The erosion of colonial trade linkages after independence*

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Abstract

High trade between countries with colonial ties may be explained by government policies that establish preferential access or as a consequence of networks formed through social interactions. Using bilateral trade data from 1948 to 2003, we examine the effect of independence on post-colonial trade. The severing of formal colonial relations can lead to an immediate reduction in trade as preferential access is eliminated as well as a gradual reduction corresponding to the deterioration of trading networks. Our results reveal that independence reduces colonial trade with its colonizer (metropole), the reduction cumulates over a 30-year period, and the disruption is particularly severe for hostile separations. We also find that overall colonial trade falls subsequent to independence, but to a lesser extent than trade with the metropole.

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1 Introduction

The dismantling of European empires after World War II led to sweeping changes in the governance of developing countries in Africa and Asia. Recent research in economics has investigated the long-run consequences of colonial rule. La Porta et al. (1998) argue that the British endowed their colonies with a legal system that produces superior economic outcomes. Acemoglu et al. (2001, 2002) find that colonizers were more likely to establish pro-growth institutions in sparsely populated areas with lower settler mortality. Banerjee and Iyer (2004) find that 50 years after India abolished land revenue systems imposed in the mid-19th by British rules, their "institutional overhang" can be seen in agricultural productivity differences. In this paper, we investigate a different legacy of colonial rule: the bias in post-colonial bilateral trade patterns.

The impetus for writing this paper came from the example of Algeria's exports to France. In 1960, two years before independence, Algeria accounted for 8.5% of French imports. Over the succeeding 42 years, that share fell by an order of magnitude to just 0.73% in 2002. A variety of potential explanations for this fact suggest themselves. First, it might reflect poor economic performance over the last for decades by Algeria, which may have reduced its exports to all markets. Second, Algeria's abandonment of the Franc in 1964 may have raised currency transaction costs. Third, France's participation in GATT and the European Community probably redirected its import purchasing patterns, lowering the share taken by any absolute level of imports from Algeria. Identifying the effects of independence on trade between a colony and its metropole (colonizer) requires controls for these three mechanisms and other forces that affect bilateral trade.

We compile a large data set on annual bilateral trade between almost every country in the world from 1948 and 2003. Employing a sequence of gravity-based specifications, we assess the impact of independence on colonial trade patterns. We estimate a semi-parametric specification in which years since independence is divided into seven intervals.

Independence effects are identified from within-dyad variation in trade. The influential work of Anderson and van Wincoop (2003) has stressed the importance of taking into account "multilateral resistance." With 50 years of data, 200 trading entities, the fixed effects approach to this problem would require estimating about 20,000 ($50 \times 200 \times 2$) year-specific importer and exporter effects. To avoid the computational difficulties of inverting such a large matrix, we propose a method of "'tetrads." In what can be thought of as an extension of the method of Anderson and Marcouiller (2002), we take the ratio of ratios of trade flows as a means of eliminating the multilateral resistance terms for exporters and importers. The tetrads method leads to slightly smaller independence effects than obtained in more standard gravity estimation. We show that this difference appears to arise because following independence former colonies had declining propensities to trade with all countries, not just the metropoles. That is their multilateral resistance seemed to increase.

Our paper relates to several strands in the literature. First, unlike the work cited in the opening paragraph, we will take as a given any changes in per capita incomes caused by changing *internal* institutions. Second, we also use *formal external* institutions (membership in regional trade agreements, GATT, and currency unions) as controls because our goal is to measure the effects of unobserved *informal external* institutions on trade. We chiefly have in mind the role of business and social networks put forward by Rauch (1999).

We also conduct two additional exercises to investigate the mechanisms that underlie the post-independence erosion of trade with the metropole. We exploit a data set showing the number of French nationals living in different countries which we consider as a proxy for the metropole's social and business network. We find the population of French expatriates in former colonies declines in much the same way as bilateral trade. The declining expatriate presence explains a substantial portion the diminished trade between France

and its former colonies. Hypothesizing that wars of independence will likely lead to more abrupt and permanent decline in bilateral business networks, we categorize independence effects into amicable and hostile separations and find that the latter are more destructive to trade—although the gap seems to disappear after 50 years.

The paper proceeds as follows. In the next section we describe our panel of bilateral trade and independence data. Section 3 specifies the gravity model and discusses the estimation issues. We present our results on the impact of independence on bilateral trade in section 4. Our analysis allows for asymmetric independence effects for imports and exports, colonial trade with metropole and third countries, and amicable and hostile separations. The concluding section summarizes and discusses potential welfare implications.

2 Data on trade and independence

The trade data used in this paper come from the International Monetary Fund's *Direction of Trade Statistics* (DOTS). the only data set containing a panel of bilateral trade that goes back as far as we need to study the main independence events of the twentieth century. It covers the 1948–2003 period, which is of crucial importance, since this includes pre-colonial years as well as immediate years following independence. The main alternative bilateral worldwide dataset available is the aggregation of UN's COMTRADE.[1] However, that data set begins in 1962 and therefore offers insufficient coverage of earlier independence events.

The data base we compiled is larger than most comparable work using DOTS. Our typical regression includes around 520,000 observations. Glick and Rose (2002) use DOTS over the 1948–1997 but have about 220,000 observations in their baseline specification

[1] An easy-to-use version of this dataset has been made available by Robert Feenstra and Robert Lipsey recently at (`http://www.internationaldata.org/`).

because they average bilateral exports and imports for each country-pair.[2] Baier and Bergstrand (forthcoming) also use DOTS (without averaging) but only at 5 years intervals (9 different years starting in 1960) which reduces the sample to 47,081 observations. For our study it is important to consider the direction of trade and also to have annual data.

There are very important features of this data that readers (and users) should be aware of. First, there are often two reported values for the same flow. This is because Country A may report its imports from B and Country B reports its exports to A. Some researchers average the two "mirror" flows while others give priority to the import-country report. These approaches make sense when all reporters can be thought of as equally reliable in their institutional measurement capability. Since this is unlikely for the set of countries in our data, we take a new approach, selecting the report of the higher income partner. When data is not reported or reported as 0 by the high-income partner, we take the flow reported by the other partner, if available.[3] When using exporter reported trade, we adjust for the fact that exports are reported FOB while imports are reported CIF, with a 10% difference in value, which is the actual mean margin revealed by countries reporting imports in both CIF and FOB values.

A second important feature of DOTS data is that the number of trade partners increases substantially over time. This arises because some countries are "created" (most French ex-colonies start reporting trade in 1960 for instance), and also because many (usually small and remote) countries enter the dataset as reporters along the way. A related feature of this trade data is the gradual filling of the trade matrix over time. While a very large share of observed trade flows are reported as zero in the first years, this share falls regularly over time.

Figure 1 represent those trends in data availability over our time frame using declared

[2]Baldwin (2006) argues that the procedure of averaging trade flowing in different directions conflicts with the theoretical foundations of gravity equations and leads to biases in empirical implementations.

[3]Although DOTS report both zero value flows and missing data, it is very hard in practice to distinguish missing values from zeros trade flows. Inspection of the data shows many examples with 0 reports that are clearly positive in reality. Hence we regard positive reports as more reliable than zeros.

imports in DOTS. The highest staircase represents for each year the maximum number of origin countries of imports. Starting at 90 in 1948, those figures grow up to 195 in 2003. For comparison purposes we also show the number of members of the United Nations. The fact that this line generally falls below the number of export origins is because many of the export origins are not independent countries (e.g. Ghana before 1957 and Reunion today). The lowest line shows that on average countries import from a relatively small share of the potential set of origins. The set of actual positive flows as percent of the potential flows (indicated at the beginning of each decade with triangles) is rising, going from less than a quarter to more than one half.

