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Abstract[1]

This paper shows that bank linkages have a positive effect on international trade. A global banking network (GBN) is constructed at the bank level, using individual syndicated loan data from Loan Analytics for 1990-2007. Network distance between bank pairs is computed and aggregated to country pairs as a measure of bank linkages between countries. Data on bilateral trade from IMF DOTS are used as the subject of the analysis and data on bilateral bank lending from BIS locational data are used to control for financial integration and financial flows. Using a gravity approach to modeling trade with country-pair and year fixed effects, the paper finds that new connections between banks in a given country-pair lead to an increase in trade flow in the following year, even after controlling for the stock and flow of bank lending between the two countries. It is conjectured that the mechanism for this effect is that bank linkages reduce export risk, and four sets of results that support this conjecture are presented.

JEL Classification: F10, F15, F34, F36
Keywords: International Trade, Financial Networks, International Banking, Gravity, Export risk

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1 Introduction

The global financial crisis demonstrated that connections between banks can be fragile and dangerous. Not surprisingly, much of the recent literature on banking linkages or networks has focused on the risk and contagion aspects of such connections,[2] with hardly any attention devoted to the benefits of bank linkages beyond the obvious risk-sharing effects. In this paper we demonstrate that there are positive externalities associated with bank linkages by showing that, even when controlling for actual financial flows and financial integration, there is a positive effect of bank linkages on international trade. We conjecture that bank linkages, which are formed through bank-to-bank lending, reduce the asymmetry of information and the resulting risk exporters or their funders face, and we provide four pieces of evidence supporting this conjecture.

The main goals of this paper are (1) to show that bank linkages have a positive impact on trade that goes beyond the immediate effect of bank lending and (2) to explore the mechanism behind this effect. In particular, we argue that export risk arising from information asymmetries or payment enforcement difficulties can be mitigated through bank linkages. Bank linkages can help enforce or guarantee payments, as in Olsen (2013) and Niepmann and Schmidt-Eisenlohr (2013). In addition, banks are likely to have access to information on the creditworthiness of potential importers, and they may pass on this information to banks in exporting countries to which they are connected, information which may then be passed on to exporting firms.

We proxy for the tightness of bank linkages for each country pair using individual loan-level data from the Loan Analytics database. We construct a global network of banks in which relationships are formed when banks extend syndicated loans to each other.[3] Dealogic's Loan Analytics database provides information on syndicated banks loans, including those extended to financial institutions. For our purposes, syndicated loans are a good proxy for bank relationships because they tend to have much longer maturities than interbank loans and thus represent a larger commitment with greater potential for information flows.[4] In fact, anecdotal evidence suggests that establishing relationships is one of the main purposes of bank-to-bank syndicated lending on

[2] Battiston et al. (2012); Castiglionesi and Navarro (2011); Chan-Lau et al. (2009); Cocco et al. (2009); Craig and von Peter (2010); Delli Gatti et al. (2010); Elliot et al. (2012); Garratt et al. (2011); Giannetti and Leaven (2012); Haldane (2009); Haldane and May (2011); Imai and Takarabe (2011); Kalemli-Ozcan et al. (2013a); May and Arinaminpathy (2010); Mirchev et al. (2010); Nier et al. (2007); Sachs (2010) and von Peter (2007).

[3] In this we differ from Garratt et al. (2011); Kubelec and Sá (2010); Minoiu and Reyes (2013); von Peter (2007), who construct banking networks at the aggregate level, using BIS data. See Hale (2012) for the discussion of advantages of the bank-level approach.

[4] The bank-to-bank syndicated loan market is relatively large—in the late 1990s syndicated bank loans extended to banks and reported in Loan Analytics amounted to over 30 percent of total bank claims on banks as reported by the BIS. This ratio fell to below 20 percent by the end of our sample as interbank lending ballooned prior to the global financial crisis. In 2007 alone 4.7 trillion USD worth of syndicated loans extended to banks are reported in Loan Analytics.

some occasions.[5] In constructing the network we take into account the direction of the lending, but we ignore the amounts lent to avoid results being driven by trade financing.

We test our hypothesis that bank linkages have an impact on trade using a standard gravity model with country-pair and year fixed effects in our benchmark specification. Our sample includes the 29 largest industrialized and developing countries and extends from 1991 to 2009.[6] We use trade data from the IMF Direction of Trade Statistics (DOTS), which is a standard source, and show that in our sample the gravity model has the same fit as in the literature. We also show that measures of financial integration and financial flows, which we proxy for with BIS locational data on bilateral stocks and flows of bank assets, are correlated with international trade.

Controlling for measures of financial flows and financial integration, along with other standard variables, as well as country pair and year fixed effects, we find that trade is higher between country pairs in which banks have established new connections in the previous year. The magnitude of this effect is statistically significant, but not very large: doubling the change in the intensity of bank linkages due to new banking connections increases trade in the subsequent year by about 2 percent. Our estimate, however, is likely to be a lower bound on the total effect of bank linkages on trade, because our measure of bank linkages captures only a subset of bank relationships, those established from lending in the syndicated loan market. We analyze the effect of bank linkages on exports over time and find that this result is very robust. Moreover, while the effect of bank linkages did become larger during the crisis of 2008-09, our main results are not driven by those two years. We also find that the effect of bank linkages became more important towards the end of our sample.

Next we provide evidence that the mechanism by which bank linkages affect trade is through the reduction of export risk. To conduct these tests we gather additional data on industry-level trade from Comtrade, export insurance premia from the U.S. EXIM bank, and insured export credit exposure from Berne Union. All our tests support the export risk channel of the effect of bank linkages on exports. First, we show that bank linkages matter much more for exports of differentiated goods, for which export risk tends to be higher (Ranjan and Lee, 2007; Rauch and Trinidade, 2002). Second, we show that bank linkages are significantly more important for exports to countries where export risk is higher. Third, we show that the effect of bank linkages on exports is significantly smaller if the importing country has better access to export insurance, which would make bank linkages a secondary avenue of mitigating export risk. Fourth, we show that bank linkages are twice as important for exports to non-OECD countries, where contract enforcement tends to be worse, than for exports to OECD countries. We provide three different approaches to

5 See, for example, the media coverage of a syndicated loan to Turkish Garanti Bank in 2010, such as "Banks on Parade," IFR Turkey 2010.

6 Countries included in the sample are listed in Figure 1.

address endogeneity concerns: dynamic panel regression, instrumental variables, and propensity score matching.

While we emphasize the importance of bank linkages in reducing export risk and contract enforcement, our results can also be interpreted in the spirit of the literature on social networks in international trade surveyed by Rauch (2001).[7] Bank linkages can be similar to social network linkages in that they may provide channels of information flows and help match sellers to buyers in different countries. This interpretation is partially encompassed in our main interpretation of bank linkages as reducing export risk given that banks are particularly good at providing information on creditworthy buyers. Thus, they may not only facilitate the matching of sellers to buyers, but in doing so, they may reduce information asymmetries that lead to payment enforcement problems in international transactions.

In addition to showing the benefits of bank linkages, our paper contributes to the literature on trade and financial globalization in a number of important ways. First, it adds to the body of evidence showing the connection between globalization of goods and capital markets highlighting the importance of finance in trade.[8] We show that, beyond the direct effect of financial flows on trade, a positive externality arises from bank linkages. Recently, a similar phenomenon has been documented for the trade across the U.S. states by Michalski and Ors (2012).

Second, our paper contributes to an understanding of border effects by suggesting that asymmetric information generates export risk and by showing that such risk is likely reduced through bank linkages between countries. Papers that analyze the impact of information and contract enforcement in international trade are closely related. For example, Rauch and Trinidade (2002) show the importance of ethnic networks; Guiso et al. (2009) show the role of trust in explaining international trade patterns; and Cristea (2011) and Poole (2012) show the importance of business relations.

Third, by relating bank linkages to trade, our paper contributes to the literature on the role of financial flows in international business cycles. While Imbs (2006) shows a positive cross-country correlation between financial flows and business cycle comovements, a recent paper by Kalemli-Ozcan et al. (2013b) finds a negative within correlation. A more precise understanding of mechanisms through which financial flows affect economic relationships between countries can shed further light on this issue.

[7] Since the survey, the importance of social and information networks has been further shown in Combes et al. (2005), and Baston and Silva (2012), among others.

[8] See survey by Contessi and de Nicola (2012) as well as Ahn et al. (2011); Amiti and Weinstein (2011); Chor and Manova (2012); Manova (2008); Minetti and Zhu (2011) and references therein. Paravisini et al. (2011), however, find that in the case of Peru a shortage of credit affects production rather than export-specific activities.

In the next section we present the theoretical background for our analysis, describe our data, and present our empirical model. In Section 3 we describe and discuss our results. Section 4 concludes.

2 Theoretical Background, Data, and Empirical Approach

Our analysis fits well in the general framework of the gravity model of trade. To show this, it is worth reviewing the basic microfoundations of the model.

2.1 Theoretical Underpinnings of the Gravity Model and Export Risk

Following Feenstra (2004), assume that preferences of a representative consumer are isoelastic (CES) and that consumers in each country j consume goods produced in all other countries $i \in [1, C]$ so that the utility function is

$$U^j = \sum_{i=1}^{C} N^i (c^{ij})^{\frac{\sigma-1}{\sigma}},$$

where N^i is the number of goods produced in country i and c^{ij} is country j's consumption of goods made in i, which also corresponds to the volume of exports from i to j, and $\sigma > 1$ is elasticity of substitution. We assume that all goods produced in country i are sold in country j for the same price p^{ij}. We also assume balanced trade, which implies that the budget constraint for country j is given by its total output Y^j as

$$Y^j = \sum_{i=1}^{C} N^i p^{ij} c^{ij}.$$

The optimization yields

$$c^{ij} = \frac{p^{ij}}{P^j}^{-\sigma} \frac{Y^j}{P^j},$$

where P^j is the CES price index

$$P^j = \left(\sum_{i=1}^{C} N^i (p^{ij})^{1-\sigma} \right)^{\frac{1}{1-\sigma}}.$$

The value of exports is then

$$X^{ij} = N^i Y^j \left(\frac{p^{ij}}{P^j} \right)^{1-\sigma}.$$

Assuming labor to be the only input and full employment (Krugman, 1979), the zero-profit condition implies that $Y^i = yN^i p^i$, where y is the labor productivity, N^i is the labor supply in country i and p^i is the price of the domestically produced output in country i. Further assume that there is a wedge T^{ij} between the price of the good made in country i sold domestically, p^i, and the same good sold in country j, $p^{ij} = T^{ij} p^i$, with $T^{ii} = 1$, $T^{ij} > 1$.

