Exchange-Rate Regimes and International Trade: Evidence from the Classical Gold Standard Era

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Abstract

We apply a gravity model of trade to more than 1,100 country-pairs during the 1870-1910 period. We use cross-sectional and time-series variance in regime choice with a sample that includes a representative array of nations—some of which are large and participate in currency unions—to identify the relationship between monetary regimes and international trade. We show that countries that share currency regimes trade substantially more with each other even after controlling for exchange rate volatility. Countries on the gold standard trade as much as 60 percent more than with partners not on the gold standard. Evidence also suggests that common currencies are associated with a doubling of trade flows. Further, our point estimates appear robust to the potential endogeneity of the monetary regime, unobservable heterogeneity at the country level and a number of other specifications. Our evidence is compatible with the notion that common currencies and regime coordination decrease the transaction costs of trade. Our findings are relevant for current discussions on alternative monetary arrangements for the twenty-first century.

Keywords: Exchange rate regimes; currency unions; international trade; gold standard; gravity equation; economic history

JEL Classification Numbers: F15, F33, N21, N23, N26

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1 Introduction

The late nineteenth century global economy was a period of integration strikingly comparable to the contemporary phenomenon of "globalization." O'Rourke and Williamson (1999, 2000) document the startlingly rapid and deep integration between formerly isolated national markets that occurred in the nineteenth century.

Bordo, Eichengreen, and Irwin (1999) suggest that today there is an even stronger resurgence of market integration. This wave of integration is accompanied by increasing international cooperation on trade policy, monetary integration (e.g., an ever-expanding European Monetary Union, incipient dollarization in Latin America and the increasing use of only a handful of currencies in international transactions according to Cohen (1998)), and even an ideological harmonization embodied in the Washington Consensus. There is little doubt that these changes have helped spur trade and integration by eliminating institutional barriers to trade.

Nevertheless, the majority of empirical research has found little connection between the exchange rate regime and trade.[1] But theoretically national currencies may be a large barrier to international trade, and people in the nineteenth century believed that disparate national monetary regimes stifled international commerce.[2] The question then arises: how did institutional arrangements such as currency unions, and monetary regimes (e.g., the gold standard) affect globalization in the late nineteenth century? Our analysis supports the idea that coordination on a commodity money regime and membership in a monetary union significantly increased international trade.

We address these issues by studying the correlates of bilateral trade for a global sample of nations from 1870 to 1910. The data set includes ample cross-sectional and *time-series* variation in commodity money regimes and other key explanatory variables. Relative to previous studies, our data improve the ability to identify the effects of regime coordination because some of our observations on currency unions include economically

[1] Rose (2000) is an important-but not uncontroversial-exception.

[2] See Section 2 for such statements.

significant nations. Current criticisms by Anderson and van Wincoop (2000) suggest the relationship between currency unions and trade that Rose (2000) proposes (i.e., currency unions are correlated with a doubling of trade) is overstated because small countries are used to identify the "treatment effect". Our data overcome this problem and yet we still find a statistically significant, economically large and largely robust association between currency unions, regime coordination and trade.

Using a *gravity* equation, we explain up to 70 percent of the variance in trade patterns in the late nineteenth century. Besides controlling for geographic and economic factors, we examine the correlation between bilateral trade and exchange rate volatility, monetary union membership and commodity money regime coordination. We argue that membership in a monetary union was correlated with a two-fold increase in bilateral trade between any two members while adherents to the gold standard traded roughly 60 percent more with each other than with nations not in the gold club.

Our results appear robust to potential endogeneity problems and other possible misspecifications including unobservable heterogeneity at the country or country-pair level. Virtually the only limitation in our data set is the time-invariance of currency union arrangements. Hence we rely on cross-sectional variation in the data to identify the effect of a currency union. Nevertheless, our results on currency unions appear fairly insensitive to the exact specification we implement.

With our methodology we are able to address a number of other interesting empirical questions of interest to macroeconomists and economic historians alike. Our empirics suggest exchange rate volatility had a negligible effect on the level of trade, but that in a few particular cases (e.g., parts of South America) high volatility co-existed with high trade volumes. Additionally, the gravity framework allows us to use a novel approach to test economic historians' views that falling transportation costs and the level of development of two trading partners increased bilateral trade [see Saul (1996) and Bairoch (1996)]. And although Bairoch (1996), Flandreau (1993) and Flandreau and Maurel (2000) have addressed some of these issues on smaller samples or with less reliance on

contemporary econometric techniques, to the best of our knowledge, this is the first long-run *global* econometric examination of trade patterns and monetary arrangements in the nineteenth century which uses a modern gravity approach to provide apparently very robust lessons about such relationships.

We begin by introducing some historical context and outlining contemporary work related to monetary regime variables and trade. In Section 3 we introduce our econometric methodology, and in Section 4 we describe our panel data. We turn to a discussion of our main findings in Section 5, including checks for the robustness of our baseline results with a variety of specification tests (5.4). Here we tackle, among other issues, the potential endogeneity problems that may affect the estimated relationship between the gold standard/currency unions and trade. We conclude our discussion in section 6.

2 Historical background and previous work

2.1 Previous Work

Historians have long studied the general trade patterns of the first period of globalization. Bairoch (1996) examined nineteenth century European trade. His work showed that roughly 80 percent of all European trade was with other developed countries. This share remained roughly constant over time. Without the aid of regression analysis, Bairoch attributed those patterns of trade to three main variables: "the geographical location of the country, the availability of a colonial empire and the degree of industrialization." Bairoch also noted that the size of a country did not seem to influence the direction of trade. In our opinion Bairoch's analysis can be improved using modern econometric analysis that holds other factors constant.

To the best of our knowledge, the only work investigating the effect of currency unions on trade in the 1800s is unpublished work by Flandreau (1993) and Flandreau and Maurel (2000). This work is based on a limited European sample over a limited set of years. Flandreau (1993) controls only for the product of total trade for each of the two countries, distance, sharing a border, and membership in the Latin Monetary Union

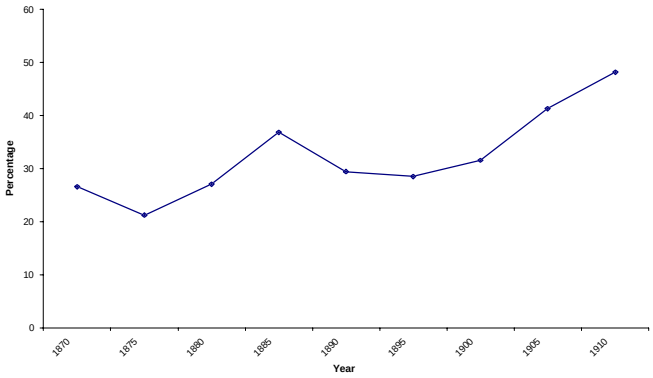
or the Scandinavian Monetary Union (the latter in 1880 only). His results suggest that Latin Monetary Union membership could not explain bilateral trade flows.Flandreau and Maurel (2000) also use a gravity model during the late 1800s in Europe. They find that monetary unions in Scandinavia and in Austria-Hungary increased international trade twofold. Similarly, contemporary evidence by Rose (2000) has shown that currency unions are likely to increase trade by nearly 200 percent. Did monetary regimes play as large of a role in the past? Contemporary observers thought so. Moreover, our econometric evidence is compatible with the idea that monetary regimes influenced trade patterns and the evolution of the global economy.

2.2 Commodity Money and Regime Coordination

In 1867 France hosted the first International Monetary Conference in Paris. Among other issues, the delegates approved a motion, subject to subsequent approval by domestic political authorities, to adopt a monometallic gold standard, and delegates seriously considered adopting a globally uniform coinage system [**?** and Russell (1898)]. While such extreme global monetary harmony never materialized, from 1870 to 1910 nations increasingly coordinated on commodity money regimes.

The early years of the period saw the world divided between gold, silver, bimetallic and fiat currencies. Each country with a commodity money regime stood ready to trade national currency for a fixed quantity of precious metal, or, in some countries metallic coins constituted the exclusive medium of exchange. Table 1 presents the countries in our sample and their monetary regime at any one time. By 1905 most nations were *de jure* if not *de facto* gold standard countries. Figure 1 presents the percentage of country pairs in our sample sharing a similar monetary regime in the nineteenth century. This uniformity of monetary regimes seems striking given the previous 2000 years of monetary history when sundry metals like copper, silver and gold all played monetary roles concurrently, and compared to the rest of the nineteenth century when large blocs of gold, silver and bimetallist countries co-existed. We believe that this convergence

Figure 1: Percentage of Country Pairs Sharing a Similar Commodity Money Regime, 1870-1910



onto a similar institutional arrangement can help explain the rise of the first truly global economy—an economy characterized by an historically large degree of trade integration.

But we also believe that this process was part of a virtuous cycle, and our empirical results support this idea. Nations that traded heavily with nations of a particular regime may have had a lot to gain from conforming to others' standards because they could reduce the transaction costs to trade Meissner (2000).[3] In turn, coordination may have raised international trade.

In testimony before the House of Representatives of the United States in 1878, J.S. Moore, a U.S. Treasury official, averred that trade largely depended on having a similar monetary standard [United States Monetary Commission (1879)]. The testimony is as follows:

Q. 118. Do you not think that the use of a common standard of value has a

[3]Meissner (2000) explores this question, and finds strong evidence that such network externalities operated in the international monetary system. The transaction costs we are referring to could be the costs of hedging exchange rate volatility or the brokers' commissions to trade gold for silver when two nations have different metallic regimes see Meyer (1878) and Unger (1964)

Table 1: Monetary regimes of the countries included in the baseline sample

	Year								
Country	*1870*	*1875*	*1880*	*1885*	*1890*	*1895*	*1900*	*1905*	*1910*
UK	Gold	Gold	Gold	Gold	Gold	Gold	Gold	Gold	Gold
France	Bimetal	Bimetal	Gold	Gold	Gold	Gold	Gold	Gold	Gold
US	Paper	Paper	Gold	Gold	Gold	Gold	Gold	Gold	Gold
Belgium	Bimetal	Bimetal	Gold	Gold	Gold	Gold	Gold	Gold	Gold
Switzerland	--	--	--	--	--	--	Gold	Gold	Gold
Italy	Paper	Paper	Paper	Gold	Gold	Paper	Paper	Paper	Paper
Germany	Silver	Gold	Gold	Gold	Gold	Gold	Gold	Gold	Gold
Netherlands	Silver	Gold	Gold	Gold	Gold	Gold	Gold	Gold	Gold
Denmark	Silver	Gold	Gold	Gold	Gold	Gold	Gold	Gold	Gold
Norway	Silver	Gold	Gold	Gold	Gold	Gold	Gold	Gold	Gold
Sweden	Silver	Gold	Gold	Gold	Gold	Gold	Gold	Gold	Gold
Finland	Silver	Silver	Gold	--	--	--	--	Gold	Gold
Austria	Paper	--	--	--	--	--	Paper	--	--
Russia	Paper	--	--	--	Paper	--	Gold	--	--
Spain	Bimetal	--	--	--	Paper	--	Paper	Paper	Paper
Portugal	Gold	--	--	--	Gold	--	Paper	--	--
Australia	Gold	Gold	Gold	Gold	Gold	Gold	Gold	Gold	Gold
Canada	Gold	Gold	Gold	Gold	Gold	Gold	Gold	Gold	Gold
Japan	Silver	--	--	Paper	Paper	Paper	Gold	Gold	Gold
Brazil	Paper	--	--	--	Paper	--	Paper	Paper	Gold
Mexico	Silver	--	--	--	Silver	--	Silver	Gold	Gold
Chile	--	--	--	--		--	Paper	Paper	Paper
Argentina	--	--	--	--	Paper	--	Paper	Gold	Gold
Egypt	--	--	--	--	--	--	Gold	--	--
India	Silver	--	--	--	Silver	--	Gold	Gold	Gold
China	Silver	--	--	--	--	--	Silver	--	--
Indonesia	--	--	--	--	Silver	--	Silver	Silver	Silver
New Zealand	Gold	Gold	Gold	Gold	Gold	Gold	Gold	Gold	Gold
Philippines	--	--	--	--	--	--	Silver	--	--
Total # countries	23	14	14	14	22	14	28	23	23
Total # country pairs	90	56	59	70	139	81	274	189	182

NOTE: "--" indicates that the country was not included in the sample during a given year.

tendency to promote a free commercial interchange between the various countries using it?

