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What separates us?
Sources of resistance to globalization

Keith Head and Thierry Mayer

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WHAT SEPARATES US?
SOURCES OF RESISTANCE TO GLOBALIZATION

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HIGHLIGHTS

- We advocate investigation of sources of resistance to trade other than tariffs and transport costs
- We review the literature that has made an attempt to do so
- We emphasize the role played by cultural differences forged along the history

ABSTRACT

With increasing sophistication, economists have been estimating gravity equations for five decades. Robust evidence shows that borders and distance impede trade by much more than tariffs or transport costs can explain. We therefore advocate investigation of other sources of resistance, despite the greater difficult involved in measuring and modeling them. From our selective review of recent findings, a unifying explanation emerges. A legacy of historical isolation and conflict forged a world economy in which neither tastes nor information are homogeneously distributed. Cultural difference and inadequate information manifest themselves most strongly at national borders and over distance.

JEL Classification: F10

Keywords: Globalization, Gravity, Cultural differences

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POINTS CLEFS

- Nous soulignons l'importance de la recherche sur les causes de résistance au commerce, au delà des simples coûts de transport et de douanes
- Nous établissons une revue de la littérature sur les facteurs de résistance au commerce
- Nous montrons le role joué par les différences culturelles acquises au cours de l'histoire dans la structuration du commerce contemporain

RÉSUMÉ

Au cours des cinq dernières décennies, les équations de gravité sont devenues un outil privilégié dans la recherche sur le commerce international. De multiples travaux ont montré que le commerce est bien plus affecté par les frontières et par la distance que ce que ne laisseraient à penser les barrières douanières et les coûts de transport. Il nous semble donc nécessaire de s'intéresser à d'autres sources de résistance au commerce. Malgré la difficulté à mesurer et à modelliser ces facteurs, une explication dominante émerge de notre revue de littérature. L'histoire, ponctuée de conflits et de périodes d'isolation, a forgé une économie mondiale dans laquelle ni les goûts, ni les informations ne sont distribués de manière homogène. Les différences culturelles et les informations biaisées qui résultent de ces processus historiques sont fortement liées aux frontières nationales et à la distance.

Classification JEL : F10

Mots clés : Mondialisation, Gravité, Différences culturelles

WHAT SEPARATES US?
SOURCES OF RESISTANCE TO GLOBALIZATION[1]

Keith Head* and Thierry Mayer†

1. INTRODUCTION

The world is not borderless, flat, small, or even shrinking. Put another way, the new world economy announced on the covers of books in airport non-fiction sections bears little resemblance to the real world economy.[2] Academic economists tend to approach such books with considerable skepticism, so one might question the need to write an academic paper debunking them. Our aim here is first to explain *how* trade data lead us to the conclusion that the gap between reality and full globalization is very wide and not likely to be closed under current trends. Then we will explore *why* the gap remains so wide despite the advent of policies and technologies that were, with some justification, expected to foster globalization.

We see evidence suggesting that the absence of globalization cannot be reduced to conventional explanations, such as tariffs and freight costs. Instead, we argue that what separates us can be broadly thought of as "isolation legacy" effects: high costs of mobility and trade in the past lead generate persistent sources of bilateral resistance to trade in the present. We want to admit up front that the collage of evidence we present is incomplete and often admits alternative explanations to the ones we propose. We see this as a feature, not a bug, of this paper because it allows us to use this as an opportunity to promote a research agenda.

The paper proceeds as follows. The next section shows graphically that, relative to a full globalization ideal, there is currently much too little trade and what trade there is occurs over too short distances. The following section introduces the modern gravity equation as a tool for determining the principal forms of resistance to globalization. We inspect distance and border effects and show that both are too large to be explained by observed freight and tariff rates. Making an analogy with astrophysics, we quantify the importance of "dark" distance- and border-related costs that are difficult to observe but needed to explain the "missing trade," (a term coined by Trefler (1995)). The final section before concluding then delves into four sources of resistance that we see as promising explanations: spatial decay of information, localized tastes, colonial legacies, and long-run impacts of conflict.

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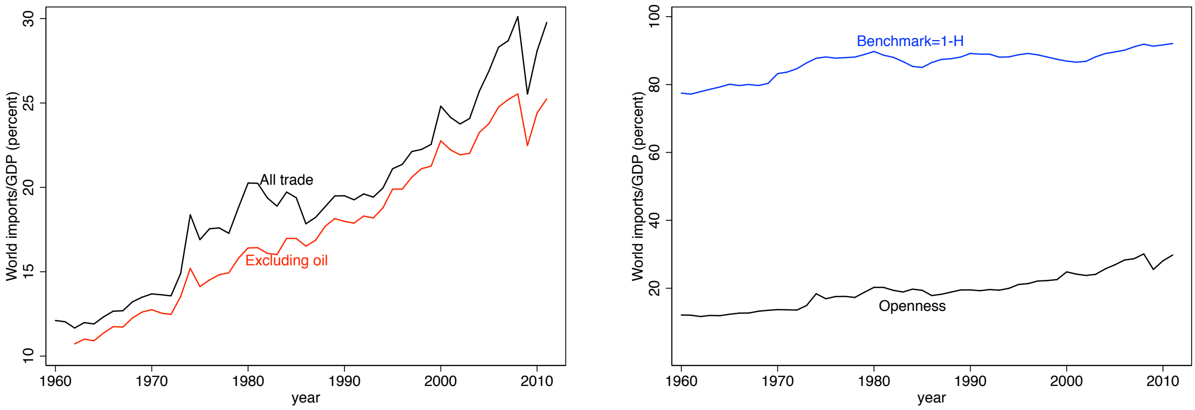
[2]As examples of the titles we have in mind, see Cairncross' *The Death of Distance*, Ohmae's *The Borderless World* and, most prominently Friedman's *The World is Flat*.

2. The globalization gap

There are a many different ways to reach the conclusion that globalization is a fundamental and inexorable trend. Much of the evidence is anecdotal, for example the ubiquity of Starbucks or sushi. For those more data-minded, Exhibit A is often a plot such as the one shown in the left panel of Figure 1. It shows world imports of both goods and services divided by world GDP.[3] Much of the volatility in the openness derives from oil price variations. When we remove oil trade, the trend towards greater openness shows little variation other than the "trade collapse" of 2008–9.

Figure 1 – Rising openness hasn't closed the globalization gap

(a) Openness (b) Globalization Gap



How open should we expect the world to be? Is 30% openness in 2011 a high number or a low number? To answer this we follow Helpman (1987) in constructing a benchmark based on an idealized notion of a world with no trade impediments. If foreign products were just as accessible and desirable as domestic ones, then under complete specialization each country would consume its expenditure share of every other country's production. Using the notation of Eaton and Kortum (2002), bilateral imports of country n from country i are $X_{ni} = (X_n/X_w)X_i$. World imports are therefore $\sum_n \sum_{i \neq n} X_{ni} = \sum_n (X_n/X_w)(X_w - X_n)$. Dividing by world expenditure, X_w, results in a simple formula for the world import to expenditure ratio:

$$\text{Benchmark} = \sum_n \frac{X_n}{X_w} - \sum_n \left(\frac{X_n}{X_w}\right)^2 = 1 - H \quad (1)$$

Since H is the Herfindahl index of expenditure concentration, Helpman (1987) refers to $1-H$ as a dispersion index for the world economy. As total expenditure is not a conventional component of national accounts, GDP is used as the proxy for X_n. Over time, the benchmark for complete globalization has been rising, going from 77% in 1960 to 92% in 2011. One reason is that new countries have come into existence, often by splitting up prior nations. This mechanically leads to more measured international trade even if the producers and consumers have not changed. Similarly, rising Asian GDP shares lower H which raises the benchmark. The entire rise in openness that has occurred over the last half century, an 18 percentage point increase from 12% in 1960 to 30% in 2011, is less than one third of the gap that remains at the end of the data (62 percentage points).

[3] Openness is sometimes defined as the sum of imports and exports divided by GDP but this makes little sense when calculated at the world level.

Figure 2 – Far from the Flat-World Ideal

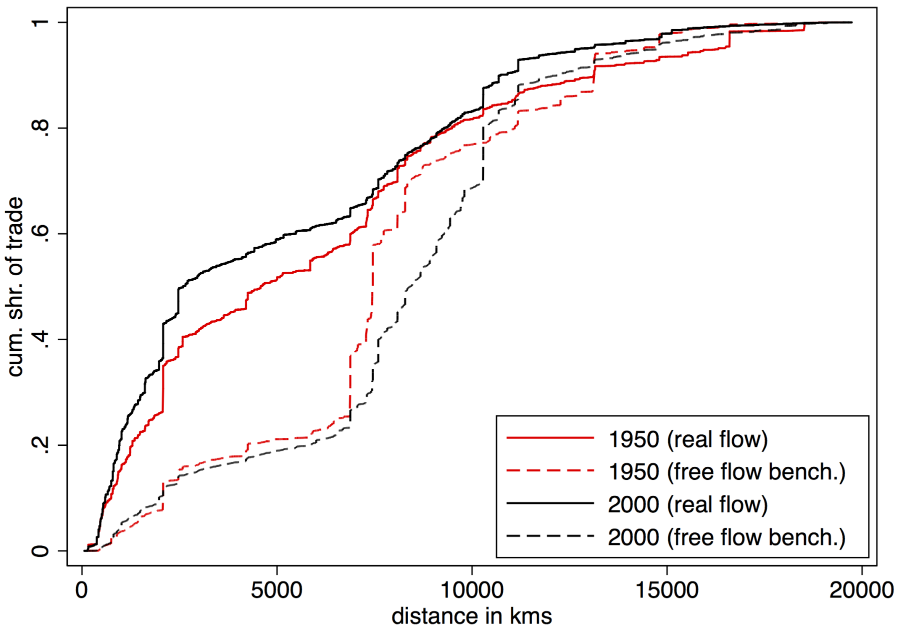


Figure 2 provides a different way to illustrate the gap between current trade patterns and those that would prevail under complete globalization. Rather than consider the binary choice between buying at home and abroad, it examines the distribution of international trade across distances. The CDF of distance conveys some interesting facts: About 60% of trade moves less than 5000km. More than 80% of trade occurs over distances less than 10,000km. But given that many large economies are located near each other, we require a standard against which to judge these shares.

We devise a benchmark by generating hypothetical trade flows at each distance in which each country n consumes its GDP share of each other country's GDP: $X^*_{ni} = (X_n/X_w)X_i$. The dashed black line shows the distribution of distances that would prevail under this distance neutral benchmark. Now less than 20% of traded goods would travel less than 5,000km under full globalization. The red solid and dashed lines in Figure 2 show the actual and flat-world distributions based on 1950 trade and GDP patterns, respectively. In contrast to the prediction that technology would be "flattening," goods in 1950 not only traveled further than in 2000, they were *closer* to the benchmark.

