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Gravity in International Finance: Evidence from Fees on Equity Transactions

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Abstract
We shed light on the impact of institutional quality and information barriers on trade in financial services using a novel panel data set on revenue earned on domestic and cross-border equity securities underwriting transactions. Our data set covers 91,511 transactions across 122 countries of origin and 145 countries of destination for the period 2000-2015. The granularity of our data set enables us to estimate theory-consistent gravity equations, avoiding the methodological caveats that apply to most of the existing literature on gravity in international finance. First, we find that institutional quality in the exporting country, proxied by the rule of law, is an important determinant of financial services trade. In addition, we provide support for the "bonding hypothesis" (Coffee, 1999) in the literature on the determinants of foreign listings. Foreign firms can increase their valuation by bonding themselves to high-quality institutions through cross-listing. In line with this hypothesis, we find that institutional quality matters primarily for transactions where the underwriter is located in the country of the stock exchange where the shares are listed. Second, we focus on the role of multinational business networks in breaking down information frictions. Specifically, we control for several measures of "connectivity" based on banks' parent-subsidiary networks and syndication ties across banks. We find evidence supporting our hypothesis. In all our estimations, we control for the classical determinants of trade in the gravity framework, including distance. Interestingly, we find that the inclusion of our institutional and informational variables leaves a very limited role for physical distance - supporting the consensus in the literature on gravity in international finance that the role of distance reflects institutional and information frictions.

Key words: Gravity, international trade, international finance, equity securities underwriting, multinational business networks, financial geography.
JEL Codes: F14; F23,;F65, G15; G24.

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1 Introduction

The gravity model is undoubtedly one of the workhorses of empirical work in international goods trade. Over the last two decades, it has increased in popularity in international finance where it has been used to explain international transactions and holdings in financial assets, such as portfolio equity and debt securities. A stable finding of this literature is that distance has a negative effect on trade in financial assets. The magnitude of the elasticity is similar to that found in the goods trade literature. This is surprising since there are no transportation costs involved. The consensus is that distance is a proxy for informational and institutional frictions, and there is evidence pointing in this direction. Our paper contributes to the literature on gravity in international finance both methodologically and conceptually. The literature suffers from several shortcomings, mainly regarding data availability and quality, econometric estimation, and the extent to which empirical specifications are theory consistent. Our paper addresses some of these shortcomings by applying theory-consistent methods to a novel panel data set on fees from domestic and cross-border equity securities underwriting services. The granularity of our data set is key to our conceptual and methodological contributions. We build a data set of cross-border and domestic trade flows by aggregating transaction-level data on revenue flows associated with the underwriting of new issues of equity securities from the Dealogic Equity Capital Market (ECM) database. Our data set covers 91,511 transactions from 7,326 underwriters serving 46,408 equity issuers across 122 countries of origin and 145 countries of destination for the period 2000-2015. This data set not only allows us to estimate theory-consistent gravity equations, it also allows us to examine the role of information barriers through the lens of multinational business networks. To the best of our knowledge, this is the first contribution of this kind in the literature on gravity in international finance. Specifically, we build several measures of "connectivity" based on banks' parent-subsidiary networks and syndication ties across banks. Multinational business networks matter for trade in financial services as they help trading partners break down information frictions. We find evidence supporting this hypothesis. In all our estimations, we control for the classical determinants of trade in the gravity framework, including distance. Interestingly, we find that the inclusion of our institutional and informational variables leaves a very limited role for physical distance - supporting the consensus in the literature on gravity in international finance that the role of distance reflects institutional and information frictions.

We start by highlighting how our paper addresses several of the methodological shortcomings of the existing literature. The gravity model posits that trade between countries increases in their combined economic mass, and decreases in the geographical distance and trade barriers between them. The gravity framework was initially developed for trade in goods, but it can be applied equally to services. Since the mid-2000s economists have also applied gravity to the realm of international finance. The interest in gravity was sparked by the finding that gravity equations explain international transactions in financial assets at least as well as goods trade transactions (Portes et al., 2001; Portes and Rey, 2005). Since then a large number of papers have estimated gravity equations for cross-border equity, bond and bank holdings. The two main sources of data on financial holdings used in the gravity litera-

ture are the IMF *Coordinated Portfolio Investment Survey* and the BIS *Locational Banking Statistics*.[1] Despite its popularity, the gravity framework in international finance suffers from several caveats and shortcomings, which we attempt to address both through the very nature of our data set and through our methods.