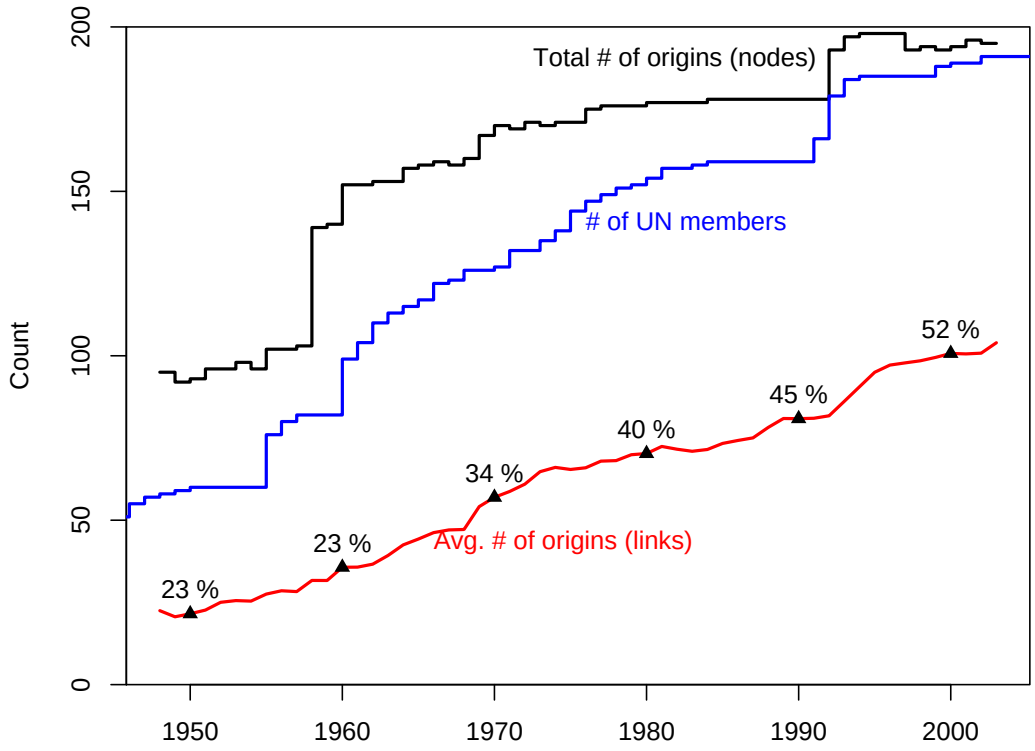


Figure 1: Growth in number of trade partners

The principal variable of interest in our study is the timing of independence events. We do not consider the end of a military occupation as being sufficient condition for an independence event. Thus France does not become independent from Germany in

1945 in our data set. Rather, independence arises following a *colonial* period which should involve long-term, non-wartime, civilian administration that includes significant settlement. Information on colonial episodes comes from a variety of sources but the main authority for independence dates was the CIA World Factbook.

In total, our data set comprises 253 country pairs with colonial histories, of which 33 remain current. Figure 2 displays the number of countries that gained independence since 1900, a total of 174. The two main colonizers in this sample, UK and France, are shown in red and blue, respectively, with all others grouped and represented as black bars. In this figure, the bulk of the black bar events in 1991 reflect the break up of the Soviet Union. We conduct robustness checks by omitting those countries since there is some controversy over whether they should be considered colonies of Russia.

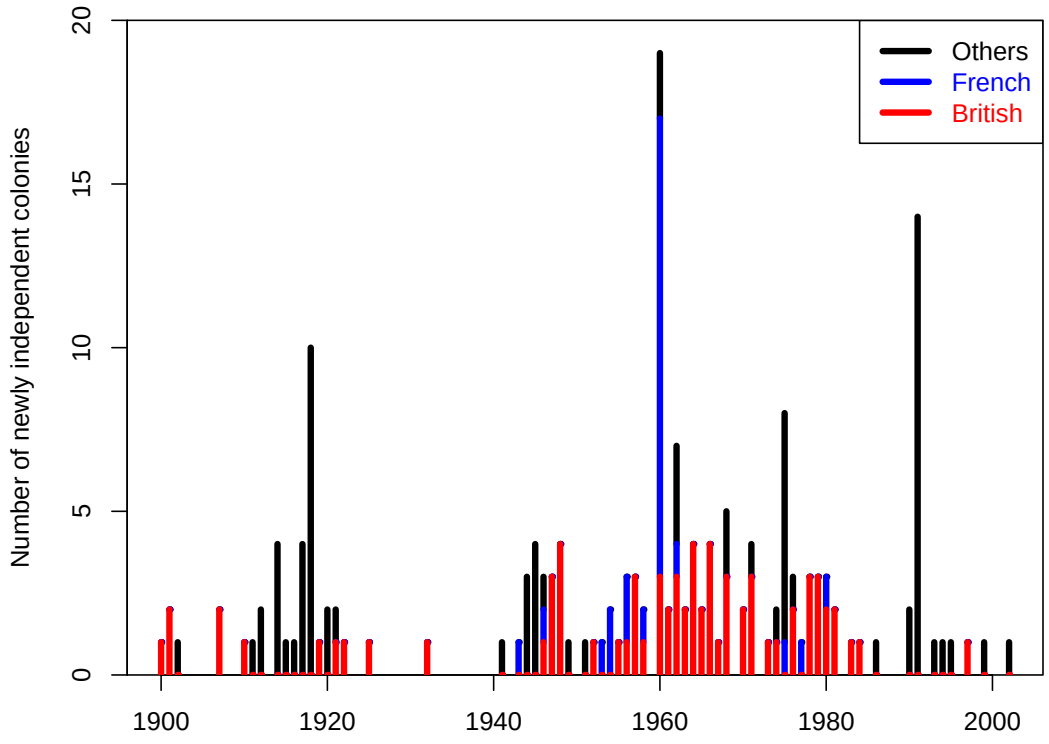


Figure 2: Independence events since 1900

3 Specification

In order to estimate the effects of independence, we need a benchmark for the amount of trade expected had independence not occurred. We will follow the common practice of modeling "expected" bilateral trade using the gravity model. Since it was initially formulated as an analogy with the gravity equation in physics, the gravity equation for trade was widely thought to lack economic foundations. In recent years, however, economists have derived formulations resembling the standard gravity equations from a variety of different structural assumptions.[4]

All the well-known empirical and theoretical formulations of the gravity equation can be represented in the following equation for the value of x_{ij}, the exports from supplying country i to importing country j:

$$x_{ij} = GS_iM_j\phi_{ij}. \tag{1}$$

In this equation, S_i and M_j are indexes of the attributes of supplier i and importer j, and G is a factor that does not across countries (but it might vary across time periods). Variation in bilateral trade intensity enters through ϕ_{ij}. We refer to S_i and M_j as monadic effects and ϕ_{ij} as the dyadic effect.[5]

The general approach to estimation is is take logs to achieve an equation that is linear in the parameters.

$$\ln x_{ij} = \ln G + \ln S_i + \ln M_j - \ln \phi_{ij}. \tag{2}$$

[4]Bergstrand (1985) derived a version of the equation using monopolistic competition. Anderson and van Wincoop (2003), basing their work on Anderson (1979), construct a symmetric gravity equation assuming national product differentiation and imposing a market clearing assumption. Both specifications work off constant elasticity of substitution between products. Eaton and Kortum (2002) show that a similar equation emerges even with homogeneous products as long under particular assumptions on international heterogeneity in productivity. Chaney (2005) derives his formulation using monopolistic competition between firms with heterogeneous productivity.