The evidence presented in Figures 1 and 2 suggests that the current level of trade is far from the globalization ideal. In most economic models that would suggest the possibility that considerable future gains from further integration are potentially available. Arkolakis et al. (2012) provide a simple formula we can use for a back-of-the-envelope calculation of these welfare changes.[4] The welfare in some hypothetical trade cost regime, W' relative to the current welfare, W, is given by

$$W'_i/W_i = \left(\pi'_{ii}/\pi_{ii}\right)^{1/\varepsilon},$$

where $\varepsilon < 0$ is the elasticity of imports with respect to trade costs and π_{ii} is the share of expenditures on all goods that are sourced domestically. We follow Melitz and Redding (2013) in

[4] It is valid under a variety of model structures so long as the economy has a fairly simple structure and some functional forms are valid approximations.

using $\varepsilon = -4.25$. For Canada π_{ii} is about 0.75.[5] Two interesting values of π'_{ii} are 1 (autarky) and 0.02 (Canada's approximate share of world production).[6] Applying the formula to both π'_{ii} cases yields

- **Losses from autarky: -7%** $((1/0.75)^{(-1/4.25)} = 0.93)$
- **Potential gains from complete globalization: 135%** $((0.02/0.75)^{(-1/4.25)} = 2.35)$[7]

These numbers tell us that, in standard models, the gains from complete economic integration dwarf the losses from reverting to autarky. They motivate a strong public policy interest in understanding the forces that impeded globalization, but we should not take them too seriously. First, the full globalization ideal involves a world without mountain ranges, oceans, or even time zones. It speaks a single language, uses a single currency, and has a complete customs union. And the people living in that world share a common set of tastes. Recognizing some of these features as constraints on feasible integration, the π'_{ii} of 0.02 may be seen as too low to even be justified as a thought experiment. A second concern is that some of the sources of resistance to globalization may invalidate the welfare formula itself, a point we will return to later when we discuss those forces.

3. GRAVITY IN A NUTSHELL

Graphing trade propensities and the distribution of trading distances relative to a benchmark is a powerful way to falsify the claim that we are close to full globalization. But these graphs do not provide estimates of the magnitude of the distance effect on trade. Furthermore, they cannot tell us which other forces impede globalization, controlling for distance. For these purposes we need an equation expressing bilateral trade as a function of its chief impediments and facilitators. That equation, generally credited to Tinbergen (1962), is the gravity equation.

What we call the Naive form of the gravity equation is expressed as

$$X_{ni} = \frac{GY_i^a Y_n^b}{D_{ni}^c}, \tag{2}$$

where Y_i and Y_n are exporter and importer GDPs, D_{ni} is distance from i to n, and G is a constant. In most estimations $a \approx b \approx c \approx 1$ such that we obtain a very simple law-like relationship:

> **Gravity Law**: *Holding constant the product of two country's sizes, their bilateral trade will, on average, be inversely proportional to the distance between them.*

3.1. A better answer to Ulam's challenge

Mathematician Stanislaw Ulam (inventor of the Monte-Carlo method) challenged Paul Samuelson to **"name me one proposition in all of the social sciences which is both true and non-trivial."** Samuelson (later) came up with an answer: comparative advantage. "That it is logically true need not be argued before a mathematician; that it is not trivial is attested by the thousands of important and intelligent men who have never been able to grasp the doctrine for themselves or to believe it after it was explained to them." Granting Samuelson the non-trivial

[5]CANSIM Table 386-0003 shows international imports are \$384bn. Dividing by total demand, \$1,502bn yields $1-\pi = 0.255$.

[6]Canada's 2009 share of world GDP in PPP was 1.85%.

[7]Doubling the trade elasticity to 8.5, the upper bound of the reliable estimates, lowers the potential gain to $(0.02/0.75)^{(-1/8.5)} = 1.53$, that is a 53% welfare improvement.

part, Ulam probably did not mean a logical or mathematical truth since social science is supposed to make *empirically* true claims. A more compelling response to Ulam would be the Gravity Law.

We will use the same argument as Samuelson to back the assertion that gravity is "not trivial": Many intelligent commentators on the world economy have denied gravity in one way or another. First, there are the widely read and discussed books by respected journalists including a former editor of *The Economist* (*The Death of Distance*) and weekly columnist for the *New York Times* (*The World is Flat*).

Journalists may be more inclined to believe in globalization as a reality, rather than an ideal, because they often base their conclusions on specific examples.[8] Even a former director general of the World Trade Organization embraced the anti-gravity view:

> "I just want to mention several key features that will define this new borderless economy: *One is its increasing indifference to geography, time and borders.* Trade used to be shaped by the realities of geography as one element in a nation's comparative advantage. Now, in important sectors, trade will be shaped by the absence of geography."
> Renato Ruggiero, 1997, (italics in original)

Distance denial has been going on for a long time. George Orwell complained in 1944:

> "Reading recently a batch of rather shallowly optimistic 'progressive' books, I was struck by the automatic way in which people go on repeating certain phrases which were fashionable before 1914. Two great favourites are 'the abolition of distance' and 'the disappearance of frontiers'..."

While there are few trade economists now who are unaware that distance impedes bilateral trade, thirty years after Tinbergen's gravity estimations, Bhagwati (1993), one of the most prominent trade economists of the time, sought to cast doubt on the notion that there were "natural" free trade agreements based on geographic proximity:

> "If I had access to captive research assistance and funds, I could examine whether, for all conceivable combinations of countries and distances among them, and for several different time periods, the premise [that proximity increases trade] is valid. I do not, so I must rely on casual empiricism and a priori arguments...Borders [such as the one between Pakistan and India] can breed hostility and undermine trade, just as alliances between distant countries with shared causes can promote trade... ...[The premise that distance reduces trade] does not have a firm empirical or conceptual basis."

Bhagwati was certainly onto something important in discussing the role of hostilities and alliances—as we will discuss later—but he seems unaware that these are the exceptions: the norm is for trade to decline with distance.

Having thus established that the Gravity Law is not obvious or trivial, we now turn to establishing that it is *true*.

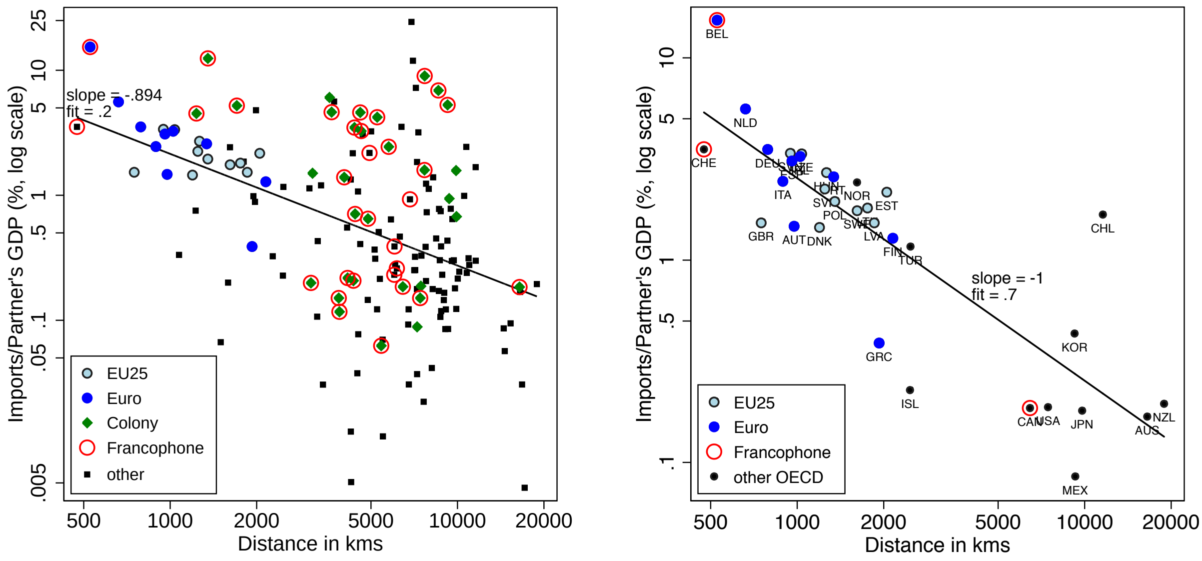
3.2. 50 years of estimating gravity

Our first argument is an appeal to authority: In their *Handbook of International Economics* chapter, Leamer and Levinsohn (1995) assert that gravity models "have produced some of the

[8] Ghemawat (2011) notes that "Something other than data must account for the success of *The World is Flat* since its 450-plus pages contain not a single table, chart, or footnote to back its pronouncements."

Figure 3 – France's 2006 imports follow the gravity law

(a) All origins (b) OECD + EU25 only



clearest and most robust findings in economics." To make an evidence-based case, our first exhibit is Figure 3, inspired by a similar figure in Leamer and Levinsohn (1995), which itself echoed a plot Isard and Peck (1954) published 40 years earlier.

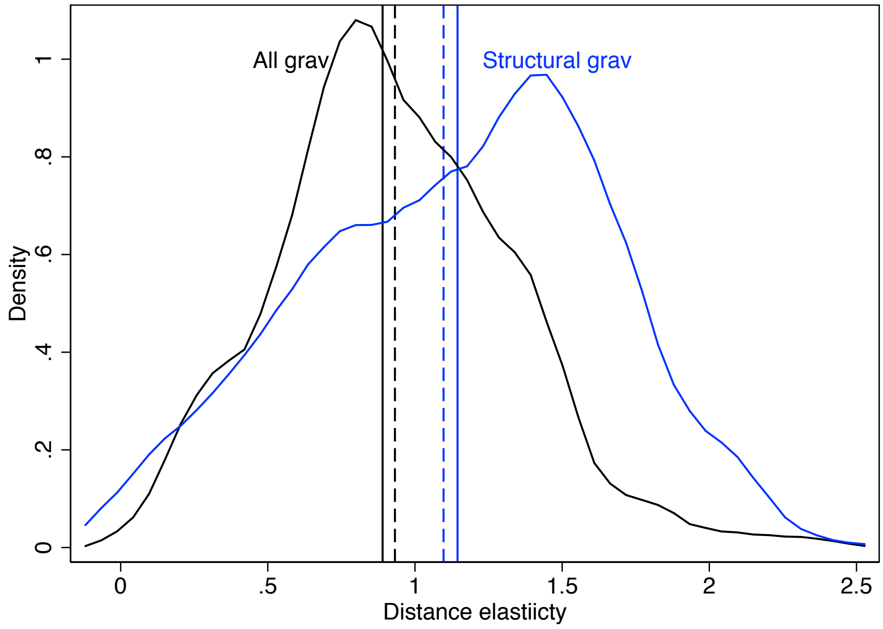
Panel (a) shows France's imports in 2006 divided by the GDP of the exporter for all origins. The distance elasticity estimated over all origins, -0.89, is close to the -1 implied by the Gravity Law. As a demonstration of law-like behaviour, this figure has a serious drawback: with an R^2 of just 20%, the fit is not very impressive. There are clearly many more determinants of bilateral trade than just GDP and distance. Yet it does not seem appropriate to insist that social behavior follow laws that are as parsimonious as those in the physical sciences. The gravity law should be seen as a partial elasticity holding many confounding factors constant.

In that spirit, we zoom in on France's trade with other members of the EU and OECD. The EU grouping neutralizes trade policy and standardizes some institutions. The OECD group is believed to have higher data quality and also higher per capita income. Panel (b) of Figure 3 shows that the restricted sample adheres more closely to gravity law, with distance explaining 70% of the variation in the import to partner GDP ratio. The estimated distance elasticity rounds to -1.00. To the extent this figure is representative of broader samples, we may fairly claim to have answered Ulam's challenge with a non-trivial yet demonstrably true empirical proposition from the social sciences.

The graphical approach taken in Figure 3 has the great advantage of transparency: there is no econometric layer between the data and the reader. Nevertheless, the discussion of the figures above reveals the limitations of the graphical approach. We have only considered one importer in one year and we have no controls (except for dividing by partner GDPs). To find partial elasticities that are representative of a broad sample it is therefore essential to run regressions.

The solid black line in Figure 4 describes the distribution of 1835 estimates of the distance effect, $-\partial \ln X_{ni}/\partial \ln D_{ni}$, using data assembled for the meta-analysis reported in Head and Mayer (2013). The solid and dashed vertical lines denote the values of the median and mean estimates respectively. Coincidentally, the median figure is -0.89, the same as the one estimated for

Figure 4 – The distribution of 1835 estimates of distance effects



France in Figure 3(a). The data sets, sample periods and econometric methods for these estimates vary considerably. Yet the central tendency of the estimates around -1 is undeniable.

