Trade Costs, 1870–2000

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What has driven trade booms and trade busts in the past century and a half? Was it changes in global output or in the costs of international trade? To address this question, we derive a micro-founded measure of aggregate bilateral trade costs based on a standard model of trade in differentiated goods. These trade costs gauge the difference between observed bilateral trade and frictionless trade in terms of an implied markup on retail prices of foreign goods. Thus, we are able to estimate the combined magnitude of tariffs, transportation costs, and all other macroeconomic frictions that impede international trade but that are inherently difficult to observe. We use this measure to examine the growth of global trade between 1870 and 1913, its retreat from 1921 to 1939, and its subsequent rise from 1950 to 2000. We find that trade cost declines explain roughly 55 percent of the pre–World War I trade boom and 33 percent of the post–World War II trade boom, while a precipitous rise in trade costs explains the entire interwar trade bust.

I. Trade Costs

International trade costs are the costs of transaction and transport associated with the exchange of goods across national borders and, thus, impede international economic integration. They may also drive many findings in the contemporary open-economy macroeconomics literature, such as home bias in trade and equity (Maurice Obstfeld and Kenneth S. Rogoff 2001). At the same time, economists know little about the magnitude, evolution, and determinants of these obstacles to international trade (James E. Anderson and Eric van Wincoop 2004).

For example, research on the nineteenth-century trade boom has tracked certain costs like freight rates and tariffs reasonably well (Michael A. Clemens and Jeffrey G. Williamson 2001; Jacks and Krishna Pendakur 2007; and Saif I. Shah Mohammed and Williamson, 2004). Likewise, Barry Eichengreen and Douglas A. Irwin (1995) and Antoni Estevadeordal, Brian Frantz, and Alan M. Taylor (2003) have documented evidence on frictions during the interwar period, while Irwin (1995) and David Hummels (2007) have done much the same for the post–World War II period. However, the magnitude and impact of a host of other important impediments to trade that are inherently difficult to measure, like informational, institutional, and nontariff barriers to trade, remain unexplored. There has also been very little work on consistently measuring barriers to trade over the last 130 years.[1] This paper is the first step in filling the gap on both counts of comprehensiveness and consistency.

Specifically, we present a micro-founded measure of aggregate trade costs. We focus on three periods: the first wave of globalization from 1870 to 1913, the interwar retreat dating from 1921, and the present-day rise of globalization dating from 1950. Consistent with the state-of-the-art gravity literature (e.g., Anderson and van Wincoop 2003), we derive this measure from a multiple-country general equilibrium model of trade in differentiated goods based on the approach by Novy (2007). The innovation of the micro-founded measure is to control for multilateral resistance in a tractable, yet previously unnoticed, way which makes it possible to back out the bilateral trade costs. The model yields a gravity equation of international trade

[1] A notable exception here is the work of Clemens and Williamson (2001) which documents worldwide tariffs—measured as customs revenue over the declared value of imports—from 1875 to 1997. Shah Mohammed and Williamson (2004) also piece together information on shipping costs from 1869 to 1950.

that allows us to compute trade costs on the basis of bilateral trade, total trade, and output data.

Our baseline findings demonstrate that the average level of trade costs (expressed in tariff-equivalent terms) between the United States, the United Kingdom, France, and 18 of their trading partners[2] fell by 23 percent relative to their domestic trade costs in the 40 years before World War I. For the same countries, we find that the average level of trade costs increased by 10 percent in the 20 years from the end of World War I to the beginning of World War II. Finally, average trade costs are shown to have fallen by 16 percent in the years after 1950.

After examining the levels and trends in trade costs, we turn to the determinants of trade costs. This exercise is meant to underscore that our trade cost measure is economically sensible. In particular, our evidence suggests that standard factors like geographic proximity, trade policy, adherence to fixed exchange rate regimes, and membership in the British Empire matter for explaining trade costs. A sizeable fraction of the variation remains unexplained, however, offering a promising avenue for future research.

Returning to the question of what drives globalization episodes, we use the micro-founded gravity equation to attribute changes in global trade to two fundamental driving forces—changes in productive capacity and changes in trade costs. For the pre–World War I period, we find that trade cost declines explain roughly 55 percent of the growth in global trade. And consistent with previous studies for the post–World War II period (see Scott L. Baier and Jeffrey H. Bergstrand 2001; John Whalley and Xian Xin 2007), we find that only 33 percent of the present-day global trade boom can be explained by the decline in trade costs. Thus, we document substantial differences between the two waves of globalization. Finally, the precipitous rise in trade costs following the Great Depression explains the entire interwar trade bust.