The main shortcoming affecting the existing literature is that most estimated gravity equations in international finance do not have a theoretical foundation (Okawa and van Wincoop, 2012). The first, and most obvious, violation of theory is the omission of the appropriate source and destination country fixed effects that capture multilateral resistance (Anderson and van Wincoop, 2003). Fixed effects are sometimes explicitly omitted because the authors aim to explore the impact of variables that would be absorbed by those fixed effects. Our novel panel data set enables us to include importer-year and exporter-year fixed effects, and at the same time study the impact of information barriers that are not necessarily dyadic, but rather vary at the country-year level. Our identification strategy relies on the fact that we observe both domestic and cross-border transactions. Specifically, we multiply our explanatory variables by a dummy variable for international trade.

The second violation of theory in the existing literature comes from the inclusion of explanatory variables without theoretical foundation. This violation has to do with the fact that the gravity literature in international finance has looked at international financial flows through the lens of data on *financial holdings*, rather than data on trade in *financial services*. According to the theory of optimal portfolio choice the demand for an asset depends not only on its expected return, but also on the latter's covariance with other assets. As a consequence, researchers often include correlations (mainly across asset returns) as explanatory variables in their gravity equations.[2] However, as highlighted by Okawa and van Wincoop (2012), this is not theory consistent. Paralleling Anderson and van Wincoop (2003) in the goods trade literature, Okawa and van Wincoop (2012) discuss the two key assumptions that must be satisfied to generate a gravity specification for asset holdings. The first condition is that decisions about the overall demand for assets are separable from the portfolio allocation across assets. This condition holds in many models. The second condition is that asset demand depends on a relative price. This assumption is problematic for gravity in finance because it is not in line with the predictions of the theory of optimal portfolio choice. Our paper is not subject to these caveats because we use data on the value of financial *services*, rather than financial *holdings*. Specifically, we use data on revenues (fees) earned from the provision of underwriting services by securities underwrit-

[1] Papers that examine cross-border bank holdings using the BIS *Locational Banking Statistics* include among others Papaioannou (2009), Brei and von Peter (2017), Daude and Fratzscher (2008), and Houston, Lin and Ma (2012). Papers that examine equity holdings using the IMF *Coordinated Portfolio Investment Survey* (CPIS) include among others Lane and Milesi-Ferretti (2008), Daude and Fratzscher (2008), Lane and Milesi-Ferretti (2005), Veronique and Benassy-Quere (2006), Faruqee et al. (2004), Coeurdacier and Martin (2009), Coeurdacier and Guibaud (2011), and Berkel (2007). The literature that relies on other data sets is dominated by papers focusing primarily on a single country, with most attention paid to the United States; e.g. Portes et al. (2001), Ahearne et al. (2004), Forbes (2010), and Chiţu et al. (2014).

[2] See among others Lane and Milesi-Ferretti (2008), Forbes (2010), Faruqee et al. (2004), Coeurdacier and Guibaud (2011), Berkel (2007), and Chan et al. (2005).

ers to issuers. We do not model the demand for assets, but rather the demand for services provided by financial services firms. This is not only methodologically appealing, it also enables us to assess the impact of specific variables directly on revenue flows from international trade, rather than holdings.