An important caveat about these estimates is that the vast majority of them are based on the Naive form of the gravity equation (augmented with numerous controls). The highly influential work of Anderson and van Wincoop (2003) forced trade economists to recognize that while theories had been derived to justify the naive gravity equation, *none* of those theories actually predicts the functional form in equation (2). A range of theoretical underpinnings all point to the need to revise our view of the appropriate way to think of country size. A country's total output needs to be discounted by the opportunities it has for exporting that output and, similarly a country's total expenditure should be discounted by the opportunities it has to source from alternative suppliers. Specifications incorporating these adjustments, following directly from the equilibrium conditions in the models are called "structural gravity."

Structural gravity comprises the following system of equations

$$X_{ni} = \frac{S_i M_n}{r_{ni}} \quad \text{where} \quad S_i = Y_i/\Omega_i, \quad \text{and} \quad M_n = X_n/\Phi_n,$$
$$\Phi_n = \sum_\ell \frac{Y_\ell}{r_{n\ell}\Omega_\ell} \quad \text{and} \quad \Omega_i = \sum_\ell \frac{X_\ell}{r_{\ell i}\Phi_\ell}. \tag{3}$$

In these equations r_{ni} denotes bilateral *resistance* and Φ^{-1} and Ω^{-1} are multilateral resistance terms.[9]

Resistance can be specified in various ways. The way that links best to the bulk of empirical work is as the product of border (β) and distance (D) effects $r_{ni} = \beta_{ni} D_{ni}^{\delta}$. Border effects can be thought of as the collective effect of all the increases in trade impediments that typically occur when goods cross an international border. In practice, gravity estimations often control for

[9]See Anderson and van Wincoop (2003) for the initial derivation, and Head and Mayer (2013) for a list of all models that are compatible with this formulation.

many of those effects—free trade, common currency, common language and legal system—since certain facets of border costs are selectively lower for some bilateral pairs. In those regressions, the border effect may be estimated as the residual influence of borders. A second way to think of resistance that ties more closely to theory and welfare is $r_{ni} = \tau_{ni}^{-\varepsilon}$. In this specification $\tau - 1$ is the *ad valorem* equivalent of all trade costs and ε is the trade cost elasticity ($\partial \ln X_{ni}/\partial \ln \tau_{ni}$).

The structural gravity equation can be estimated in a variety of ways but by far the easiest is with fixed effects for each exporter-year and importer-year. Head and Mayer (2013) describe other methods and pits them against each other in a Monte Carlo study. At the risk of oversimplifying the results, the two-way fixed effects method emerges as the clear winner.[10] The intuitive reason why country-level fixed effects are important for estimating bilateral effects (such as distance and borders) is that equation (3) reveals that the S_i and M_n terms are functions of all the bilateral sources of resistance.

The blue line in Figure 4 shows the distribution of the 328 estimates that we classified as structural (because they use one of the approved methods for dealing with multilateral resistance, usually two-way fixed effects). The central tendencies (dashed mean lines and solid median lines) are not so different but the distributions have notably different shapes, with the structural mean lower than the median, which is less than the mode.

What can we conclude from these distributions? First we see the "on average" part of the Gravity Law is doing double duty. Firstly, it is invoking a conditional expectation (holding other variables constant). Secondly, the inverse proportionality is itself only an average elasticity. Disdier and Head (2008) show that there is too much variation in the estimated distance effect to be derived simply from sampling error. An important unresolved question is whether all this variation derives from estimation method differences or true parameter heterogeneity. While the distinction between naive and structural estimates points to some of the heterogeneity coming from method, the remaining variance of estimates inside each method suggests that it cannot be the whole story.

3.3. Decomposing the distance effect

To understand why the distance effect might vary, we decompose it into the product of two more fundamental elasticities:

$$\delta \equiv \frac{\partial \ln r_{ni}}{\partial \ln D_{ni}} = -\frac{\partial \ln \text{Trade}}{\partial \ln \text{Trade costs}} \frac{\partial \ln \text{Trade costs}}{\partial \ln \text{Distance}} = -\varepsilon\rho. \tag{4}$$

The first factor, ε, is a structural parameter in *most* models.[11] In models such as Anderson and van Wincoop (2003), it is one minus the elasticity of substitution between goods from different countries, i.e. $\varepsilon = 1 - \sigma$. In the Ricardian model of Eaton and Kortum (2002) $\varepsilon = -\theta$, where θ is the parameter governing the dispersion of labour requirements across goods and countries. In trade models featuring firm-level heterogeneity, such as Chaney (2008), $\varepsilon = -\theta$ as well but now θ is the shape parameter of the Pareto distribution assumed to govern performance

[10]Other methods, such iterative estimation of equation (3), and various approaches that use ratios or subtract off means to remove the S_i and M_n terms gave equivalent results under full samples but poor results with missing data.
[11]We know of three exceptions. First, the Novy (2013) translog bilateral trade equation implies a non-constant trade elasticity. Second, Head et al. (2013) find that log-normal firm-level heterogeneity (instead of the usual Pareto assumption) implies a trade elasticity that decreases with expected trade. A variable trade elasticity also arises in Helpman et al. (2008) because of upper truncation of a Pareto productivity distribution.

differences between firms. The second factor, ρ, measures the effect of distance on the cost of delivery. In models featuring full pass-through of costs into prices, it is also a measure of the change in delivered prices as distance rises.

For the absolute value of the trade elasticity to take the unit value of the Gravity Law, it would have to be the case that $-\varepsilon\rho = 1$. How plausible is that? Reviewing the set of elasticity estimates available when they were writing, Anderson and van Wincoop (2004) conclude that σ "is likely to be in the range of five to ten," implying ε between -4 and -9. Conventional wisdom appear to have shifted towards the smallest (absolute) elasticities in this range. For example, Eaton and Kortum (2012) use $\varepsilon = -4$ in their quantification of the Ricardian model, considering it to be "in line with" several studies. Head and Mayer (2013) summarize all the available estimates and find $\varepsilon = -5$. This is the median of 435 estimates identified based on variation in trade in response to variation in tariff or freight costs. Smaller estimates ($\varepsilon \approx -3$) result when including other identification approaches.

Estimates of ρ are relatively rare. If freight and insurance are the main components of trade costs then ρ can be measured in three different ways. The first two methods involve regressing the log of the ratio of CIF to FOB trade flows on log distance.[12] This because CIF is the sum of FOB and transport costs; thus, CIF/FOB equals one plus the *ad valorem* freight and insurance rate. A first version of this approach obtains CIF and FOB values come from *different declarations*, namely the exporter's report of the FOB value and the importer's report of the CIF value. The first estimate of ρ that we know appears in Geraci and Prewo (1977) who use this method on an OECD sample and estimate $\hat{\rho} = 0.07$. More recently Limão and Venables (2001) use the same type of data but with a much larger sample to estimate $\hat{\rho} = 0.25$ (without controls). The difference arises mainly because Limão and Venables code $\tau = 50$ (the highest observed CIF/FOB ratio in their sample) for the 22% of the sample where bilateral trade was zero and then estimate with (upper limit) Tobit.[13] Re-estimating using OLS on just the non-zero flows with data provided on Nuno Limão's website, we find $\hat{\rho} = 0.07$. We have to be cautious about all of these estimates because Hummels and Lugovskyy (2006) show that matched CIF and FOB data from different reporters do not yield reliable measures of the CIF/FOB ratio. They point out that "Roughly half of all observations in the IMF DOTS database lie outside a reasonable range of variation (*ad valorem* costs between 0% and 100%)." When we restrict τ to the "reasonable range" (i.e. $\tau < 2$), we obtain $\hat{\rho} = 0.026$.

Hummels (2007) pioneers a second method, calculating freight costs for a country that collects *both* CIF and FOB import values. He specifies the dependent variable as the log of the freight to value ratio, $\ln(\tau - 1)$. We will use $\tilde{\rho}$ to denote the elasticity of $\tau - 1$ with respect to distance. In columns 1 and 3 of Table 2, Hummels (2007) estimates $\tilde{\rho} = 0.27$ and 0.15 for air and sea transport into the US, respectively. As pointed out by Anderson and van Wincoop (2004), ρ is much smaller than $\tilde{\rho}$. In our notation, $\rho = \tilde{\rho}(\tau - 1)/\tau$. In the Hummels data $(\tau - 1)/\tau$ is less than 0.1 so ρ is an order of magnitude smaller than $\tilde{\rho}$. Alternatively, one can estimate ρ directly just by re-specifying the dependent variable as $\ln(\tau)$. Using the data David Hummels provides on his website, we estimate that $\rho = 0.03$ for air transport and $\rho = 0.01$ for sea transport.

[12] CIF stands for "cost, insurance and freight" and FOB stands for "free on board." The FOB value sums the value at the factory gate with the costs of transporting the good from factory to the carrier. CIF is FOB plus cost of shipping to the importing country and marine insurance.

[13] If zero trade flows occur for bilateral pairs due to prohibitively high freight costs then excluding those flows could induce selection bias. On the other hand the zero flows could arise from declaration thresholds or prohibitively high *fixed* market entry costs, rather than freight costs. In that case the top coding of transport costs would be inappropriate.

A third method for measuring ρ relies on direct freight cost data generally obtained from private shipment companies. Limão and Venables (2001) use the cost of shipping a standard container from Baltimore to 64 countries where the World Bank has operations. They estimate a linear relationship between freight costs and distance. Using the Limão and Venables data, we estimate $\tilde{\rho} = 0.32$. Applying the $(\tau - 1)/\tau$ correction using $\tau = 0.07$ (obtained from Hummels (2007) Figure 6 showing ad valorem ocean shipping rates) yields $\rho = 0.021$.

Taking all the freight-based methods together we would say that the reasonable range for the elasticity of the log CIF to FOB ratio with respect to distance is $0.01 < \rho < 0.07$, with the best estimates at the lower end of this range. For these values to be consistent with a unit distance elasticity $\delta = 1$, the trade elasticity, $|\, \varepsilon \,|$ would have to be in the 14–100 range, magnitudes that few would take seriously. Conversely, papers that assume or estimate reasonable ε are bound to estimate ρ outside the range implied by the freight data regressions.[14]

We can reconcile the two sets of results by decomposing trade costs into two components: $d\ln\tau = d\ln\tau_f + d\ln\tau_d$, where τ_f is one plus the freight to value ratio (the CIF to FOB ratio) and τ_d is the "dark" trade cost. We use dark here not to suggest something sinister, but rather to make analogy with astrophysics—which seems fitting since the term gravity was itself coined as a physics analogy. In cosmology dark energy is invoked to explain why the universe appears to be expanding at an accelerating rate and dark matter explains why galaxies rotate at higher velocity than they should based on their observed mass. Neither dark energy nor dark matter can be observed directly but their presence is inferred to be huge. Taken together, dark energy and dark matter are thought to account for 95% of the mass-energy in the universe. Our goal here is to infer the importance of unobserved or difficult-to-observe trade costs. Letting ρ_f denote the elasticity of τ_f with respect to distance (observed) and ρ_d be the corresponding dark elasticity, the observed distance effect can be expressed as

$$\delta = -\varepsilon(\rho_f + \rho_d).$$

Taking $\delta \approx 1$ and $\varepsilon \approx -4$ we can infer $0.18 \leq \rho_d \leq 0.24$. This implies 72%–96% of the rise in trade costs associated with distance is attributable to the dark sources of resistance. We are not alone in attributing a high share of the distance effect to dark trade costs. Allen (2012) estimates that search costs account for 90% of the distance effect, leaving only 10% for transport costs. Feyrer (2009) uses the closing of the Suez Canal between 1967 and 1975 to investigate the effect of changes in bilateral shipping distances. This allows him to control for dyadic fixed effects and thereby isolate the pure effect of changing transportation costs on trade. The resulting δ ranges from 0.15 to 0.5. Assuming that Feyrer's δs correspond to $-\varepsilon\rho_f$ and maintaining $\varepsilon = -4$ implies $0.038 \leq \rho_f \leq 0.125$. Therefore dark trade costs account for 50%–85% of the effect of distance on trade flows.[15] We will try to uncover the underlying dark mechanisms in section 4. The next two subsections consider the evolution of distance effects over time and the border effect.

