked or islands. The surface area variable represents the logarithm of the product of surface areas for each country pair.

The cut-off point for the colonial dummy is 1900. According to that criterion, the U.S. and Canada are not regarded as British colonies but Australia and Ireland had to be converted into British colonies. India and New Zealand were counted as British colonies already. The language dummy needed correction in that English had to be replaced by Italian as an official Swiss language. The coding of the trade agreement dummy had to be switched for the Netherlands and New Zealand. Australia was counted as an island.

Rose's data are updated for the year 2000. IMF IFS exchange rate data are used to compute the exchange rate volatility in the same way as in the original data set. Information about recent free trade agreements is available on the WTO website at `http://www.wto.org/english/tratop_e/region_e/region_e.htm` under 'Facts and figures.' Amongst others the updated free trade agreement variable includes the Canada-Chile free trade agreement, the Mercosur agreement and NAFTA.

The remaining four variables (the tariff variable, the government share of consumption, the inflation variable and the extent of capital controls) are taken from the Economic Freedom of the World 2004 Annual Report, published by the Fraser Institute and made available at `http://www.fraserinstitute.ca/economicfreedom/`. For each variable the report gives a rating on a scale from 0 to 10. A rating of 10 is given for the lowest tariff rates, the lowest government share of consumption, the lowest inflation rate and the lowest extent of capital controls. Joint observations for countries j and k are constructed by multiplying the single-country ratings and then taking natural logarithms. Using the logarithms of the products instead of the logarithms of the sums leads to symmetric and constant interaction effects. In order to make the coefficients in the regressions more intuitive, the logarithms are multiplied by (-1) such that higher values indicate higher tariff rates, higher government shares of consumption, higher inflation rates and greater extents of capital controls.

The tariff variable is constructed using the data from component 4A of the Economic Freedom Report, "Taxes on international trade." It combines the tariff revenue as a percentage of exports and imports, the mean tariff rate and the standard deviation of tariff rates. The government share of consumption is constructed using the data from component 1A, "General government consumption spending as a percentage of total consumption." The inflation variable is constructed using the data from component 3C, "Recent inflation rate." The variable indicating the extent of capital controls is constructed using the data from component 4E, "International capital market controls." It combines the access of citizens to foreign capital markets as well as foreign access to domestic capital markets and restrictions of the freedom of citizens to engage in capital market exchange with foreigners. For the 2000 regression in Table 5 only, the tariff, inflation and capital control variables are multiplied by 100.

Table A1 reports simple correlations between the variables used in the regressions.

Table A1: Simple Correlation Coefficients

	TEquiv.	Dist.	Border	Area	Landl.	Isl.	Lang.	Col.	Tar.	FTA	ERV.	GCons.	Infl.	CContr.
Tariff Equiv.	1.00													
Distance	0.39	1.00												
Border	−0.30	−0.44	1.00											
Area	0.18	0.37	−0.02	1.00										
Landlocked	−0.04	−0.28	0.15	−0.26	1.00									
Island	−0.04	0.16	−0.14	0.03	−0.20	1.00								
Language	−0.20	0.03	0.27	0.09	−0.03	0.14	1.00							
Colonial	−0.11	0.05	0.07	−0.05	−0.06	0.25	0.30	1.00						
Tariffs	0.20	0.13	−0.07	0.22	−0.05	−0.05	0.10	0.04	1.00					
FTA	−0.25	−0.60	0.24	−0.28	0.15	0.01	−0.04	−0.03	−0.15	1.00				
ER Volatility	0.21	0.33	−0.07	0.26	−0.09	−0.03	−0.05	−0.02	0.10	−0.21	1.00			
Gov. Cons.	−0.24	−0.31	0.08	−0.01	−0.08	−0.08	−0.09	−0.03	−0.20	0.31	−0.20	1.00		
Inflation	0.20	0.18	−0.02	0.21	−0.07	−0.05	−0.06	−0.04	0.10	−0.10	0.68	−0.13	1.00	
Capital Contr.	0.28	0.15	−0.06	0.23	0.03	−0.06	−0.10	−0.02	0.51	−0.25	0.42	−0.34	0.51	1.00

Number of observations: 1290 for each variable.