Combining all of the above, we can express the value of exports from i to j in each period t as

$$X_t^{ij} = \frac{Y_t^i Y_t^j}{(p_t^i)^\sigma y} \left(\frac{T_t^{ij}}{P_t^j} \right)^{1-\sigma}.$$

The wedge T^{ij} between domestic and foreign prices has been given many interpretations in the literature, including transportation costs, trade barriers, and information costs. Here, we will focus on what we believe are two important components: geographical distance and export risk. Our specific interpretation of export risk is related to the cost of payment or contract enforcement, in cross-border deals, the importance of which is well documented in Anderson and Marcouiller (2002). This cost is likely to be increasing with distance because of longer shipping time, and it will also be affected by the relative quality of institutions in countries i and j and by how differentiated the traded good is, which we do not model explicitly. Assume that this cost can be reduced if banks in country i are closely linked with banks in country j, either through direct payment enforcement and guarantees as in Olsen (2013) or through selection of creditworthy counterparties by banks in country j. Thus we assume

$$T_t^{ij} = D^{ij} \left(R_t^{ij} \right)^{(1-a_t^{ij})},$$

where D^{ij} is constant distance between countries i and j, R_t^{ij} is the cost of contract enforcement in country j relative to country i in the absence of bank linkages and in case of unit elasticity, and a_t^{ij} is the strength of bank linkages between countries i and j. We use the relative cost of contract enforcement because the assumption is that firms in country i can always sell their output in domestic markets, which can also be subject to contract enforcement problems. That is, we continue to interpret T^{ij} as the wedge between the export price and the domestic price of goods.

Combining the above and taking logs, we obtain

$$\begin{aligned} \ln X_t^{ij} = {} & \ln Y_t^i + \log Y_t^j - (\sigma - 1) \ln D^{ij} - (\sigma - 1) \ln R_t^{ij} \\ & + (\sigma - 1) \ln R_t^{ij} a_t^{ij} - \sigma \ln p_t^i - \ln y + (\sigma - 1) \ln P_t^j. \end{aligned}$$

From this equation we can draw two main testable implications with respect to bank linkages:

1. exports are an increasing function of bank linkages a_t^{ij}, and
2. the effect of bank linkages is stronger the higher the export risk in country j relative to country i, R_t^{ij}.

In what follows, we will put these predictions to the test.

2.2 Data

We collect three main types of data. First, our trade data come from the IMF Direction of Trade Statistics (DOTS). Second, we use BIS locational banking statistics for bilateral data on *stocks* of claims of banks on all sectors, to proxy for the degree of financial integration of each country pair, and data on valuation-adjusted bank *flows* from the same source to proxy for financial flows within each country pair. Third, we construct a measure of bank linkages using data on banks' syndicated lending to each other, at the loan level, from the Dealogic Loan Analytics Database (a.k.a. Loanware). In addition, we use industry-level trade data from Comtrade, as well as a number of additional sources described below. GDP and population data are from the World Bank's *World Development Indicators*.

2.2.1 International Trade

We use the measure of bilateral exports from country i to country j reported in USD, deflated by the U.S. CPI, EX_{ij}. Our sample includes a strictly balanced panel of 29 countries for the period of 1991-2009 at an annual frequency. We conduct our analysis using the logarithmic transformation of the data

$$ex_{ij} = \log(1 + EX_{ij}),$$

which allows us to preserve the zeros. Since our sample is limited to 29 countries that are actively engaged in international goods and capital markets and thus available in BIS data sets, we do not have many zeros in our data set.[9] Appendix Figure A.1 shows the distribution of ex_{ij} in the beginning of our sample, in 2007, and in 2009. While there is a small mass point at and near zero, especially in the early part of our sample, it is not large enough to influence our results[10]

We also use Comtrade to obtain industry-level trade data at the 4-digit SITC level of aggregation in order to compute exports by Rauch (1999) categories of product differentiation. Rauch (1999) sorts SITC codes into three categories of goods: those traded on international exchanges, those with reference prices — both considered homogeneous goods, or differentiated goods for which branding information precludes them from being traded on exchanges or reference priced.

2.2.2 Financial Integration and Financial Flows

We use bilateral data on banks' claims on all sectors from BIS locational banking statistics including all types of claims. BIS reports both stocks and valuation-adjusted flows of these variables, for both assets and liabilities. We use stocks of claims outstanding, in real USD, to represent the degree of financial integration between the countries in the pair. We use flows of bank credit to proxy for financial flows. Since trade credit extended by banks to firms is frequently backed up by

[9] See Figure 1 for the list of countries in the sample. Out of 16,240 observations (812 country pairs for 20 years), only 126 are zeros.

[10] Our results remain unchanged if we exclude pairs without trade.

credit lines the banks obtain from larger financial institutions, flows of bank claims also provide a proxy for the availability of trade credit.

There are many missing values in the BIS series for the 812 country-pairs we have in the data. We replaced, when possible, missing values of assets of i in j with the reported value of liabilities of j to i, for both stocks and flows. In addition, some stocks of claims are negative. We replaced both remaining missing values of stocks and flows and negative values of stocks with zeros. In our view, small claims of stocks are more likely to be missing, thus we claim that zero is a reasonable approximation in these cases. As a result, stock and flow measures are zero for about 5,000 of 16,240 observations, with a larger share of zeros in the first half of the sample.

For the regressions we make the following logarithmic transformation of the stocks BS_{ij}

$$bs_{ij} = \log(1 + BS_{ij}).$$

Since flows BF_{ij} can be negative, we compute

$$bf_{ij} = \log(1 + BF_{ij})\ , BF_{ij} >= 0\ ;\ \ bf_{ij} = -\log(1 - BF_{ij})\ , BF_{ij} < 0.$$

The distribution of these variables for 1990, 2007, and 2009, including the zeros, is shown in Appendix Figure A.2.

2.2.3 Bank Linkages

We obtain deal-level data on syndicated international and domestic bank loans from Dealogic's Loan Analytics database (also known as Loanware). As our goal is to capture bank-to-bank lending activity, we obtain data on all loans extended to public and private sector banks between January 1, 1990 and December 31, 2009. To get a sense of the importance of the syndicated loans extended to financial institutions, consider just one pre-crisis year, 2006. During this year about 4 trillion USD worth of new loans were extended to public and private sector banks. In December of that same year, 2006, BIS reports the total amount of banks' claims on banks, domestic and international, to be about 18 trillion USD. While these numbers are not directly comparable because Loan Analytics reports amounts of loans originated and BIS reports amounts of loans outstanding, they give a sense of the relevance of the syndicated loan market.

Ideally, we would like to ensure that each of the loans in our sample is a bank-to-bank loan, but the Dealogic database only allows us to identify borrower type (which we constrain to be either public or private sector bank); it does not allow us to place the same constraints on lenders.[11]

[11] Some of the lenders within a syndicate may not be banks. Upon detailed review of the lenders' names, we find that the non-bank lenders account for roughly 29 percent of all lenders in our sample and consist mostly of insurance companies and special purpose vehicles. We kept them in our sample because there was no way to systematically exclude them.

Among the loans in our sample, over 60 percent are term credit, with the rest being revolving loans, CDs, and various credit facilities. We replicate syndicated loans as many times as there are lenders in the syndicate on the signing date of the loan.

The vertices (nodes) of our network, each representing a bank, are indexed by $m = 1, ..., I$. The edges (direct connections) between each pair of nodes m and n, loans in our case, are denoted by c_{mn}, which is binary $\{0, 1\}$. Not every pair of nodes is connected by edges. The edges are directed so that $c_{mn} \neq c_{nm}$. We will denote c_{mn} as connections going from node m to node n, i.e., a link generated by bank m lending to bank n. We will refer to it sometimes as a *lending* connection or connection through lending; we will refer to c_{nm} as a *borrowing* connection or connection through borrowing.

For our purposes, the *length* of a path is the number of edges that comprise that path. A *geodesic path* is a path between two given nodes that has the shortest possible length. We denote the length of the geodesic path from node m to node n as g_{mn}.[12] Because the network is directed, there are pairs of nodes for which there is a path in one direction, and not in the other.

For each of the years in our sample, we construct a cumulative global banking network (GBN), where for each year t all loans between 1990 and t are included.[13] Thus, cumulative GBN expands every year through the addition of new connections as loans between bank pairs that have not engaged in lending previously. By the end of our sample, we have 5,942 banking institutions as lenders and 3,646 banking institutions as borrowers. For further detail on the data and network construction, see Hale (2012).

For each year t and for each pair of banks, we compute their *proximity* p_{mnt} as the inverse of the length of the geodesic path, that is $p_{mnt} = 1/g_{mnt}$. The interpretation of this measure aligns more closely with information flows than to lending because our network does not account for the size of the loans extended and we assume that relationships between banks persist even after the loans mature.

We link each banking entity to a country on a locational basis,[14] and we compute *aggregate proximity*, the sum of proximities for each pair of banks in a given pair of countries i and j in year t,

$$AP_{ijt} = \sum_{m \in i} \sum_{n \in j} p_{mnt},$$

[12] Note that each pair of nodes m and n can have more than one geodesic path which will, by definition, have the same length.

[13] While Dealogic's data extends back to 1980, the loan coverage is substantially limited before 1990. The resulting network would be expanding due to expanding coverage, not increasing connectivity.

[14] Mian (2006) shows that cultural and geographical distances between headquarters and local branches play an important role in lending practices.

so that two countries are more closely linked if there are more bank pairs between them that are connected, and if these pairs of banks are connected more closely. This is our main measure of bank linkages.

In the regressions we use the logarithmic transformation of a one-period change in the aggregate proximity measure as

$$ap_{ijt} = \log(1 + (AP_{ijt} - AP_{ijt-1})).$$

This one-period change measures the increase in proximity that is due to new connections that were formed in year t. In our regressions we use the first lag of this measure to measure the effect of new bank linkages formed between years $t-2$ and $t-1$ on exports in year t.

In addition, we compute a secondary measure of bank linkages that only takes into account direct connections, that is, geodesic paths of length one, with all other connections set to 0. We refer to this measure as the aggregate number of linkages AL_{ij}, and it is simply the sum of bank pairs in countries i and j that are directly connected. We will use the same log transformation of the one-period change in the aggregate number of linkages, which is simply the logarithm of a number of new connections formed between countries i and j:

$$al_{ijt} = \log(1 + (AL_{ijt} - AL_{ijt-1})).$$

The distribution of our proximity measures over years, over lenders, and over borrowers is shown in Figure 1. The left-hand side of Figure 1 shows the distribution of ap_{ijt} and al_{ijt}. We can see that most linkages in our sample are direct. The spike in the first year of the data simply shows the formation of the network, and the results of the analysis are not sensitive to the inclusion of this year. We also compute the measure of indirect proximity, that is

$$aind_{ijt} = \log(1 + ((AP_{ijt} - AL_{ijt}) - (AP_{ijt-1} - AL_{ijt-1}))).$$

The right-hand side of Figure 1 shows the average of $aind_{ijt}$ over years, over lenders, and over borrowers. In the regressions we use a one-year lag of al_{ijt} and of $aind_{ijt}$. Appendix Table A.3 provides summary statistics for all measures described above as well as their components.