II. Gravity Redux

Consider a world of N countries and a continuum of differentiated goods. Assume that countries specialize in a range of goods and that consumers have constant elasticity of substitution preferences. In this context, Anderson and van Wincoop (2003) derive the following "gravity" equation of international trade:

$$(1) \qquad x_{ij} = \frac{y_i y_j}{y^W}\left(\frac{t_{ij}}{\Pi_i P_j}\right)^{1-\sigma},$$

where x_{ij} denotes exports from country i to j, y_i and y_j are the income levels of country i and j, y^W is total world income, and $\sigma > 1$ is the elasticity of substitution. The trade cost factor, $t_{ij} \geq 1$, is defined as the gross bilateral cost of importing a good (one plus the tariff equivalent) so that if p_i is the supply price of a good produced in country i, then $p_{ij} = t_{ij} p_i$ is the price faced by consumers in country j. Trade costs are not constrained to be symmetric, but we will restrict our attention to the geometric average of trade costs going in either direction. Π_i and P_j are country i's outward and country j's inward *multilateral resistance* variables, respectively. The multilateral resistance variables capture countries' average international trade barriers. The important insight of the model is that bilateral trade flows x_{ij} depend on the bilateral trade barrier t_{ij} relative to average international trade barriers.

A problem in the theoretical work so far has been to find an appropriate expression for the multilateral resistance variables. Novy (2007) demonstrates that an analytical solution for the price indices can readily be found. In particular, this solution is a function of intranational trade flows. Intuitively, the more a country trades with itself, the higher must be its average international trade barrier. This approach leads to a bilateral gravity equation of international trade of the following form:

$$(2) \qquad x_{ij} x_{ji} = x_{ii} x_{jj}\left(\frac{t_{ij} t_{ji}}{t_{ii} t_{jj}}\right)^{1-\sigma}.$$

The size variable in this gravity equation is not total income. Instead, the size variable is intranational trade, x_{ii} and x_{jj}, which also controls for multilateral resistance. The trade cost terms can be interpreted as the extent to which international trade is more costly than domestic trade. We emphasize that we do not assume domestic trade costs to be zero, and that to be consistent with theory, bilateral trade costs must

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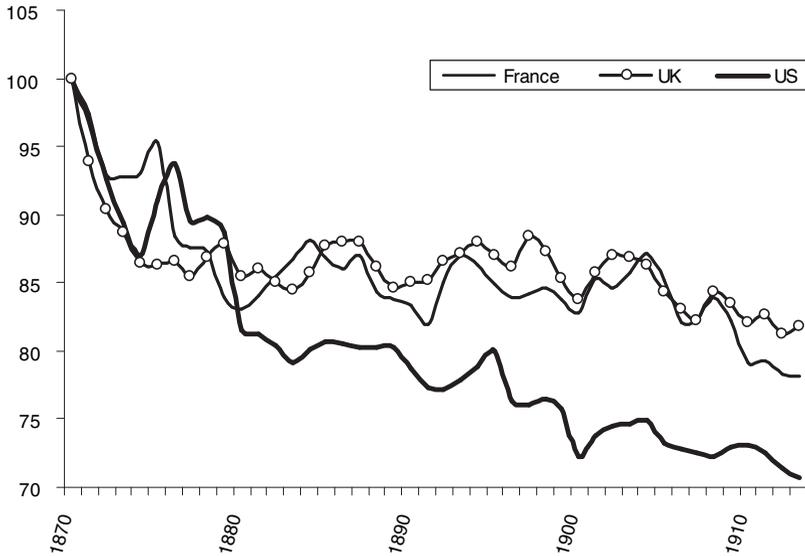
FIGURE 1A. TRADE COST INDICES, 1870–1913 (1870 = 100)

be measured against a benchmark (on this point, see Anderson and van Wincoop 2004). Using equation (2) we solve for the geometric average of the tariff equivalent, τ_{ij}, of these costs as

$$(3) \qquad \tau_{ij} = \left(\frac{x_{ii}\,x_{jj}}{x_{ij}\,x_{ji}}\right)^{1/[2(\sigma-1)]} - 1.$$

We use this expression along with an extension of the trade and output data underlying Jacks, Meissner, and Novy (2006) to plot average bilateral trade costs in Figures 1A through 1C.