3.4. Distance effects: Why won't the world flatten?

Leamer (2007) expresses considerable frustration over Friedman's "flat world" metaphor, whose meaning Leamer diplomatically describes as "elusive." Here we use the metaphor in a very precise way. We will say the world is flattening if the lines shown in Figure 3 are flattening, that is if the distance elasticity is declining.

[14] For example, Balistreri et al. (2011) assumes $\sigma = 3.8$, estimates a Pareto shape parameter of 5.2 and a ρ of 0.16.
[15] The greater importance that the Suez-closing results attribute to transport costs may derive from including not just the pure freight carrier cost of distance but also the additional time cost from the longer trip.

Taking gravity theory seriously, does it actually predict declining distance effects? In order for distance costs to fall over time, we need either a reduction in ρ or in $-\varepsilon$. We are inclined to think that transport improvements should lower ρ. Looking back on the last half-century of innovations in technological progress and deregulation in transportation and communication, one could point to many reasons why trade resistance should have fallen. The following list includes some of the most notable changes.

1. Containerization dramatically lowered the cost and time of shipping manufactured goods.[16]
2. Commercial jet air transport costs fell by 90% from 1955 to 2004.[17]
3. International telephone costs per minute fell 95% from 1980 to 2010.[18]
4. Internet-based communication (email, Skype, eBay, Alibaba etc.) increased the "bandwidth" of long distance information flows and reduced their monetary cost to near zero.

All these factors suggest declines in r_{ni}. The item in the above list with a direct link to the elasticity of transport costs with respect to distance (ρ) is the decline in the cost per mile of jet transport. The most prominent innovation in sea transport technology, containerization, mainly reduced port costs. Bernhofen et al. (2013) cite a McKinsey study to conclude "The construction of purpose-designed container terminals increased the productivity of dock labor from 1.7 to 30 tons per hour." Lower port costs would show up as a reduction in β the resistance function. However, Hummels (2007) points to an indirect effect that could lower ρ: "Because containerships spend more time steaming, investments in larger, faster ships become feasible." Such ships "substantially reduce the price per ton-mile." The new communication technologies reduce ρ for information-intensive service trade. To see their effect on goods trade, we will have to consider the complementarity between information and goods flows.

Thus, we have some reason to believe that ρ has been falling. However, it is far from obvious which direction, if any, the trade elasticity, ε, should have moved over the last decades. In Armington models, a rise in $|\varepsilon|$ would occur if products become closer substitutes. Broda and Weinstein (2006) find evidence of the opposite trend. They estimate product-specific σ for the two periods 1972–1988 and 1990–2001. The mean σ for disaggregated goods falls from 17.3 to 12.6 whereas the median falls from 3.7 to 3.1. These correspond to decreases in $|\varepsilon|$ of 22% and 29%, respectively. Hanson (2005) also finds a declining value of σ (14% between 1970–1980 and 1980–1990 in the main regression), with a radically different estimation method relying on a wage equation of the New Economic Geography type. In Ricardian and Melitzian models, $|\varepsilon|$ rises when industries or firms become more similar in terms of productivities. We are not aware of evidence that preference or technologies are evolving over time in such a way as to predict a rise in $|\varepsilon|$. Indeed the size distribution of firms is thought to be governed reasonably well by a stable power law.

With $|\varepsilon|$ stable or moderately declining, and ρ probably declining, δ should be falling as well. However, a stable value of δ near 1 would be consistent with the model of Chaney (2013) who writes, "even if technological, political or economic changes affect the particular shape of firm level exports, in the aggregate, the gravity equation remains essentially unaffected." With these expectations informed by theory in mind, we now turn to actual estimates of the evolution of the distance effect over time.

[16] See *The Box: How the Shipping Container Made the World Smaller...* and Bernhofen et al. (2013) for descriptive and quantitative assessments of the transformative role of containerization.

[17] See Hummels (2007), Figure 1.

[18] See FCC report "Trends in the International Telecommunications Industry: Summary through 2010," Table 2.

Figure 5 – Rising distance effects

(a) Samples (b) Methods

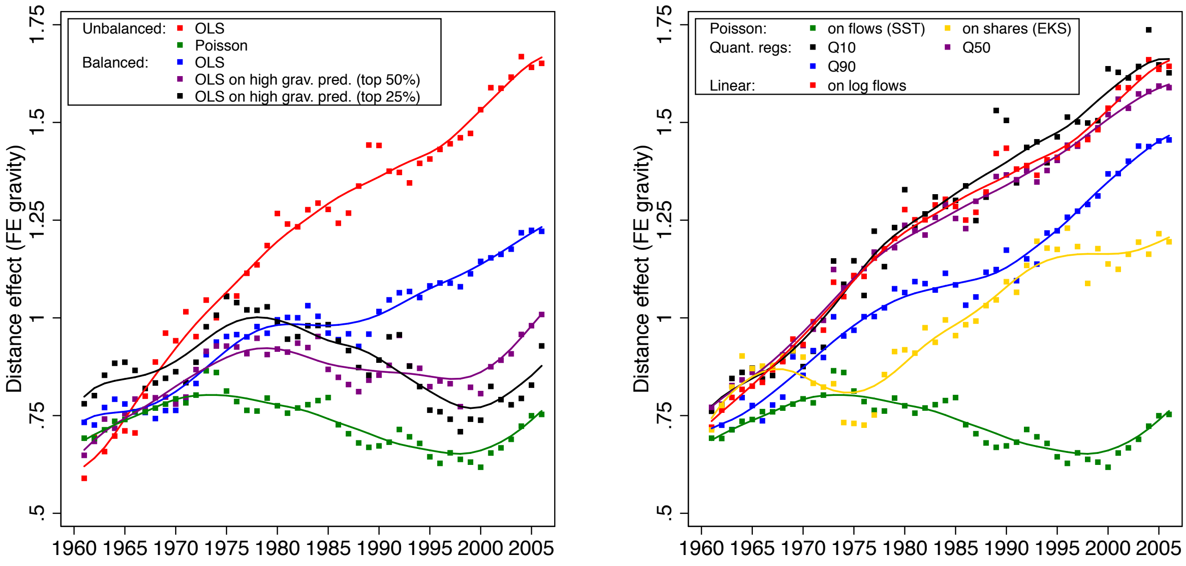


Figure 5 graphs a series of $\hat{\delta}_t$ estimated in cross-section regressions. In every case there are origin and destination fixed effects and a set of standard gravity covariates (common language, contiguity, RTAs, common currency, past and current colonial link). The simplest specification (linear in logs regression on the whole sample—the red line of panel a) exhibits a very steady rise in distance effects. This tendency for increasing effects of distance over time is known as the "distance puzzle" in the literature. One simple explanation for it would be that over that period, the end of colonies and the surge in regional trading arrangements have made short distance trade easier in relative terms. However our list of controls includes those determinants, and therefore account for those trends.

Alternative explanations involve evolution of the gravity sample over time. Indeed it is very well known that the number of positive flows currently in the bilateral trade flow matrix is much larger now than in the 1960s. If those "entrants" in the trade data are pairs of countries with relatively long distance and small flows (which we have good reasons to believe should be the case theoretically), it could explain the trend in distance effects. Panel (a) investigates the samples hypothesis, by first restricting the sample to the set of dyads with positive trade over the entire period. The trend is still upwards, but with a a slope that is much less steep. We then investigate heterogeneous effects by restricting the sample to the set of dyads with both balanced data and high expected trade values (top 50% and top 25% of naive gravity predicted trade). The conclusion of those two sets of regressions is that distance effects of a balanced set of high traders are relatively stable over time. On the contrary, distance effects are rising most for the new and low-trading countries. This finding is related to the impact of using Poisson rather than linear regressions on the distance puzzle. Bosquet and Boulhol (2009) first showed that the distance effects were much more stable when using Poisson. One key difference between PPML and OLS is that the former puts a lot more weight on high expected trade dyads since it tries to minimize the distance between real and expected trade in levels rather than in logs. Panel (b) of the figure investigates the issue deeper, proceeding with quantile regressions for the 10th, 50th, and 90th percentiles of the unbalanced sample. Again, as the expected level of trade rises, the rise in distance effects over time is less pronounced.

Last, we present the results for the estimation method proposed by Eaton et al. (2012), running PPML on shares of bilateral imports over total expenditure rather than on levels. Intuitively, this should give less weight to large absolute values of trade than PPML on levels. The results seem to be quite intermediate between OLS and PPML.

Overall, our figure therefore presents consistent evidence of heterogeneous (non-constant) effects of distance, with lower impacts for larger trade flows. We hypothesize that estimated distance effects are rising because of a combination of changing participation in trade and a non-constant trade cost elasticity.

Head et al. (2013) develop a non-pareto version of the Melitz/Chaney model that can make sense of this pattern of implied differences in trade cost elasticities. The key to understanding heterogeneity over time in the distance effect may be its cross-sectional heterogeneity. From 1960 to present: new countries start exporting and existing countries initiate new positive dyads. Since they were not exporting before, the new flows are for low cost cutoff and low probability of exporting origin-destinations. In a log-normal model, these dyads have higher absolute trade elasticities. The already positive dyads could have relatively stable elasticities. The combination of new high elasticity dyads and stable incumbents raises the average elasticity—if the estimator "pays attention" to small dyads. Our results offer an explanation for why methods that weight the data differently obtain such different results.[19]

3.5. Border effects: In decline, but still puzzling

Using a naive gravity equation, McCallum (1995) showed 1988 trade between Canadian provinces was about 20 times higher than trade between province-state pairs of comparable size and distance. This paper started a literature, interested in three main objects: (1) the evaluation of the effects of borders other than US-Canada (e.g. within the EU, for developing countries); (2) the appropriate ways to estimate a border effect taking into account the underlying theory; and (3) the explanation of the high levels of border effects that were invariably found.

Before considering each of these issues, we illustrate the border effect concept using figure 6. It depicts flows of goods between Canadian provinces, American states, and between states and provinces. The thicknesses of these lines are drawn proportional to the amount traded on each route. The four circles are sized in proportion to the value of shipments that are both produced and consumed in each province or state (i.e. "exports to self"). Two facts emerge that are very important. First, there is clearly very strong trade between each province and its adjacent state. This would be even more extreme if we had chosen Michigan instead of New York because of the massive auto-related flows between southern Ontario and the Detroit area. To determine if these adjacent cross border flows were above or below the gravity norm, we would have to be quite confident that we were measuring the distance correctly. Second, trade with self is very high (we actually had to rescale it to be able to fit the circles in the figure) but it is conceptually difficult to say whether it is too high because a province's distance to self is a problematic concept.

The flows we want to focus on in figure 6 are the eight long distance flows, four that cross national borders and four that do not. It should be clear that the latter are *much* larger than the former, despite the distances being approximately the same in the figure. The distances

[19] Duranton and Storper (2008) provide an alternative account emphasizing the changing nature of what is traded as trade costs fall. In their model lower transport costs leads to great trade in custom-made machines. Trade in these varieties is more distance-sensitive than for standardized machines.

are even more similar in reality. According to Google Maps, the actual driving distances are 4372km (Vancouver to Toronto), 4392 (Vancouver to Buffalo), 4156 (Seattle to Toronto), and 4176 (Seattle to Buffalo).