2.2.4 Export Risk

Our main proxy for export risk is the export insurance premia obtained from the U.S. EXIM Bank. Per our request, the EXIM Bank compiled average insurance premia they charged on export insurance contracts by destination country, including the United States, for all the years in our sample. For the United States, data are only available starting in 1996. We matched these insurance premia to source and destination countries and computed the differential between target and source export insurance premium in each year as our proxy of relative risk R_{ijt}. Summary statistics for this measure are reported in Appendix Table A.3.

Another way to test whether the effect of bank linkages on exports reflects mitigation of export risks is to test whether bank linkages are less important if there are alternative ways of mitigating export risks. One alternative is insured export credit that could be provided by a variety of financial institutions. Data on insured export credit exposures is provided by Berne Union and available from the Joint External Debt Hub (JEDH) for 2005-2012. Since we cannot use the time-series information from just these years, we compute the maximum stock of export insurance claims for each country, in real terms, during this time period. Summary statistics for this measure are also reported in Appendix Table A.3. We interact this measure for the exporter and the importer countries with our measures of direct and indirect bank linkages and add them to our benchmark regressions.

2.3 Empirical Gravity Model with Extensions and Export Risk

The empirical gravity model is a direct application of the equations derived in the theoretical discussion. As a benchmark model (without the effect of bank linkages) we estimate

$$ex_{ijt} = \alpha_{ij} + \alpha_t + \mathbf{Z_{ijt}}'\delta + \varepsilon_{ijt},$$

where ex is a log of exports, as described above, vector $\mathbf{Z}$ includes GDP per capita, population in both countries, and the ratio of GDP deflators in countries i and j. Time fixed effects α_t absorb y_t, while the time-invariant portion of T_t^{ij} is absorbed by country-pair fixed effects α_{ij} and the time-varying portion is reflected by the error term ε_{ijt}. Measures of geographical and cultural distance between the countries that are commonly included in gravity models are absorbed by pair fixed effects α_{ij}, since they do not vary over time.

Appendix Table A.1 presents these benchmark regressions for our sample. Columns (1) through (3) only include fixed effects for source country i, target country j, and year, while columns (4) through (6) include country-pair fixed effects and year fixed effects as described above. All estimated coefficients have expected signs, most are statistically significant, and the fit of the regressions is similar to those found in the previous literature. We do not have data on GDP deflators for all countries in all years, therefore including the ratio of price deflators reduces our sample by about 30 percent, leaving the rest of the coefficients mostly unaffected. In order to ensure that our estimates are not driven by the large plunge in global trade in the second half of 2008 and first half of 2009, we run subsample regressions in columns (3) and (6), limiting our sample to end in 2007. As shown, limiting the sample does not meaningfully affect estimates of the effects.

A number of recent papers show the importance of financial linkages in explaining trade (Ahn et al., 2011; Amiti and Weinstein, 2011; Chor and Manova, 2012; Manova, 2008; Minetti and Zhu, 2011). For this reason, and to ensure that our main results are not driven by financial linkages, we include measures of financial linkages in our gravity regression. As discussed above, we include measures of stocks, to proxy for financial integration, and flows. Both of these measures can be thought of as reducing the wedge between domestic and foreign prices, T^{ij}. Since these measures are included as controls and are not central to our analysis, we did not introduce them into the model above to avoid clutter. Including them, our regression becomes

$$ex_{ijt} = \alpha_{ij} + \alpha_t + \gamma_1 bs_{ijt} + \gamma_2 bs_{jit} + \gamma_3 bf_{ijt} + \gamma_4 bf_{jit} + \mathbf{Z_{ijt}}'\delta + \varepsilon_{ijt}.$$

The results of these regressions are reported in Appendix Table A.2. All regressions include year and country-pair fixed effects, GDP per capita, population, and the ratio of GDP deflators. We find, without assigning any causality, that countries tend to export more to countries on which they have larger stocks of bank claims, while the association between exports and banking flows tends to be negative. Since we do find significant effects, we will continue to include these measures as control variables in all our regressions.

As the first step of our main analysis, we estimate a reduced-form equation by including our measures of bank linkages as affecting the time-varying component of T^{ij}.

$$ex_{ijt} = \alpha_{ij} + \alpha_t + \beta\, ap_{ijt-1} + \gamma_1 bs_{ijt} + \gamma_2 bs_{jit} + \gamma_3 bf_{ijt} + \gamma_4 bf_{jit} + \mathbf{Z_{ijt}}'\delta + \varepsilon_{ijt}$$

with β being our coefficient of interest, which we expect to be positive. Note that we include changes in our aggregate bank proximity measures lagged by one year. Thus, we test how new connections formed between banks in year $t-1$ affect trade in year t.

As shown in the literature, export risks tend to be more important for more differentiated goods (Ranjan and Lee, 2007; Rauch, 1999; Rauch and Trinidade, 2002). Thus, we expect the effect of bank linkages to be higher for more differentiated goods. We will, therefore, estimate the model separately for exports of homogeneous and differentiated goods, expecting coefficient β to be higher for differentiated goods.

As shown in the theoretical discussion, if our hypothesis of bank linkages mitigating export risk is correct, the effect of bank linkages will vary with the export risk of country j relative to country i, thus we extend our analysis, estimating

$$ex_{ijt} = \alpha_{ij} + \alpha_t + \beta_1\, ap_{ijt-1} + \beta_2\, R_{ijt} ap_{ijt-1} + \gamma_1 bs_{ijt} + \gamma_2 bs_{jit} + \gamma_3 bf_{ijt} + \gamma_4 bf_{jit} + \mathbf{Z_{ijt}}'\delta + \varepsilon_{ijt},$$

where R_{ijt} is a proxy for relative export risk, with its main effect included in $\mathbf{Z_{ijt}}'\delta$. We expect both β_1 and β_2 to be positive.

We also test, using a similar approach, whether access to export insurance reduces the importance of bank linkages, because it provides alternative ways of mitigating export risk. Moreover, we test whether the importance of bank linkages varies with the level of economic development, by splitting our sample into countries that are members and non-members of the OECD.

3 Effects of Bank Linkages on Exports

Our reduced-form results are presented in Table 1, where we test whether changes in our measure of new bank linkages formed during year $t-1$ affect exports in year t. The first four columns report regressions with changes in aggregate proximity ap, and the last four columns split this measure into changes in direct linkages al and changes in indirect proximity $aind$. In each of these sets, the first regression does not include controls for BIS stocks and flows, the second regression does include them, the third regression includes all controls but limits the sample to years prior to the trade collapse of 2008-2009, and the fourth regression goes back to the full sample and excludes the ratio of GDP deflators to increase the sample. All regressions include country-pair and year fixed effects and are reported with robust standard errors.

In all specifications we find a positive effect of newly formed bank linkages on next year's exports. Both direct and indirect lending linkages have a positive effect on exports, but only the effect of direct linkages is statistically significant. The coefficient on bank linkages, total or direct, remains unchanged whether or not we control for BIS stocks and flows of foreign bank claims, indicating that our measure of newly formed bank linkages is effectively orthogonal to actual banking flows in the following year. Since some BIS measures enter significantly, we continue to include them in all our regressions. The effect of banks' lending linkages becomes smaller if we exclude 2008 and 2009, the years of the global trade collapse, from the sample (columns (3) and (7)). This indicates that bank linkages became especially important for trade during the global financial crisis, a hypothesis we will explicitly test next. Finally, the effect of bank linkages on exports increases slightly if we expand the sample by excluding the ratio of GDP deflators, as in columns (4) and (8), which become our benchmark regressions.

Since in the regressions all variables are in logs, it is easy to interpret the magnitudes of the coefficients. Most of our results suggest that doubling the change in intensity of bank linkages due to new banking connections is associated with a 2-2.5 percent increase in exports in the following year; this impact is not very large, but it is not negligible either. In other words, when banks in country i extend loans to twice as many banks with whom they previously did not have a relationship in country j as in country k, other things being equal, exports from i to j increase in the following year by 2-2.5 percent more than exports from i to k. Given that the standard deviation of newly formed linkages is twice its mean, as reported in Appendix Table A.3., doubling the change in intensity of bank linkages is not an unreasonable thought experiment. Note also that this is likely to be a lower bound on the effect of bank linkages on trade, because our measure captures only a subset of bank relationships, those through the syndicated loan market.

Table 2 presents the results of our further investigation of the effects of time and of the financial crisis and global trade collapse in 2008-2009. To this end we include in our benchmark regressions an indicator of "crisis" (years 2008 and 2009) and linear trend, both interacted with our variables of interest. We continue to include country-pair and year fixed effects. To make sure we carefully control for financial integration and financial flows, the effects of which could also have changed during the crisis and over time, we interact the crisis indicator and the linear trend with the measures of stocks and flows of bank claims as well.

In columns (1) through (3) we use our aggregate proximity measure, while in columns (4) through (6) we decompose it into direct and indirect linkages. As we expected, we find that bank linkages, including indirect linkages, became more important during the crisis years, when global trade and bank lending shrank substantially—as indicated by positive and statistically significant interaction terms in columns (1) and (4). The increased importance of overall and direct bank linkages during the crisis remains statistically significant even if we allow for increasing importance of bank linkages over time, as in columns (3) and (6). We can see, however, that indirect linkages became gradually more important over time, and once we allow for this trend, the effect of the crisis is no longer significant.

Columns (2) and (5) of Table 2 show that all bank linkages became more important over time. While the coefficients on the main effect and the interaction of our bank linkage variables with linear trend are not statistically significant (except for the indirect linkages), we can compute the threshold year for which the sum of the main effect and the effect of the interaction with trend is statistically significant at the 10 percent level according to the F-test. We find that, depending on whether we allow for the level shift during the crisis years, overall and direct bank linkages became important for trade in 1992-94 and 1990-93, respectively, while indirect connections became statistically important in 2003 if we do not allow for the level shift in 2008-09. We also tested whether the slope of the trend changed during crisis years, but we found no evidence for that.[15]

To sum up, we find that effects of bank linkages are positive and statistically significant, and that they are driven predominantly by direct bank linkages. Moreover, we find that bank linkages, including indirect ones, became more important in the last years of the sample, due to both positive trends and the financial crisis. We next test our hypothesis that bank linkages influence exports by reducing export risks associated with payment enforcement and other problems arising from information asymmetries.