[5]The simplest theoretical derivation of this equation assumes identical preferences and no trade costs, yielding $\phi_{ij} = 1$, $S_i = Y_i$, $M_j = Y_j$, and $G = 1/Y_w$, where Y_i, Y_j and Y_w respectively denote GDPs of the exporter, importer and world.

Then the researcher chooses proxies for the monadic and dyadic effects and inserts an error term to represent remaining variation in trade. Two sets of problematic specification issues however arise, one with the measurement of monadic effects, and one with the specification of dyadic effects.

3.1 Monadic issues

In many empirical applications, which we will refer to as the "simple gravity" approach, the exporter and importer attributes are assumed to be given by $S_i = N_i^{\alpha_1} y_i^{\alpha_2}$ and $M_j = N_j^{\alpha_3} y_j^{\alpha_4}$, where N represents population and y is GDP per capita.[6] Plugging in these monadic effects we obtain,

$$\ln x_{ij} = \ln G + \alpha_1 \ln N_i + \alpha_2 \ln y_i + \alpha_3 \ln N_j + \alpha_4 \ln y_j - \ln \phi_{ij}. \tag{3}$$

The theoretical derivations cited in footnote 4 mainly predict $\alpha_1 = \alpha_2 = \alpha_3 = \alpha_4 = 1$, but it is conventional to not to constrain the parameters to their theoretical values. Theory also suggests that monadic factors are non-linear functions of the dyadic part of (1). This occurs for two main reasons. In the Anderson and van Wincoop (2003) derivation for instance, the basic reason why M_j depends on the whole set of dyadic variables and parameters is that the consumer's allocation of income depends on relative prices. The reason why the exporter's monadic effect S_i depends on the dyadic vector is the market-clearing constraint. This condition says that total sales in all markets from origin i should equal the supplier's aggregate output. Anderson and van Wincoop call the monadic terms involving the whole vectors of dyadic ϕ_{ij} "multilateral resistance indices." Their omission in equation (3) has the potential to cause severe mis-specification.

The solution proposed in Anderson and van Wincoop (2003) requires that a struc-

[6] Alternatively, one can substitute GDP for population which will result in different coefficient estimates but with identical fit.

tural model be used to specify the monadic effects as a function of GDPs and the dyadic vector. There are three problems. First, the results may depend on the structure. While there are multiple micro-foundations for equation (1), they differ in terms of the underlying monadic terms. Second, the monadic terms depend upon the whole dyadic vector including the "internal" distance of countries. Applications suggest that results are not robust to alternate ways of calculating "internal" distance. Third, the method presents computational difficulties.

An alternative estimates the monadic effects $\ln S_i$ and $\ln M_j$ in equation (2) using fixed effects for i and j. With a balanced panel of bilateral exports, a *within* transformation can be used for removing the monadic effects. Due to missing data, zeros, and variation in the number of partner trade for each reporting country, actual bilateral data sets are almost never balanced. Baltagi (1995, p. 160) points out that the within transformation does not work with unbalanced two-way panels. One should therefore use he least squares dummy variable (LSDV) method. Since DoTS has close to 200 trade entities and over 50 years of trade, the LSDV approach involves about 20,000 dummies. This presents computational difficulties of a different kind: programming is trivial but the execution requires a massive matrix inversion.

Baier and Bergstrand (2006) offer a third approach they call *bonus vetus* OLS. It is based on a linear approximation around a centering point and is implemented via demeaning transformations of the dyadic variables. We are not sure whether the approach generalizes to panel data. We are also concerned that the linearization is done around a point derived from assuming symmetric countries with symmetric transport costs. This would not seem to fit the world economy during the Post-War period.

We propose a new approach to estimation. It takes advantage of the multiplicative structure of equation (1) and then takes ratios of ratios to eliminate the monadic effects. This requires a set of *four* trading partners. For that reason, we call it the method of

tetrads.

Consider four countries indexed i, j, k, and ℓ. Using (1), the ratio of i's exports to j over its exports to importer k is given by

$$R_{i\{dk\}} = \frac{x_{ij}}{x_{ik}} = \frac{M_j \phi_{ij}}{M_k \phi_{ik}}. \tag{4}$$

We have canceled out G, and more importantly, S_i, the exporter fixed effect, via this transformation, which is the same as the one adopted by Anderson and Marcouiller (2002) in their study of the effects of insecurity on bilateral trade. They used the USA as the reference importer k.

The M_j/M_k ratio remains problematic for estimation however, and we now need an expression parallel to (4) containing M_j/M_k that we can divide $R_{i\{jk\}}$ by in order to cancel out these remaining monadic terms. This can be achieved by picking a reference exporter ℓ and calculating the corresponding ratio to the same pair of importers:

$$R_{\ell\{jk\}} = \frac{x_{\ell d}}{x_{\ell k}} = \frac{M_j \phi_{\ell j}}{M_k \phi_{\ell k}}. \tag{5}$$

Taking the ratio of ratios we can define the tetradic term

$$r_{\{i\ell\}\{jk\}} = \frac{R_{i\{jk\}}}{R_{\ell\{jk\}}} = \frac{x_{ij}/x_{ik}}{x_{\ell j}/x_{\ell k}} = \frac{\phi_{ij}/\phi_{ik}}{\phi_{\ell j}/\phi_{\ell k}}, \tag{6}$$

where the tetrad comprises two exporters, $\{i\ell\}$, and two importers, $\{jk\}$. Taking logs, we have

$$\ln r_{\{i\ell\}\{jk\}} = \ln \phi_{ij} - \ln \phi_{ik} - \ln \phi_{\ell j} + \ln \phi_{\ell k}. \tag{7}$$

We now specify ϕ_{ij} to show how the $r_{\{i\ell\}\{jk\}}$ can be used estimate the parameters determining bilateral trade intensity. In the theoretical derivations $\phi_{ij} = \tau_{ij}^{-\theta}$, where τ

denotes trade costs and θ corresponds to different primitives in different models.[7] Trade costs in gravity equations are invariably specified as function of distance, D_{ij}, and bilateral dummy variables, B_{ij}, that capture various types of trade-facilitating linkages: $\tau_{ij} = D_{ij}^{\delta} \exp(-[\beta B_{ij} + u_{ij}])$. The u_{ij} in this equation represents unobserved bilateral linkages. The log dyadic effect is given by

$$\ln \phi_{ij} = \theta(-\delta \ln D_{ij} + \beta B_{ij} + u_{ij}) \tag{8}$$

Plugging this expression back into equation (7), we have

$$\ln r_{\{o\ell\}\{dk\}} = -\theta\delta \ln [\ln D_{ij} - \ln D_{ik} - \ln D_{\ell j} + \ln D_{\ell k}] + \theta\beta(B_{ij} - B_{ik} - B_{\ell k} + B_{\ell k}) + \theta(u_{ij} - u_{ik} - u_{\ell k} + u_{\ell k}). \tag{9}$$

The sum involving the B dummies can take on five possible values: 2, 1, 0, -1 and -2, depending on the pattern of linkages within the tetrad. Thus one can use the $r_{\{i\ell\}\{jk\}}$ and the other ratios of ratios for each tetrad to estimate $\theta\delta$ and $\theta\beta$.