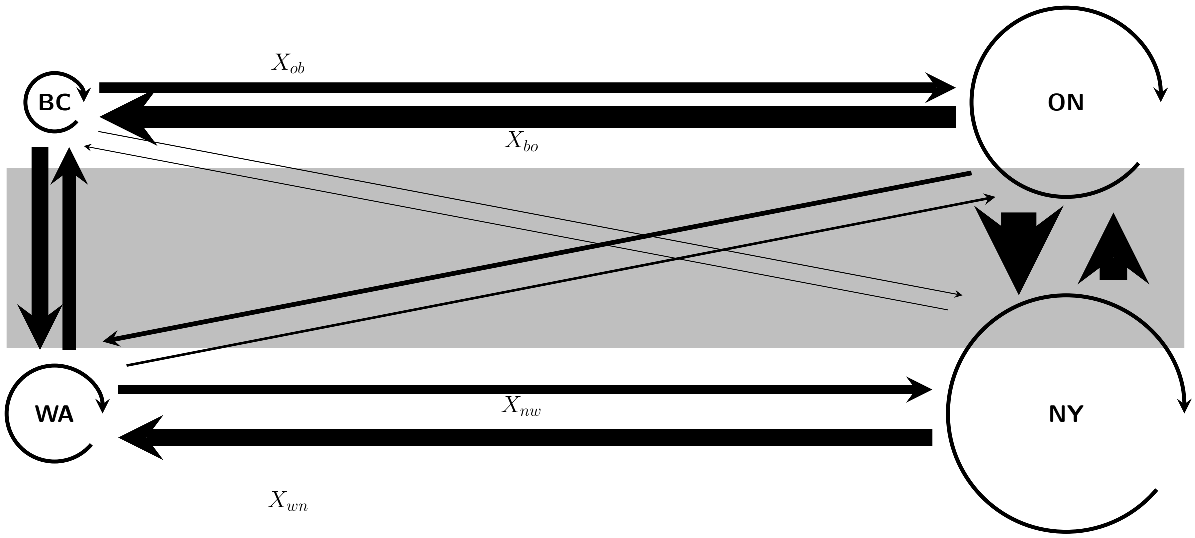


Figure 6 – Border effects illustrated

The border effect is typically estimated using gravity regressions that control for country size and distance, looking for a discontinuity in the trade cost function associated with crossing the international border. Whenever a discontinuity is estimated, we need to worry whether it actually just reflects some non-linearity in the distance cost function. To assuage such concerns, we calculate the Canada-US border effect without parameterizing the distance function—or even estimating a regression at all. In contrast to the examples given by McCallum (1995), the new method we propose takes the model seriously; it is constructed in such a way as to eliminate the troublesome multilateral resistance terms.

Recall that $X_{ni} = GS_iM_n/r_{ni}$. Rather than force the power function form on distance, let cross-border resistance $= r_{ni} = \beta_{ni}g(D_{ni})$. For the within border dyads $\beta_{bo} = \beta_{ob} = \beta_{wn} = \beta_{nw} = 1$, whereas for goods that cross a border the increase in resistance is determined by identity of the importer, with $\beta_{ow} = \beta_{bn} = \beta_a$ and $\beta_{wo} = \beta_{nb} = \beta_c$. The geometric mean of the within-border flows divided by the geometric mean of the cross-border flows provides our estimate of the border effect:

$$b = \frac{(X_{bo}X_{ob}X_{wn}X_{nw})^{(1/4)}}{(X_{bn}X_{nb}X_{wo}X_{ow})^{(1/4)}} = \sqrt{\beta_c\beta_a}\sqrt{\frac{g(D_{bn})g(D_{wo})}{g(D_{bo})g(D_{wn})}} \quad (5)$$

Since we picked our four trading entities such that $D_{bo} \approx D_{bn}$ and $D_{wo} \approx D_{wn}$, the second factor above is approximately one. As a consequence, b corresponds to the geometric mean of the two border resistances. In 2007 our calculations yield $b = 7.3$, well below the McCallum figure of 22 but above the Anderson and van Wincoop (2003) value of 5.

As with the distance effect, δ, the border effect can be decomposed as the product of the trade elasticity and the impact of the border on delivery costs. The latter can be expressed as one plus the *ad valorem* tariff charged at customs, denote t_c, plus the *ad valorem* equivalent of any dark costs associated with crossing borders, which we will denote t_d. Thus, omitting the origin-destination subscripts, we have

$$\ln\beta = -\varepsilon\ln(1 + t_c + t_d), \quad (6)$$

where the left-hand side can be estimated as the coefficient on a dummy that equals 1 for trade flows that do not cross a national border. As before, we take $\varepsilon = -4$ as the current consensus estimate of the trade elasticity. McCallum (1995) estimates $\widehat{\ln\beta} = 3.09$ in 1988. At that time, the production-weighted average Canadian tariff was 4.4%. Solving for t_d in equation (6), we obtain $t_d = \exp(3.09/4) - 0.044 - 1 = 1.25$. Non-tariff aspects of the border have the equivalent impact of a 125% tariff and they constitute 96% of the total tariff equivalent.

Anderson and van Wincoop (2003) set out to "solve the famous McCallum border puzzle." Their key idea was that border effect measurement must take into account differences in *multilateral resistance*, denoted Ω_i^{-1} and Φ_n^{-1} in the structural gravity model. Using 1993 data that included state-to-state shipments measured as part of the US Commodity Flow Survey, Anderson and van Wincoop (2003) estimate $\widehat{\ln\beta} = 1.62$. Five years into the implementation of the Canada-US FTA, about half the original tariffs had been eliminated. Plugging in the new numbers, t_d =49%, again about 96% of the total tariff equivalent of the border. The BC-ON-NY-WA border effect of 7.3 reported above corresponds to a tariff-equivalent of 64%. all of which is dark, given that duties had been eliminated almost a decade before. Of course this is but one observation. However, the states and provinces we use are large and important and so it is not an example that can be dismissed.

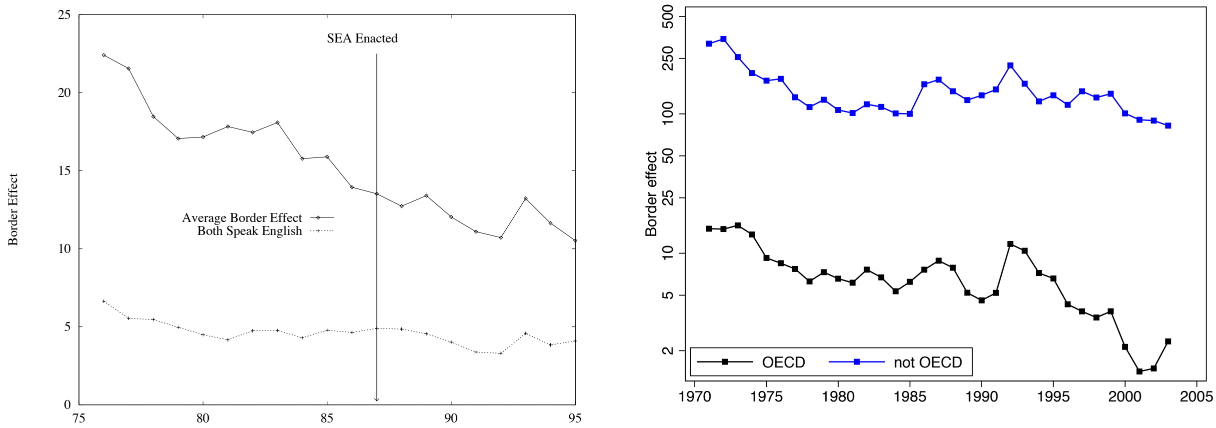
Head and Mayer (2013) collect 71 different structural (including country fixed effects or the equivalent) estimates of the border coefficient. The median $\widehat{\ln\beta}$ estimated with country fixed effects (or the equivalent) is 1.55. The current trade-weighted world average MFN tariff is 3.8%. These numbers imply $t_d = 43.5\%$, about 92% of the full tariff equivalent. The trade-weighted tariff underestimates the importance of tariffs in the world economy since it down-weights precisely the observations where tariffs have eliminated the most trade. We can bracket our estimates by using the simple average world tariff, 12.5%. In that case the implied t_d shrinks to 34.5% but this still represents 72% of the total impact of the border. The inescapable conclusion is that border effects are equivalent to very high tariffs and actual tariffs can only explain a small share of this. The rest, over 90% in most of the cases considered, has to be attributed to the dark costs of selling to consumers across borders.

Our category of dark costs encompasses everything other than tariffs. This misses an important distinction. There are a set of border compliance costs that are not as easy to measure as tariffs but they can be assessed through careful study and their effects are easily understood. Such costs were a major focus of the 1988 Cecchini Report of the European Economic Community. They have also attracted attention in Canada, especially because the costs appear to have increased as a consequence of heightened security measures since 9/11. At the risk of abusing our astrophysics analogy, we can call these "gray" border costs. Most calculations show that they are non-negligible but far too small to explain much of the total effect of borders described above. For example the Cecchini calculation of the total "direct cost of customs formalities and the administrative costs that derive from them" was 1.8% of the value of goods traded.[20] Head and Mayer (2000) estimate the border coefficient between EU members from 1984–86 to be 2.75. The tariff equivalent is 99%. The situation at the Canada-US border is similar. Based on field work in 2002, Taylor et al. (2004) put the total cost of delays, uncertainty, and customs clearance costs at 2.0%–3.4% *ad valorem*. While larger than the figure for the EU, even the upper estimate remains puny compared to the total border cost tariff equivalent. We conclude that, as with distance effects, we are going to need unconventional sources of resistance to explain the effects of borders.

[20] http://www.thefederalist.eu/index.php?option=com_content&id=391&lang=en

Figure 7 – Border effects are large, but declining

(a) European Union (b) Worldwide



Concerning the evolution over time of those border effects, the impact of national borders appears to be falling in most samples. The first such finding was Helliwell (1998), who estimated a series of McCallum-style regressions and found the border effect fell from 17 to 12 in the period 1991–1996. Head and Mayer (2000) and De Sousa et al. (2012) estimated border effects for the EU and world and also found falling border effects even when accounting for multilateral resistance terms, as shown in Figure 7.

Similar to the dark part of the explanation for the *level* of border effects, there is room for mystery in their time pattern. The most obvious reason to expect border effects to decline is tariff reductions. With Canada and the US there were indeed some tariff reductions (associated with the phase-in of the Canada US FTA from 1989 to 1998) during Helliwell's estimation period. With $\varepsilon = -4$ the observed decline in the border effect implies an 18 percentage point tariff reduction, much larger than the actual average reduction of approximately 3 percentage points. Intra-EU trade has been tariff-free since 1968, that is before the start of the estimation period in Head and Mayer (2000). Hence none of the decline observed in Figure 7(a)—equivalent to a 25 percentage point[21] tariff reduction between the late 1970s and early 1990s—can be explained by tariffs.

De Sousa et al. (2012) find similar declines in their global sample, even controlling for the evolution of bilateral tariffs. Harmonization of regulation or reductions in other "gray" border costs might have played a role in the falling effects of borders. Head and Mayer (2000), however, find very little evidence of this for the single market program (SMP) implemented in Europe in the late eighties. The simplest evidence of this is the vertical line in Figure 7(a), which indicates the start of the SMP. No change in the declining trend of the border effects seems discernible. The SMP policies have very little explanatory power in regressions with the level and change of the EU border effects as the dependent variables.