[15] In the interest of space, we are not reporting these results.

3.1 Export Risk and Bank Linkages

In this section we provide evidence that tests our hypothesis that the mechanism through which bank linkages affect exports is related to export risk. All regressions that follow include country pair and year fixed effects as well as controls for BIS measures of stocks and flows of international banking claims, and gravity measures.

As we discussed earlier, the existing literature suggests that export risks are higher for goods that are more differentiated (Ranjan and Lee, 2007; Rauch and Trinidade, 2002). If bank linkages help reduce export risk, this implies that for more differentiated goods the effects of bank linkages will be larger, because there are more risks to mitigate. We test this hypothesis by estimating our benchmark regressions for exports of differentiated, exchange-traded, and reference-priced goods, using Comtrade data at the 4-digit SITC level sorted into Rauch (1999) categories.[16] The results are presented in Table 3, where the first three columns test this hypothesis with respect to our benchmark bank linkages measure, and the last three columns split this measure into direct and indirect linkages.

Columns (1) and (4) of Table 3 report the results of the regression for the exports of differentiated goods. We find that the coefficients on overall proximity and direct linkages are substantially higher for differentiated goods than for the full sample. Comparing to columns (2)-(3) and (5)-(6) we can see that coefficient on differentiated exports is almost double that on homogeneous goods, whether they are traded on an exchange or are reference priced. The differences between these coefficients are statistically significant. We do not find such a difference for indirect linkages. These results also hold if we exclude crisis years.[17] Thus, bank linkages are more important for exports of differentiated goods, which is consistent with the interpretations of our results as bank linkages reducing export risk.

A more direct test of our hypothesis that bank linkages alleviate export risks is a regression with measures of bank linkages interacted with a proxy for bank risk as specified in Section 2.3. Our proxy for export risk is the export risk premium differential between the target and the source country. The regressions are presented in Table 4, where again, the first two columns estimate regressions for overall measure of bank linkages, while the second two columns split the measure into direct and indirect linkages.

Across all columns in Table 4, we find that the effect of our export risk proxy is as expected. An increase in the difference between the cost of export insurance in the target country and that in

[16] Since the totals across all SITC4 categories in Comtrade data are not identical to IMF DOTS data, and there are no data for one of our countries, Panama, we verify that our benchmark results hold for the total exports computed from Comtrade data. This is indeed the case for the coefficient on bank linkages, which is slightly larger with Comtrade data. We also verified that our benchmark result is unchanged if we use IMF DOTS export data, but reduce the sample to be identical to that with Comtrade data.

[17] In the interest of space we do not report these regressions.

the source country tends to lower exports. Note that this result is obtained in the regression with country-pair fixed effects and therefore should be interpreted in dynamic terms. Columns (1) and (3) of Table 4 show that simply introducing this control into our regression does not affect our benchmark results.[18] Columns (2) and (4) show that the effect of bank linkages, both overall and direct, is substantially higher for country pairs with larger export risk in the destination country compared to the source country. In terms of magnitude, an increase in risk premium differential by one standard deviation, 0.15, corresponds to a 64 percent higher importance of overall bank linkages and a 63 percent higher importance of direct bank linkages. We find no significant effect of indirect bank linkages. These results are robust to excluding crisis years.

Obviously bank linkages are not the only way to alleviate export risk, as many institutions provide export insurance around the world. Thus, another way to test whether the positive effect of bank linkages on export works through alleviating export risk, is to see whether bank linkages are less important for the countries where export insurance is more readily available. We proxy for the availability of export insurance using Berne Union data on insured export credit exposures and interact this measure for the exporter and the importer countries with our measures of bank linkages. The results are presented in Table 5, where again the first two columns estimate regressions for the overall measure of bank linkages, while the second two columns split the measure into direct and indirect linkages.

In all regressions in Table 5 we can see that the main effect of bank linkages, which represents the effect for country pairs with no export insurance availability, is twice as high as in our benchmark regressions. In columns (1) and (3) we show that the higher the sum of export insurance availability in source and target countries, the lower the effect of overall and direct bank linkages. Columns (2) and (4) show the regressions where we separate export insurance availability in exporting and importing countries. We find that the effect of export insurance availability in the country pair is entirely due to the effect of export insurance availability in the importing countries. An increase in export insurance availability in the destination country by one standard deviation, 11.1, reduces the importance of overall bank linkages by 26 percent and of direct bank linkages by 23 percent. Some of the decline in the effect of overall linkages is due to a decline in the effect of indirect bank linkages as availability of export credit in the destination country increases, as indicated by a negative and significant interaction term in column (4). Thus, the results of these regressions are consistent with the idea that bank linkages may help mitigate export risk—when export insurance is ubiquitous in the import market, the risk of exporting to this country is most likely mitigated through insurance, making bank linkages less important. These results are also robust to excluding crisis years.

[18] This is despite the fact that the sample is reduced slightly because export insurance premium data are not available for the United States prior to 1996.

Another implication of the export risk reduction mechanism is that bank linkages should be more important for countries in which contract enforcement institutions are generally worse. We take a simple approach to testing this implication and split importers into OECD and non-OECD countries, since by all measures of the rule of law, contract enforcement and the like, OECD countries score on average much better than non-OECD countries. The results are presented in Table 6, where the first two columns estimate regressions for overall measure of bank linkages, while the last two columns split the measure into direct and indirect linkages.

Regressions in columns (1) and (3) of Table 6 are limited to destination countries being in OECD, (2) and (4) limit the sample to non-OECD importers. We find that the effect of bank linkages is more than twice as large for the subsample of non-OECD importers. The difference between the coefficients for OECD versus non-OECD importers is statistically significant. This is consistent with our hypothesis that bank linkages will matter more if importers' institutions are less developed. These results are robust to excluding crisis years. We also find that for non-OECD importers indirect linkages have a positive effect on trade.

Tying these findings together, we find strong support for our conjecture that bank linkages increase exports by reducing export risk that arises due to asymmetric information. Four separate tests of that mechanism point towards this conclusion. Moreover, we find that the effects of bank linkages are predominantly driven by direct connections, which are naturally more important in mitigating asymmetric information and enforcing payments.

3.2 Endogeneity concerns and other robustness tests

An important concern is that our main results are driven by omitted variables or reverse causality. Our main argument against this concern is that the mechanism we discussed above and showed evidence for cannot be easily explained by omitted variables or reverse causality. However, to further assure the reader, we provide additional tests that are designed to address endogeneity through various econometric techniques: dynamic panel analysis, instrumental variables, propensity score matching, and including additional control variables. While none of these tests are perfect, due to limited data availability, their combination is quite reassuring in that our results are robust across all of them.

Our tests rely on lags to avoid effects of direct reverse causality. Persistence of the variables we consider, however, is potentially an important problem. To alleviate concerns that it is persistence in both trade and bank linkages that is driving our results, we estimate a panel regression with fixed effects and lagged dependent variables, using the Arellano and Bond (1991) approach, where we treat bank stock and flow variables and GDP per capita as predetermined and bank linkages as endogenous variables. We present the results of this regression for our benchmark specification with two different lag configurations in the first two columns of Table 7. We can see that i) our dependent variable is, indeed, rather persistent, although it is stationary; and ii) our main results not only survive, but the coefficient on bank linkages is also now higher. Overall these results suggest that the long-run effect of bank linkages on exports is also present and amounts to an increase of about 8-14 percent in exports in the long run as a result of doubling the number of new bank linkages.

Our next approach uses instrumental variables analysis. Because our analysis covers a large number of countries, we cannot use the instrument for bank linkages successfully used in Kalemli-Ozcan et al. (2013b), as it is limited to European countries. Because identification in our regressions with country-pair fixed effects comes from within country pair over-time variation, we cannot use any time-invariant instruments proposed in the literature (Aviat and Coeurdacier, 2007). We attempt two sets of instruments that are likely to affect creation of new bank linkages through lending but should not have direct effect on trade.

The higher is the interest rate differences between target and source countries, the more likely banks in the source country are to extend the loans to the target country. We believe that interest rate differences are unlikely to directly affect trade between the two countries in the following year.[19] In the first specification, we instrument change in the aggregate proximity by the interaction of the change in the interest rate differential for country pairs with the aggregate proximity measure between the two countries in the first year of our sample. In the second specification, we use as instruments both the interest rate differential and its interaction with the aggregate proximity measure between the two countries in the first year of our sample. First stage estimation results and specification tests are presented in Appendix Table A.4. Columns (3) and (4) of Table 7 present the second-stage results. We see that the coefficients on instrumented lagged changes in aggregate proximity measures continue to be positive and statistically significant. Their magnitude increases substantially, which in part could be due to weak instrument problem.[20] Our main conclusion, however, remains unchanged. The second instrumental variables regression is overidentified, so we can use Hansen J-test to asses instrument validity. We find that, indeed, we cannot reject the hypothesis of orthogonality (exclusion) of instruments.

Next, we estimate a propensity score (probit) regression of whether there are new bank linkages between source and target countries in year $t-1$ and then compute the average treatment effect on treated (ATT) in terms of exports from source to target in year t. In doing so we discard information on how many bank linkages are created and therefore expect our results to be weaker. We continue using the interest rate differential and add aggregate proximity in year $t-2$ along

[19] An important caveat here is that the uncovered interest parity condition would imply close relationship between interest rate differential and the exchange rate, with exchange rate obviously affecting trade. Empirically, however, uncovered interest parity condition is shown not to hold during the time period we study (Chinn, 2006; Chinn and Quayyum, 2012).

[20] Tests consistent with weak-instruments show that even when biases are corrected, the coefficient on the endogenous variable in the second stage regression is statistically significant. Moreover, when we use estimators that are consistent with weak instruments, using LIML, GMM or k-class estimators, we continue to find the same results.

with all other control variables and fixed effects. We use five different matching techniques: nearest neighbor, two nearest neighbors, radius, Mahalonobis, and local linear. We use caliper of 0.05 for the first three methods and for all five methods we limit analysis to common support observations. In addition to computing ATT, we estimate our benchmark regression on a matched sample, with results reported in columns (5) and (6) of Table 7 using one-to-one nearest neighbor and local linear matching, respectively. ATT for all five matching techniques are reported in Table 8.

While we lose a lot of observations both through missing data on interest rates and through limiting sample to matched observations, our benchmark results are robust. As shown in columns (5) and (6) of Table 7, the effect of new bank linkages on trade remains positive and statistically significant, although its magnitude is slightly smaller than for the full sample. In Table 8 we report unconditional ATT as well as average treatment effect on untreated (ATU), a placebo test. We find that for all five matching techniques, the ATT is positive and, with the exception of the one-to-one nearest neighbor matching, statistically significant, while ATU is very close to zero.[21] Thus, even for reduced matched sample of observations, we find positive and statistically significant effect of new bank linkages (vs. no new linkages) formed in the previous year on exports.