Note that our approach can be seen as a synthesis of existing ratio approaches that did take advantage of the multiplicative functional form of the gravity equation to get rid of *either* the exporters' (Anderson and Marcouiller, 2002) or importers' (Head and Mayer, 2000, and Martin et al., 2005) fixed effects. Combining the two approaches enables to obtain a specification *free of any monadic term*. Note also that our approach generalizes very easily to richer monadic terms, in particular when the sample consists of a panel of country pairs over time (as is the case here) or when there is an additional industry dimension in the data set.

Two issues with applying the method. First, one needs to select the reference countries k and ℓ in order to do the tetrad calculations.[8] Here, we will proceed using three different

[7] In Anderson and van Wincoop (2003) and monopolistic competition derivations, $\theta = \sigma - 1$. In Eaton and Kortum (2002) θ is the Frechet distribution shape parameter for cross-industry productivity variation. In Chaney θ is the Pareto shape parameter for cross-firm productivity variation.

[8] Generating all possible tetrad combinations would involve dealing with literally billions of observa-

sets of country pairs as reference countries. In related estimation methods, Anderson and Marcouiller (2002) and Martin et al. (2005) take the United States as a reference point. In our first country pair we take the two big colonizers over our sample, France and the United Kingdom. We also consider small open economies without much in the way of colonial histories, Canada and Switzerland. Last we consider as reference points the United States and Germany.

A second issue concerns the independence of the observations. As represented in (9), the error terms $u_{\ell k}$, u_{ik}, and $u_{\ell j}$, appear repeatedly across observations. Indeed, $u_{\ell k}$ is contained in each observation. We will use year dummies to account for $u_{\ell k}$ but are still left with correlated errors as a consequence of u_{ik}, and $u_{\ell j}$. This issue will need to be taken into account in estimating standard errors in a future version of this paper.

3.2 Dyadic issues

Another concern in this study is that the vector of linkage variables, B_{ij}, is necessarily incomplete. This means unobserved dyadic (ij) linkages will contaminate the error term. That is, even if we control for importer and exporter effects there are unobserved bilateral influences on both trade and the decision to become independent. With panel data, one can remove the unobserved but fixed component of bilateral linkages using dyadic (country-pair) fixed effects. This identifies the effect of independence based on time series variation. We will therefore also use this type of specification, and follow Baier and Bergstrand (forthcoming) and Glick and Rose (2002) who underscore the importance of capturing policy changes using time series rather cross-sectional variation. To sum up, we will use three different specifications:

1. *A simple gravity specification* where equation (3) is estimated approximating monadic fixed effects by population and GDP per capita.

tions in our case.

2. *A dyadic gravity specification*, where a directional country-pair fixed effect captures all dyadic characteristics that are constant over time in (3).

3. *A tetradic gravity specification*, where (9) is estimated which obviates the need to control for any importer and exporter fixed effects, which is the source of the specification problem in (3). An ij fixed effect is introduced here to account for time invariant unobservables.

Finally we need to specify the set of observable linkages between country pairs over time in our sample. Using abbreviations, we specify the linkages vector as

$$\mathbf{B}_{ij} = \text{Lang}_{od}, \text{Colony}_{od}, \text{RTA}_{od}, \text{Legal}_{od}, \text{GATT}_{od}, \text{CU}_{od},$$

and therefore control for common language, the effect of having had a colonial linkage at some point, belonging to a common regional trade arrangement, having common legal origins in national law, belonging to GATT/WTO, or to a currency union. We additionally employ year indicator variables to capture changes in average trade propensities over time.

To measure the effect of independence, we could employ a dummy variable indicating independence. Given that we are explicitly capturing colonial history, the interpretation of this variable is the average (over time) discount or premium associated with gaining independence. Rather than use a single variable to capture independence, we employ six indicators variables corresponding to years subsequent to independence: 1–3, 4–6, 7–11, 12–19, 20–29, 30–49 and 50 or more years. There are two reasons for this choice. First, if networks underlie the reason why countries with colonial ties trade more with each other, we would expect a gradual decline in these networks over time once independence is achieved. Indeed, it could take a generation for the full effects of independence to be felt as individuals raised in colonial times cease to participate in trading activities.

A second reasons for considering separate interval effects is a practical one. The use of dyadic fixed effects forces identification based on time-series variation within dyads but there is very limited information on pre-independence trade (262 positive trade values). With the time intervals, we can compare how trading within dyads declines using the more plentiful post-independence trade flow information.

4 Results

Before proceeding to the regression analysis, it is instructive to examine two cases. Figure 3 shows Ivorian and Ghanaian trade patterns with France and the United Kingdom. The figure reports the ratio of the two countries' trade to France and the UK as well as the ratio of French to UK GDP. The Ivory Coast was a colony of France until 1960 and Ghana a colony of the UK until 1957. Ghana and the Ivory Coast make a useful case study since they are adjacent, comparable in size, and yet were colonized by different countries. Differences in distances between colonies and metropoles seem negligible. Furthermore, changes in multilateral resistance indices should be fairly similar.[9] If colonial ties did not influence trade, we would expect that the ratio of exports to France to exports to the UK (shown with x-marked lines) to be approximately equal to the relative size of their markets. Similarly, relative imports from the two sources would be equal to their relative production. Using GDP as the measure of relative market and production size, we would expect all four trade lines to be close to the dashed relative GDP line. Instead, we see large gaps on both sides.

France's former colony Ivory Coast trades much more with its former metropole than France's relative size would imply. The ratio of export ratios to GDP ratios is 82.5 in the year it became independent. By 2003, the ratio had fallen to 4.0. Its imports also begin

[9] A surge in Nigerian GDP would have approximately the same effect on Ghana and Ivory Coast, whereas a surge in German GDP would have similar effects on the UK and France.