To sum up, Figure 7 makes it clear that despite going in the intuitive direction of being reduced in recent years, the impact of national borders remains very strong, contradicting once again the claims that the world is now a flat surface on which goods can slide effortlessly. We are therefore facing two puzzles, one for distance, and one for borders: despite technological and policy changes that should by now have made distance and borders unimportant, their influence remains of first order. We now turn to explanations of this current state of "unfinished"

[21]This calculation is based on the first and last columns of Table 5: $\exp(3.04/4) - \exp(2.54/4) = 0.251$.

globalization.

4. EXPLAINING HIGH DISTANCE AND BORDER EFFECTS

The obvious sources of resistance—*traditional trade barriers* like tariffs at the border and freight costs of moving goods across space—do not appear sufficient. Grossman (1998) argued that distance effects are too large to be explained by freight costs (and also that it is the wrong functional form). He proposed three possible explanations:

1. "imperfect **information** where familiarity declines rapidly with distance"
2. "very localized **tastes** (as in Trefler's "home bias"), which are historically determined and change only slowly with experience."
3. "distribution **networks** play a more central role."

In a seminal paper Rauch (1999) proposed a broader view of the importance of networks encompassing much more than just distribution networks. Helliwell (2002) argues that such networks are key underlying determinants of border and distance effects.

> Networks and common norms, often described as social capital, underlie successful interactions of all types... These networks are fuelled by mutual trust, abetted by common institutions, and lubricated by frequent interactions. All of these decline with distance and as national borders are crossed. Although changing costs and technologies have radically altered the scope for long-distance and transborder linkages, the scale of these is still dwarfed by the density of local contacts... (p. 74)

Thus, the hypothesis is that the structure of business networks exhibits border and distance effects, which are then manifested in trade patterns. This begs the questions of why networks would have such a structure. The answer implicit in the Helliwell quote and Rauch's use of a colony/language "links" variable to test his theory is that current networks were shaped by history. If networks are the principal conduits of information, we can infer a role for history in Grossman's declining familiarity hypothesis. A role for history is explicit in the Grossman localized tastes hypothesis.

In sum, our skepticism about the ability of contemporaneous measured trade barriers to account for persistently high distance and border effects leads us to conclude that the answer may lie in *the past.* Nunn (2009) surveys an increasingly sophisticated literature that establishes that historical circumstances have long run effects on economic performance. Two key mechanism are institutions (often set by colonizers) and cultural norms.

Eichengreen and Irwin (1996) is the first effort we know of to inject the past into trade. They did so by adding lagged bilateral trade to the set of explanatory variables in the gravity equation. Content with their results, Irwin and Eichengreen concluded the paper with the pronouncement that "...we will never run another gravity equation that excludes lagged trade flows. If our paper is successful (and widely read) neither will other investigators." Estimations with lagged dependent variables generally leave results that admit two very different interpretations: path dependence vs unobserved heterogeneity. In other words the significance of lagged trade may have little to do with history if it simply captures omitted determinants of bilateral trade. We are convinced that progress can only be made by exploring direct evidence for specific historical mechanisms. There are two hypotheses of particular interest.

- Historical isolation or conflict $\Longrightarrow$ low bilateral business network connections $\Longrightarrow$ *lack of* *information*

- Historical isolation (lack of cross-migration + high trade costs) $\Longrightarrow$ evolution of *home-variety biased preferences.*

4.1. Informational impediments to trade

A satisfying explanation for why distance has a large effect on trade in goods should take into account the fact that distance has a similarly large effect on a variety of other flows and transactions that do not involve physically moving goods. Estimated distance effects for commercial services and foreign direct investment (FDI) are remarkably similar to those estimated for goods using comparable methods and samples. Head et al. (2009) find a commercial services distance effect of 1.2 in 2006, compared to 1.4 for goods using the same sample, method, and explanatory variables. Head and Ries (2008) estimate an FDI distance effect of 1.25 and a cross-border M&A effect of 0.92. All these specifications include importer and exporter fixed effects. In the case of commercial services, distance effects might arise due to the need for face-to-face delivery, which in turn requires travel. Since FDI by definition entails some controlling influence on management it may also involve travel.

It does not seem sensible to invoke a travel explanation for the distance effects estimated for portfolio investment, web browsing, and patent citations since none of these require proximity of the two parties in the transaction. Coeurdacier and Martin (2009) find distance effects of 0.4, 0.7, and 0.5 for equity, bond, and bank assets (respectively). While these estimates are smaller than those typical for goods, we cannot compare them reliably because the authors included bilateral trade in goods as a control. This would be expected to rob some of the explanatory power from distance.

A unified explanation for distance effects in all these cases is that they all involve information. For almost all forms of exchange, information about "product" quality and vendor trustworthiness is paramount—and hard to obtain remotely. Even when there is no buyer or seller involved, information can facilitate a flow that would not otherwise occur. For example, an inventor writing a patent application should cite all the prior work that is relevant. In practice, however, she will cite the prior work she is familiar with. Thus if one can control for relevance, a negative distance effect on citations points to spatial decay of familiarity, the second Grossman hypothesis.

Huang (2007) investigates an implication of Grossman's hypothesis that distance proxies for familiarity. The key idea is that if distance is a proxy for lack of information, which leads to uncertainty, then greater aversion to uncertainty should cause larger distance effects. Using the influential cross-country survey by Hofstede, Huang estimates that countries that are more averse to uncertainty have larger distance effects on their exports. He shows that this result comes mainly from differentiated products. Rauch (1999) argues that such products are subject to greater informational impediments. Products with international organized exchanges or reference prices—i.e. the products that Rauch hypothesizes to suffer less from information problems—do exhibit smaller interactions.

Hortaçsu et al. (2009) find that eBay transactions have a distance elasticity of -0.07. This is much smaller than the near unit elasticities estimated for commodity flows within the United States. One interpretation, consistent with Rauch, is that eBay is functioning as a conduit of information about the availability of products with specific desired attributes. For non-eBay transactions, the declining familiarity effect is much larger. The residual distance effect could come from distance-decay in information that eBay cannot convey. Supporting this interpretation is the finding that the distance elasticity does not change when the authors control for shipping costs. More surprising is the finding that transactions are 75% more likely to occur within the same state (after controlling for distance and state fixed effects). The in-state effect should have been negative given that sales taxes are only applicable when the buyer and seller reside in the same state. Hortaçsu et al. (2009) suggest different levels of trust may underlie these effects, perhaps because "increased possibility of direct enforcement of the trade agreement, either by returning the good in person or by compelling the seller to deliver on his or her promise." They find support for this hypothesis by interacting distance and same-state with an indicator for states whose median seller has poor reliability ratings. When the median seller is classified as "very bad," the distance effect rises from -0.07 to -0.11 and the same-state effect rises from 1.75 to 4.44!

Lendle et al. (2012) estimate gravity equations for eBay and "offline" trade for similar goods using 62 countries. They find much larger distance effects for eBay transactions than Hortaçsu et al. (2009), -0.38, with near unit elasticities for offline trade using the same specification. Corroborating Hortaçsu et al. (2009), they also find that transactions involving less trustworthy sellers have higher absolute distance effects. Moreover they find that distance elasticities between eBay and offline transactions seem to converge at intermediate values when the countries involved are high Google/internet users and not perceived as corrupt. Collectively, the eBay results support a view of trade where (a) lack of information is a key impediment, (b) eBay partially solves the problem.

The natural question is why should information be subject to iceberg melting with distance? If we have a Wikipedia model of information transmission, then everyone would have access to the same information no matter where they resided spatially relative to each other. The spatial decay of information we observe empirically suggests another form of diffusion. Suppose that the type of information that drives transactions is mainly not broadcast but rather conveyed selectively within business networks. Then if those business networks have a geographic bias, so will the resulting pattern of information flows.[22]

A different, but related set of evidence on the impact of distance on information focuses on knowledge flows, based primarily on citation patterns and their spatial decay. This is currently the main "trace" left by flows of knowledge, and have generated quite a large literature.[23] While the initial approach used matched local and non-local patents, Peri (2005) analyzes citations using a gravity equation, except that he uses distance intervals rather than the standard log distance parameterization. He shows that most of the national border effect occurs within the limits of the region where knowledge is generated. Starting with an initial knowledge stock of 100 in a EU region, there is only 20% left when crossing a regional border inside the same country, 12.4% when leaving the country, and the slope of decay becomes then very flat at -0.03 for each bin of 1000kms covered. Li (2012) estimates a more standard gravity specification and finds distance elasticity on citation of -0.12 (when she excludes self-citation). The elasticity falls to -0.02 when considering only patents above 15 years in age.[24]

[22] Chaney (2013) models how geographically biased patterns of initial contacts emerge and lead to distance effects of $\delta \approx 1$. Allen (2012) attributes 90% of distance effects in Philippine agricultural trade to information, estimating a model where producers randomly search in different markets to learn about the local retail price.

[23] It is quite likely that with the rise of tools like Google Scholar, flows of knowledge based on citations of research articles becomes a new popular data source used for identification of the importance of proximity on knowledge and innovation.

[24] When adding controls for 3-digit patent-class effects the corresponding elasticities fall to -0.04 and -0.02

Griffith et al. (2011) examine the speed at which new patents are cited at home compared to when they are cited in other countries. Despite the title, "Is Distance Dying at Last," the paper only estimates the degree of home bias, what we would term the border effect. The key finding is that the bias towards citing domestic patents first at home is declining over time. Comin et al. (2012) also focus on the geographic diffusion of knowledge. Instead of measuring this with citations, they examine adoption of "20 major technologies in 161 countries over the last 140 years." In a structural model they estimate that the frequency of interactions decays by 73% every 1000km for the median technology. As predicted by their model, geographic interactions in adoption taper off as the technology diffuses.

4.2. Localized, historically determined tastes

> "The world's needs and desires have become irrevocably homogenized." (Theodore Levitt, *Harvard Business Review* 1983)

Marketing professor Theodore Levitt was one of the early proponents of the view that markets were already globalized. Based on the empirical claim above, Levitt pointed to the ascendancy of the "global corporation" that "sells the same things in the same way everywhere." As with subsequent globalization boosters, Levitt attributed the changes in large part to technology. Writing a decade before the release of the first web browser (Mosaic), the technology Levitt was talking about was not the internet, but rather television and inexpensive jet travel. These technologies heightened awareness of consumption opportunities in other countries. "Almost everyone everywhere wants all the things they have heard about, seen, or experienced via the new technologies." Later he observes "Ancient differences in national tastes ... disappear."