Another important potential source of spurious correlation is general economic and financial conditions in each country. Hale (2012) shows that bank linkages are less likely to form if a country is experiencing a recession or a banking crisis. Clearly, these conditions can also affect exports as well as imports. Thus, we control for GDP growth in both countries as well as for financial crises (both banking and currency) in either or both countries (Laeven and Valencia, 2012). We find that our benchmark results as well as other regressions remain identical to those presented above, even though these controls enter our regressions significantly.[22]

Other robustness tests include controls for additional variables that may explain trade. We experimented with adding controls for common currency, WTO membership and regional trade agreements between source and target,[23] time-varying transportation costs,[24] and bilateral nominal exchange rates, or all of these variables at once. If anything, the results of our benchmark regression as well as the analysis of export risk gain in significance and become significant at 1 percent in most cases.

We also attempted specifications in which we drop initial years in the sample, 1990-91, or drop all observations in which exports are zero. These changes do not affect our results. In addition, we attempted weighted regressions using as weights either the sum of the GDPs of the

[21] For local linear matching approach we bootstrap standard errors.

[22] We do not report the results of this and other robustness tests in the interest of space, but they are available from the authors upon request.

[23] These variables are from Head and Mayer (2013) obtained via CEPII and are updated using the information from WTO website.

[24] Time-varying transportation costs are measured as an interaction of the Baltic Dry Index, from Bloomberg, with the distance between capitals of each country pair.

country pair, average over the sample period, or the sum of exports from source to target, also average over the sample period.[25] Most of our results remain unchanged, with significance of some of the coefficients increased. One notable change is that the effect of bank linkages on exports of homogeneous (exchange-traded) goods is much smaller and no longer statistically significant, which yields an even stronger support to the mechanism we discuss.

4 Conclusion

In this paper we demonstrate that connections between banks may have a positive externality. We show that when banks in a given country pair become more closely connected, it tends to increase trade between these two countries in the following year by an economically and statistically significant amount. We find this result controlling for gravity variables, financial integration and financial flows, as well as country-pair and year fixed effects.

We conjecture that the mechanism for this effect is related to asymmetric information that leads to export risk. Export risk could be mitigated by bank linkages, either because they provide avenues for payment enforcement and guarantees, or because banks have access to information on importers' creditworthiness which they may share with other banks. We show in four separate tests that the data support this conjecture.

We believe that this is just one example of a positive externality that arises from bank linkages, one we can easily measure. In the wake of the global financial crisis, the literature on international banking is dominated by the discussion of the costs of bank linkages. We encourage researchers in the field to keep in mind potential benefits, whether direct ones, such as risk-sharing and diversification, or external, such as the one we demonstrated in this paper.

[25] Solon et al. (2013) recommend weighted regression as a useful specification test to make sure heterogeneity of observations does not spuriously drive the results.

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Figure 1. Measures of Bank Linkages

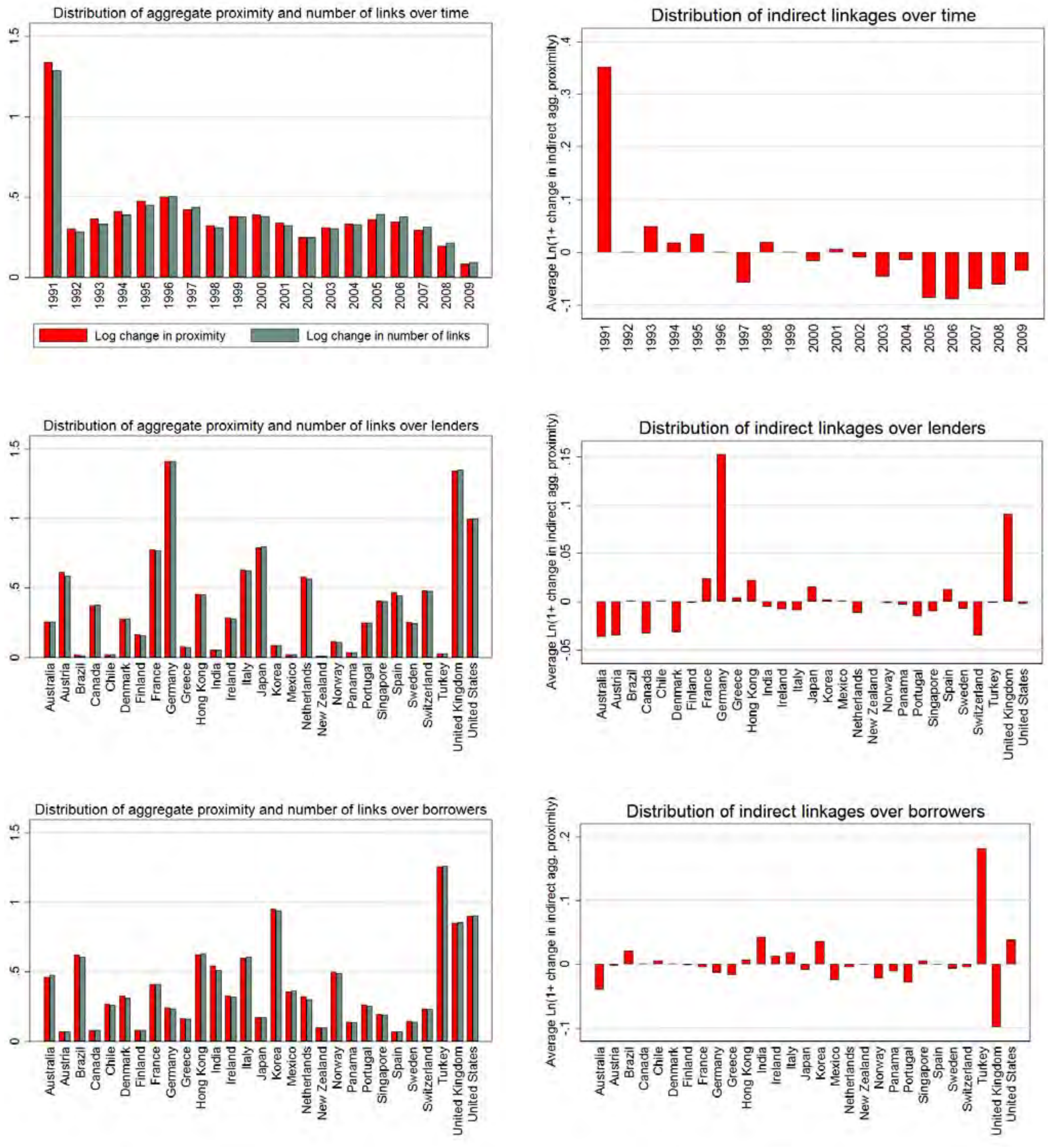


Table 1. Gravity Regressions with Aggregate Proximity Measures.

	Full sample (1)	Full sample (2)	yr< 2008 (3)	Full sample (4)	Full sample (5)	Full sample (6)	yr< 2008 (7)	Full sample (8)
ap_{ijt-1}	0.0210***	0.0211***	0.0110*	0.0257***				
	(0.00599)	(0.00600)	(0.00595)	(0.00562)				
al_{ijt-1}					0.0193***	0.0193***	0.0106*	0.0249***
					(0.00562)	(0.00564)	(0.00560)	(0.00523)
$aind_{ijt-1}$					0.00640	0.00757	0.00191	0.00509
					(0.00556)	(0.00563)	(0.00523)	(0.00516)
bs_{ijt}		0.0195*	0.0320***	0.0107		0.0197*	0.0320***	0.0107
		(0.0115)	(0.0118)	(0.0110)		(0.0115)	(0.0118)	(0.0110)
bs_{jit}		0.00703	0.00353	0.0104		0.00702	0.00348	0.0103
		(0.00884)	(0.00849)	(0.00813)		(0.00883)	(0.00848)	(0.00811)
bf_{ijt}		-0.00106	-0.00419**	0.000348		-0.00106	-0.00420**	0.000345
		(0.00165)	(0.00174)	(0.00141)		(0.00165)	(0.00174)	(0.00141)
bf_{jit}		-0.00638	-0.00741*	-0.00945**		-0.00634	-0.00740*	-0.00941**
		(0.00459)	(0.00443)	(0.00413)		(0.00460)	(0.00444)	(0.00412)
P_j/P_i	0.0217***	0.0219***	0.0196***		0.0217***	0.0219***	0.0196***	
	(0.00611)	(0.00611)	(0.00590)		(0.00612)	(0.00611)	(0.00590)	
N_i	1.241***	1.298***	1.052**	1.283***	1.239***	1.295***	1.052**	1.282***
	(0.440)	(0.431)	(0.487)	(0.351)	(0.440)	(0.431)	(0.487)	(0.351)
N_j	1.745***	1.786***	1.768***	1.454***	1.743***	1.785***	1.767***	1.452***
	(0.375)	(0.375)	(0.400)	(0.326)	(0.375)	(0.376)	(0.400)	(0.326)
Y_i	0.762***	0.750***	0.642***	0.756***	0.762***	0.751***	0.642***	0.757***
	(0.148)	(0.149)	(0.153)	(0.121)	(0.148)	(0.149)	(0.153)	(0.121)
Y_j	1.164***	1.152***	1.060***	1.127***	1.164***	1.153***	1.060***	1.127***
	(0.153)	(0.153)	(0.166)	(0.130)	(0.153)	(0.153)	(0.166)	(0.130)
Observations	10652	10652	9758	15428	10652	10652	9758	15428
Within R^2	0.395	0.395	0.361	0.386	0.395	0.395	0.361	0.386

Dependent variable $\log(1 + EX_{ijt})$. Country pair and year fixed effects are included in all regressions. L. indicates one-year lag. P is GDP deflator. N is population. Y is per capita real GDP. ap_{ijt}, $aind_{ijt}$, al_{ijt} measure changes in aggregate bank proximity, direct, and indirect linkages, respectively. bs_{ijt}, bs_{jit}, bf_{ijt}, bf_{jit} are measures of stocks and flows of bank claims from BIS. Robust standard errors in parentheses. Within R^2 reported for pair fixed effects regressions. 812 country pairs. 29 countries. *(P$<$ 0.10), **(P$<$ 0.05), ***(P$<$ 0.01).

Table 2. Gravity regressions with aggregate proximity measures — crisis and trend effects.