Contributions using data on trade in financial services are surprisingly scarce. However, this scarcity is no longer surprising once one considers the severe limitations of data on financial services. Data sets on trade in services, including financial services, are compiled on the basis of balance of payments data provided by national statistics offices. There are many challenges to overcome in order to develop a global database of coherent bilateral trade in services statistics. These challenges include missing data, trade asymmetries (where the reported exports of country j to country k do not align with the reported imports of country k from country j), and differences in reporting standards and statistical methodologies. These challenges are particularly acute when trying to compile a database at a disaggregated level to look at certain categories of services in isolation, e.g. financial services. Recent efforts by the OECD and the WTO have lead to the creation of the OECD-WTO Balanced Trade in Services (BaTIS) dataset. It provides annual bilateral data on trade in services covering 191 economies and broken down by services categories, including a broad "financial services" category.[3] The primary official data is subjected to multiple cleaning, mirroring, and estimation procedures to produce an internationally coherent data set. While this is a welcome development, our data set presents numerous advantages over data sets that are based on balance of payments statistics. Our data set has a comprehensive global coverage (zero observations are true zeros with a very high probability) and does not require any manipulations designed to harmonize the data across countries, to mirror exports and imports, and to predict missing trade flows among countries. In particular, using "synthetic" observations obtained through mirroring and prediction techniques might be problematic in regressions that study the determinants of bilateral trade because there is a danger that a similar gravity model was used to fill in the missing cells in the trade matrix. In addition, the amount of modeling contained in the data will vary across country groups. The data set might be heavy on modeling for emerging markets for example, particularly when applying sectoral disaggregation. Finally, our data set is at the transaction level and contains data on both domestic and cross-border transactions. This fine level of disaggregation enables us to be flexible with how we aggregate trade flows and make use of them in the empirical strategy. In particular, having data on both domestic and cross-border transactions enables us to identify coefficients on country-time specific variables despite the inclusion of country-time fixed effects. The granularity of our data set also enables us to build connectivity measures based on banks' parent-subsidiary networks and syndication ties across banks.

The remaining shortcomings in the existing literature are related to estimation issues. Beyond the failure to include the appropriate fixed effects, the main methodological problem is that the overwhelming majority of contributions, even relatively recent ones, use log-linearized forms of the gravity equation. Santos Silva and Tenreyro (2006) explain that this is a problem because under heteroskedasticity, the parameters of log-linearized models estimated by OLS lead to biased estimates of the true elasticities.

[3] A recent contribution using this database is Nordås and Rouzet (2017).

We follow the authors' proposed solution and use Poisson pseudo-maximum likelihood (PPML) to estimate the gravity equations in their multiplicative form.

We now turn to a summary of our main findings. First, we examine the role of institutional quality in the exporting country, proxied by the exporter's rank on the Rule of Law index proposed by Kaufmann et al. (2011). Rule of Law captures institutions that are vital for the financial services industry, such as the legal environment. In support of this hypothesis, we find that moving down one rank (indicating a deterioration in institutional quality) is associated with a decrease in international trade relative to domestic trade by 62.2%. These results are in line with the economic geography literature. For example, Wójcik et al. (2018b) find that international financial centers (IFCs) emerge from well-developed cities in countries with strong Rule of Law and cost efficient enforcement of contracts. Among the traditional gravity control variables, a shared colonial history appears to be particularly important. Being a previous colonial partner increases international trade relative to domestic trade by 195.9%. This coefficient is higher than magnitudes previously found in the goods trade literature. The apparent importance of a shared colonial history is intuitive. Countries that have been in a colonial relationship are more likely to share common institutional and legal frameworks, which are paramount for trade in financial services.

In addition, we provide support for the "bonding hypothesis" (Coffee, 1999) in the literature on the determinants of foreign listings. Foreign firms can increase their valuation by bonding themselves to high-quality institutions through cross-listing (Doidge et al., 2004). Cross-listing firms subject themselves to stricter standards of regulation, disclosure, and enforcement to signal their commitment to respecting the rights of shareholders (Doidge, 2004; Doidge et al., 2007, 2009). The added protection and the reputational effects (Siegel, 2005) make investors more willing to buy the shares of foreign firms that "tie their hands" in this manner. In order to examine this hypothesis, we exploit differences in the sensitivity of certain transaction types to the institutional environment. Our strategy relies on the fact that equity underwriting services are provided by syndicates of underwriters, not all of which will be geographically located in the country of the stock exchange where the shares are listed. Underwriters located in the country of the stock exchange typically help with the listing itself. By contrast, underwriters located in other countries are typically used to help sell shares in the offering to local institutional investors (Pollock et al., 2004). The "bonding hypothesis" suggests that institutional quality should matter more when the trade flow pertains to listing, i.e. is between an issuer and an underwriter located in the country of the stock exchange where the shares are issued (Doidge, 2004; Doidge et al., 2007). We find evidence supporting this conjecture. Specifically, we find that institutional quality matters primarily for transactions where the underwriter is located in the country of the stock exchange where the shares are listed. This points to a significant role played by institutional quality in determining where firms choose to list their shares.