III. Trade Costs over Time

Figures 1A through 1C are normalized to 100 for the initial observation in each period, i.e., 1870, 1921, and 1950, so that they are not comparable in terms of levels over time. Our goal, instead, is to highlight the changes within a given period. Thus, for the first wave of globalization from 1870 to 1913, we document an average decline in international, relative to domestic, trade costs of 23 percent, led by a nearly 30 percent decline for the United States, while France and the United Kingdom muster a roughly 20 percent decline. We can note that most of the decline, especially for France and the United Kingdom, is concentrated in the 1870s. This was, of course, a time of simultaneously declining

freight rates and tariffs, as well as increasing adherence to the gold standard. In subsequent periods, the decline in freight rates was substantially moderated, while tariffs climbed in most countries, dating from the beginning of German protectionist policy in 1879.

Turning to the interwar period from 1921 to 1939, we can see that the various attempts to restore the prewar international order—e.g., restoration of the gold standard and the normalization of trading relationships—were somewhat successful. Trade costs fell on average by 4 percent up to 1929. Although much less dramatic than the fall for the entire period from 1870 to 1913, this average decline matches that for the equivalent period from 1905 to 1913. The turning point of the Great Depression, however, marks the most dramatic increase in trade costs in our sample, as they jump on average by 18 percentage points in the space of the three years between 1929 and 1932. This, of course, corresponds exactly to the well-documented implosion of international trade in the face of declining output and highly protectionist trade policy. Trade costs declined from these heights, but not enough to reach their 1921 levels: average trade costs stood 10 percent higher at the outbreak of World War II.

Finally, the second era of globalization from 1950 to 2000 registered declines in average trade
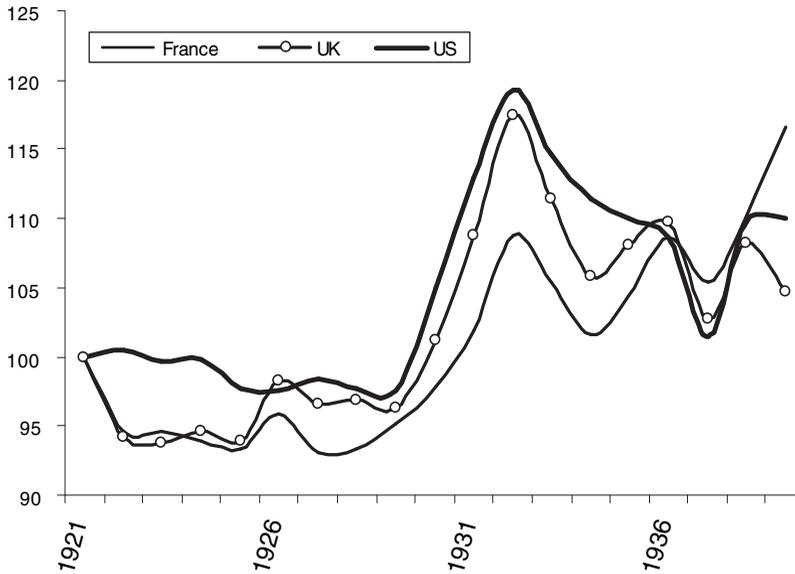
FIGURE 1B. TRADE COST INDICES, 1921–1939 (1921 = 100)

costs on the order of 16 percent. The most dramatic decline was that for France, at 25 percent, while the most recalcitrant decline was that for the United Kingdom, at 19 percent. Thus, there seems to be a slightly greater heterogeneity of experience than in the past.

IV. The Determinants of Trade Costs

Trade costs in our model are derived from a gravity equation rather than estimated as is typically the case in the literature. Commonly, log-linear versions of equation (1) are estimated by substituting an arbitrary trade cost function for τ_{ij}. Such specifications, to the extent that the trade cost function and the econometric model are well specified, could be used to provide estimated values of trade costs. We proceed in the opposite direction and derive the implied trade costs directly from the model without imposing a trade cost function.