Reading Levitt, and then reflecting on the last 30 years of technological progress culminating in the worldwide success of the "Gangnam Style" Youtube video, Grossman's hypothesis of localized, historically determined tastes seems utterly quaint and out-dated. Yet Levitt made empirically testable claims. Hence, it makes sense to approach the issue by looking at what the data say. A variety of studies point to persistent, spatially correlated, heterogeneity *within and between* countries.[25]

As we have tried to do whenever possible, we begin by illustrating raw data phenomena. Figure 8, kindly prepared for us by José de Sousa, shows how allocation of total expenditures on fats and oils are allocated between (a) butter and (b) olive oil in France in 2005. The left panel shows butter demand appears to be spatially concentrated in the Northwestern regions of Normandy and Brittany. In contrast olive oil demand is especially strong in the Mediterranean départements, as shown in the right panel. The pronounced demand differences cannot be easily dismissed as the consequences of price differences since the latter seem rather minimal. A recent check on the Carrefour online store revealed that a stick of butter costs 0.97 € in Rennes and 1.06 € in Marseille whereas a bottle of olive oil costs 6.05 € in Rennes and 6.26 € in Marseille.[26]

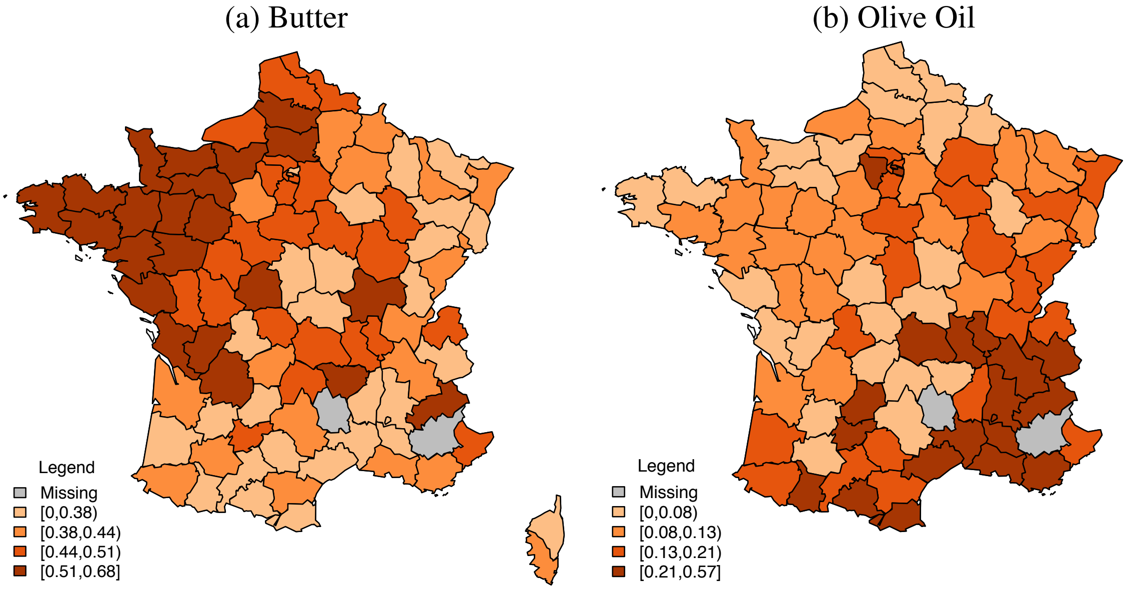
The localized tastes hypothesis explains such demand differences as arising mainly because

respectively.

[25] There is also evidence that for television, music, and movies have much more limited effects on domestic culture than Levitt claims. Disdier et al. (2010) estimate the impact of media on names given by French parents from 1967 to 2002. Using the estimated parameters, a counterfactual exercise suggests that even if foreign media had been banned entirely from France, fewer than 5% of French babies would have been named differently.

[26] To be specific the butter prices are for 125g of President butter and the olive oil prices are for one litre of Puget extra virgin olive oil. We checked prices May 29, 2013.

Figure 8 – Expenditure shares (out of all fats & oils) of 10,240 French households, 2005–6



of history. Before rapid, cheap, refrigerated transportation became available, it seems likely that butter would have been unavailable in Marseille or at least priced very unattractively. The converse would be true for olive oil in Brittany. Consumers would rationally use the locally supplied form of fat and would adopt recipes featuring this ingredient. Children would be habituated to the taste of the local variant. Producers would also develop skills in manufacturing butter in the North and olive oil in the South. The production-side improvements would further motivate taste adjustment. Cultural evolution would thereby result in differences in preferences that could be expected to persist even after falling transport costs had driven down price differences.

Detecting spatial patterns in tastes is clearly more challenging if the goods themselves are subject to the confounding factor of distance-related transport costs. Music, being "weightless" and mainly unpriced, seems like a product where we can safely rule out distance matter because of transport costs. Ferreira and Waldfogel (2012) show music market shares follow a gravity equation that is remarkably similar to the one exhibited by trade in goods. Success in foreign markets is predictably higher if the market is proximate and shares a common language. The elasticity with respect to distance is 0.31, lower than observed for goods but higher than domestic eBay transactions and patent citations cited in previous section.[27] The authors find that distance effects are stable over time but home bias, always large, has risen substantially since the 1980s. At their low point, the same country coefficient was 1, implying domestic market shares were almost triple the gravity benchmark. By the end of the sample they had risen to 2.5, implying a ten-fold preference for domestic music. These results sharply contradict the Theodore Levitt view of irrevocable homogenization of preferences.

A related piece of evidence for "weightless" products comes from Blum and Goldfarb (2006) who show that distance reduces website visits with a very large elasticity ($\delta \approx 3$) for "taste-dependent digital products, such as music, games, and pornography." Though imprecisely

[27] Ferreira and Waldfogel (2012) estimate many of their regressions with a control for the share of artists exporting. This controls for the extensive margin and leads to marked drops in the coefficients on other variables. Distance effects, for example, fall to 0.14. We focus on the Table 4 specification (1) results because they combine both margins and are thus comparable to the other gravity specifications we report in the paper.

estimated, the effect is statistically significant. For other sites, the distance effect is generally much smaller and not statistically significant. Head and Mayer (2008) find distance effects within France used to have a significant impact on differences in tastes in names for children, but the distance decay of name similarity has all but disappeared over time *within* France.

Atkin (2013b) formalizes the hypothesis of localized, historically determined tastes in the context of cereals consumption in India. Controlling for price differences, he estimates region-cereal specific preference parameters. The taste for a cereal is negatively related to prices in the past, evidencing habit formation, and positively related to endowments (cropland suitable for rice, wheat, etc.). Thus, Northern, wheat producing states have larger wheat dummies in their demand functions. Finally the paper points to an important implication of localized tastes: the caloric gains from trade are much diminished compared to a model with identical tastes and no habit formation.

If habits are set in childhood, then one powerful way to identify taste differences is to compare behavior of migrants in their new homes to that of natives who grew up there. Both types face the same prices so identification of preference parameters is easier than if the econometrician has to purge out the effects of inter-regional differences in price and availability. Atkin (2013a) finds that migrants within India retain the preferences of their origin states. As a result they pay a 7% "cultural penalty"—measured as the reduction in calories consumed if the destination village has high prices for their preferred home varieties. Bronnenberg et al. (2012) examine brand preferences of migrants within the United States. Their dependent variable is top brand's share of expenditures on the top two brands in each of 238 packaged goods categories. Migrants' gaps in top brand shares relative to natives close by 60% in the year of arrival. The authors interpret this as the immediate impact of the change in supply conditions and infer that 40% of the gaps can therefore be attributed to persistent brand preferences. With more time in the new location, market shares close gradually, with the slowest convergence observed for migrants who arrive as adults.

We see the data as supporting a model along the lines of the following sketch: Preferences evolve towards locally available goods/varieties. Thus, far from the olive trees lining the Mediterranean coasts, Britons and Bretons make butter their fat of choice. Local supply in turn co-evolves with local preferences since a large demand will reinforce the initially favorable supply-side conditions. Tastes are transmitted vertically from parent to child via childhood habituation (food) and parental effort to maintain culture (religion, etc.). The only things that can disrupt the tendency towards divergence of tastes are trade openness and migration: i) easier trade of goods can confront people with alien varieties so cheap that it overcomes the initial taste resistance, ii) migrants bring their preferences with them. While they tend to assimilate over time, migrants expose their cultural traits to natives, resulting in at least some experimentation and adoption by locals. Since migrants mainly move nearby this creates a tendency for proximate locations to have similar preferences. Some elements of the model we have in mind are contained in Olivier et al. (2008) and Maystre et al. (2009), in particular the endogenous effort parents make to transmit their cultural trait, when confronted to rising foreign influence.

4.3. Persistent colonial legacies

Revisiting Figure 3, we see that many of the observations above the gravity prediction line are former colonies of France and Francophone countries. And of course we note the high level of overlap in the two categories. Former colonies of France also frequently use the French legal system. Eight former French colonies in West Africa use a currency, the CFA Franc, that is pegged to the Euro.

Table 1 – Meta-analysis of Colony-related indicators

	All Gravity				Structural† Gravity			
Estimates:	median	mean	s.d.	#	median	mean	s.d.	#
Colonial link	0.91	0.92	0.61	147	0.84	0.75	0.49	60
Same language	0.49	0.54	0.44	680	0.33	0.39	0.29	205
Same currency	0.87	0.79	0.48	104	0.98	0.86	0.39	37
RTA/FTA	0.47	0.59	0.5	257	0.28	0.36	0.42	108

†: Structural here means either country fixed effects or a ratio method.

Table 1 returns to the meta-analysis conducted in Head and Mayer (2013) and focuses on results for three colony-related indicators: whether the importer and exporter were ever in a colonial relationship, whether they share a common official language, and whether they have a common currency. We also include effects of regional trade agreements as comparisons. On average colony, language, and currency effects are as strong or stronger than the impact of a free trade agreement.[28]

Canada offers a unique history and data opportunity to investigate colonial legacies. Since the British defeated the French in 1763, the province of Quebec has been politically severed from its colonizer. Nevertheless, French is still the principal language, the legal system is based on the Napoleonic Code of 1804, and most visitors perceive it to share other cultural aspects with France. The data opportunity comes from the fact that Canadian import statistics record the province of destination. This allows us to compare Quebec and Ontario import patterns of detailed goods. In keeping with our focus in the previous subsection on tastes, we first examine six types of food where France supplies unique varieties. Table 2 shows the harmonized system code for each of these taste-oriented goods along with 6 industrial goods where consumer tastes are not relevant.

Table 2 – Cultural and non-cultural goods

Food & beverage		Industrial goods	
HS	Description	HS	Description
1601	Sausages, similar meat products of (Saucisse)	7007	Safety glass
1602	Other prepared/preserved meat (Jambon)	8467	Hand tools
220410	Sparkling wines (Champagne)	8427	Fork-lift trucks
220421	Other grape wines	85	Electric machy.
040640	Blue-veined cheese ("Roquefort")	9018	Medical instruments
040690	Other cheeses	9025	Measuring equipment

To avoid comparison with quite distinct American versions of the food products, we calculate import shares using the total value of imports from the "Continental 5" as the denominator. In addition to France, this comprises Germany, Italy, Spain, and Portugal. The 2006 Canadian Census tabulated ethnic origins in each province. In Quebec 79% of those claiming origin in Continental 5 were of French ancestry. However many also claim Canadian and Quebecois origins. If we assumed they also had French ancestry, the share rises to 92%. In Ontario the self-declared French ancestry share is just 36%. According to our cultural heritage hypothesis, the modern Quebecois should exhibit a preference for French varieties.

[28]It should be noted that currency and colony effects estimated using Poisson PMLE are normally much smaller.

Figure 9 – Did French colonists set modern Quebecois tastes?

(a) Food & beverage, 2007 (b) Industrial goods, 2007

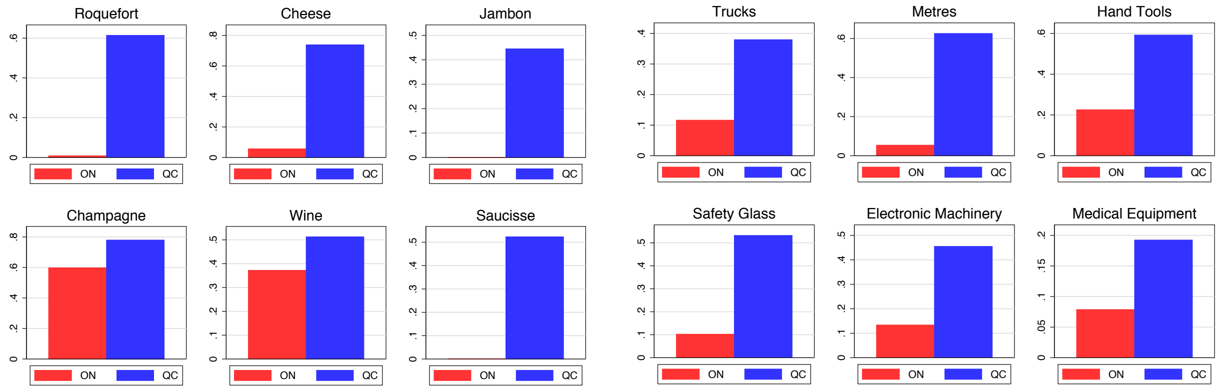


Figure 9(a) shows that for each of the food and beverage categories, the French share is considerably higher in Quebec than Ontario. In the case of the four foods, the gap is extreme. An alternative explanation, however, is that French suppliers are preferred because they are easier to communicate with. The fact that the right panel shows substantial French preference for industrial goods, showing that consumer tastes alone do not explain the Francophilia of modern Quebecois importers.