A. . . . and if two countries , be they ever so distant from each other should have the same standard of money . . . there would be no greater harmonizer than such an exchange. If our silver dollar were to pass current in Mexico and South America, or if we had a union dollar, we should have much more of their trade and intercourse . . .

The quote reflects the opinion of important policy makers of the time, and it also highlights another issue. Although having a common standard of value is good, having a monetary union is even better. **?** also points out that French merchants thought the same as the treasury official. In a monetary survey from 1868, northern merchants who had major business with gold-backed England preferred a gold regime while southern traders with connections to the silver-using East preferred retaining silver's monetary role. Policy makers of the day believed that monetary regimes and financial issues played a key role in determining the shape of international commerce.

2.3 Currency Unions

During the period we study, a wide range of principal countries of the world participated in some form of a monetary union.[4] The monetary unions can be classified into three broad types. The first is an EMU-type of union. Countries in this sort of union had a unique monetary authority with only one system of coinage. Another kind of monetary union, like the Latin Monetary Union, or the Scandinavian Monetary Union was established by treaty, did not have a completely uniform coinage, allowed full legal tender status of member-nations' currencies in any country of the union, and also had autonomous national monetary authorities. The final type of monetary union evident in the nineteenth century was more akin to contemporary de facto or de jure dollarized

[4]See Willis (1901) for the most authoritative study on the Latin Monetary Union, Bordo and Jonung (1999) for a recent survey on a range of monetary unions since the nineteenth century, and Henriksen and Koergard (1995) for a look at the origins of the Scandinavian Monetary Union.

Table 2: Monetary unions

Latin Monetary Union	Scandinavian Monetary Union (from 1875
France	Denmark
Belgium	Sweden
Switzerland	Norway
Italy	
Greece (1885)	
Sterling Union	Other
Great Britain	Canada with U.S.
Australia	
Canada	
New Zealand	

countries. In these types of arrangements, one country declared the currency of another country legal tender while it may or may not have had its own uniform currency. Table 2 shows which countries in our sample were involved in which type of a monetary union.

Curiously that table would have be radically different had the American republics, including the United States, carried out proposals for an *American Monetary Union* (AMU). Subercaseaux (1915) highlights the costs and benefits such a policy would have entailed from the perspective of a late nineteenth century policy maker/economist. Subercaseaux points out, as did nearly all economists of the day, that fiat currencies would give rise to fluctuations and nominal depreciation, and argues that being on a gold standard was equivalent to a nineteenth-century-style monetary union. In either case the currencies are pegged but the former arrangement saves the political costs of having to negotiate escape clauses and contingency plans for members that do not abide by the currency union treaty. Further he argued that the only benefits from AMU would accrue to tourists who would save on exchange operations. Apparently policy makers did not think this was a large enough benefit to justify the implementation costs.

So while we suspect that commodity money regimes are part of a virtuous cycle with trade we are sceptical that nations' main consideration in forming currency unions was the pattern of trade. Creators of the Latin Monetary Union hoped to cooperatively coerce nations into coining currency of similar weight and fineness as their neighbors

so that Gresham's law would not continually debase local currencies and rob domestic authorities of seignorage revenue [Russell (1898) and Bordo and Jonung (1999)]. Similar factors appear to have been at work in the creation of the Scandinavian Monetary Union [Bordo and Jonung (1999) and Henriksen and Koergard (1995)]. The fact that Australia and New Zealand used the pound sterling probably had more to do with the close colonial relationships between them and England than their trade patterns.[5]

2.4 Other Considerations

The a priori expectation of how exchange rate volatility might have affected commerce is ambiguous, and historical actors seem not to have paid too much attention to such oscillations. Even modern researchers like Obstfeld (1997) and Wyplosz (1997) have all but discounted the negative effects of volatility on trade. Their conclusions rest on a large body of empirical research that shows the same. The only strong evidence on the negative impact of volatility on trade that we are aware of is Rose (2000) who convincingly shows a large negative relationship between bilateral exchange rate volatility and trade. We can measure the effect of exchange rate volatility using the cross-sectional approach as Rose does, and we provide evidence that in the nineteenth century volatility had a negligible effect on trade.

Other important issues which we seek to investigate with the gravity approach are questions already familiar to economic historians. For instance, the rapid decline in transportation costs over the nineteenth century is a well-known phenomenon [O'Rourke and Williamson (1999, chapter 3)]. We are able to measure the effects of falling transportation costs on trade. We also try to examine the impact of trade policies on commercial exchange. The 1870s saw a resurgence of protectionism in Europe. Such protectionism was accompanied by many bilateral trade agreements that kept tariffs reduced for a given pair of countries, but that discriminated against third parties. We present evidence suggesting that the use of the most-favored nation (MFN) clause ameliorated, to some

[5]Similarly, Cohen (1998) argues that trade relations play little role in explaining the emergence of currency unions in the past thirty years.

degree, the negative effect of discriminatory protection.

In addition, cultural and political variables may have mattered for integration. Colonial domination and political union are generally thought to increase commercial intercourse by harmonizing the institutional environment. We are able to see just how strong these forces were. Also, current literature has found evidence that having a common language with a trading partner may also increase the level of trade, especially in differentiated goods markets (see Bordo, Eichengreen, and Irwin (1999) for a summary of these conclusions). The nineteenth century might be seen as an era of less differentiated production. If so, then language should not have influenced the direction of trade significantly in the nineteenth century. Finally, we can rigorously test the notion that trade remained "intra-industry" over the course of the nineteenth century.

Overall the gravity approach allows us to test a number hypotheses and conjectures salient to researchers of the contemporary economy and economic historians. To our knowledge, we are the first to estimate econometrically all of these effects using such a broad ranging data set for the period under scrutiny. The next section presents our approach and our data.

3 Empirical strategy

One way to capture the effects of key variables on trade patterns and integration is to use the gravity equation. In the spirit of Newtonian physics, the gravity equation posits that trade flows (i.e., gravitational forces) are a function of the distance between two countries and their combined mass (measured by gross domestic product). Distance, through its effects on transportation costs, acts as a barrier that discourages bilateral trade. In contrast, as a country's GDP increases, its demand for foreign imports naturally rises.

Moreover, the model allows the addition of any other important variables that theory or observation might suggest are important in explaining the variance in bilateral trade. For example, GDP per capita is usually included in the standard gravity equation and is considered to increase bilateral trade because richer countries usually rely on trade

Table 3: Summary of previous studies

Dependent variable:	*Rose (2000)*		*Eichengreen and Irwin (1995)*					
			1928		1935		1938	
Bilateral trade	Coefficient	Std. Error	Coefficient	Std. Error	Coefficient	Std. Error	Coefficient	Std. Error
Monetary variables:								
Gold	---		0.290	0.397	0.530	0.389	0.680	0.386
Silver	---		---		---		---	
Bimetal	---		---		---		---	
Monetary union	1.210	0.140	---		---		---	
Volatility	-0.017	0.002	-0.040	0.017	-0.030	0.027	-0.030	0.017
Gravity equation variables:								
GDP	0.800	0.010	0.910	0.032	0.730	0.031	0.770	0.032
GDP per capita	0.660	0.010	0.330	0.050	0.160	0.050	0.160	0.044
Distance	-1.090	0.020	-0.780	0.063	-0.400	0.047	-0.530	0.061
Other explanatory variables:								
Border	0.530	0.080	0.790	2.940	0.410	0.196	0.450	0.298
Political union	---		---		---		---	
Common language	0.400	0.040	---		---		---	
Free-Trade Asstn	0.990	0.080	---		---		---	
Number of obs	22948		561		561		561	
R-squared	0.630		0.690		0.630		0.630	
Root MSE	2.020		3.201		2.542		2.542	

barriers to a lesser extent than poorer countries, and because intra-industry trade would be higher between richer countries. The gravity approach is an attractive methodology because it consistently returns precise point estimates in samples that vary widely over space and time, giving remarkably similar results in many studies. We summarize the findings of some previous research using the gravity equation in table 3.

To investigate these relationships and those considered in section 2 we estimate the following gravity equation:

$$\begin{aligned}\ln(\text{Trade})_{ijt} &= \beta_0 + \beta_1 \text{Gold}_{ijt} + \beta_2 \text{Silver}_{ijt} + \beta_3 \text{Bimetal}_{ijt} + \beta_4 \text{MonetaryUnion}_{ijt} \\ &+ \beta_5 \text{Volatility}_{ijt} + \beta_6 \ln(Y_{it}Y_{jt}) + \beta_7 \ln\left(\frac{Y_{it}Y_{jt}}{Pop_{it}Pop_{jt}}\right) + \beta_8 \ln(\text{Distance}_{ij}) \\ &+ \beta_9 \text{Border}_{ijt} + \beta_{10} \text{Political union}_{ijt} + \beta_{11} \text{Language}_{ij} + \beta_{12} \text{MFN}_{ijt} + \varepsilon_{ijt}\end{aligned}$$

where subscripts i and j are country specific identifiers; t is the year of observation; $\beta' = [\beta_0, ..., \beta_{11}]$ is a vector of the coefficients of interest; ε_{ijt} is a disturbance term; and

Y_{it} and Pop_{it} refer to country i's real GDP and population in period t. The rest of the variable definitions appear in table 4. We estimate our baseline regression, which includes time dummies, by pooling the data and using feasible generalized least-squares (section 5), but we also use more sophisticated econometric techniques and specifications to validate the robustness of our baseline estimates (section 5.4).

Table 4: Variables

Variable	*Description*
Trade	Natural log of bilateral trade in 1990 U.S. dollars
Gold	Dummy equal to 1 if both countries were on the gold standard
Silver	Dummy equal to 1 if both countries used a silver standard
Bimetal	Dummy equal to 1 if both countries used a bimetallic standard
Monetary union	Dummy equal to 1 if a common currency is legal tender in both countries
Volatility	Bilateral exchange rate volatility (see text)
GDP	Natural log product of the two country's real GDP
GDP per capita	Natural log product of the two country's per capita real GDP
Distance	Natural log of the distance, in miles, between the two countries
Border	Dummy equal to 1 if the two countries shared a common border
Common language	Dummy equal to 1 if the two countries speak a common language
Political Union	Dummy equal to 1 if countries shared a colonial relationship, shared a common colonizer, or formed a single political entity
MFN	Dummy equal to 1 if a treaty containing an MFN clause was in force between the countries

4 Data

Our baseline regressions use an unbalanced panel consisting of 1,140 country-pair observations. We present summary statistics in table 5. The data cover the period 1870 to 1910 every five-years. This yields a total of nine annual observations. Given the limited availability of nineteenth-century GDP data, the last row of table 1 shows that the size of our annual cross-sections increases as we move into the 1900s. Similarly, the number of countries that make up our pairwise observations is larger toward the end of our sample period. Not surprisingly, Table 1 also indicates that present-day OECD member countries are heavily represented in our sample.

We obtained bilateral trade data for 2,848 country dyads. We complemented a data set put together by Barbieri (1996) with information from national statistical yearbooks

Table 5: Summary statistics

Variable	*# Obs*	*Mean*	*Std. Dev.*	*Min*	*Max*
Trade	2848	4.006	2.367	-6.724	9.452
Gold	6556	0.263	0.441	0.000	1.000
Silver	6556	0.050	0.219	0.000	1.000
Bimetal	6556	0.010	0.099	0.000	1.000
Monetary union	11025	0.017	0.128	0.000	1.000
Volatility	3977	1.514	1.583	0.000	9.230
GDP	2050	19.741	1.969	14.358	25.236
GDP per capita	2050	15.150	0.926	12.367	17.639
Distance	10071	8.270	0.851	4.922	9.417
Border	11025	0.034	0.182	0.000	1.000
Common language	11025	0.093	0.291	0.000	1.000
Political Union	11025	0.023	0.150	0.000	1.000
MFN	11025	0.219	0.413	0.000	1.000

and other publications from the period; a detailed description of our sources appears in the data appendix. Trade figures were transformed into 1990 U.S. dollars using a U.S. consumer price index and annual average exchange rates. This made our trade information comparable to the real GDP data in Maddison (1995).[6]

Information on every country's monetary regime was used to create dummy variables indicating whether any pair of countries shared a common monetary standard. In Table 1 we report the monetary standard used in each country that enters our baseline regression. Observe that there was a general movement in favor of the adoption of the gold standard as the nineteenth century progressed, although a number of countries remained outside the gold bloc throughout our period of analysis. There are also a number of important countries that changed regimes throughout the period. In addition to cross-sectional variation, these countries provide important time-series variation in regime stance. This improves the possibility of identifying how a drop in the costs of trade (i.e., a move to or away from a similar commodity money regime) is associated with changes in bilateral trade.