Second, we focus on the role of multinational business networks. To the best of our knowledge, this is the first study of this type in the literature on gravity in international finance. Multinational

business networks matter for trade in financial services as they help trading partners break down information frictions. The economic geography literature proposes that trade frictions, such as information frictions, may be reduced through the strategic business activities of multinational companies in finance, accounting, law and management consulting, which operate networks of offices or subsidiaries across multiple countries (Taylor and Derudder, 2016). The expectation is that the more a country-dyad is connected through the subsidiary networks of multinational companies, the lower the information frictions will be between the two countries, ceteris paribus. To examine this hypothesis, we build several measures of network connectivity based on banks' parent-subsidiary networks and syndication ties across trading partners. First, we construct a measure of ownership ties, based on the number of underwriters for each country-dyad that have subsidiaries in both countries. We find that connectivity has a significantly positive impact on international trade. Specifically, a one percentage point increase in ownership ties is associated with a 10.8% increase in international trade relative to domestic trade. Second, we build two alternative measures of multinational connectivity based on ties formed by co-membership of underwriting syndicates (Pažitka et al., 2019) using data on issues of equity securities with more than one underwriter (representing 42.7% of all deals).[4] First, we define *syndication ties count* as the number of ties formed by the co-membership of underwriting syndicates among underwriter parents headquartered in the exporting country with those headquartered in the importing country in a given year. Second, we construct *unique syndication ties count* for exporter-importer-year observation by counting the number of *unique* syndication partners that underwriters in the exporting country have in the importing country in every year. This means that each underwriter in the importing country is counted only once, even if multiple underwriters in the exporting country had co-syndicated with that underwriter. Finally, we transform the *syndication ties count* (*unique syndication ties count*) into percentages by normalizing them by the sum of syndication ties (unique syndication ties) for each exporter-year. We find that a one percentage point increase in syndication ties (unique syndication ties) is associated with a 6.5% (9.4%) increase in international trade relative to domestic trade. Interestingly, we find that after accounting for ownership or syndication ties, the impact of Rule of Law and a shared colonial history decreases in magnitude. This could indicate that (physical or relational) networks might help overcome issues associated with weaker, or different, institutional frameworks.

In all our estimations, we control for the classical determinants of trade in the gravity framework, including distance. A stable finding of the literature on gravity in international finance is that distance has a negative effect on trade in financial assets. The magnitude of the elasticity is similar to that found in the goods trade literature. This is surprising since there are no transportation costs involved. The consensus is that distance is a proxy for informational and institutional frictions, and there is evidence pointing in this direction. Interestingly, we find a very limited role for physical distance. We find that the latter only matters at the extensive margin of trade. Specifically, a 10% increase in bilateral distance translates into a 4.58% decrease in the probability of international trade relative to domestic trade when we control for Rule of Law. The elasticity decreases further when we

[4]The construction of these measures is described in detail in Section 3.4.

also control for syndication ties. This result is in sharp contrast with the previous literature on gravity in international finance, where many authors find elasticities commensurate with those in the goods trade literature. Our finding is driven both by our methods and the inclusion of relevant institutional and informational variables. First, we estimate theory-consistent gravity equations unlike most of the previous literature on gravity in international finance. Because we have data on both international and domestic transactions, and multiply distance by a dummy for international trade, our distance elasticity is to be interpreted as the impact of distance on international trade relative to domestic trade. Second, to illustrate the power of our explanatory variables, we estimate a classical gravity equation without the latter and indeed find much larger distance elasticities, which are significant along both the intensive and extensive margins of trade.