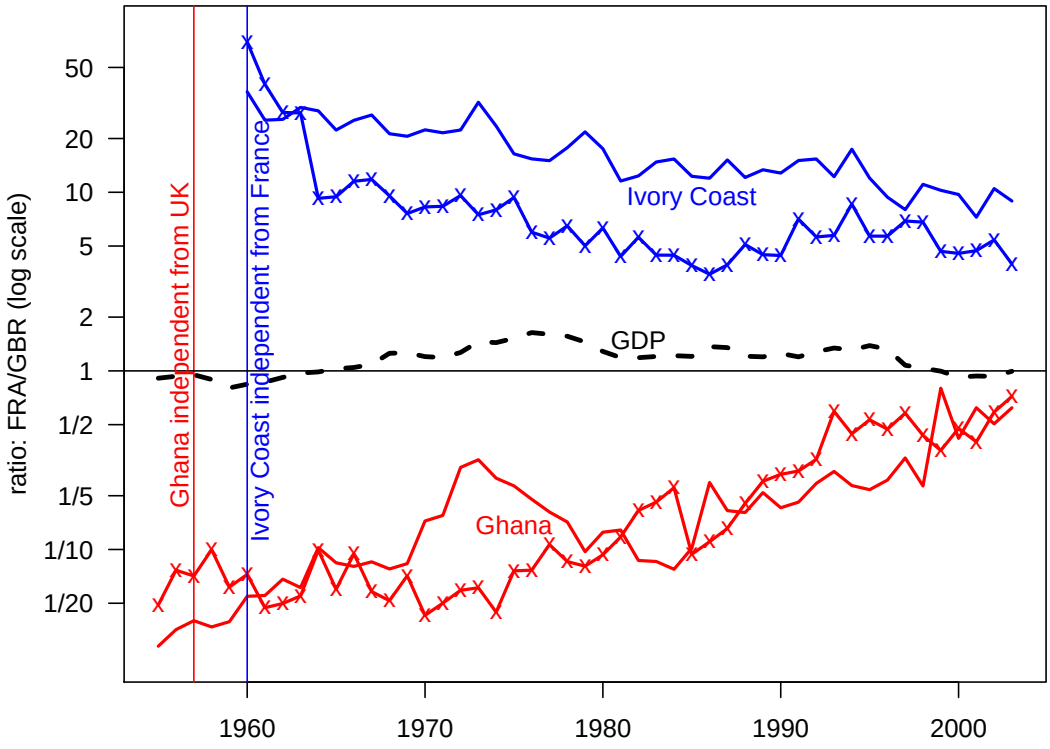


Figure 3: Trade of Ivory Coast and Ghana with their respective metropoles

heavily biased towards France (43.4) and, while the import bias also declines, it persists at 9.0 in 2003. On the other hand, Ghanaian trade exhibits bias towards the UK. The ratios of relative trade to relative GDP are 13.4 (exports) and 23.8 (imports) in 1957. Their decline in recent years has been remarkable and the bias has fallen to 1.4 (exports) and 1.6 (imports). Even these numbers should be seen as impressive: Forty-six years after independence Ghana still exports about 50% more to its former ruler than a simple gravity model would predict. Figure 3 portrays an erosion of colonial trade subsequent to independence. To see if this picture extends generally, we turn to the regression results.

Tables 1 and 2 contain estimation results. We report results for five specifications and present estimates of the "control" variables in the first table and the independence variables in the second table. The first two columns portray results where origin and destination population and per capita GDP proxy for origin-specific and destination-specific effects. In the ensuing three columns, these effects are eliminated by creating tetradic trade flows. This requires choosing reference countries. To investigate the robustness of the method, we employ three country pairs—Great Britain-France, the United States-Germany, and Switzerland-Canada—as the reference countries (designated k and l in the previous section) and report estimates for all three. All specifications include year dummies that are not reported in the table.

The first specification does not include dyadic fixed effects and allows us to compare results for our large panel to those in the literature. The results, listed in column (1), show that increases in origin- and destination-country per capita income and population promote bilateral trade with elasticities close to one (as predicted in most theoretical derivations). Distance between partners reduces trade and and the estimated elasticity is very close to one (the typical finding). The linkages variables—colonial history, common language, GATT membership, RTAs, and currency union—increase trade and all estimates are highly statistically significant (we cluster standard errors at the dyadic

level).

Interestingly, the pooled OLS coefficients for RTA and GATT are higher than in published studies. Rose (2004) tends to find negative and insignificant GATT effects in his study of 178 countries over the 1948–1998 period when dyadic effects are excluded. The number of observations in his study, 234,597 in the baseline regression, are less than half the 520,236 observations in our analysis. Likewise, Baier and Bergstrand (forthcoming) obtain RTA coefficients of 0.27 for pooled OLS, considerably smaller than our 0.68 estimate. They use 1960, 1970, 1980, 1990, 2000 data and 96 countries and thus only have 47,081 observations.

Column (2) introduces dyadic fixed effects and thus estimates are based on time-series variation within dyads. Linkage variables that do not vary over time (distance, shared language, colonial history, and share legal origins) are captured by the dyadic fixed effects. In comparison to the column (1) pooled OLS estimates, the coefficients fall but remain statistically significant. The GATT effect of 0.16 is almost the same as the 0.15 estimate that Rose obtains when he employs dyadic fixed effects. The RTA estimate of 0.63 is very close to Baier and Bergstrand's estimate of 0.68.[10] The effect of currency unions, 0.36, is somewhat lower than the 0.65 found in Glick and Rose (2002).

In the final three specifications, the tetrad method removes all (time-varying) monadic effects (e.g., population, per capita income, and multilateral resistance terms). We also employ tetradic fixed effects which eliminate non-time varying linkage variables. We report standard errors but consider them to suffer from severe downward bias because we do not know how to adjust them to take into account the correlations induced by using repeat trade observations from the reference countries. Consequently, we do not use "a", "b", and "c" to denote significant differences from zero.

Looking across columns (3)–(5), regressions that use Great Britain-France, the United States-Germany, and Switzerland-Canada as reference countries, we find that the signs of

[10]Their estimate falls to 0.46 when monadic fixed effects are introduced.

Table 1: Gravity Regression Control Variables

Model :	(1)	(2)	(3)	(4)	(5)
ln Pop, origin	0.859^a	0.235^a			
	(0.006)	(0.047)			
ln Pop, dest	0.756^a	0.923^a			
	(0.006)	(0.040)			
ln GDP/Pop, origin	1.017^a	0.669^a			
	(0.007)	(0.015)			
ln GDP/Pop, dest	0.872^a	0.611^a			
	(0.007)	(0.014)			
ln Dist (avg)	-0.984^a				
	(0.013)				
Shared Language	0.398^a				
	(0.033)				
Colonial History	1.410^a				
	(0.448)				
Shared Legal Origins	0.343^a				
	(0.025)				
RTA	0.695^a	0.630^a	0.456	0.544	0.336
	(0.046)	(0.032)	(0.022)	(0.029)	(0.023)
Both GATT	0.159^a	0.161^a	0.20	0.306	0.162
	(0.019)	(0.016)	(0.029)	(0.031)	(0.029)
Currency union	0.770^a	0.364^a	0.462	0.163	0.105
	(0.134)	(0.108)	(0.049)	(0.049)	(0.137)
Tetrads:			GBR,FRA	USA,DEU	CHE,CAN
Fixed Effects:	None	Dyads	Tetrads	Tetrads	Tetrads
N	521849	524820	562463	551883	528261
R^2	0.616	0.393	0.091	0.027	0.08
RMSE	1.894	1.242	1.459	1.508	1.57

Note: Standard errors in parentheses with ^{a}, ^{b} and ^{c} respectively denoting significance at the 1%, 5% and 10% levels. Standard errors are corrected to take into account correlation of errors within dyads.

estimated coefficients on RTA, GATT, and currency union are the same as the those listed in column (2) but the magnitudes vary a bit. The RTA and currency union estimates are smaller than those shown in column (2) whereas the estimates of GATT membership are slightly larger. While the R^2s in the tetrad regressions are low, less than 0.10, they yield reasonable estimates on time-varying linkage variables.

Table 2 lists estimates of the seven independence variables corresponding to trade at increased intervals since liberation: 1–2 years, 3–6 years, 7–11 years, 12–19 years, 20–29 years, 30–49 years, and 50+ years. Column (1) exhibits the pooled OLS results. Since Colonial History captures the effects of ever being a colony, the independence variables indicate the discount or premium of independence in relation to the 1.41 coefficient on Colonial History listed in Table 1. For the newly independent (1–2, 3–6 years), independence is associated with *higher* trade while subsequent interval estimates are statistically insignificant. Evidently, trade between colony and colonizer shortly after independence was higher trade than colonial trade for existing colonies and colonies that were independent for longer periods of time. Of course, it may be the case that these newly independent countries' trade with their colonizer was higher than average *before* independence as well. For this reason, we prefer the estimates in the ensuing columns that use dyadic- or tetradic fixed effects because it purges observation of average country-pair trade and estimates are based on time-series changes in trade.

Column (2) reveals that with dyadic fixed effects, independence is shown to have negative effects that grow over time. In this regression, the reference trade level is trade that occurs in the year of independence or before. In column (2), effects beginning 12–19 years subsequent to independence and later periods differ significantly from zero. The effects grow until the 30–49 year interval and then appear to flatten out.[11] Based on the column (2) estimate, colonial trade of countries that are independent for 30–49 years falls

[11] We experimented with expanding the number of periods to 50-99 years and 100+ years and found the "flat" section persists.