We constructed our measure of exchange-rate volatility as the standard deviation of the first difference of the natural logarithm of the monthly bilateral exchange rate for the

[6] Maddison's figures take into consideration purchasing power differences across countries and are therefore better suited for international comparisons.

Table 6: Bilateral exchange rate volatility under each monetary regime

Monetary standard	*# Obs*	*Mean*	*Std. Dev.*	*Min*	*Max*
Same standard					
Gold	1256	0.688	0.998	0.000	6.148
Silver	123	1.748	1.272	0.000	6.687
Bimetal	12	0.660	0.799	0.000	2.538
Different standard	2586	1.907	1.673	0.000	9.230
All country pairs	3977	1.514	1.583	0.000	9.230

previous three years. Monthly exchange rates, mostly with respect to the pound sterling, were taken from Schneider, Schwarzer, and Zellfelder (1991); additional exchange rates with respect to the U.S. dollar were obtained from *Global Financial Data's* "Long-Term Database". For our sensitivity analyses, we also constructed alternative measures of exchange-rate volatility which we describe in appendix B.

Table 6 shows that mean exchange-rate volatility was more than one percentage point lower among gold-bloc countries when compared to country pairs that used different monetary standards. Similarly, exchange rate volatility among silver countries was higher than in countries on the gold standard.

Nevertheless, it is interesting to note that exchange rate volatility over the period of analysis was low from a contemporary perspective. Whereas mean exchange-rate volatility in our sample was only 1.5 percent, Frankel and Wei (1998, table 7.3) report that in 1990 volatility in a sample of 63 countries was 7.7 percent. Similarly, mean volatility reported by Rose (2000) for the period 1970-1990 stood at 4.7 percent.

We also constructed a dummy variable indicating whether a common currency was legal tender in both country-pair members; we refer to this variable as "monetary union." Accordingly, for the members of the Latin and Scandinavian Monetary Unions, this variable received the value of one. More subtly, Canada was considered to be in a monetary union with the United Kingdom and some of the British colonies and dominions, as well as with the United States. This is because both British sovereigns and the U.S. dollar

were legal tender in Canada. Since Canadian residents or merchants could easily cover for exchange-rate uncertainty with Britain and the United States by carrying out international transactions in the currencies of the latter countries, we believe that the effects of a monetary union we look to capture are present in this case.[7]

In contrast, there were instances in which trade transactions were carried out using the currency of a third country, but the latter was not the local medium of exchange (e.g., Mexican silver pesos in use in China). Those cases were not considered to form a monetary union because the domestic unit of account/medium of exchange was fundamentally different for both sides of the transaction. In this case, the Mexican peso played a role more akin to a vehicle currency. See Table 2 for the list of our monetary unions and the countries in each union. In our data set we have over 100 observations (i.e., roughly 10 percent of our sample) where both of the trading partners are in a monetary union.

We also control for the effect of trade policy on bilateral exchange. Even though protectionism was relatively mild in 1870, increasing tariffs and intermittent trade wars characterized the last two decades of the nineteenth century. While England maintained its free-trade stance, countries like Germany and the United States raised tariffs. Moreover, Frieden (1997) suggests that U.S. tariffs might have been increased to compensate import-competing industries hurt by the adoption of the gold standard.[8]

We stress that protectionism is problematic to the extent that it is not applied evenly to all nations. In the postwar era, the inclusion of the "most-favored nation" (MFN) principle in Article I of the GATT reduced the scope for the use of trade policies that discriminated against particular countries.[9] In contrast, MFN treatment during the nineteenth century was negotiated in bilateral trade agreements and, as such, would in all certainty affect bilateral trade. To control for this possibility, we constructed a dummy

[7] It should be emphasized that our results do not rely on the fact that Canada and the United States are coded as having a monetary union. See section 5.1.

[8] The argument claims that increased imports arising from an appreciating gold currency could have been mitigated by higher protectionism.

[9] Some exceptions to MFN treatment, such as those that exist under Article XXIV allowing for the creation of free trade areas and customs unions, have been properly accounted for in the gravity-equation literature, whereas others, like the unilateral preferences granted to developing countries, have not.

indicating whether two countries shared a trade agreement including an MFN clause; the sources are described in the data appendix.

Last, we incorporated a number of additional explanatory variables. The standard distance variable—the literature's proxy for transportation costs—was taken from Rose (2000).[10] We included common language, common border and year-specific indicators. We also created a "political union" dummy encompassing a colonial relationship—colony-colonizer and colonies with the same colonizer—as well as countries that formed a single political entity—e.g., Russia and Finland, and, until 1905, Sweden and Norway.

5 Baseline results

In column 1 of Table 7 we report pooled OLS estimates with White, heteroscedasticity-robust standard errors of the baseline regression.[11] This specification explains nearly 60 percent of the variation in bilateral trade flows. The coefficients on GDP, GDP per capita, and distance are precisely estimated and their signs and magnitudes are consistent with the standard gravity model's predictions. Moreover, they are remarkably similar to those found by other authors. Our estimates show that monetary regimes had a non-negligible impact on international trade and are in accordance with previous studies. Other explanatory variables seem in line with our predictions although in some instances they are statistically insignificant. Annual cross-section regression results appear in Table 8. The limited size of our annual samples for some years resulted in poor regression results, but in broad terms annual estimates support our conclusions.

5.1 Monetary variables

Our baseline regression cannot reject the hypothesis that monetary regime coordination had a significant impact on bilateral trade flows. The coefficient on "gold", "silver", and "monetary union" are positive and statistically significant. Our baseline results show that

[10] The distance measure comes in turn from the CIA's website and measures Great Circle distance. We also try, as per Jeff Williamson's suggestion, a cost/distance interaction to allow for falling transportation costs and to reduce potential bias from pooling the data.

[11] Standard errors are corrected for heteroscedasticity among country pairs.

Table 7: Pooled OLS regressions

Regressors	*Baseline*	*Reg. 1*	*Reg. 2*	*Reg. 3*	*Reg. 4*	*Reg. 5*
Gold	0.479	0.367	0.399	0.399	1.576	--
	(0.124)	(0.125)	(0.124)	(0.120)	(0.442)	
Silver	0.765	0.749	0.786	0.995	-0.087	--
	(0.394)	(0.373)	(0.378)	(0.365)	(0.368)	
Bimetal	-0.303	-0.336	-0.341	-0.292	0.707	--
	(0.269)	(0.264)	(0.269)	(0.267)	(0.149)	
Monetary union	0.716	0.527	0.621	0.631	0.655	1.046
	(0.186)	(0.192)	(0.187)	(0.188)	(0.185)	(0.205)
Volatility	0.167	-0.253	0.020	-0.014	0.194	-0.114
	(0.044)	(0.115)	(0.061)	(0.047)	(0.045)	(0.135)
Squared volatility	--	0.068	--	--	--	--
		(0.016)				
Gold * volatility	--	--	--	--	-0.309	--
					(0.127)	
Silver * volatility	--	--	--	--	-0.539	--
					(0.373)	
Bimetal * volatility	--	--	--	--	-0.212	--
					(0.354)	
GDP	0.861	0.867	0.863	0.904	0.870	0.896
	(0.028)	(0.027)	(0.028)	(0.026)	(0.027)	(0.031)
GDP per capita	0.656	0.588	0.612	0.759	0.604	0.491
	(0.081)	(0.081)	(0.083)	(0.083)	(0.083)	(0.101)
Distance	-0.661	-0.642	-0.664	-0.713	-0.651	-0.722
	(0.045)	(0.045)	(0.045)	(0.045)	(0.045)	(0.056)
Border	0.625	0.610	0.594	0.510	0.632	0.263
	(0.122)	(0.122)	(0.123)	(0.118)	(0.121)	(0.144)
Political union	0.927	0.968	0.982	1.101	0.915	0.527
	(0.293)	(0.287)	(0.290)	(0.289)	(0.292)	(0.275)
Common language	0.165	0.158	0.171	0.111	0.143	0.051
	(0.167)	(0.163)	(0.164)	(0.159)	(0.168)	(0.133)
MFN	0.142	0.153	0.109	0.091	0.149	0.172
	(0.095)	(0.094)	(0.096)	(0.090)	(0.095)	(0.111)
Brazil dummy	--	--	--	2.243	--	--
				(0.207)		
Chile dummy	--	--	--	0.868	--	--
				(0.366)		
Constant	-18.438	-17.353	-17.632	-20.365	-18.003	-14.117
	(1.392)	(1.394)	(1.415)	(1.409)	(1.407)	(1.648)
Number of obs	1140	1140	1108	1140	1140	622
R-squared	0.595	0.601	0.603	0.631	0.598	0.677
Root MSE	1.453	1.442	1.445	1.388	1.449	1.242

NOTES: Dependendent variable: ln(trade). Robust standard errors are reported in parentheses. Year dummies are not reported. Regression 2 excludes 32 observations with volatility above the 95th percentile. Regression 5 focuses on gold countries only.

Table 8: Annual OLS regressions

Regressors	*1870*	*1875*	*1880*	*1885*	*1890*	*1895*	*1900*	*1905*	*1910*
Gold	1.583	0.894	2.603	0.191	-0.465	1.993	0.449	0.161	0.662
	(0.490)	(0.320)	(0.733)	(0.681)	(0.371)	(0.460)	(0.256)	(0.306)	(0.250)
Silver	1.479	--	--	--	--	--	-0.307	--	--
	(0.410)						(1.230)		
Bimetal	-0.366	-0.987	--	--	--	--	--	--	--
	(0.282)	(0.529)							
Monetary union	0.129	-0.138	2.558	0.737	0.363	1.448	0.380	0.933	0.778
	(0.404)	(0.662)	(0.817)	(0.784)	(0.646)	(0.477)	(0.459)	(0.575)	(0.408)
Volatility	0.396	-1.102	1.995	-0.899	0.209	0.373	0.163	0.073	0.282
	(0.190)	(0.246)	(0.917)	(0.971)	(0.364)	(0.340)	(0.070)	(0.172)	(0.082)
GDP	0.817	0.780	1.047	0.906	0.736	1.064	0.822	0.991	0.886
	(0.095)	(0.097)	(0.097)	(0.091)	(0.089)	(0.112)	(0.055)	(0.076)	(0.052)
GDP per capita	1.617	1.519	1.120	1.268	0.991	0.559	0.825	0.298	0.291
	(0.280)	(0.325)	(0.404)	(0.306)	(0.412)	(0.533)	(0.157)	(0.172)	(0.140)
Distance	-0.349	-0.724	-0.977	-0.888	-0.912	-0.755	-0.607	-0.672	-0.520
	(0.210)	(0.165)	(0.156)	(0.140)	(0.141)	(0.196)	(0.099)	(0.126)	(0.090)
Border	1.506	0.931	0.195	0.184	0.529	-0.023	0.645	0.503	0.697
	(0.366)	(0.379)	(0.377)	(0.374)	(0.371)	(0.417)	(0.275)	(0.405)	(0.274)
Political union	0.143	0.401	0.970	0.439	0.514	0.917	1.088	0.816	0.465
	(0.615)	(0.788)	(0.778)	(0.862)	(1.026)	(0.714)	(0.709)	(0.695)	(0.907)
Common language	0.611	0.545	-0.076	0.046	0.799	-0.488	0.228	-0.214	0.078
	(0.411)	(0.506)	(0.354)	(0.303)	(0.585)	(0.350)	(0.301)	(0.555)	(0.236)
MFN	0.187	-0.346	0.030	0.234	0.370	-0.028	-0.102	0.139	0.287
	(0.344)	(0.287)	(0.308)	(0.252)	(0.306)	(0.350)	(0.205)	(0.246)	(0.190)
Constant	-34.649	-28.406	-29.905	-26.777	-18.849	-22.036	-21.114	-15.682	-15.030
	(5.121)	(5.335)	(6.502)	(5.044)	(6.281)	(7.781)	(3.134)	(3.105)	(2.456)
Number of obs	90	56	59	70	139	81	274	189	182
R-squared	0.673	0.852	0.835	0.794	0.486	0.753	0.567	0.568	0.650
Root MSE	1.134	0.877	0.963	1.172	1.755	1.310	1.550	1.643	1.215