	Full sample (1)	Full sample (2)	Full sample (3)	Full sample (4)	Full sample (5)	Full sample (6)
ap_{ijt-1} (1)	0.0203***	0.00686	0.0159			
	(0.00560)	(0.0109)	(0.0110)			
$ap_{ijt-1} * Crisis$ (2)	0.0713***		0.0714***			
	(0.0177)		(0.0165)			
$ap_{ijt-1} * t$ (3)		0.00174	0.0000829			
al_{ijt-1} (4)				0.0200***	0.0110	0.0204*
				(0.00521)	(0.0105)	(0.0107)
$al_{ijt-1} * Crisis$ (5)				0.0670***		0.0703***
				(0.0170)		(0.0159)
$al_{ijt-1} * t$ (6)					0.00132	-0.000346
$aind_{jit-1}$ (7)				0.00188	-0.0157**	-0.0169*
				(0.00502)	(0.00797)	(0.00900)
$aind_{jit-1} * Crisis$ (8)				0.0303**		0.0185
				(0.0131)		(0.0167)
$aind_{jit-1} * t$ (9)					0.00192***	0.00171*
bs_{ijt}	0.0240**	0.0520***	0.0455***	0.0242**	0.0517***	0.0454***
bs_{jit}	0.00869	0.0296*	0.0368**	0.00876	0.0297*	0.0371**
bf_{ijt}	-0.00390**	-0.00734**	-0.00708*	-0.00394**	-0.00726**	-0.00702*
bf_{jit}	-0.0113***	-0.0227***	-0.0248***	-0.0113***	-0.0229***	-0.0250***
$bs_{ijt} * Crisis$	-0.0385***		-0.0314***	-0.0378***		-0.0309***
$bs_{jit} * Crisis$	-0.000308		0.0290**	-0.000231		0.0290**
$bf_{ijt} * Crisis$	0.00487		-0.000337	0.00484		-0.000408
$bf_{jit} * Crisis$	0.00442		-0.0124	0.00478		-0.0121
$bs_{ijt} * t$		-0.00252***	-0.00136		-0.00248***	-0.00133
$bs_{jit} * t$		-0.00200	-0.00319**		-0.00200	-0.00319**
$bf_{ijt} * t$		0.000534**	0.000418		0.000527**	0.000416
$bf_{jit} * t$		0.00130*	0.00168**		0.00131**	0.00169**
Within R^2	0.388	0.388	0.389	0.388	0.388	0.389
Prob ((1)+(2)=0)	0.000***		0.000***			
Prob ((4)+(5)=0)				0.000***		0.000***
Prob ((7)+(8)=0)				0.009***		0.942
Threshold year 1[a]		1994	1992		1993	1990
Threshold year 2[b]					2003	N.A.

[a]Threshold year 1 is the first year in which Prob ((1)+(3)=0),or ((4)+(6)=0) is less than 0.1. [b]Threshold year 2 is the first year in which Prob ((7)+(9)=0) is less than 0.1. Dependent variable $\log(1 + EX_{ijt})$. Country pair and year fixed effects are included in all regressions. L. indicates one-year lag. ap_{ijt}, $aind_{ijt}$, al_{ijt} measure changes in aggregate bank proximity, direct, and indirect linkages, respectively. bs_{ijt}, bs_{jit}, bf_{ijt}, bf_{jit} are measures of stocks and flows of bank claims from BIS. $crisis_t = 1$ in 2008 and 2009, $t \in [1; 19]$ is linear trend, Y is year. Controls for population and GDP per capita are included in all regressions but not reported in the interest of space. Robust standard errors in parentheses, omitted for some variables in interest of space. Not reported for trend interactions and BIS variables in the interest of space. 15428 observations. 812 country pairs. 29 countries. *(P< 0.10), **(P< 0.05), ***(P< 0.01).

Table 3. Gravity Regressions with Aggregate Proximity Measures — by Rauch (1999) categories of exports.

	Differentiated (1)	Exchange (2)	Reference price (3)	Differentiated (4)	Exchange (5)	Reference price (6)
ap_{ijt-1}	0.0511***	0.0295**	0.0296***			
	(0.00721)	(0.0133)	(0.00723)			
al_{ijt-1}				0.0478***	0.0267**	0.0293***
				(0.00660)	(0.0126)	(0.00663)
$aind_{ijt-1}$				0.00554	-0.0135	0.00453
				(0.00742)	(0.0139)	(0.00765)
bs_{ijt}	-0.00458	0.000850	0.0168	-0.00473	0.000211	0.0168
	(0.0129)	(0.0224)	(0.0145)	(0.0129)	(0.0224)	(0.0145)
bs_{jit}	0.00949	0.0121	-0.00842	0.00925	0.0116	-0.00851
	(0.00934)	(0.0192)	(0.0122)	(0.00933)	(0.0192)	(0.0122)
bf_{ijt}	0.000146	-0.00327	-0.000527	0.000136	-0.00328	-0.000533
	(0.00185)	(0.00345)	(0.00192)	(0.00185)	(0.00344)	(0.00192)
bf_{jit}	-0.00965*	-0.000880	-0.00166	-0.00953*	-0.000684	-0.00162
	(0.00494)	(0.00982)	(0.00669)	(0.00494)	(0.00981)	(0.00668)
N_i	1.463***	-1.110**	2.160***	1.465***	-1.097*	2.160***
	(0.414)	(0.559)	(0.350)	(0.414)	(0.561)	(0.350)
N_j	2.264***	-0.0559	1.714***	2.258***	-0.0640	1.711***
	(0.390)	(0.537)	(0.374)	(0.390)	(0.537)	(0.374)
Y_i	0.838***	0.221	0.957***	0.840***	0.225	0.958***
	(0.138)	(0.252)	(0.163)	(0.138)	(0.252)	(0.163)
Y_j	0.916***	1.319***	0.617***	0.916***	1.318***	0.617***
	(0.145)	(0.254)	(0.146)	(0.145)	(0.254)	(0.146)
Observations	14364	14364	14364	14364	14364	14364
Within R^2	0.404	0.105	0.291	0.404	0.105	0.291

Dependent variable $\log(1+EX_{ijt})$. Country pair and year fixed effects are included in all regressions. L. indicates one-year lag. N is population. Y is per capita real GDP. ap_{ijt}, $aind_{ijt}$, al_{ijt} measure changes in aggregate bank proximity, direct, and indirect linkages, respectively. bs_{ijt}, bs_{jit}, bf_{ijt}, bf_{jit} are measures of stocks and flows of bank claims from BIS. Full sample Comtrade results not different from DOTS. All results are robust to excluding Crisis years (2008, 2009). Robust standard errors in parentheses. Within R^2 reported for pair fixed effects regressions. 756 country pairs. 28 countries (Panama is not in the sample). *(P< 0.10), **(P< 0.05), ***(P< 0.01).

Table 4. Gravity Regressions with Aggregate Proximity Measures — Effects of Insurance Premium.

	Full sample (1)	Full sample (2)	Full sample (3)	Full sample (4)
ap_{ijt-1}	0.0263***	0.0235***		
	(0.00592)	(0.00590)		
$ap_{ijt-1} * (\rho_{jt} - \rho_{it})$		0.100***		
		(0.0284)		
al_{ijt-1}			0.0259***	0.0225***
			(0.00553)	(0.00546)
$al_{ijt-1} * (\rho_{jt} - \rho_{it})$				0.0943***
				(0.0277)
$aind_{ijt-1}$			0.00298	0.00469
			(0.00526)	(0.00514)
$aind_{ijt-1} * (\rho_{jt} - \rho_{it})$				-0.0152
				(0.0358)
$\rho_{jt} - \rho_{it}$	-0.188**	-0.224***	-0.189**	-0.224***
	(0.0748)	(0.0767)	(0.0746)	(0.0764)
bs_{ijt}	0.00921	0.00762	0.00909	0.00766
bs_{jit}	0.0114	0.0109	0.0113	0.0110
bf_{ijt}	0.000959	0.00117	0.000951	0.00113
bf_{jit}	-0.0105**	-0.0100**	-0.0105**	-0.0100**
N_i	1.339***	1.353***	1.340***	1.353***
N_j	1.468***	1.455***	1.466***	1.450***
Y_i	0.734***	0.730***	0.735***	0.731***
Y_j	1.141***	1.148***	1.140***	1.148***
	(0.132)	(0.132)	(0.132)	(0.132)
Observations	15148	15092	15148	15092
Within R^2	0.384	0.384	0.384	0.384

Dependent variable $\log(1 + EX_{ijt})$. Country pair and year fixed effects are included in all regressions. L. indicates one-year lag. ap_{ijt}, $aind_{ijt}$, al_{ijt} measure changes in aggregate bank proximity, direct, and indirect linkages, respectively. bs_{ijt}, bs_{jit}, bf_{ijt}, bf_{jit} are measures of stocks and flows of bank claims from BIS. ρ is the export insurance premium. N is population. Y is per capita real GDP. Missing for the U.S. for years 1990-1995. All results are robust to excluding Crisis years (2008, 2009). Robust standard errors in parentheses. Not reported for BIS and macro variables in the interest of space. 812 country pairs. 29 countries. *(P$<$ 0.10), **(P$<$ 0.05), ***(P$<$ 0.01).

Table 5. Gravity regressions with aggregate proximity measures — effects of access to export insurance.

	Full sample (1)	Full sample (2)	Full sample (3)	Full sample (4)
ap_{ijt-1}	0.0470***	0.0469***		
	(0.0120)	(0.0120)		
$ap_{ijt-1} * (S_i + S_j)$	-0.00058**			
	(0.00025)			
$ap_{ijt-1} * S_i$		-0.00014		
		(0.00031)		
$ap_{ijt-1} * S_j$		-0.0011***		
		(0.00034)		
al_{ijt-1}			0.0451***	0.0450***
			(0.0113)	(0.0112)
$al_{ijt-1} * (S_i + S_j)$			-0.00055**	
			(0.00023)	
$al_{ijt-1} * S_i$				-0.00021
				(0.00030)
$al_{ijt-1} * S_j$				-0.00094***
				(0.00031)
$aind_{ijt-1}$			0.0152	0.0162
			(0.0123)	(0.0124)
$aind_{ijt-1} * (S_i + S_j)$			-0.00025	
			(0.00029)	
$aind_{ijt-1} * S_i$				0.00019
				(0.00039)
$aind_{ijt-1} * S_j$				-0.00077**
				(0.00037)
bs_{ijt}	0.0103	0.0100	0.0104	0.0101
bs_{jit}	0.0105	0.0110	0.0105	0.0109
bf_{ijt}	0.000563	0.000681	0.000536	0.000612
bf_{jit}	-0.00938**	-0.00965**	-0.00934**	-0.00964**
N_i	1.289***	1.288***	1.288***	1.286***
N_j	1.460***	1.465***	1.458***	1.464***
Y_i	0.755***	0.757***	0.756***	0.757***
Y_j	1.130***	1.132***	1.130***	1.132***
	(0.130)	(0.130)	(0.130)	(0.130)
Observations	15428	15428	15428	15428
Within R^2	0.386	0.386	0.386	0.386

Dependent variable $\log(1 + EX_{ijt})$. Country pair and year fixed effects are included in all regressions. L. indicates one-year lag. ap_{ijt}, $aind_{ijt}$, al_{ijt} measure changes in aggregate bank proximity, direct, and indirect linkages, respectively. bs_{ijt}, bs_{jit}, bf_{ijt}, bf_{jit} are measures of stocks and flows of bank claims from BIS. S is total insured export claims computed as described in the text. N is population. Y is per capita real GDP. All results are robust to excluding Crisis years (2008, 2009). Robust standard errors in parentheses. Not reported for BIS and macro variables in the interest of space. 812 country pairs. 29 countries. *(P<0.10), **(P<0.05), ***(P<0.01).