Table 2: Independence Effects on bilateral trade flows

Model :	(1)	(2)	(3)	(4)	(5)
1–2 years	0.734^c	-0.058	-0.038	-0.138	-0.385
	(0.446)	(0.205)	(0.041)	(0.142)	(0.160)
3–6 years	0.812^c	-0.070	-0.029	-0.574	-0.268
	(0.448)	(0.213)	(0.043)	(0.146)	(0.170)
7–11 years	0.734	-0.189	-0.128	-0.734	-0.435
	(0.449)	(0.220)	(0.048)	(0.153)	(0.182)
12–19 years	0.40	-0.450^c	-0.218	-0.913	-0.317
	(0.450)	(0.231)	(0.051)	(0.168)	(0.192)
20–29 years	0.184	-0.730^a	-0.447	-1.166	-0.523
	(0.450)	(0.228)	(0.053)	(0.170)	(0.195)
30–49 years	-0.334	-1.112^a	-0.753	-1.649	-0.974
	(0.457)	(0.233)	(0.056)	(0.171)	(0.204)
50+ years	-0.961^b	-0.979^a	-0.919	-1.318	-0.879
	(0.455)	(0.290)	(0.072)	(0.189)	(0.275)
Tetrads:			GBR,FRA	USA,DEU	CHE,CAN
Fixed Effects:	None	Dyads	Tetrads	Tetrads	Tetrads
N	521849	524820	562463	551883	528261
R^2	0.616	0.393	0.091	0.027	0.08
RMSE	1.894	1.242	1.459	1.508	1.57

Note: Standard errors in parentheses with ^{a}, ^{b} and ^{c} respectively denoting significance at the 1%, 5% and 10% levels. Standard errors are corrected to take into account correlation of errors within dyads.

to 33% of its independence-year level ($e^{-1.112}$).

Columns (3)–(5) show the tetrad results and corroborate the findings of steady declines in trade associated with independence that cumulate over an extended period. The point estimates vary somewhat depending on the reference countries, being larger than the column (2) estimates for USA-Germany as references and smaller in the case of Switzerland-Canada and Britain-France as reference countries. As mentioned previously, the standard errors are almost certainly downward biased. The Britain-France referenced estimates exhibit the smallest standard errors. However, they might be the most biased since, as the largest metropoles, their trade is associated with a large number of independence events that are repeatedly incorporated as a consequence of the method of creating the tetrads. This is not the case for Switzerland and Canada and column (5) reveals much higher standard errors for estimated independence effects. Overall, the table depicts a continual erosion trade is consistent with the hypothesis that colony networks are deteriorating.

Previous research has shown that immigrants are associated with increased trade with their countries of birth (see Gould (1994) and Head and Ries (1998) for early evidence). The interpretation of this result is that immigrants bridge "informational" barriers to trade. Our results may result from expatriates returning to their home countries after independence and severing network linkages. We are able to directly test this proposition by compiling time-series information on French nationals living abroad made available by the French Ministry of Foreign Affairs.[12] The data covers expatriates in 153 countries over the 1965–2003 period. French living abroad in colonies were quite substantial. For instance, in 1965, there were about 137,000, 90,000, 60,000 French expats in Morocco, Algeria and Madagascar, respectively.

In the first specification in Table 3 we use a gravity model framework to examine the

[12]We are very grateful to Bernard Gentil for making this data available to us, and helping us with the extraction and understanding of this data.

effects of independence on expatriate populations. The specification, as well as all others in the table, includes fixed effects for dyads (France and partner) and years. The results reveal that partner population, per capita GDP, and GATT membership are associated with more French expats, although only per capita and GATT are significant. Currency union enters insignificantly.[13] As might be expected, the number of French living in colonies falls steadily after independence. French expat data is only available after independence so here the reference group is immigrant levels 1–2 years since independence. Similar to what we saw with trade, the effects cumulate over time, peaking 30–49 years after independence.

Columns (2) and (4) of Table 3 show independence effects for French exports and exports, respectively. The results are comparable to those for the full sample shown in Tables 1 and 2, although the control variables are often insignificant and population enters with a perverse negative sign in the import regressions. Comparing the independence effects shown in columns (2) and (4), we see that independence reduces French imports to a greater extent than French exports. The interesting results are contained in columns (3) and (5) where we add expats to the trade regressions. As found in other studies, people living outside their country of birth are associated with more trade.[14]. However, since expat populations fall with independence, adding this variable to the specifications accounts for a large portion of the independence effects. Specifically, the coefficients on the"years after independence" variables fall by as much as one half once we include immigrants. We consider this strongly suggestive evidence that the decline in trade subsequent to independence relates to the erosion of trade networks which occurs over an extended period of time.

We observe that independence reduces colony trade with the metropole. But how

[13]In unreported gravity regressions without dyadic fixed effects, we observe that expats tend to follow a very strong gravity pattern, with the size of the host country, the ex-colonial status, distance and common language all having very strong and expected effects.

[14]The coefficient on French expats is very strong, and in line with existing studies on the topic (Rauch and Trindade, 2002, Wagner et al. 2002 for instance)

Table 3: French Expatriates and Trade

Model :	(1)	(2)	(3)	(4)	(5)
Depvar:	Expats	$\ln x_{\mathrm{FRA},j}$		$\ln x_{i,\mathrm{FRA}}$	
ln Pop, partner	0.333	0.530^a	0.413^a	-0.867^b	-0.973^b
	(0.257)	(0.195)	(0.159)	(0.393)	(0.383)
ln GDP/Pop, partner	0.434^a	0.724^a	0.577^a	0.825^a	0.685^a
	(0.086)	(0.072)	(0.065)	(0.088)	(0.082)
RTA	0.185	0.202^c	0.139	-0.077	-0.138
	(0.160)	(0.119)	(0.106)	(0.171)	(0.161)
Both GATT	0.173^a	0.078	0.021	0.083	0.028
	(0.066)	(0.074)	(0.074)	(0.149)	(0.149)
Currency union	-0.004	0.079	0.000	-0.132	-0.132
	(0.120)	(0.114)	(0.085)	(0.147)	(0.148)
3–6 years	-0.233^c	-0.031	0.052	-0.338	-0.267
	(0.140)	(0.097)	(0.084)	(0.539)	(0.551)
7–11 years	-0.356^a	-0.225^b	-0.106	-0.293	-0.182
	(0.092)	(0.091)	(0.091)	(0.513)	(0.523)
12–19 years	-0.462^a	-0.267^a	-0.113	-0.705	-0.554
	(0.092)	(0.083)	(0.092)	(0.576)	(0.588)
20–29 years	-1.015^a	-0.613^a	-0.274^b	-1.037	-0.711
	(0.154)	(0.109)	(0.107)	(0.641)	(0.654)
30–49 years	-1.536^a	-0.907^a	-0.394^a	-1.237^c	-0.746
	(0.227)	(0.156)	(0.131)	(0.638)	(0.655)
50+ years	-1.335^a	-1.209^a	-0.765^a	-1.018	-0.593
	(0.273)	(0.195)	(0.153)	(0.883)	(0.865)
ln (1+ Expats)			0.336^a		0.326^a
			(0.043)		(0.060)
N	5010	4998	4998	4975	4975
R^2	0.317	0.807	0.830	0.613	0.629
RMSE	.492	.477	.448	.787	.77

Note: Standard errors in parentheses with ^{a}, ^{b} and ^{c} respectively denoting significance at the 1%, 5% and 10% levels. Standard errors are corrected to take into account correlation of errors among dyads.

about colonial trade with other countries? There are a couple of reasons to expect that trade might *increase* with other countries. First, the deterioration of trading networks with the metropole may have diverted trade to other countries. Second, the metropole may have instituted commercial policies that limited the ability of colonies to trade with third countries. To test for third country effects, we code independence variables to "turn on" for colonial trade with non-metropole trading partners (RoW countries).[15] Table 3 indicates the effects of independence may vary depending on the direction of the trade flow and consequently, we allow for effects to vary depending on whether it is an export or import of a colony. Since the tetrad method eliminates monadic effects, which include a colony's average trade propensity in a given year, it is not suitable to this specification and instead we augment the single trade flow, dyadic, fixed-effect specification used in column (2) of Tables 1 and 2.