NOTES: Dependendent variable: ln(trade). Robust standard errors are reported in parentheses.

two countries that were on the gold standard traded 62% ($e^{0.48}-1$) more with one another than with countries under a different monetary regime. Trade between countries on silver received an even bigger boost from the common monetary regime of approximately 115% ($e^{0.76}-1$). Nevertheless, we must keep in mind that the number of pairs in which "silver" is equal to one is small, and that these observations tend to appear at early stages of our period of analysis. Bimetallism does not seem to be a significant force encouraging bilateral trade flows.[12]

Monetary unions are also associated with more bilateral trade. Controlling for being under the same monetary standard, countries in a monetary union appear to trade more than two times ($e^{0.72}-1$) more with each other than they would with countries outside the union.[13] Furthermore, it is worth observing that the association between trade and a monetary union is likely understated by looking at the OLS coefficients. Joining a monetary union effectively implied being on the same commodity regime standard. For example, in our baseline sample 96 out of 118 pairs which share a currency are also on the gold standard. It is reasonable to assert that bilateral trade would be about 3.30 ($e^{.716+.479}$) times larger when both countries belong to a monetary union.[14]

According to our baseline regression, after controlling for the type of monetary arrangements between two countries, exchange-rate volatility *positively* affects international trade, with a statistically significant coefficient of 0.17. This finding contradicts our expectations and is in contrast to Frankel and Wei (1998) and Rose's (2000) findings. As we argue in Appendix B however, unexpectedly large trade in Brazil and Chile—despite high exchange rate volatility in both countries—may explain this puzzling result. Inter-

[12] Evidence from unreported regressions showed that treating a bimetallic country as if it were on both silver and gold could not explain trade flows. One explanation could be that bimetallism's fallibility to Gresham's Law made circulation in a given country uncertain at any point in time. This could generate increases in transaction costs offsetting the hypothetical reductions we mention above.

[13] We ran our baseline regression under the alternative assumption that the United States and Canada were not part of a monetary union. Our new estimates, which we do not report, remain virtually the same.

[14] Remarkably, this is nearly the figure Rose (2000) suggests is a reasonable estimate of the association between monetary unions and trade. Also, taking a broader view of coordination has little impact: 98 out of 118 observations shared a similar standard.

estingly, regression 5 finds a non-linear effect of exchange rate volatility. This suggests that at high levels of depreciation (e.g., during crises) trade can be spurred while in normal times volatility reduces trade. Appendix B suggests we should be compelled to take our results with a grain of salt. In our sample we conclude that exchange rate volatility's impact on trade is most likely negligible.

5.2 Gravity-equation variables

The estimated coefficient on GDP, 0.86, is slightly higher than those reported by Frankel and Rose (2000) and by Rose (2000), around 0.8 in both cases, but smaller than Eichengreen and Irwin's (1995) coefficient (from 0.8-1.0). Frankel and Rose (2000) interpret their estimate as indicating that a one percent increase in GDP, keeping GDP per capita constant, implies that the ratio of trade to GDP falls by 0.2 percent. Under this logic, a literal reading of our estimate suggests that trade openness during the nineteenth century was affected to a lesser extent by the size of a country and that commercial integration had reached a level at least as high as today's level.

Our estimate for GDP per capita, 0.66, is identical to the Frankel-Rose results. This is a bit of a surprise since one would expect that as income per capita increased over the twentieth century, a larger proportion of bilateral commerce would have taken the form of intra-industry trade. Indeed, for the interwar period, Eichengreen and Irwin (1995) find lower estimates on income per capita than those found by other authors looking at the post-war era, and take this as evidence that intra-industry trade gained prominence after World War II. We conjecture that barriers to trade between more developed countries were lower than in the Inter-war period when colonial blocs and free trade zones haunted the global economy.

In our regression, a one percent increase in the distance between two countries reduces bilateral trade by only 0.66 percent —compared to a one percent decline in the late twentieth century, according to Frankel and Rose (2000). Anderson and van Wincoop (2000) argue that bilateral trade should be homogeneous of degree 0 in transportation

costs so that this coefficient should be relatively stable over the long term.[15] Still, both our measure and that of Frankel and Rose (2000) contain a noisy measure of the level of bilateral protection. The distance coefficients may be capturing differences in the degree of relative trade openness that existed in each period.

5.3 Other variables

Estimates on the rest of our explanatory variables have the expected sign, although we did not find statistically significant coefficients for the common language and MFN dummies. If product differentiation during the nineteenth century was limited, cultural similarities, captured in the common language dummy, would have been a less important determinant of trade, explaining the lack of significance of the former variable. We attribute the statistically insignificant estimate of the MFN dummy to the dearth of easily accessible sources regarding nineteenth century trade treaties. In contrast, both contiguity and close political ties between two countries (or colonies) are highly correlated with trade. A common border seems to yield higher trade—higher by 90 percent than for countries without a common frontier. Finally, countries in a political union traded two and one-half times more with one another than two politically independent nations.

5.4 Sensitivity analysis

5.4.1 Endogeneity and Heterogeneity

Our initial results provide strong evidence that monetary regimes matter for explaining trade patterns. At the same time, they provide econometric support for the pre-existing but incomplete views on the correlates of trade flows in the economic history literature. In this section we show that our results are robust to imperfections in the data, omitted variables and model specification.

Another way to identify the effects of regime coordination is to study trade pat-

[15] Our increasing (in absolute terms) distance coefficient through the 1870s may be reflecting the increasing protectionism of the decade. Below we allow for a time varying distance coefficient in the pooled sample. We also discuss how sample selection may be biasing our results.

terns before and after the "treatment effect" of coordination. To do so we take a simple "difference-in-differences" approach in Table 9. Using OLS and controlling for autocorrelation and heteroscedasticity we estimate

$$\Delta \ln (Trade_{ij}) = \gamma_0 + \gamma_1 \Delta (\text{Gold}_{ij}) + \Delta (X_{ij})' \gamma + \nu_{ijt} \quad (1)$$

where Δ denotes the difference between the year t and year $t-5$ values of a variable (divided by five and multiplied by 100 in the case of the continuous controls), $\Delta (\text{Gold}_{ij})$ is one if two countries were *not* both on the same commodity money regime in year $t-5$ but in year t both *were* on the same standard, X_{ij} is a vector of control variables included in the baseline specification, γ is a vector of coefficients and ν is a possibly auto-correlated and heteroscedastic error term. With this type of approach we effectively difference out idiosyncratic shocks specific to country pairs. Additionally, in a given year, we "difference" out global shocks common to all dyads. We focus on commodity money regime changes since few observations moved in to or out of currency unions in our data.[16]

Table 9 reports various specifications of equation 1. Column 1 suggests that the average increase in the annual growth rate of trade associated with a move to regime coordination was on the order of 2.39 percentage points. Adding country-pair dummies or including changes in the control variables from the baseline increases the point estimate to around 3. Adding time dummies with or without fixed effects for country pairs keeps the point estimate's magnitude, but the coefficient loses its statistical significance at conventional levels of confidence. Nevertheless, taking the point estimate of 3 as the effect on the annual growth rate of trade, assuming exponential growth in trade levels, and taking our point estimate from Table 5 as a literal comparative static result our coefficient implies it would take about fifteen years after adopting the gold standard to increase trade to the levels implied by our baseline regression. In regressions 6 and 7 of Table 9 we insert an indicator for when countries departed from regime coordination and

[16] In our first-differenced data there are 79 (11 percent of the observations) moves to coordination on commodity money regimes while there are only 2 observations that involve a currency union regime switch.

Table 9: Time series regressions

Regressors	*Reg. 1*	*Reg. 2*	*Reg. 3*	*Reg. 4*	*Reg. 5*	*Reg. 6*	*Reg. 7*
move to coordination on	2.396	2.995	3.41	1.788	3.193	2.284	3.194
metallic regime	(1.29)	(1.83)	(1.92)	(2.06)	(2.15)	(1.29)	(2.15)
move away from coordination						-6.31	-0.297
on metallic regime						(2.289)	-2.837
change in product of GDP		1.201	1.15	1.289	1.019		1.018
		(0.310)	(0.231)	(0.348)	(0.246)		(0.248)
Change in product of per capita		0.101	0.125	0.104	0.129		0.129
GDP		(-0.063)	(-0.086)	(0.07)	(0.09)		(0.09)
change in distance*cost index		0.054	0.032	0.052	0.035		0.035
		(0.03)	(0.03)	(0.03)	(0.03)		(0.03)
change in volatility		0.003	-0.012	0.024	-0.211		-0.211
		(0.03)	(0.03)	(0.16)	(0.15)		(0.15)
instated MFN treaty		1.498	2.185	0.682	1.842		1.84
		(2.75)	(2.21)	(2.81)	(2.22)		(2.22)
time controls		no	no	yes	yes		yes
pair controls		yes	no	yes	no		no
Constant	5.084	-0.156	-0.433	4.54	2.285	5.281	2.308
	(0.342)	(1.81)	(1.31)	(3.22)	(2.21)	(0.348)	(2.24)
Number of obs	1880	714	714	714	714	1880	714
R-squared	0.004	0.054	0.075	0.059	0.076	0.008	0.076

NOTES: Dependendent variable: Average growth rate in trade over previous five years.
Robust, autocorrelation-corrected standard errors are reported in parentheses.

find a negative and statistically insignificant effect. We have only ten observations in this reduced sample where regimes moved away from coordination, so imprecise results are not a surprise.

Another way to deal with country-specific heterogeneity or pair specific heterogeneity is to use a fixed effects estimator. First we control for pair-specific heterogeneity by adding an indicator for each of 305 pairs in our sample. Regression 1 of Table 10 shows that coordination on the gold standard still has a positive and statistically significant association with trade. This fixed effects cross-sectional coefficient is directly comparable to the time-series examination. Our estimate implies that trade is 15 percent higher among countries on gold. Comparing this to the "difference-in-differences" approach suggests that it would take around five years after moving to coordination to reach this higher level of trade. Predictably the coefficient on the monetary union indicator shrinks in magnitude and is no longer statistically significant since there is little variation in the variable over time. It is re-assuring to see that the point estimate is still positive

Table 10: Endogeneity and heterogeneity regressions

Regressors	*Country-Pair FE*	*Country FE*	*IV Regression*
Gold	0.15	0.28	0.97
	(0.077)	(0.125)	(1.32)
Silver	0.18	1.10	---
	(0.27)	(0.396)	
Bimetallism	0.19	-0.31	---
	(0.31)	(0.35)	
Monetary union	0.26	1.34	1.31
	(0.54)	(0.389)	(1.36)
Volatility	0.02	0.05	0.11
	(0.02)	(0.03)	(0.37)
GDP	0.55	0.36	0.91
	(0.148)	-0.27	(0.091)
GDP per capita	0.31	0.43	0.81
	(0.092)	(0.113)	(0.519)
Distance*Cost Index	-0.33	---	---
	(0.121)		
Distance		-0.49	-0.74
		(0.136)	(0.103)
Border	---	0.57	0.27
		(0.30)	(0.39)
Political union	0.16	0.91	0.22
	(0.69)	(0.53)	(1.14)
MFN	-0.03	-0.16	0.07
	(0.11)	(0.13)	(0.22)
Country-Pair Controls	yes	no	no
Country Controls	no	yes	no
constant	-9.53	-7.44	-21.26
	(3.290)	(6.584)	(6.210)
Number of obs	1140	1140	681
R-squared	0.50	0.74	0.67

NOTES: Robust standard errors are reported. Year dummies are not reported.
Regression 3-- Variable instrumented for: Gold and Monetary Union. Instruments Ratio of Gold Reserves to domestic liabilities outstanding and common languag indicator

however. Regression 2 uses country-specific fixed effects. This controls for unobserved *multilateral* barriers to trade specific to each country. Anderson and van Wincoop (2000) argue it is essential to control for this to achieve unbiased relationships between bilateral barriers and trade. Results indicate that both the gold standard and the monetary union coefficients are statistically significant and still important. Country-pairs on a gold standard trade about 30 percent more with each other while countries in a currency union trade nearly 2.8 times more than they might if not in a currency union.