Table 6. Gravity Regressions with Aggregate Proximity Measures by OECD Membership.

	OECD importer (1)	non-OECD importer (2)	OECD importer (3)	non-OECD importer (4)
ap_{ijt-1}	0.0195***	0.0443***		
	(0.00606)	(0.0123)		
al_{ijt-1}			0.0299***	0.0590***
			(0.00676)	(0.0138)
$aind_{ijt-1}$			0.00726	0.0181*
			(0.00563)	(0.0103)
bs_{ijt}	0.00389	0.0369	0.00370	0.0397
	(0.0122)	(0.0303)	(0.0124)	(0.0337)
bs_{jit}	0.00681	0.00261	0.00628	0.0287
	(0.00839)	(0.0278)	(0.00856)	(0.0292)
bf_{ijt}	-0.00000203	-0.00176	0.00121	-0.00197
	(0.00149)	(0.00479)	(0.00159)	(0.00526)
bf_{jit}	-0.00825**	0.00133	-0.00743*	-0.0148
	(0.00418)	(0.0151)	(0.00426)	(0.0161)
N_i	1.086***	1.694**	0.901**	1.580**
	(0.396)	(0.700)	(0.404)	(0.746)
N_j	1.320***	0.541	1.268**	0.500
	(0.496)	(0.641)	(0.496)	(0.649)
Y_i	0.657***	0.980***	0.619***	0.970***
	(0.125)	(0.262)	(0.129)	(0.278)
Y_j	1.255***	0.649**	1.207***	0.797***
	(0.182)	(0.254)	(0.192)	(0.276)
Observations	10640	4788	9828	4183
Within R^2	0.380	0.406	0.376	0.375

Dependent variable $\log(1+EX_{ijt})$. Country pair and year fixed effects are included in all regressions. L. indicates one-year lag. N is population. Y is per capita real GDP. ap_{ijt}, $aind_{ijt}$, al_{ijt} measure changes in aggregate bank proximity, direct, and indirect linkages, respectively. $bs_{ijt}, bs_{jit}, bf_{ijt}, bf_{jit}$ are measures of stocks and flows of bank claims from BIS. All results are robust to excluding Crisis years (2008, 2009). *(P$<$ 0.10), **(P$<$ 0.05), ***(P$<$ 0.01). Robust standard errors in parentheses. Within R^2 reported for pair fixed effects regressions.

Table 7. Arellano-Bond Regressions (AB), IV, and matched sample (PSM) regressions.

	AB1 (1)	AB2 (2)	IV1 (3)	IV2 (4)	PSM-nn (5)	PSM-l (6)
ap_{ijt}	0.0402***	0.0495***				
	(0.00624)	(0.00686)				
ap_{ijt-1}		0.0232***	0.352**	0.321**	0.0170*	0.0183*
		(0.00843)	(0.170)	(0.155)	(0.00951)	(0.00949)
$\log(1+EX_{ijt-1})$	0.496***	0.492***				
	(0.0104)	(0.0104)				
bs_{ijt}	-0.0135*	-0.0130*	-0.0110	-0.0115	0.0185	0.0265
	(0.00776)	(0.00775)	(0.0086)	(0.00838)	(0.0176)	(0.0180)
bs_{jit}	0.00567	0.00694	0.0149*	0.0141*	0.0216**	0.0192*
	(0.00687)	(0.00687)	(0.0083)	(0.00790)	(0.00967)	(0.0103)
bf_{ijt}	0.00249	0.00235	0.00757**	0.00718**	-0.000402	-0.00159
	(0.00203)	(0.00202)	(0.0032)	(0.00303)	(0.00216)	(0.00212)
bf_{jit}	-0.00627*	-0.00700*	-0.016***	-0.0154***	-0.0160***	-0.0146***
	(0.00380)	(0.00380)	(0.0055)	(0.00517)	(0.00521)	(0.00548)
Y_i	0.564***	0.555***	0.523***	0.556***	0.972***	0.965***
	(0.0552)	(0.0553)	(0.198)	(0.179)	(0.190)	(0.203)
Y_j	0.807***	0.802***	1.156***	1.180***	1.231***	1.196***
	(0.0570)	(0.0571)	(0.157)	(0.148)	(0.165)	(0.168)
N_i	0.605***	0.594***	2.283***	2.318***	1.606***	1.500***
	(0.110)	(0.110)	(0.319)	(0.320)	(0.515)	(0.532)
N_j	0.340***	0.344***	1.486***	1.484***	1.058**	1.198**
	(0.110)	(0.110)	(0.234)	(0.231)	(0.486)	(0.497)
Observations	14616	14616	7912	7912	4553	4321
R^2			0.36	0.39	0.55	0.54
F-test for IV			7.25	7.31		
Hansen J P-value				0.76		

Dependent variable $\log(1+EX_{ijt})$. Country pair and year fixed effects are included in all regressions. L. indicates one-year lag. N is population. Y is per capita real GDP. ap_{ijt} measures changes in aggregate bank proximity. bs_{ijt}, bs_{jit}, bf_{ijt}, bf_{jit} are measures of stocks and flows of bank claims from BIS. PSM-nn is nearest neighbor matching, PSM-ll is local linear matching. Standard errors in parentheses. *(P<0.10), **(P<0.05), ***(P<0.01).

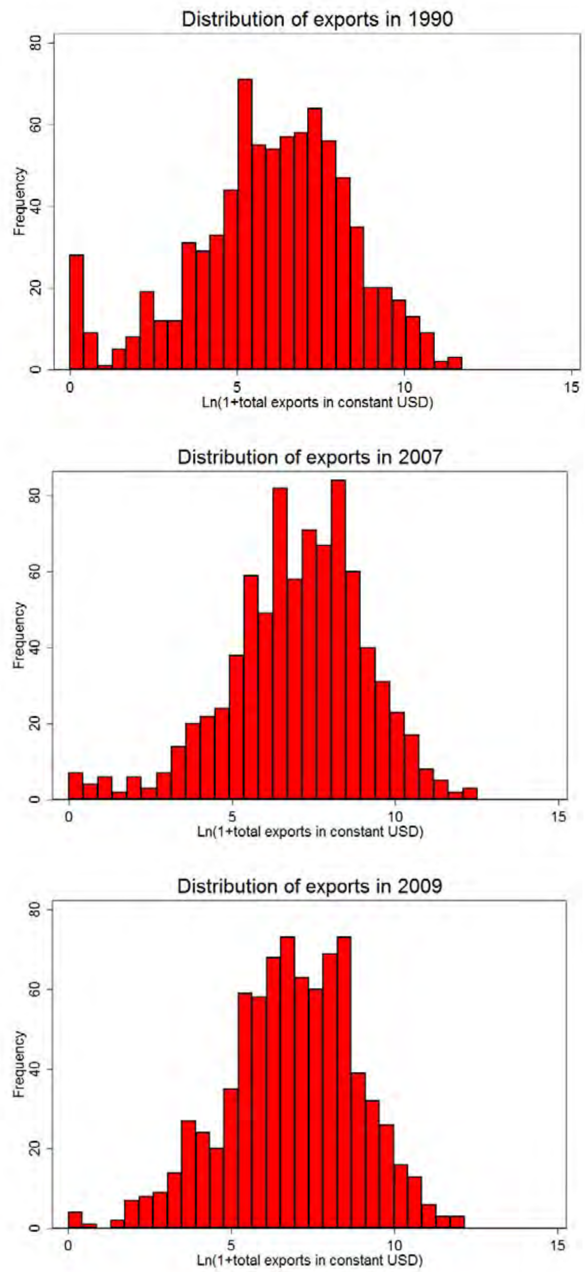
Table 8. Average Treatment Effect on Treated (ATT) and Untreated (ATU)

Matching method	ATT (1)	S.e. (2)	ATU (3)
Nearest neighbor	0.12	0.12	0.002
2 nearest neighbors	0.15*	0.1	-0.024
Radius	0.12*	0.09	-0.055
Mahalonobis	0.10*	0.08	0.009
Local linear	0.11**	0.067	-0.08
Unmatched difference	0.55***	0.05	