The estimates on the control variables hardly change at all when we add the additional variables capturing trade effects of independence and we do not report them. We construct Figure 4 to portray the estimates of the 28 independence variables (imports and exports, seven intervals, and trade with metropole and RoW). The figure shows each of the seven independence intervals as a step function and identifies one-standard deviation around the point estimate. The dashed lines show colonial trade (imports and exports) with non-metropole (RoW) countries and solid lines represent trade with the metropole. The left axis shows the coefficient estimate and the right axis converts the estimate to the ratio of post-independence trade to pre-independence trade.

The figure reveals that, contrary to expectations, colonial trade with RoW countries *fell* after independence. Colonial exports tended to fall slightly more than imports with the peak fall occurring in the 30–49 year interval with trade declining to roughly two-thirds of pre-independence levels. The lower two lines reveal that, as established in column

[15] A number of countries were colonized by a succession of metropoles (Great Britain and then Australia, for instance). In these cases, the RoW dummy variables does not turn on until the colony is free from the final metropole.

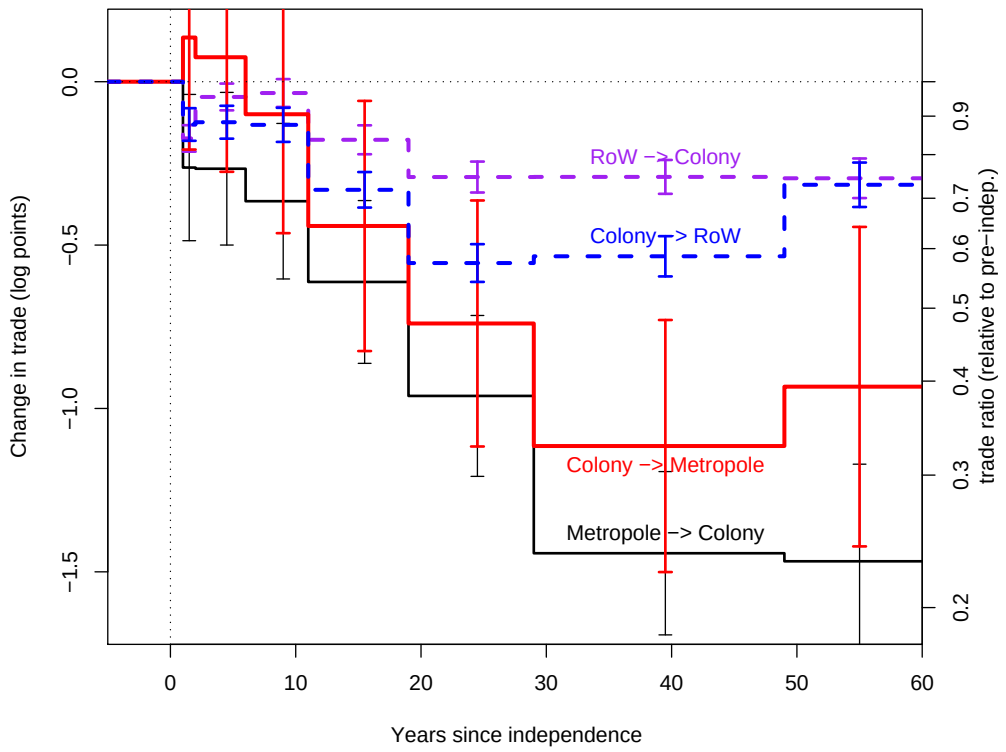


Figure 4: Independence effects on colonial trade with metropole and Rest of World (RoW): Imports and Exports

(2) of Table 2, a much greater decline in trade with the metropole. Colony imports from the metropole fell more than colony exports to the metropole, a result at variance from those for France reported in Table 3. The standard errors are fairly high, however, and an F-test does not reject the hypothesis equality for estimates for imports and exports for each time interval.

Some independence events were associated with hostilities and civil conflict and others were amicable.[16] We might expect hostile independence events to cause more trade disruption than amicable ones. We test this proposition by categorizing the events into peaceful and hostile. [17]. Of the 220 independence events in our data set, we categorized 154 as amicable and 66 as hostile. However, if we limit the sample to events that provide times series information in our period of study, those occurring after 1900, we have 131 amicable and 43 hostile separations.

Figure 5 presents estimated independence coefficients along with their standards errors. The top panel shows colony exports and the lower panel colony imports. The first result to note is that hostile separations lead to larger declines in trade with the metropole than amicable separations, with the effect larger for exports than imports. The dynamics are a bit different between hostile and amicable separations as well. Hostile separations have larger immediate effects (1–2 and 3–6 years after independence), again being most pronounced for exports to metropole. A long period of time after independence, 50 years or more, the colony trade effects appear to converge at about 20% of pre-independence trade. Examining trade with RoW, we see that hostile separations seems to have *smaller* trade reducing effects than amicable separations. Perhaps some of the trade reduction with metropole associated with hostile separations is being diverted to other countries. Due to the paucity of data on hostile separations, the estimates are measured imprecisely

[16]For example, the Algeria's independence from France in 1962 involved much bloodshed whereas Morocco's 1956 independence was peaceful.

[17]We started with information listed in the "Territorial Change" database (Tir, Schafer, and Diehl) from the Correlates of Wars project and used the internet (the CIA factbook, BBC country briefs, and Wikipedia) to complete the data set