One could also argue that an endogeneity bias is affecting our results. Countries that traded disproportionately may have found it more lucrative to coordinate on the gold standard or to form a currency union.[17] We use two-stage least squares to alleviate the potential endogeneity bias. We instrument for the gold standard dummy with the

[17] We focus on the gold standard and currency union effects here due to the lack of available instruments we can use simultaneously for the silver standard, bimetallic and gold standard indicators. In any case, the majority of our observations are for gold standard countries.

product of each country's ratio of gold reserves to domestic liabilities in circulation. To be on the gold standard a country necessarily possessed a substantial level of gold reserves. However it is unlikely that this gold cover ratio would be affected by the level of integration between countries. We instrument for the monetary union variable with a common language indicator.[18] Countries in our sample that had monetary unions often shared a similar language yet we find no reason why language might be correlated with the error term especially since we are controlling for so many factors already and explaining nearly 60 percent of the variation in trade.[19] Regression 3 shows results from the second-stage regression. The magnitude of both effects has increased in size but neither coefficient is statistically significant. However, a Hausman test cannot reject the null hypothesis of exogeneity of the regressors (χ^2 = .07, p-value 1.00). We find no conclusive evidence that endogeneity bias explains our baseline parameter estimates.

In Table 11 we check to see if outliers might be influencing our results or if autocorrelation is producing inconsistent parameter estimates. In columns 1 and 2 we run a robust (iterative Huber/bi-weight) regression and a quantile (median) regression. According to these checks our baseline results do not appear to be influenced by outliers. Autocorrelation correction changes our point estimates slightly. When controlling for first-order auto-correlation we find an estimated AR(1) parameter of 0.69.[20] The coefficients on the gold standard and currency union variables are deflated in magnitude but still highly statistically significant. In this specification, gold countries trade only about 13 percent more with each other, and currency union countries trade about 60 percent more with other members.

We also tackled the issue of *endogeneity* of national output. As instruments, we use the natural logarithm of the product of total land area of the countries and the log of the product of the percentage of the population in cities of greater than 50,000 inhabitants.

[18] Accordingly we leave this variable out of our second-stage regression. In our gravity specifications this variable never enters with a statistically significant coefficient.

[19] The coefficients and their standard errors in parentheses in the first stage regressions were 0.0000177 (.000000193) and 0.088 (.004) respectively.

[20] In this case one period is a five-year interval.

Table 11: Robustness

Regressors	*Huber/biwieght*	*Quantile*	*Autocorrelation Correction*
Gold	0.49	0.547	0.13
	(0.106)	(0.110)	(0.042)
Silver	0.83	0.863	0.555
	(0.406)	(0.389)	(0.166)
Bimetallism	-0.285	-0.429	-0.232
	(0.57)	(0.54)	(0.16)
Monetary union	0.747	0.389	0.481
	(0.180)	(0.186)	(0.139)
Volatility	0.175	0.145	0.038
	(0.035)	(0.036)	(0.012)
GDP	0.83	0.859	0.838
	(0.025)	(0.026)	(0.018)
GDP per capita	0.611	0.547	0.417
	(0.064)	(0.066)	(0.043)
Distance	-0.577	-0.63	-0.636
	(0.044)	(0.046)	(0.033)
Border	0.629	0.542	0.476
	(0.155)	(0.158)	(0.116)
Political union	0.774	1.267	0.75
	(0.211)	(0.219)	(0.170)
Common Language	0.188	0.261	0.445
	(0.15)	(0.16)	(0.117)
MFN	0.18	0.149	0.132
	(0.084)	(0.09)	(0.047)
constant	-17.696	-16.767	-14.39
	(1.133)	(1.179)	(0.787)
Number of obs	1140	1140	1057
R-squared			
Root MSE	0.62		

NOTES: Robust standard errors are reported.
Year dummies are not reported.
Regression 3-- Variable instrumented for: Gold and Monetary Union. Instruments: Ratio of Gold Reserves to domestic liabilities outstanding and common language indicator

The size of a country might have been correlated with the size of GDP because it provided a more extensive market or simply because it increased the available inputs to the production function including land and labor. However, there is no reason to suspect that there could be a correlation between the error term and the land area of a country. The second variable is likely to be correlated with GDP per capita when spillover effects or spatial externalities are present. It is also a key historical fact that as countries industrialized (and their levels of output per capita increased) that they became more urbanized. At the same time, we can think of no reason why urbanization *rates*—a socio-political variable—and the error term for bilateral trade should be correlated. We use two stage least squares to re-estimate our baseline equation using these instruments.[21] Regressions 1 and 2 in Table 12 report the results. A Hausman test rejects the null hypothesis of exogeneity of the variables at the one-percent confidence level. The elasticities on GDP

[21] First stage regressions show that both instruments are positively correlated with each regressor and highly statistically significant.

and per capita output increase from 0.86 and 0.66 to 1.18 and 1.15 respectively. Other parameters of interest in the regressions remain significant but fluctuate in magnitude. Volatility seems to be related to trade more strongly than before while the gold standard coefficient rises a bit and the coefficient on monetary union increases from 0.72 to 1.1.

5.4.2 Omitted Variables

In addition, we were concerned that our baseline regression excluded other determinants of bilateral trade. In Table 12, regressions 3 and 4, we include other variables that may theoretically affect bilateral trade. Shipping costs fell dramatically during our period of analysis and using a time-invariant measure of distance may be omitting important information about falling transportation costs.[22] We remedy this by multiplying our time-invariant great circle distance by the ratio of Isserli's (1938) index of transportation costs in a given year to the index of 1870. The interaction term is insignificant when we include it in the regression. In column 6 we interact time dummies with the distance variable. None of the coefficients are individually statistically significant, but we can reject the null hypothesis that all of the interactions are zero. The insensitivity of the distance parameter to these changes may reflect the theoretical prediction by Anderson and van Wincoop (2000) that bilateral trade should be homogeneous of degree 0.

Results in columns 3 and 4 are in line with predictions from the Heckscher-Ohlin model of trade. The wider the gap in income per capita, and the larger the disparity in natural resource endowment —proxied here as the ratio of land-to-population— the more two countries would trade. Also, when two countries are in different hemispheres, they trade more with one another. This would occur, for example, because seasonalities in agricultural trade would increase the demand for imports from southern hemisphere countries in the northern countries and vice versa. We also included dummies indicating when a country pair consisted of at least one Latin American or Asian country; both are significant, however the former is positive while the latter is negative. Special quasi-colonial relationships, heavy capital and migrant flows from Europe to Latin America,

[22] We thank Jeff Williamson for encouraging us to explore this possibility.

Table 12: Endogeneity of GDP and omitted variables

Regressors	*Reg.1**	*Reg. 2**	*Reg. 3*	*Reg. 4*	*Reg. 5*	*Reg. 6*		
Gold	0.540	0.643	0.689	0.595	0.482	0.431		
	(0.166)	(0.191)	(0.119)	(0.126)	(0.163)	(0.165)		
Silver	2.070	3.833	1.371	1.395	0.726	0.836		
	(0.452)	(0.736)	(0.356)	(0.352)	(0.39)	(0.418)		
Bimetal	-0.085	0.116	-0.082	-0.114	-0.368	-0.281		
	(0.186)	(0.251)	(0.300)	(0.293)	(0.35)	(0.35)		
Monetary union	1.105	1.061	0.612	0.642	0.725	0.71		
	(0.246)	(0.244)	(0.191)	(0.192)	(0.43)	(0.43)		
Volatility	0.41	0.425	0.084	0.076	0.168	0.159		
	(0.046)	(0.046)	(0.041)	(0.046)	(0.052)	(0.051)		
GDP	1.181	1.172	1.085	1.067	0.862	0.859		
	(0.082)	(0.081)	(0.035)	(0.033)	(0.046)	(0.046)		
GDP per capita	1.153	1.146	0.561	0.713	0.654	0.673		
	(0.203)	(0.204)	(0.109)	(0.135)	(0.109)	(0.109)		
Distance	-0.702	-0.691	-1.064	-1.027	-0.567	-0.601		
	(0.068)	(0.068)	(0.081)	(0.080)	(0.153)	(0.136)		
Distance*Cost Index Ratio	--	--	--	--	-0.143	--		
					(0.20)			
Border	0.521	0.546	0.386	0.399	0.624	0.615		
	(0.183)	(0.180)	(0.141)	(0.136)	(0.241)	(0.242)		
Political union	0.935	0.908	0.939	0.944	0.922	0.916		
	(0.281)	(0.283)	(0.247)	(0.242)	(0.60)	(0.60)		
Common language	-0.206	-0.226	0.041	0.010	0.168	0.209		
	(0.206)	(0.206)	(0.184)	(0.179)	(0.28)	(0.27)		
MFN	0.106	0.112	-0.021	-0.026	0.145	0.139		
	(0.108)	(0.108)	(0.089)	(0.088)	(0.16)	(0.16)		
Same hemisphere	--	--	-1.278	-1.085		Distance*1875	dummy	-0.161
			(0.237)	(0.262)				(0.14)
Abs. difference in GDP per capita (log)	--	--	0.142	0.114		Distance*1880	dummy	-0.139
			(0.039)	(0.038)				(0.13)
Abs. difference in land/population (log)	--	--	0.112	0.107		Distance*1885	dummy	-0.298
			(0.035)	(0.034)				(0.147)
Latin America	--	--	0.816	0.804		Distance*1890	dummy	-0.156
			(0.254)	(0.251)				(0.14)
Asia	--	--	-0.680	-0.630		Distance*1895	dummy	-0.162
			(0.246)	(0.248)				(0.15)
Armed conflict	--	--	-0.318	-0.240		Distance*1900	dummy	-0.015
			(0.226)	(0.223)				(0.13)
Brazil dummy	--	--	--	0.668		Distance*1905	dummy	-0.032
				(0.276)				(0.14)
Chile dummy	--	--	--	-0.228		Distance*1910	dummy	0.123
				(0.379)				(0.13)
Number of obs	881	881	900	900	1140			1140
R-squared	0.586	0.590	0.728	0.732	0.595			0.598
Root MSE	1.465	1.460	1.191	1.185	1.453			1.452

NOTES: Dependent variable: ln(trade). Robust standard errors are reported in parentheses. Year dummies and constant are not reported. Regressions 1 and 2 are 2SLS estimations.

and geography likely explain this result.[23]

One might argue that convertibility was a mark of distinction among countries that assured stability of the monetary rule. Such stability and predictability might be leading to more trade among a group of well-kept economies. We control for the possibility that our regime indicators are simply picking up a convertibility effect. We constructed a dummy that was one if either of the countries were convertible, but not on the same standard. Controlling for this allows us to assert that the coefficients on the other monetary standard dummies are picking up the relation between trade and *similarity in* monetary regime. Table 13 shows that trade between two partners is not increased when both partners have convertible currencies, and similarity in monetary regimes remains important in promoting trade.

*** Capitalize all section heads.

Last, armed conflict, defined either as a war between the two states or a civil war in one of them, shows up with an expected negative sign, although it is statistically insignificant. Importantly, the coefficients on "gold", "silver", and "monetary union" remain significant and positive; in fact, the first two are estimated to have a substantially larger impact on trade.

By adding in other variables, we have explained nearly 73 percent of the variance in trade flows. We have included nearly all theoretically justified variables possible and more. And yet omitted variable bias does not seem to drive our results regarding the association between monetary regimes and trade.

[23] Latin American countries like Mexico, Argentina and Brazil had historically special relationships to England, France, Portugal and Spain while no formal ties existed. Hence we cannot control for these effects as we can with the Asian colonies. European capital and migration favored American states over Asian states and hence trade is likely to have been heavily associated with these flows. Finally, shipping routes to Asia from Europe (the most common type of dyad in our data when at least one country is from Asia) were probably more cumbersome than those to Latin America. Internally, railroad construction was heavier in Latin America while routes to Asia from Europe had to pass by the British-controlled Suez Canal or navigate around Africa.