While the Quebec-France example is interesting, it is always possible that it is a completely isolated case. Furthermore, because independence took place very long before official trade data was collected in a modern way, it offers no insight about the time pattern of trade preferences when two "countries" separate. Head et al. (2010) provide an extensive study of the erosion of the colonial legacy in trade, studying the vast movement of independence that mostly took place in the second half of the twentieth century.

Figure 10 – Post-independence trade of former colonies

(a) Colonizer & "Siblings" (b) Hostile separations

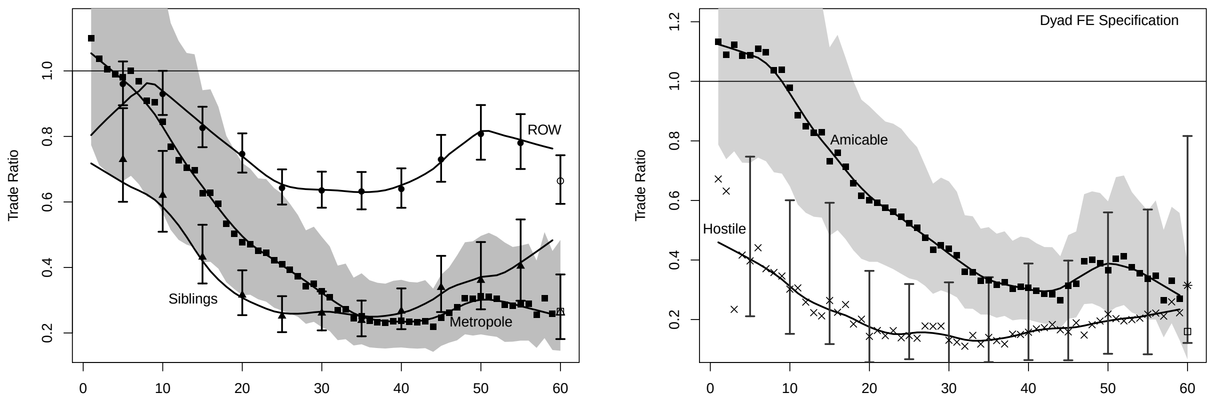
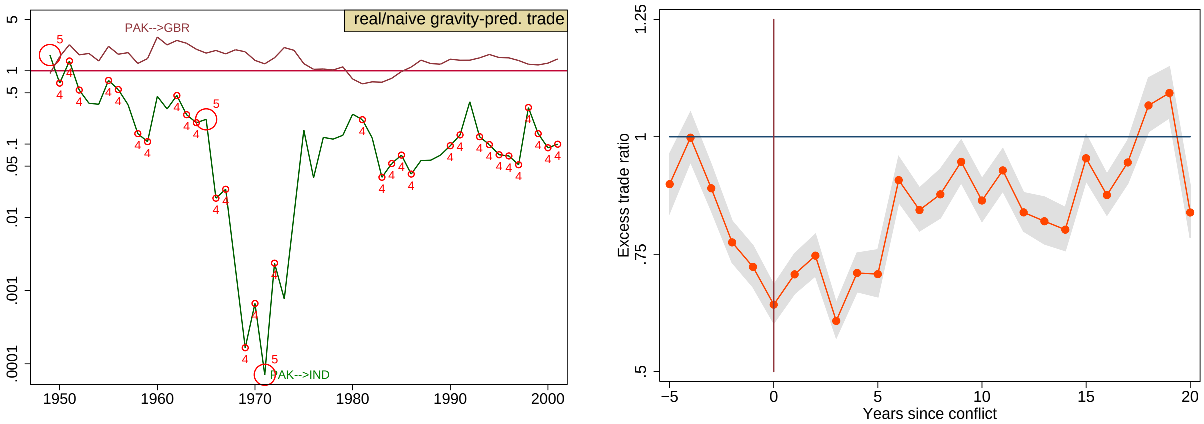


Figure 10 shows that for most independence events (the ones that took place without military conflict), trade between the colonizer and its former colony declines steadily before flattening out after 40 years at around 35% of its initial level. A further finding is that trade with the rest of the world does not jump up to compensate, while trade between siblings (ex-colonies of the same empire) also follow a regular decline. This suggests that what happens is a gradual depreciation of some sort of trade capital that favored trade between all parts of the existing

Figure 11 – Conflict, trade, and trust

(a) Pakistan's exports (b) All conflict 1950–2000



empires. It is also interesting to note that while hostile separations result in much larger drops in trade immediately after independence, the two types of independences converge to statistically indistinguishable trade levels after 40 years. Military conflicts destroy more trade capital than amicable separation, but this is not a permanent effect, a finding we will revisit when we consider trade effects of conflict more generally. Note finally that trade never comes back to its initial level: Countries that separate lose a lot of trade on a permanent basis, even if most of those pairs still speak the same language, have many common institutions left, often have very low official trade barriers, sometimes the same or pegged currency, and usually have substantial bilateral migration.

What these graphs do not show is the extent to which having lost 65% of the initial trade level makes trade between ex-colonies and the ex-hegemon "normal." Table 1 and further evidence in Head et al. (2010) suggest that nearly 60 years after independence for most countries that were colonies in the 1950s, trade with the ex-colonizer is still much larger than the gravity prediction (even after including controls for trade policy preferences, common currency, language and institutions). This is perhaps a consequence of the long-run persistence of tastes that we discussed in the preceding section.

4.4. Histories of violence and contemporary trade

A last piece of evidence about the importance of historical connections between two nations for their current trade patterns is related to military conflicts. In a sense, if we should find current effects of historical heritage, tracing the consequences of the most traumatic violent episodes opposing two countries is probably a good starting point. One just has to remember the importance given to military conflicts in school textbooks to realize that people are probably aware of this type of historical linkages since very early in life, at an age where tastes, preferences and opinions are still pretty much in the making.

Let us start with "short-run" effects of wars. Martin et al. (2008) find that conflict between two countries lowers bilateral trade by around 40% for the first three years after initial hostilities and that trade remains significantly below the gravity benchmark for slightly more than a decade. Glick and Taylor (2010) find an even larger contemporary effect on a longer sample that includes the two world wars. They also show that it takes about 10 years for trade to return to its normal level.

Figure 11(a) illustrates the influence of war on trade, returning to an example that Bhagwati used to cast doubt on the distance effect. Pakistan's trade with India and the UK are expressed as ratios over a naive gravity prediction (based on GDP and distance). In the initial years after independence, both flows were reasonably close to the gravity prediction. Unfortunately, the relationship between Pakistan and India featured a series of conflicts, whose intensity is shown in the graph. The 5s (circled) correspond to actual wars whereas the 4s are "use of force."[29] We see that conflict causes trade to defy gravity. Nevertheless, gravity appears determined to reassert itself. During the 1970s respite from conflict, Pakistan's exports to India surged back towards the gravity benchmark, but that progress was halted when hostilities flared up again in the early 1980s.

Figure 11(b) (taken from Martin et al. (2008)) shows more generally the evolution of trade before and after conflicts, averaging the effects of all type of conflicts (3 to 5 using the same COW range) between 1950 and 2000.

Apart from that contemporaneous effect of conflict on bilateral trade, do conflicts have impacts that persist for long periods? We can think of three main mechanisms by which past conflict should reduce current bilateral trade (over and above the effect of reduced GDPs, which are controlled for in gravity regression settings).

- Destruction of bilateral physical trading *infrastructure* such as bridges and railroad tracks.
- Destruction of *social capital/networks* that facilitate interactions.
- Formation of persistent *negative sentiment*, that acts as a psychological cost of bilateral trade with past enemies.

The very long run effects of war are of the greatest interest for this paper since they might account for some of the "dark energy" pushing countries apart. Che et al. (2013) examine the effects of the Japanese invasion of China in WWII on provincial trade patterns 56 years later. Controlling for province fixed effects, they find that Chinese provinces that suffered greater casualty rates between 1937 and 1945 have lower trade with Japan in 2001. All together, the legacy of the war invasion is a 5.43% annual reduction in Sino-Japanese trade. Guiso et al. (2009) make the most ambitious attempt to link historical conflict to current economic exchange. They have a two-stage empirical model. In the first stage, the authors find that a past history of frequent conflict leads to lower levels of bilateral trust among European countries (as measured in surveys taken recently). In the second stage, the results show that lower predicted levels of bilateral trust cause lower levels of bilateral trade.

We are fascinated by these findings of very long run effects of conflict but do not believe they are strong enough to decisively refute the Martin et al. (2008) and Glick and Taylor (2010) finding that trade returns to normal after a decade without hostility. First, the China results appear to be identified from a handful of provinces where the Japanese invasion inflicted heavy casualties. Hence, they depend upon log distance controlling for all the relevant determinants of bilateral trade between those provinces and Japan. Second, France and England are classified as having 198 years of war by Guiso et al. (2009). Being 10 times the average, this observation may have undue influence in the Guiso et al. (2009) bilateral trust regressions. If war really did have trade-destroying effects that persist for decades, then we would expect to see a large negative residual in France's imports from Germany. But despite inflicting French war deaths of 4% of its population in World War I and 1% in World War II, Figure 3(b) shows Germany

[29] The classification is carried out by political scientists and available online in the Covariates of War (COW) database.

(DEU) very slightly *above* the prediction line for France's imports. Finally, Figure 10(b) shows that after 40 years conflictual separations do not have significantly lower trade than colonial relationships that ended peacefully.

Summing up, the short to medium run negative effect of hostilities on trade is very clear. More work is needed to ascertain the very long run effects of war on trade.

5. Conclusion

Trade is rising faster than GDP, but the remaining "globalization gap" is much wider than the total increase in openness. Distance deters trade even *more* today than it did 50 years ago. Estimated distance effects are too large, too ubiquitous and of the wrong form to be explained entirely by freight costs. National borders impede trade *less* than before, but their effect remains too large to be easily explained with conventional barriers. We have not found a simple explanation for these findings. There is a range of suggestive evidence pointing towards information-based mechanisms as well as historical legacies. One force of resistance we find particularly interesting is historically determined differences in tastes. Such differences have the potential to explain some of the large distance and border effects that have been found for trade data. However, they differ from other impediments to trade in that they are not so much *costs* of trade as they are limitations to the gains from trade. Put another way, full removal of all trade impediments is less attractive if consumers mainly prefer the varieties that are already domestically available. On the other hand, informational barriers could be removed and result in large gains.

While the main task of this paper has been to synthesize and discuss prior research, we want to end by highlighting four novel contributions that may prove useful in future research. First, Figure 2 demonstrates a non-parametric method of illustrating the role of distance in impeding trade. Second, Figure 5 applies quantile regression to gravity estimation and shows that distance elasticities are not constant across the distribution. We applied the same approach to language effects and found larger differences, with the gap widening over time. Third, we have proposed a method of calculating border effects that takes into account multilateral resistance but does not require a regression that estimates a parametric effect of distance on resistance. Fourth, we have suggested a way to decompose distance and border effects into a share attributable to easily measured trade costs (freight and tariffs) and a share we attribute to dark trade costs. These hidden sources of resistance appear to be far more important than those that we can see.

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