Figure 5: Amicable versus hostile separations: exports

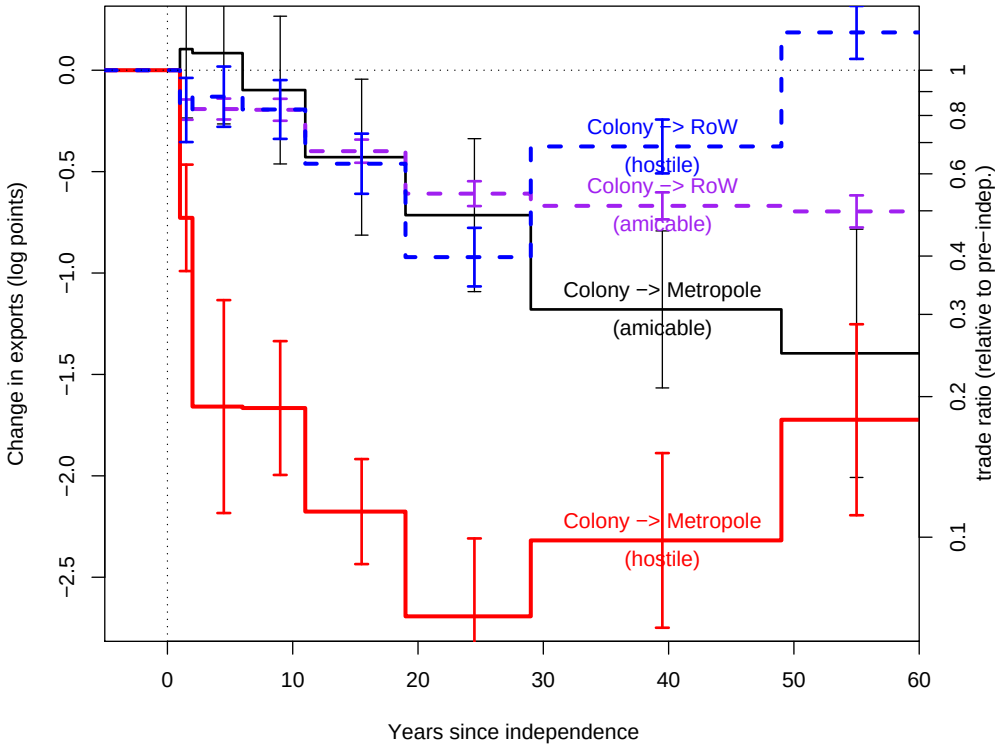
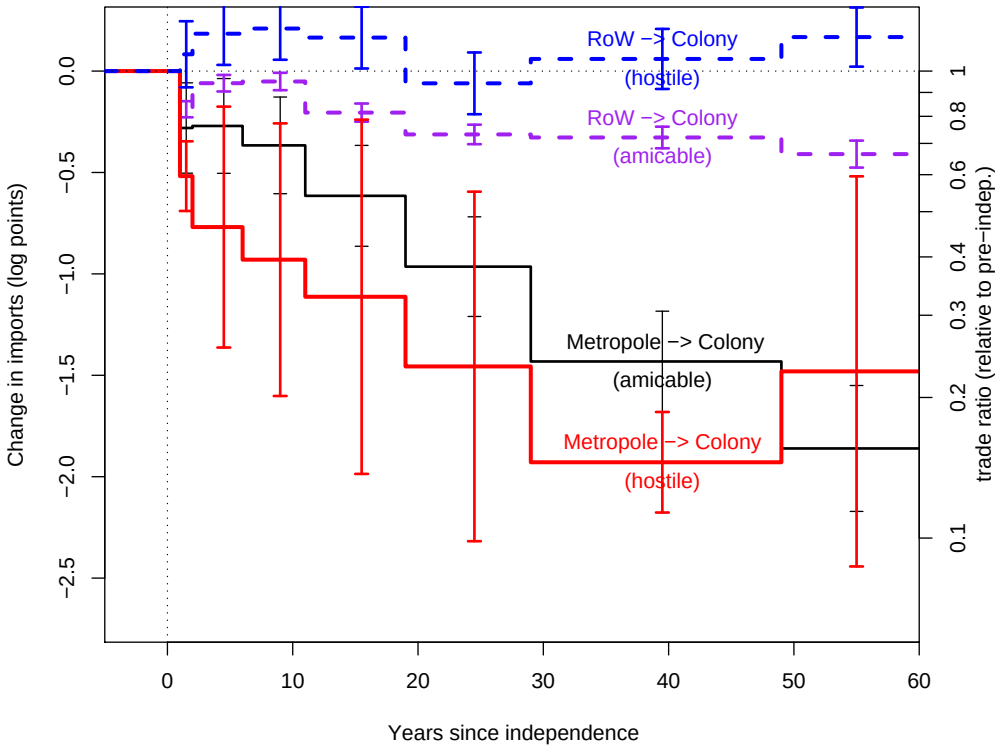


Figure 6: Amicable versus hostile separations: imports



and the standard errors are large: Differences tend not to be significant and should not be considered conclusive.

5 Conclusion

We find that independence reduces colonial trade significantly, overall and particularly with the metropole. On average, trade between a colony and its metropole is reduced by two-thirds after 30 years of independence. This deterioration is even more pronounced in the case of hostile separations.

If the newly established government of an independent country implemented trade-restricting commercial policies, we would expect an immediate and permanent reduction in trade. The observed steady erosion in trade subsequent to independence over an extended time period suggests other forces at work. In particular, trade networks embodied in individuals with knowledge of trading opportunities may have deteriorated over time. Our evidence showing that decreases in the number of French living abroad explain a large amount of the post-independence trade deterioration supports this view.

The observed erosion in colonial trade can be explained by higher trade costs associated with commercial policy and the deterioration of trade networks. Higher trade costs reduces welfare via two channels. First, consumers pay higher prices for imports. Second, producers will have less access to markets (referred to as market potential in the economic geography literature). Countries like Algeria that did not have alternative sources of demand available, which means that their relative market potential must have fallen with respect to countries that did not experience independence during that period. In New Economic Geography models (Fujita, Krugman, and Venables, 1999) a big loss in market potential can cause a substantial reduction in the earnings of the affected workers. Our future research will endeavor to measure the welfare costs associated with decreased trade following colonial independence.

Appendix: Gravity control variables

The chief gravity variables are the monadic variables measuring size and development of the each country and dyadic variables measuring their physical, economic, and cultural separation.

GDPs and populations come from the World Bank's World Development Indicators (WDI). Note that in accordance to trade flows, GDPs are not deflated, another classical error in gravity equations stigmatized by Baldwin (2006). Note also that the WDI dataset does not include Taiwan although trade data does. We use Taiwan national data to complement. WDI also has the issue of starting in 1960 and sometimes does not keep track of countries that ceased to exit, or changed definitions. Typically, WDI has Russian GDP start in 1989. In order to correct both problems, we complement WDI with population estimates provided by Angus Maddison (`http://www.ggdc.net/maddison/Historical_Statistics/horizontal-file_10-2006.xls`). Furthermore, we also use the 1948-1992 GDP estimates collected by Katherine Barbieri and made available by the Correlates of War project (`http://www.correlatesofwar.org/`).

RTAs are constructed from three main sources: Table 3 of Baier and Bergstrand (forthcoming) supplemented with the WTO web site (`http://www.wto.org/english/tratop_e/region_e/summary_e.xls`) and qualitative information contained in Frankel (1997). The data on RTAs starts with EU6 in 1958 and ends with a set of bilateral agreements in 2000. GATT/WTO membership of different countries over time comes from the WTO web site.

The data on Currency Unions comes from the dataset assembled by Glick and Rose (2002). It includes all currency unions arrangement under the definition adopted by those authors: "essentially that money was interchangeable between the two countries at a 1:1 par for an extended period of time, so that there was no need to convert prices when trading between a pair of countries." which they measure using IMF annual reports on

exchange rate arrangements as their primary source.[18] The original Currency Unions information covers the years 1948 to 1997. We extend it assuming that CUs active in 1997 stay so until 2003, and adding the eurozone (since 2002) to the list of CUs.

Finally bilateral distances, common language and contiguity come from the CEPII distance database (`http://www.cepii.fr/anglaisgraph/bdd/distances.htm`). There are several distances and common language measures proposed. In terms of distance we use the arithmetically-weighted one, which weights great circle distance between any two cities of the two countries by the population of those two cities. In terms of common language, we use the shared official language dummy.

Data on common legal origins of the two countries (whose influence trade is considered by Guiso et al., 2005) is available on Andrei Shleifer's website (`http://post.economics.harvard.edu/faculty/shleifer/Data/qgov_web.xls`).

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[18] We are very grateful to José de Sousa, who kindly made available to us his own treatment of the data, essentially rearranging and "squaring" the original data provided by Andrew Rose.

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