We show below that our trade cost measure is related in sensible ways to standard proxies for international trade costs. The determinants we consider in our log-linear model of trade costs include the logarithm of distance between two countries, the log product of each country pair's ratio of customs revenues to total imports, bilateral nominal exchange rate volatility, an indicator variable for whether the two countries

had a fixed exchange rate with one another, and an indicator for whether the two countries were both in the British Empire. We include country pair random effects, as well as year indicators. The reported regression pools the data for the 51 dyads between 1870 and 1913, 1921 and 1939, and 1950 and 2000, generating the following results (t-statistics in parentheses):

$$\tau_{ij} = 0.08 \left[\ln (distance) \right]$$
$$(8.07)$$

$$+ 0.03 \left[\ln (tariffs_i \, {}^*tariffs_j) \right]$$
$$(13.06)$$

$$+ 0.44 \left[\sigma(e) \right] - 0.01 \left[Fixed \right]$$
$$(7.70) \qquad (1.93)$$

$$- 0.42 \left[British \ Empire \right]$$
$$(8.41)$$

$$N = 5758, \ R^2 = 0.42$$

We find that a one-standard-deviation rise in distance raises trade costs by 0.40 standard deviations, while an equivalent increase in our tariff measure would be associated with a trade cost rise of 0.42 standard deviations. Exchange rate volatility raises trade costs, while fixed exchange rate regimes decrease trade costs—but

FIGURE 1C. TRADE COST INDICES, 1950–2000 (1950 = 100).

both only marginally. Finally, membership in the British Empire appears to have substantially decreased trade costs, although we note that in unreported regressions by period, this effect has strongly diminished through time.

These results demonstrate that standard factors that are known to be frictions in international trade are sensibly related to the trade cost measure. By extension, the results from the regression equation show that the trade cost measure determines trade patterns in ways largely consistent with the gravity literature (cf. J. Ernesto López-Córdova and Christopher M. Meissner 2003 for the pre–World War I period; Eichengreen and Irwin 1995 for the interwar period; and Andrew K. Rose 2000 for the post–World War II period).

V. Economic Expansion versus Trade Costs

We now turn to a decomposition of the growth of trade flows in the three periods. Gravity equation (2) can be used to attribute changes in trade flows to changes in domestic economic activity (owing to income expansion and changes in multilateral trade barriers) and changes in bilateral trade costs. We first log-linearize (2), then, at the bilateral level, we take the difference between levels in initial years (1870, 1921 and 1950) and end-point years (1913, 1939 and 2000), and finally we average across dyads. We report the results from this exercise in Table 1.

Although the percentage growth in trade volumes is roughly comparable in the two waves of globalization (at 400 and 471 percent, respectively), the principal driving forces are reversed. In the period from 1870 to 1913, trade cost declines account for a majority (55 percent) of the growth in international trade, while in the period from 1950 to 2000 trade cost declines account for a distinct minority (33 percent) of trade growth. This is congruent with traditional narratives of the late-nineteenth century as a period of radical declines in domestic and international transportation costs, payments frictions, and protective trade policy, as well as studies on the growth of world trade in the contemporary world which suggest that such changes may have been more muted. This differential response also raises questions, however, regarding the relatively low manufactured content of trade in the earlier period and the increased prominence of variety growth and inter-industry trade in the later period. Again, sorting out these factors remains an important topic for future research.

Finally, in explaining the trade bust of the 1930s, the role of trade costs is dominant. Based on output growth alone, we would have expected world trade volumes to increase by nearly 90 percent. The fact that they declined by 13 percent clearly underlines the critical role of commercial policy—and potentially the collapse of the gold standard—in determining trade costs at the time.

TABLE 1—DECOMPOSITION OF TRADE BOOMS AND BUSTS, 1870–2000
(*a.k.a. The History of World Trade in 9 Numbers*)

		Average growth in international trade		Contribution of growth in output		Contribution of change in trade costs
1870–1913	**Full sample, $N = 51$**	**400.4%**	=	**17.64%**	+	**224.0%**
	France, $N = 18$	351.3%	=	147.1%	+	204.2%
	UK, $N = 18$	289.7%	=	156.1%	+	133.6%
	US, $N = 18$	529.1%	=	230.3%	+	298.8%
1921–1939	**Full sample, $N = 51$**	**−13.1%**	=	**89.3%**	+	**−102.4%**
	France, $N = 18$	−50.9%	=	97.3%	+	−148.2%
	UK, $N = 18$	−2.1%	=	87.7%	+	−89.8%
	US, $N = 18$	−1.1%	=	84.3%	+	−85.4%
1950–2000	**Full sample, $N = 51$**	**471.3%**	=	**314.6%**	+	**156.7%**
	France, $N = 18$	578.0%	=	327.6%	+	204.2%
	UK, $N = 18$	373.8%	=	279.7%	+	94.1%
	US, $N = 18$	480.1%	=	332.6%	+	147.5%

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