Table 13: Convertibility and trade

Regressors	*Reg. 1*	*Reg. 2*
Gold	--	0.541
		(0.130)
Silver	--	0.880
		(0.401)
Bimetal	--	-0.209
		(0.279)
Monetary union	0.632	0.763
	(0.185)	(0.184)
Volatility	0.105	0.181
	(0.041)	(0.044)
Convertible & diff. standard	0.049	0.295
	(0.145)	(0.159)
GDP	0.842	0.859
	(0.027)	(0.028)
GDP per capita	0.723	0.674
	(0.078)	(0.082)
Distance	-0.677	-0.661
	(0.046)	(0.045)
Border	0.640	0.621
	(0.125)	(0.123)
Political union	1.053	0.870
	(0.272)	(0.285)
Common language	0.173	0.162
	(0.164)	(0.168)
MFN	0.152	0.153
	(0.095)	(0.095)
Constant	-18.799	-18.802
	(1.375)	(1.417)
Number of obs	1149	1140
R-squared	0.589	0.596
Root MSE	1.465	1.451

NOTES: Dependendent variable: ln(trade). Robust standard errors are reported in parentheses. Year dummies are not reported.

5.4.3 Model Specification

We also run other specifications for panel data. Table 14 presents results from a weighted-least-squares, between estimator and a random effects estimator of our baseline equation.[24] The between estimator yields results somewhat similar to the pooled OLS results, although most of our monetary variables have increased in magnitude. The gold standard variable remains significant, but its effect now is to increase trade by 1.2 times. The monetary union variable suggests that trade increases by roughly 1.6 times when two countries belong to such an arrangement. The effect of joining a monetary union, using the previous logic that any two monetary union countries share the same standard thus implies that trade is increased by 5.5 times. Additionally the standard gravity variables remain nearly unchanged in terms of magnitude and precision. The random effects estimator yields results closer to the baseline regression. Using a Hausman test we reject the null hypothesis of no correlation between the regressors and the disturbances at the one percent level.

Another issue we address is the possibility of a sample selection bias. During our period of analysis, trade statistics generally were reported only for the largest trading partners. Some countries did not report data for partners whose trade was below a given threshold. There are also many countries that have been omitted from the sample simply due to missing data. Such missing observations could give us inconsistent estimates of our parameters.

We conjecture that sample selection may lead to a downward bias on our gold standard dummy. This could arise if many non-gold standard and poor countries, such as the periphery states of Europe, Southeast Asia and America, had very low levels of trade or unreported trade with other gold standard countries in the core of Europe. Leaving these countries out could misleadingly weaken the coefficient on the gold standard dummy and may also give misleading parameters for the GDP effects. This problem can be resolved to

[24]The weights adjust for the unbalanced panel. We use the inverse of the number of time periods a country-pair is in the panel to weight the data and to dampen their over-representation in the sample.

Table 14: Panel regressions

Regressors	*Fixed effects (Between est.)*		*Random Effects*	
	Reg. 1	*Reg. 2**	*Reg. 3*	*Reg. 4**
Gold	0.902	0.714	0.164	0.136
	(0.304)	(0.303)	(0.074)	(0.074)
Silver	1.883	2.315	0.305	0.307
	(1.450)	(1.443)	(0.245)	(0.243)
Bimetal	-3.529	-3.739	0.280	0.259
	(2.582)	(2.553)	(0.306)	(0.303)
Monetary union	0.989	0.804	0.452	0.431
	(0.376)	(0.376)	(0.366)	(0.365)
Volatility	0.300	0.000	0.016	-0.045
	(0.102)	(0.141)	(0.023)	(0.030)
GDP	0.849	0.836	0.835	0.844
	(0.057)	(0.056)	(0.050)	(0.050)
GDP per capita	0.882	0.794	0.385	0.357
	(0.149)	(0.153)	(0.072)	(0.072)
Distance	-0.601	-0.604	-0.714	-0.723
	(0.100)	(0.099)	(0.099)	(0.101)
Border	0.697	0.627	0.628	0.561
	(0.305)	(0.306)	(0.366)	(0.368)
Political union	0.622	0.664	0.992	0.976
	(0.430)	(0.426)	(0.394)	(0.394)
Common language	0.137	0.187	0.271	0.282
	(0.300)	(0.301)	(0.361)	(0.364)
MFN	0.138	0.095	-0.026	-0.024
	(0.180)	(0.182)	(0.092)	(0.092)
Constant	-21.871	-19.681	-13.525	-13.143
	(2.778)	(2.822)	(1.599)	(1.608)
Number of obs	1140	1108	1140	1108
R-squared	0.644	0.651	0.578	0.589
Root MSE	1.318	1.313	--	--

NOTES: Dependent variable: ln(trade). Standard errors are reported in parentheses. Year dummies are not reported. The between estimation regression was performed using weigthed least squares. * Indicates that the top 5th percentile of the volatility observations was excluded.

some degree by using Heckman's selection correction estimator. First we predict selection from the sample and then use this information to correspondingly adjust OLS coefficients to account for selection effects.

Table 15 presents the results of the maximum likelihood estimation of the OLS parameters adjusted for the selection bias. From the first-stage estimates it appears that more distant trading partners report their trade less often (likely because trade was naturally smaller between these dyads) and more urbanized countries are less likely to have missing data (this may be a proxy for the development of the dyad). In the second-stage, when we take account of sample selection, none of our results change drastically from the baseline. The coefficient on the gold standard, silver standard and the monetary union indicators increase in magnitude as expected. Sample selection does not seem to deny the importance of having a common monetary standard or joining a monetary union, neither can it account for the positive effect of volatility.

Another specification we ran was the *Tobit* estimator. In our case Tobit is the consistent estimator when the dependent variable is truncated at or above 0. As mentioned

Table 15: Selection correction

Regressors	*Reg. 1*	*Reg. 2*	*First-Stage Selection Equation*	
Gold	0.649	0.830	Gold	0.169
	(0.136)	(0.153)		(0.175)
Silver	1.493	2.585	Silver	0.608
	(0.384)	(0.632)		(0.449)
Bimetal	-0.113	0.337	Bimetal	6.1
	(0.252)	(0.290)		(0.415)
Monetary union	0.777	0.707	Monetary union	7.268
	(0.178)	(0.176)		(0.402)
Volatility	0.269	0.289	Volatility	0.0455
	(0.042)	(0.043)		(.044)
Gold * volatility	---	-0.293	GDP	0.3844
		(0.142)		(.3662)
Silver * volatility	---	-1.563	GDP per capita	0.1228
		(0.647)		(0.3725)
Bimetal * volatility	---	-0.770	Distance	-0.294
		(0.294)		(0.119)
GDP	0.892	0.891	Border	0.395
	(0.034)	(0.035)		(0.489)
GDP per capita	0.617	0.592	Political union	8.195
	(0.128)	(0.129)		(0.819)
Distance	-0.612	-0.601	Common language	0.1185
	(0.053)	(0.054)		(0.338)
Border	0.686	0.708	MFN	-0.175
	(0.130)	(0.128)		(0.1843)
Political union	0.057	0.025	Product of Land Area	-0.054
	(0.178)	(0.179)		(0.042)
Common language	0.633	0.603	Product of Percentage in Cities > 50K	0.77
	(0.242)	(0.242)		(0.228)
MFN	0.250	0.257	Product of Population	0.263
	(0.098)	(0.098)		(0.337)
Constant	-18.862	-18.564	Constant	-8.66
	(1.896)	(1.913)		(3.585)
rho	-0.238	-0.241		
	(0.094)	(0.097)		
Number of obs	1101	1101		

NOTES: Dependent variable: ln(trade). Robust standard errors are reported in parentheses
Year dummies are not reported.

above, countries rarely coded a trade value to 0 even when the actual trade values *were* in all likelihood zero values. Thus we are unable to completely distinguish between a missing observation and a true zero for trade. We re-code all missing trade observations to 0 with the understanding that this over-estimates the true number of zeros. This may be a bad way to characterize a missing trade observation especially between two usually important trade partners. Doing this we interpret the coefficients of the re-coded variables as one bound for the parameter estimates, while the marginal effects for the original dependent variables are perhaps another bound. Re-coding the missing trade data to zero gives us nearly 300 more observations. The percentage of zero observations is near 30 percent. In table 16 we report both OLS and Tobit for the data with the zero-coded data and the original data.[25]

The Tobit estimates and OLS estimates for the original data yield similar results.[26]

[25] In each case the independent variable is $\ln(1 + Trade_{ijt})$. In this way marginal effects are interpretable as elasticities and results are comparable to Table 7, while this transformation also makes the dependent variable lie above zero.

[26] We report the margnial effects for the Tobit coefficients as $\widehat{\beta}\Phi(\widehat{\beta}\overline{x}/\widehat{\sigma})$ where Φ is the ditribution

Table 16: Tobit estimation

Regressors	*OLS*		*TOBIT*	
	Reg. 1	*Reg. 2**	*Reg. 3*	*Reg. 4**
Gold	0.636	0.546	0.637	0.508
	(0.135)	(0.136)	(0.130)	(0.181)
Silver	1.511	1.184	1.506	1.403
	(0.460)	(0.583)	(0.577)	(0.708)
Bimetal	-0.015	0.529	-0.011	1.033
	(0.379)	(0.346)	(0.677)	(1.056)
Monetary union	0.650	0.847	0.653	0.981
	(0.179)	(0.208)	(0.179)	(0.274)
Volatility	0.187	0.166	0.188	0.217
	(0.040)	(0.038)	(0.035)	(0.047)
Gold * volatility	-0.315	-0.265	-0.315	-0.217
	(0.116)	(0.109)	(0.111)	(0.150)
Silver * volatility	-0.583	-0.726	-0.608	-1.167
	(0.365)	(0.324)	(0.274)	(0.369)
Bimetal * volatility	-0.225	-0.729	-0.221	-0.702
	(0.356)	(0.782)	(1.102)	(1.556)
GDP	0.825	0.944	0.828	1.199
	(0.023)	(0.020)	(0.024)	(0.033)
GDP per capita	0.562	0.844	0.566	1.076
	(0.073)	(0.069)	(0.064)	(0.085)
Distance	-0.603	-0.819	-0.607	-1.072
	(0.041)	(0.041)	(0.043)	(0.060)
Border	0.614	0.649	0.610	0.483
	(0.117)	(0.158)	(0.151)	(0.2280
Political union	0.144	-0.043	0.142	-0.095
	(0.142)	(0.168)	(0.147)	(0.214)
Common language	0.849	1.317	0.856	1.876
	(0.277)	(0.291)	(0.207)	(0.310)
MFN	0.158	-0.076	0.161	-0.175
	(0.084)	(0.087)	(0.082)	(0.114)
Constant	-16.805	-22.946	-16.911	-30.780
	(1.211)	(1.160)	(1.111)	(1.506)
Number of obs	1150	1638	1150	1638
R-squared	0.620	0.680	--	--
Root MSE	1.290	1.590	1.280	2.020

NOTES: Dependent variable: ln(1+trade). Standard errors are reported in parentheses. Year dummies are not reported. Sigma is reported for Tobit, not RMSE. * Indicates that missing traded data was recoded to zero.

Similarly, when we re-coded our data, we find both in OLS and in Tobit that coefficients maintain their size, and their significance is not altered. What little change there is in the expected direction. Since most of the missing observations were those with low levels of GDP the coefficients on our GDP controls increase. Re-coding missing observations to zero arbitrarily imputes zero trade to gold countries and thus bumps down the effect of the gold standard on trade. We imagine the marginal effects truly lie between the Tobit and the OLS point estimates. In any case, taking this extreme assumption and using Tobit our original inferences and conclusions appear do not appear unfounded.

Table 17 re-runs our baseline regression but substitutes *proxy* variables for each partner's GDP, in order to augment the size of our sample. We use the product of the natural logarithm of miles of railroad track per square mile, the percentage of population in cities greater than 50,000 inhabitants, total population, and land area in square miles.[27] This new specification augments the sample by about 300 observations. The baseline results on the gold dummy and the monetary union dummy hold, and all variables keep their statistical significance. Bimetallism still has a negative effect but it is now statistically significant. The coefficient for silver countries grows to be unbelievably large, implying that trade would be nearly 7 times larger compared to countries with different standards or with gold or bimetallic standards.

We also checked for other more complex relations between trade and monetary regimes. Perhaps our monetary variables were not creating trade but, instead, were diverting trade away from other nations. To explore this possibility, we constructed a dummy variable that is one if either country is on gold (but not both of them) and zero otherwise; we constructed similar variables for silver, bi-metallic and currency union countries. A negative coefficient on any of these indicator variables would suggest that the corresponding monetary arrangement is trade diverting.