The remainder of the paper proceeds as follows. Section 2 describes the gravity model and our empirical strategy. Section 3 presents our data sources and descriptive statistics. Section 4 presents the estimation of our theory-consistent gravity equations, focusing on the role of institutional factors and information barriers. Section 5 concludes.

2 Structural gravity and empirical methodology

2.1 Theoretical structural gravity

One of the most attractive features of the gravity model of trade is that it can be theoretically derived from a large class of models. For example, Arkolakis et al. (2012) show that a large number of micro foundations generate isomorphic gravity equations. For the majority of the empirical results presented in this paper we can remain agnostic as to the exact underlying theoretical model, and thus the assumptions we need to make. However, for expositional reasons, we briefly formalize the gravity model using the influential supply side model presented in Eaton and Kortum (2002). Here we closely follow Yotov et al. (2016).

Issuer (consumer) preferences are assumed to be geographically invariant and can be described by a CES functional form across a continuum of *varieties* of financial services on the unit interval: $U_j = \left[\int_0^1 c(i)^{\frac{\sigma-1}{\sigma}} dl\right]^{\frac{\sigma}{\sigma-1}}$. j denotes country, i indexes varieties and σ is the constant elasticity of substitution between varieties. We assume constant returns to scale at the underwriter (firm) level. Countries, however, are heterogeneous in their technology. Specifically country j has efficiency in producing variety i given by $z_j(i)$. The key assumption in Eaton and Kortum (2002) is that z is drawn from a type-two extreme value distribution $F_i(z) = \exp\left(-T_i z^{-\theta}\right)$, where T_i is country specific and shifts the distribution, whereas θ determines the variation in the distribution.

Given constant returns to scale, and denoting the input costs in country j with c_j, we have that the cost of producing a unit of variety i in country j is given by $\frac{c_j}{z_j(i)}$. Assuming the usual iceberg trade costs

t_{jk} we can see that the cost of delivering a unit of service i from j to k is given by $p_{jk}(i) = \left(\frac{c_j}{z_j(i)}\right) t_{jk}$. Assuming perfect competition this is also the price issuers (consumers) in k would pay for variety i from country j if they decided to purchase it. However, issuers (consumers) in k may not actually purchase from j, in fact the price they actually pay for variety i is given by the minimum of the prices offered to them.

$$p_k(i) = \min_{j \in \mathcal{L}} \{p_{jk}(i)\} \tag{1}$$

where $\mathcal{L}$ is the set of possible locations. Using Equation (1) and properties of the type-two extreme value distribution, we can determine the distribution of prices from which country k actually buys services.

$$G_k(p) = \mathbb{P}[p_k \leq p] = 1 - \prod_{j \in \mathcal{L}} (1 - \mathbb{P}[p_{kj} \leq p]) = 1 - \prod_{j \in \mathbb{L}} \left(1 - \left(1 - \exp\left\{-T_j \left(c_j t_{jk}\right)^{-\theta} p^{\theta}\right\}\right)\right) \tag{2}$$

This collapses to $G_k(p) = 1 - \exp\left\{-\Phi_k p^{\theta}\right\}$ where $\Phi_k = \sum_{j \in \mathcal{L}} T_j \left(c_j t_{kj}\right)^{-\theta}$. Thus the fraction of services that country k buys from country j is given by $\pi_{jk} = T_j \left(c_j t_{jk}\right)^{-\theta} / \Phi_k$. As average expenditure per service is geographically invariant (from invariance of consumer utility), k's fraction of expenditure on services from j is given by $X_{jk} = \pi_{jk} E_k$, where E_k is k's total expenditure. Finally, we note that the value of revenue (output) in country j, Y_j, is simply equal to total expenditure on j's variety across the world (including in j itself), that is $Y_j = \sum_{k \in \mathcal{L}} X_{jk}$. Using this equation and those derived above as well as the fact that the exact price index is given by $p_j = \gamma \Phi_j^{\frac{-1}{\theta}}$[5], we can derive the following expression for trade flows:

$$X_{jk} = \frac{t_{jk}^{-\theta}}{\gamma^{\theta} P_k^{-\theta} \left(\sum_{k \in \mathcal{L}} \frac{t_{jk}^{-\theta}}{\gamma^{\theta} p_k^{-\theta}} E_k\right)} Y_j E_k \tag{3}$$