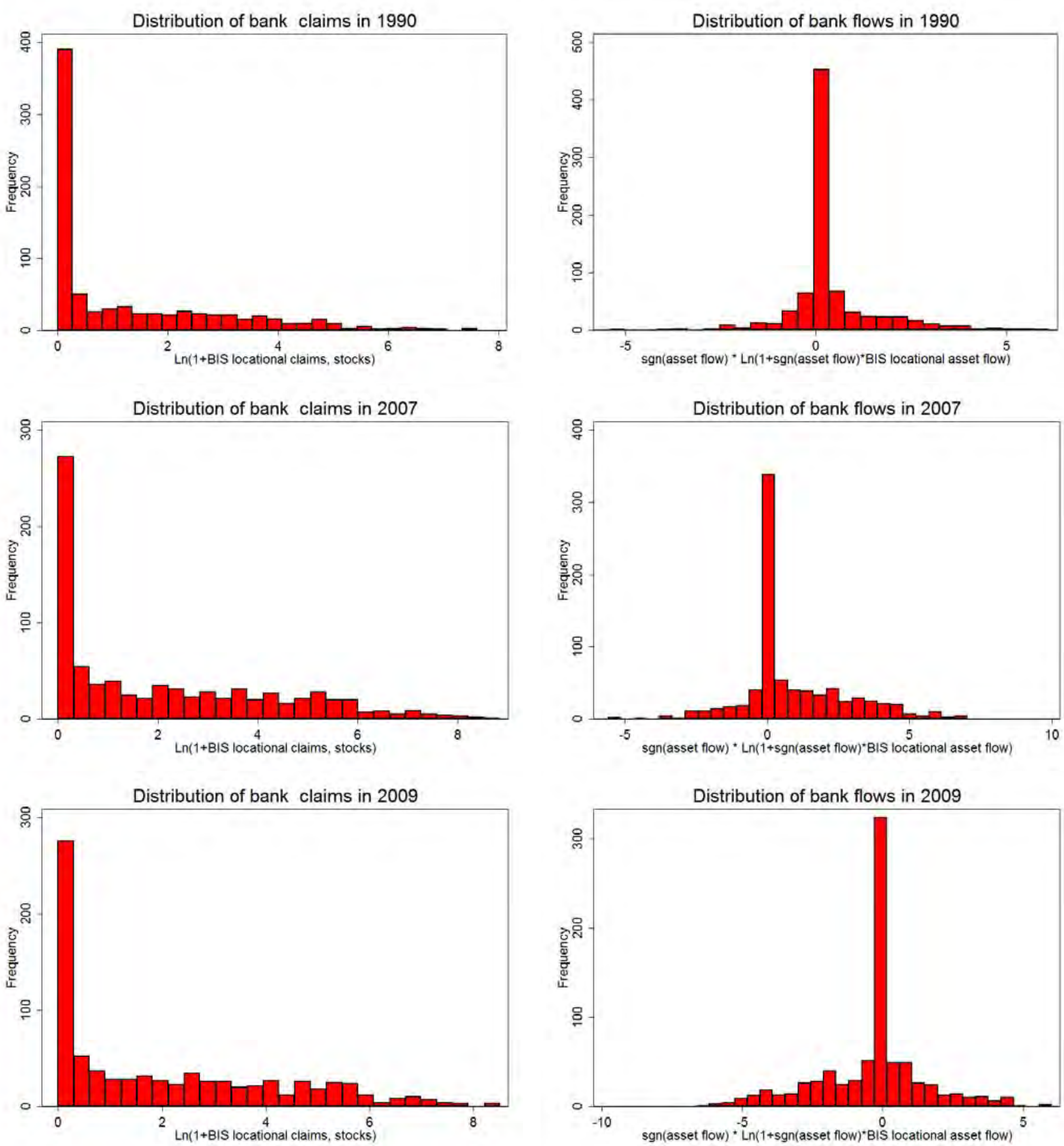
Outcome variable $\log(1 + EX_{ijt})$. Treatment is $I(ap_{ijt-1} > 0)$. Probit regression estimated is in the Appendix. Caliper 0.05 where appropriate. *(P$<$ 0.10), **(P$<$ 0.05), ***(P$<$ 0.01). Standard errors are bootstrapped for local linear matching.

A Appendix

Appendix Figure A.1. Distribution of Exports in Our Sample



Appendix Figure A.2. Financial Integration and Financial Flows



Appendix Table A.1. Gravity regressions.
Dependent variable $\log(1 + EX_{ijt})$

	Full sample (1)	Full sample (2)	year< 2008 (3)	Full sample (4)	Full sample (5)	year< 2008 (6)
popsource	1.478***	1.095***	0.905***	1.478***	1.512***	1.320***
	(0.241)	(0.304)	(0.325)	(0.357)	(0.436)	(0.480)
poptarget	1.579***	1.414***	1.267***	1.579***	1.914***	1.873***
	(0.235)	(0.290)	(0.317)	(0.328)	(0.371)	(0.388)
gdppcsource	0.777***	0.883***	0.808***	0.777***	0.788***	0.728***
	(0.101)	(0.127)	(0.135)	(0.120)	(0.143)	(0.148)
gdppctarget	1.113***	1.298***	1.211***	1.113***	1.130***	1.057***
	(0.111)	(0.133)	(0.137)	(0.128)	(0.150)	(0.160)
priceratio		0.0195**	0.0212**		0.0241***	0.0217***
		(0.00880)	(0.00937)		(0.00630)	(0.00632)
areasource	-0.486***	-0.328**	-0.244*			
	(0.107)	(0.136)	(0.145)			
areatarget	-0.497***	-0.450***	-0.381***			
	(0.103)	(0.128)	(0.140)			
contig	1.141***	1.064***	1.055***			
	(0.0303)	(0.0338)	(0.0350)			
comlang off	0.545***	0.586***	0.577***			
	(0.0256)	(0.0303)	(0.0313)			
colony	-0.0347	-0.0419	-0.0334			
	(0.0284)	(0.0332)	(0.0345)			
comcol	0.167***	0.0838	0.0390			
	(0.0644)	(0.0912)	(0.0942)			
distcap	-0.000146***	-0.000148***	-0.000149***			
	(0.00000215)	(0.00000268)	(0.00000277)			
N	16240	11436	10542	16240	11436	10542
R^2	0.871	0.879	0.881	0.390	0.399	0.363
Year FE	Y	Y	Y	Y	Y	Y
Source FE	Y	Y	Y	N	N	N
Target FE	Y	Y	Y	N	N	N
Pair FE	N	N	N	Y	Y	Y

Robust standard errors in parentheses. Within R^2 reported for pair fixed effects regressions. *(P$<$ 0.10), **(P$<$ 0.05), ***(P$<$ 0.01).

Appendix Table A.2. Gravity Regressions with Financial Integration and Capital Flows. Dependent variable $\log(1 + EX_{ijt})$

	Full sample (1)	Full sample (2)	Full sample (3)	year< 2008 (4)	year< 2008 (5)	year< 2008 (6)
bs_{ijt}	0.0238**		0.0211*	0.0339***		0.0331***
	(0.0110)		(0.0116)	(0.0112)		(0.0119)
bs_{jit}	-0.000795		0.0125	-0.00591*		0.00994
	(0.00313)		(0.00891)	(0.00320)		(0.00861)
bf_{ijt}		0.00116	-0.000789		-0.0000949	-0.00383**
		(0.00155)	(0.00167)		(0.00164)	(0.00174)
bf_{jit}		-0.00254*	-0.00872*		-0.00501***	-0.0101**
		(0.00142)	(0.00462)		(0.00144)	(0.00448)
P ratio	0.0243***	0.0241***	0.0244***	0.0217***	0.0216***	0.0219***
	(0.00629)	(0.00630)	(0.00629)	(0.00632)	(0.00631)	(0.00632)
N_i	1.579***	1.512***	1.581***	1.410***	1.311***	1.411***
	(0.427)	(0.435)	(0.427)	(0.471)	(0.480)	(0.471)
N_j	1.972***	1.915***	1.961***	1.967***	1.866***	1.952***
	(0.372)	(0.372)	(0.372)	(0.389)	(0.388)	(0.390)
Y_i	0.766***	0.790***	0.773***	0.686***	0.732***	0.689***
	(0.143)	(0.144)	(0.144)	(0.147)	(0.148)	(0.147)
Y_j	1.116***	1.130***	1.115***	1.037***	1.058***	1.034***
	(0.150)	(0.150)	(0.150)	(0.160)	(0.160)	(0.160)
N	11436	11436	11436	10542	10542	10542
N	11436	11436	11436	10542	10542	10542
R^2	0.399	0.399	0.399	0.364	0.364	0.365
Year FE	Y	Y	Y	Y	Y	Y
Pair FE	Y	Y	Y	Y	Y	Y

Dependent Variable $\log(1 + EX_{ijt})$. L. indicates one-year lag. N is population. Y is per capita real GDP. ap_{ijt} measures changes in aggregate bank proximity. bs_{ijt}, bs_{jit}, bf_{ijt}, bf_{jit} are measures of stocks and flows of bank claims from BIS. PSM-nn is nearest neighbor matching, PSM-ll is local linear matching. Robust standard errors in parentheses. Within R^2 reported for pair fixed effects regressions. *(P< 0.10), **(P< 0.05), ***(P< 0.01). *(P< 0.10), **(P< 0.05), ***(P< 0.01).

Appendix Table A.3. Summary statistics for proximity measures

Variable	Obs	Mean	Std. Dev.	Min	Max
Country-pair-year level					
Average proximity p	16240	.581	.455	0	1
Share of directly linked bank pairs	16240	.564	.454	0	1
Number of bank pairs	16240	30.5	87.05	0	1082
Aggregate proximity (Sum p) AP	16240	27.95	82.05	0	1082
Number of banks directly linked AL	16240	27.05	80.35	0	1082
Sum of indirect proximities	16240	.871	3.60	0	73.3
Log change in aggregate proximity ap	16240	.369	.788	0	6.46
Log change in number of direct links al	16240	.366	.799	0	6.43
Log change in indirect proximity $aind$	14817	.001	.443	-13.9	4.06
Insurance premium differential ρ	15904	0	.145	-.972	.972
Average elasticity σ	14360	9.67	1.59	3.23	22.9
Country-year level					
Export insurance premium	658	.551	.118	.344	1.45
Country level					
Insured export credit (bil. 2000 USD)	29	13.44	11.1	.943	48.5

Appendix Table A.4. First stage regressions for IV and probit regression for propensity score matching

Variable	IV1 First stage	IV2 First stage	PSM probit
	(1)	(2)	(3)
Dependent variable	L.ap_{ijt}	L.ap_{ijt}	I(L.$ap_{ijt} > 0$)
L.$\Delta(i_i - i_j) * AP_{ij0}$	0.00011**	0.00009*	
	(0.00005)	(0.00005)	
L.$\Delta(i_i - i_j)$		0.0023***	0.006
		(0.0009)	(0.00473)
AP_{ijt-2}			-0.0444***
			(0.005)
bs_{ijt}	-0.02	-0.02	0.11**
bs_{jit}	-0.028**	-0.028**	0.07
bf_{ijt}	-0.012**	-0.013**	-0.022*
bf_{jit}	0.021**	0.021**	-0.012
N_i	1.13***	1.16***	-4.37***
N_j	-0.13	-0.16	-1.17
Y_i	1.060***	1.050***	0.93**
Y_j	0.77***	0.78***	0.72*
Observations	7912	7912	4760
R^2	0.25	0.25	0.37
Partial R^2 of instruments	0.003	0.004	
F-tests	4.39	7.31	
Anderson-Rubin Wald F test: p-value	0.0005	0.002	
Stock-Wright LM S statistic: p-value	0.0016	0.007	
Hansen J-statistic: p-value		0.76	
Corr(predicted prob, L.ap_{ijt})			0.62
Predicted prob (L.$ap_{ijt} > 0$)			0.67

Dependent variable is ap_{ijt-1} in columns (1) and (2) and $I(ap_{ijt-1} > 0)$ in column (3). All regressions include country pair and year fixed effects. i is the interest rate. AP is the aggregate proximity level. L. indicates one-year lag. N is population. Y is per capita real GDP. ap_{ijt} measures changes in aggregate bank proximity. bs_{ijt}, bs_{jit}, bf_{ijt}, bf_{jit} are measures of stocks and flows of bank claims from BIS. Robust standard errors in parentheses. *(P<0.10), **(P<0.05), ***(P<0.01). Pseudo-R^2 reported for the probit regression.