Table 18 reports our results under different econometric methods. Our estimates show convincingly that none of the three monetary standards resulted in trade diversion.

function for a normally distributed variable. See Greene (1997) for the derivation of this correction.

[27] These proxies account for 96% of the variance in the levels of GDP in an OLS regression.

Table 17: Estimation with GDP proxies

Regressors	*Reg. 1*	*Reg. 2*
Gold	0.466	0.535
	(0.091)	(0.102)
Silver	2.162	3.761
	(0.385)	(0.571)
Bimetal	-0.792	-0.749
	(0.155)	(0.249)
Monetary union	1.028	1.009
	(0.135)	(0.135)
Volatility	0.188	0.199
	(0.031)	(0.033)
Gold * volatility	--	-0.102
		(0.080)
Silver * volatility	--	-2.114
		(0.603)
Bimetal * volatility	--	-0.045
		(0.221)
Railroad Milleage	0.366	0.367
	(0.051)	(0.051)
Urban Population	1.275	1.271
	(0.073)	(0.074)
Population	0.537	0.537
	(0.043)	(0.043)
Land Area	-0.070	-0.072
	(0.032)	(0.032)
Distance	-0.542	-0.536
	(0.059)	(0.059)
Border	0.952	0.961
	(0.113)	(0.113)
Political union	0.686	0.671
	(0.223)	(0.224)
Common language	0.243	0.236
	(0.131)	(0.131)
MFN	0.152	0.153
	(0.080)	(0.080)
Constant	-1.902	-1.918
	(0.501)	(0.501)
Number of obs	1480	1480
R-squared	0.621	0.621
Root MSE	1.430	1.430

NOTES: Dependent variable: ln(1+trade). Robust standard errors are reported in parentheses. Year dummies are not reported.

In fact, there is some suggestion that the gold standard was actually trade *creating*. In contrast, in our pooled OLS regression, monetary unions seem to have resulted in trade diversion, although in our panel, heckit, and Tobit estimates the coefficient is not statistically significant, suggesting that the aforementioned sample-selection problems may be affecting our results. Thus, we stop short from reaching any definitive conclusions regarding the trade diverting effects of monetary unions.[28]

Overall, our specification tests provide no reason to doubt the economic importance, the direction, and the statistical significance of our baseline OLS coefficients. Commodity money regimes and monetary unions are associated with an economically and statistically significant increase in trade among members. Further, our research underscores older views in the economic literature based on casual and incomplete inspection of the data. At the same time, the gravity approach has immense explanatory power not just today, but over the long-run.

6 Concluding remarks

In this paper we find evidence consistent with the idea that monetary regime choice had a large impact on patterns of trade in the first period of globalization. Trade flows may have been as much as 60 percent larger when two countries adopted the gold standard. Monetary unions, *controlling for all other effects*, are associated with levels of trade nearly 100 percent higher. Combining these two effects, which was the case more often than not, appears to have raised trade by 200 percent.

Our evidence supports theoretical arguments and anecdotal evidence that regime coordination and currency unions decrease the barriers to trade. If so, the implication from these results is that the institutional environment that governed the global economy very much influenced the operation of that economy. To the extent that monetary regime decisions were political, it would appear that political decisions were of substantial importance in explaining what happened to the global economy. When a global consensus

[28] Frankel and Rose (2000, table 1) find that monetary unions are in fact trade creating.

Table 18: Monetary variables and trade diversion

Regressors	*POOLED OLS*			*PANEL*	*HECKIT*	*TOBIT*
	Reg. 1	*Reg. 2*	*Reg. 3*	*Reg. 4*	*Reg. 5*	*Reg. 6*
Gold	0.494	0.814	0.763	1.424	0.975	0.559
	(0.123)	(0.234)	(0.423)	(0.531)	(0.281)	(0.273)
Silver	0.531	0.950	0.900	1.794	1.524	-1.080
	(0.392)	(0.429)	(0.239)	(1.507)	(0.458)	(0.456)
Bimetal	-0.247	-0.141	-0.008	-3.657	0.148	0.188
	(0.278)	(0.332)	(0.343)	(2.673)	(0.356)	(0.833)
Monetary union	0.421	0.736	0.423	0.819	0.608	0.755
	(0.218)	(0.184)	(0.218)	(0.432)	(0.217)	(0.296)
Volatility	0.155	0.183	0.173	0.318	0.272	0.156
	(0.044)	(0.046)	(0.046)	(0.106)	(0.045)	(0.048)
Trade diversion-Gold	--	0.336	0.404	0.547	0.316	0.451
		(0.197)	(0.201)	(0.470)	(0.231)	(0.222)
Trade diversion-Silver	--	0.100	0.090	0.183	0.014	-0.762
		(0.170)	(0.170)	(0.369)	(0.229)	(0.188)
Trade diversion-Bimetal	--	-0.082	0.029	-0.836	0.112	-0.768
		(0.218)	(0.225)	(1.024)	(0.233)	(0.311)
Trade diversion-Monetary union	-0.342	--	-0.365	-0.240	-0.206	-0.207
	(0.131)		(0.133)	(0.220)	(0.148)	(0.147)
GDP	0.852	0.861	0.851	0.844	0.888	1.184
	(0.028)	(0.027)	(0.028)	(0.058)	(0.035)	(0.033)
GDP per capita	0.693	0.652	0.687	0.900	0.610	1.027
	(0.080)	(0.084)	(0.083)	(0.157)	(0.129)	(0.088)
Distance	-0.678	-0.663	-0.679	-0.634	-0.623	-1.077
	(0.045)	(0.046)	(0.046)	(0.104)	(0.055)	(0.060)
Border	0.560	0.634	0.568	0.669	0.648	0.493
	(0.122)	(0.123)	(0.124)	(0.309)	(0.139)	(0.2282)
Political union	0.916	0.887	0.874	0.510	0.068	-0.050
	(0.281)	(0.289)	(0.277)	(0.437)	(0.181)	(0.213)
Common language	0.154	0.183	0.174	0.176	0.620	1.935
	(0.165)	(0.169)	(0.167)	(0.302)	(0.240)	(0.309)
MFN	0.150	0.136	0.147	0.147	0.250	-0.219
	(0.095)	(0.096)	(0.096)	(0.181)	(0.099)	(0.114)
Constant	-18.418	-18.550	-18.539	-21.729	-18.626	-28.859
	(1.387)	(1.448)	(1.444)	(2.875)	(1.932)	(1.554)
Number of obs	1140	1140	1140	1140	1101	1638
R-squared	0.598	0.596	0.599	0.648	rho = -0236	--
Root MSE	1.448	1.452	1.447	1.317	0.094	2.009

NOTES: Dependendent variable: ln(trade). Robust standard errors are reported in parentheses. Year dummies are not reported. The dependent variable in the regression is ln(1+trade); missing trade data were coded to zero; sigma, rather than RMSE, is reported.

emerged on the "right" policy to adopt (e.g., gold), and nations adopted, trade seemed to flourish.

Further, given our results, it appears that there is remarkable long-run stability in the gains to be had from monetary regime harmonization. This is unexpected given advances in financial, production, and institutional technologies over the last one-hundred years. Following Rose (2000), perhaps the cost of hedging exchange risk was much greater than previously thought and has remained so despite advances in financial instruments. Finally, monetary regime harmonization may be one way in which countries—separate political entities—edge towards building a common market. Economic historians conjecture that the extent of the market can largely explain the rise of the United States' economy in the nineteenth century. The implication of our work is that as barriers to trade fall and separate polities begin to look more and more like a single country with shared institutional arrangements productivity gains and increases in integration will be large and will be compounded as more and more countries adopt similar arrangements. How much these institutional variables can explain of nineteenth century globalization awaits further research.

Appendix A

Data Appendix

GDP: Figures were obtained from Maddison (1995). They are in real PPP U.S. dollars.

Volatility: We use monthly exchange rate data from the Global Financial Database and Schneider, Schwarzer, and Zellfelder (1991). Some series are for "sight" transactions on foreign exchange while others are for "three-month" or "six-month" exchange rates, though we operate under the assumption these series never diverge significantly. We observe that in some cases, when all series are available, this is in fact the case. The margin of error for a random variable like volatility is doubtlessly small. Countries for which we use data from Schneider are France, Netherlands, Germany, Italy, Switzerland, the United States, Norway, Sweden, Finland (before 1900), Portugal, Austria, and Belgium. To construct the volatility measure, we then take the standard deviation of $\ln(e_{ijt}) - \ln(e_{ijt-1})$ multiplied by 100. Where e_{ijt} is the bilateral exchange rate between country i and j in month t. We use cross rates when necessary.

Common Language: We code a country pair as one if both countries have significant portions of the population that speak the same language. Languages and the countries in which they are spoken are: English: UK, Canada, Australia, United States New Zealand; French: France, Belgium, Switzerland, Canada; German: Germany, Austria-Hungary, Switzerland; Dutch: Holland, Belgium; Italian: Italy, Switzerland; Spanish: Spain, Mexico, Argentina, Chile. Portuguese: Portugal, Brazil.

Distance: Distance is taken from Rose (2000). The data were downloaded from http://haas.berkeley.edu/~arose. He in turn lifted the data from the CIA's website.

Political Union: Pairs are coded one if one country is a dependency of the other (or vice-versa), countries are in a colonizer-colony relationship, are dependencies, or have a "dominion" arrangement. Countries (or colonies) with a political union are:

UK with Canada and Australia, Egypt, India, Sri Lanka, New Zealand, South Africa (and all permutations of the preceding); United States with the Philippines (1900-1910); Netherlands with Indonesia; Sweden with Norway (until 1905); Finland with Russia; Spain and the Philippines before 1900.

Monetary Regimes: We code observations as one if both countries have the same regime. A regime can be silver, gold or bimetallism. See table 2 for the regime coding. Data are from Meissner (2000).

Trade: Trade data are expressed in millions of 1990 U.S. dollars using U.S. consumer price index information kindly provided by Alan Taylor. Since Taylor reports a CPI with 1987 as the base year, we re-based his CPI to 1990. We complemented Barbieri's (1996) *International Trade Dataset*, which reports bilateral trade in current U.S. dollars among independent states, with information collected from national statistical yearbooks and other statistical compendia, especially with regard to trade data with non-independent territories. Our sources included:

General sources: Mitchell (1992), Mitchell (1995), Mitchell (1993), Foreign Commerce of the American Republics and Colonies, U.S. Bureau of Statistics (1909), Ministere du Commerce, de L'Industrie Des Postes et Des Telegraphs (Various issues); Australia: Ministry of Trade and Customs (Various issues); Belgium: Ministere de L'Interieur et de L'Instruction Publique (Various issues); Canada: Department of Agriculture (Various issues); Chile: International Bureau of the American Republics (1909), Ortuzar (1907); China: Hsiao (1974); Finland: Bureau Central de Statistique de Finlande (1911); France: Ministere du Commerce (Various issues); Germany: Statistisches Jahrbuch fur das Deutsche Reich. Berlin; Great Britain: Gastrell (1897), Board of Trade (1886); Holland: Societe de Statistique Des Pays-Bas (Various issues); Italy: Istituto Centrale Di Statistica (1958), Direzione Generale Della Statistica E Del Lavoro (Various issues); Norway: Utgit Av Det Statistiske Centralbyraa (Norway) (1911); Sweden: Utvingen Av Kungl. Statistiska Centralbyran (1914); Switzerland: Bureau de Statistique du Departement Federal de L'Interieur (Various issues); United States: Department of State (1898).

GDP proxies: Proxies for GDP —miles of railroad track per square mile, the percentage of population in cities of greater than 50,000 inhabitants, total population, and land area in square miles— were taken from Banks (1976).

MFN: We assigned a value of one to this variable whenever a commercial treaty containing a most-favored nation clause was in place between a pair of countries. In addition, we coded the variable as one whenever countries formed a political union, as defined above. The reason is that countries in a colonial relationship or with strong political bonds typically granted preferential treatment to one another. In some cases (e.g., France and its colonies), countries formed a monetary union; in others, preferential tariff treatment was granted (e.g., Great Britain and its Dominions); whereas in others, trade policy did not discriminate against third countries (e.g., Dutch colonies) [see United States Tariff Commission (1922a)]. We relied on the following sources: United States Tariff Commission (1922b), de Bernhardt (1912), United States Tariff Commission (1940), House of Commons (1908).

Appendix B

Volatility

In this appendix we explore exchange rate volatility's impact on trade in more detail. Contrary to our baseline regression's suggestion that volatility led to higher trade, we argue that such impact was negligible and is explained by unusually high trade for observations including Brazil or Chile.

First, we must remember that volatility was considerably lower during our period of analysis than during the post-Bretton Woods era. As argued earlier, low levels of volatility may have little effect on trade in most cases and our regressions may reflect that possibility. Second, in order to test for a non-linear impact of volatility on trade, we ran our baseline regression once again introducing a quadratic volatility term (see table 7, regression 1). The coefficient on volatility flips sign and is now -0.25, while the square of volatility is 0.07; both coefficients are significant. These estimates show that, starting from its mean of 1.5 percent, eliminating volatility altogether increases trade by roughly 25 percent.[29] Of course, our estimate also suggests that *increasing* volatility sufficiently beyond its mean will increase trade.

Third, the latter observation led us to test whether our baseline results are driven by observations with extreme values of volatility. In table 7, regression 2, we show estimates of our baseline regressions in which we have dropped observations in which volatility was in the upper fifth percentile of our sample distribution; only 32 observations were eliminated from a total of 1140. While the rest of our estimates remain roughly the same, the coefficient on volatility drops to 0.02 and becomes statistically equal to zero.[30] Furthermore, since Brazil appears in 17 of the 32 observations with high volatility, while Chile appears in 13 of the 32,[31] we estimated our baseline regression again introducing

[29] That is, $e^{-\left[(-0.25)(1.5)+(0.07)(1.5)^2\right]}-1 = 25\%$ (some discrepancies are due to rounding of our regression estimates).

[30] In an unreported regression, we also dropped observations in the lowest 5th percentile of the volatility distribution and confirmed that volatility is statistically insignificant.

[31] Both countries appear together in 2 instances. The observations occurred mainly in 1900 (20 observations) and 1910 (11 observations).

dummies indicating whether either of the two countries appeared in a dyad (see table 7, regression 3). The coefficient on volatility is now negative but insignificant. This result supports our claim that, if anything, volatility would have a negligible effect on trade during the period in question (controlling for the type of monetary arrangement).

Fourth, we explored whether volatility affected countries within each type of monetary arrangement. We augmented the baseline regression with interaction terms in which each monetary dummy is multiplied by our volatility measure (see table 7, regression 4). Although the volatility coefficient remains positive and significant, the interaction term between volatility and gold is *negative* and significant at the 5 percent level; the interaction term with the silver dummy is negative but statistically insignificant. Importantly, in both instances, the sum of each interaction term and the monetary-regime dummies is insignificantly different from zero. Thus, within each monetary bloc, standard hypothesis tests reveal that volatility does not affect trade flows. We pursue this idea by running our baseline regression on countries within the gold bloc only (see table 7, regression 5). Although statistically insignificant, the exchange-rate volatility coefficient is now negative.

Finally, we experimented with other measures of exchange rate volatility. We used the highest absolute first difference in the log of the exchange rate in the three years preceding the year of observation, the ninetieth percentile of that change (same time period), the standard deviation of the level of the exchange rate over the previous three years and the standard deviation of the first difference of the logarithm of the exchange rate over the previous year. None of these measures changed the conclusion in the baseline regression that volatility does not decrease bilateral trade.

References

Anderson, J. E., and E. van Wincoop (2000): "Gravity with Gravitas: A Solution to the Border Puzzle," Discussion paper, Boston College, Working Paper.

Bairoch, P. (1996): "Geographical Structure and the Trade Balance of European Foreign Trade from 1800 to 1970," I, 5–57.

Banks, A. (1976): "Cross-National Time Series: 1815-1973," Discussion Paper 7412, Inter-University Consortium for Political and Social Research.

Barbieri, K. (1996): "Economic Interdependence and Militarized Interstate Conflict, 1870-1985," Ph.D. thesis, Binghampton University.

Board of Trade (1886): *Statistical Abstract for the United Kingdom in Each of the Last Fifteen Years from 1871 to 1885*. Spottiswoode, London.

Bordo, M. D., B. Eichengreen, and D. A. Irwin (1999): "Is globalization today really different than globalization a hundred years ago?," Working Paper 7195, National Bureau of Economic Research.

Bordo, M. D., and L. Jonung (1999): "The Future of EMU: What Does the History of Monetary Unions Tell Us?," Discussion Paper 7365, National Bureau of Economic Research, Working Paper.

Bureau Central de Statistique de Finlande (1911): *Annuaire Statistique de Finlande*. Bureau Central de Statistique de Finlande, Helsinki.

Bureau de Statistique du Departement Federal de L'Interieur (Various issues): *Annuaire Statistique de la Suisse*. Buchdruckerci Stampfli & Cie, Bern.

Cohen, B. J. (1998): *The Geography of Money*. Cornell University Press, Ithaca.

de Bernhardt, G. (1912): *Handbook of Commercial Treaties, &c., between Great Britain and Foreign Powers*. His Majesty's Stationery Office, London.

Department of Agriculture (Various issues): *The Canada Year Book*. Department of Agriculture, Ottawa.

Department of State (1898): *Commercial Relations of the United States with Foreign Countries during the Years 1896 and 1897*. Government Printing Office, Washington.

Direzione Generale Della Statistica E Del Lavoro (Various issues): *Annuario Statistico Italiano*. Tipografia Nazionale di G. Bertero e C., Roma.

Flandreau, M. (1993): "Trade, Finance, and Currency Blocs in Nineteenth Century Europe:Was the Latin Monetary Union a Franc-Zone? 1860-1880," *mimeo.*

Flandreau, M., and M. Maurel (2000): "Monetary Union, Trade Integration and Economic Fluctuations, 1880-1913:Austria-Hungary in a European Mirror," *mimeo.*

Frankel, J. A., and A. K. Rose (2000): "An Estimate of the Effect of Currency Unions on Trade and Growth," Paper written for the Conference on Currency Unions, Stanford University, May 19-20, 2000.

FRANKEL, J. A., AND S.-J. WEI (1998): "Regionalization of World Trade and Currencies: Economics and Politics," in *The Regionalization of the World Economy*, ed. by J. A. Frankel. Chicago University Press, Chicago.

FRIEDEN, J. A. (1997): "Monetary Populism in Nineteenth-Century America: An Open Economy Interpretation," *The Journal of Economic History*, 57(2), 367–395.

GASTRELL, W. S. (1897): *Our Trade in the World in Relation to Foreign Competition, 1885 to 1895*. Chapman & Hall, London, UK.

HENRIKSEN, I., AND N. KOERGARD (1995): *The Scandinavian Currency Union 1875-1914* chap. 4, pp. 91–112. St. Martin's Press, New York.

HOUSE OF COMMONS (1908): *Return showing the Countries between which Commercial Treaties were in force on January 1, 1908. Presented to the House of Commons, by Command of his Majesty, in pursuance of their Address dated March 19, 1906*. Harrison and Sons, London.

HSIAO, L.-L. (1974): *China's Foreign Trade Statistics, 1864-1949*, Harvard East Asian Monograph 56. Harvard University Press, Cambridge, MA.

INTERNATIONAL BUREAU OF THE AMERICAN REPUBLICS (1909): *Chile. A Handbook*. International Bureau of the American Republics, Washington, D.C.

ISSERLIS, L. (????): "Tramp Shipping Cargoes, and Freights," 101(1), 53–146.

ISTITUTO CENTRALE DI STATISTICA (1958): *Sommario di Statistiche Storiche Italiane 1861-1955*. Istituto Centrale di Statistica, Roma.

MADDISON, A. (1995): *Monitoring the World Economy 1820-1992*. Development Centre, OECD, Paris.

MEISSNER, C. (2000): "A New World Order: Explaining the Emergence of the Classical Gold Standard," mimeo., University of California Berkeley.

MEYER, J. (1878): "The World's Money: Theory of the Coin, Coinage and the Monetary System of the World," in *Pahmplets on Finance*, vol. 5. Government Printing Office, London.

MINISTERE DE L'INTERIEUR ET DE L'INSTRUCTION PUBLIQUE (Various issues): *Annuaire Statistique de la Belgique*. Imprimerie Veuve Monnom, Brussels.

MINISTERE DU COMMERCE (Various issues): *Annuaire Statistique de la France*. Imprimerie Nationale, Paris.

MINISTERE DU COMMERCE, DE L'INDUSTRIE DES POSTES ET DES TELEGRAPHS (Various issues): *Commerce et Navigation des Principaux Pays Etrangers*, Annales du Commerce Exterieur. Imprimerie Nationale, Paris.

MINISTRY OF TRADE AND CUSTOMS (Various issues): *Annual Statement of the Trade of the Commonwealth of Australia with the United Kingdom, British Possessions, and Foreign Countries*. John Sands, Sidney.

MITCHELL, B. (1992): *International Historical Statistics. Europe 1750-1988*. Stockton Press, New York.

——— (1993): *International Historical Statistics. The Americas 1750-1988*. Stockton Press, New York.

——— (1995): *International Historical Statistics. Africa, Asia & Oceania 1750-1988*. Stockton Press, New York.

Obstfeld, M. (1997): "Europe's Gamble," *Brookings Papers on Economic Activity*, (2), 241–317.

O'Rourke, K. H., and J. G. Williamson (1999): *Globalization and History: The Evolution of a Nineteenth-Century Atlantic Economy*. The MIT Press, Cambridge, Massachusetts and London, England.

——— (2000): "When Did Globalization Begin?," (May), Working Paper.

Ortuzar, A. (1907): *Chile of To-day. Its Commerce, Its Production and Its Resources*. The Tribune Association, New York.

Rose, A. K. (2000): "One Money, One Market: Estimating the Effect of Common Currencies on Trade," *Economic Policy*, 30, 7–45.

Russell, H. (1898): *International Monetary Conferences*. Harper and Brothers, New York.

Saul, S. (1996): *The Export Economy 1870-1914*chap. 5, pp. 5–18. Elgar, Brookfield, VT.

Schneider, J., O. Schwarzer, and F. Zellfelder (1991): *Wahrüngen der Welt*. Verlag, Stuttgart.

Societe de Statistique Des Pays-Bas (Various issues): *Annuaire Statistique des Pays-Bas*. Institute de Statistique.

Subercaseaux, G. (1915): *A Common Monetary Unit for America*. Imprenta Universitaria, Santiago de Chile.

Unger, I. (1964): *The Greenback Era: A Social and Political History of American Finance, 1865-1879*. Princeton University Press, Princeton, NJ.

United States Monetary Commission (1879): *Report of the Silver Commission*, vol. II. Government Printing Office.

United States Tariff Commission (1922a): *Colonial Tariff Policies*. Government Printing Office, Washington.

——— (1922b): *Handbook of Commercial Treaties. Digest of Commercial Treaties, Conventions, and Other Agreements of Commercial Interest between all Nations*. Government Printing Office, Washington.

——— (1940): *Reference Manual of Latin American Commercial Treaties*. United States Tariff Commission, Washington.

U.S. Bureau of Statistics (1909): *Statistical Abstract of Foreign Countries. Parts I-III.- Statistics of Foreign Commerce*. Government Printing Office, Washington, D.C.

Utgit Av Det Statistiske Centralbyraa (Norway) (1911): *Statistisk Aarbok for Kogeriket Norge. Tretiende Aargang 1910*. I Kommission Hos H. Aschehoug & Co., Kristiana, Annuaire Statistique de la Norvege. Trentieme Annee.- 1910.

Utvingen Av Kungl. Statistiska Centralbyran (1914): *Statistisk Arsbok for Sverige. Forsta Argangen 1914*. Kungl. Boktryckeriet. P.A. Norstedt & Soner, Stockholm, Annuaire Statistique de la Suede. 1ere Annee. 1914.

Willis, H. P. (1901): *A History of the Latin Monetary Union: A Study of International Monetary Action*. University of Chicago Press, Chicago.

Wyplosz, C. (1997): "EMU: Why and How it Might Happen," *Journal of Economic Perspectives*, 11(4), 3–22.