Defining Π_k and P_k appropriately[6], the resulting structural gravity equation explains trade flows between two countries X_{jk} and takes the form:

$$X_{jk} = \frac{Y_j E_k}{Y} \left(\frac{t_{jk}}{\Pi_j P_k}\right)^{-\theta} \tag{4}$$

If we alternatively constructed the model from the demand side, as shown in Yotov et al. (2016), we would arrive at an isomorphic equation with $1 - \sigma = -\theta$ where σ is the elasticity of substitution between varieties. Y_k is nominal income in country k and Y is nominal world income. E_k is total expenditure in destination k. Π_j and P_k are the *multilateral resistance terms*, capturing j's outward resistance or ease of market access, and k's inward resistance or ease of market access, respectively. Finally, t_{jk} captures the bilateral trade costs between j and k.[7]

[5] $\gamma = \left[\Gamma\left(\left(\theta + 1 - \sigma\right)/\theta\right)\right]^{\frac{1}{(1-\sigma)}}$ where Γ is the Gamma function.

[6] Specifically define $\Pi_j = \left(\sum_{k \in \mathcal{L}} \left(\frac{t_{jk}}{p_k}\right)^{-\theta} \frac{E_j}{Y}\right)^{-1/\theta}$ and $P_k = \left(\gamma^{-\theta} \Phi_j\right)^{-1/\theta} = \left(\sum_{k \in \mathcal{L}} \left(\frac{t_{jk}}{\Pi_j}\right)^{-\theta} \frac{Y_j}{Y}\right)^{-1/\theta}$ where $Y = \sum_{j \in \mathcal{L}} Y_j$.

[7] Equation (4) describes *aggregate* trade flows between countries. However, we are interested in explaining

2.2 Empirical implementation of the gravity equation

The empirical estimation of Equation (4) is subject to numerous issues that have lead to many theoretically and statistically inconsistent estimates of key parameters in the past. Some of these issues have been satisfactorily dealt with only recently, with important theoretical, econometric and computational advances. Contributions such as Anderson and van Wincoop (2003), Santos Silva and Tenreyro (2006), and Piermartini and Yotov (2016) among others have insured that the quality of empirical gravity research continues to increase. However, a surprising number of contributions in international finance still fail to heed their advice. In this section, we describe the main challenges involved in estimating Equation (4) and how we overcome each obstacle in our specific empirical setting.

First, trade data, especially when disaggregated by sector, suffers from the many-zeros problem. Many countries have no trade with many other countries in many time periods. Therefore, the full trade matrix is a sparse matrix containing many zero entries. This is a serious problem, when using the traditional log-linearized version of the gravity equation estimated with OLS. Indeed, zeros are dropped as if they were missing values, despite the fact that they contain useful information about trade patterns. First-generation solutions to this problem, such as adding a small positive number to each zero, are arbitrary and lead to biased results (Head and Mayer, 2014). Therefore, we follow Santos Silva and Tenreyro (2006) and estimate our gravity equation using Poisson pseudo maximum likelihood (PPML)[8], which allows us to estimate Equation (4) directly in a multiplicative form and thus retain the zeros. This method has been shown to have excellent properties, even when the proportion of zeros is very high. In addition, log-linearized models are biased (and inconsistent) in the presence of sufficient heteroskedasticity (as is the norm with trade data) due to the simple fact, that Jensen's inequality implies $\ln(\mathbb{E}[y]) \neq \mathbb{E}[\ln(y)]$. Using PPML also enables us to overcome this problem as described in Santos Silva and Tenreyro (2006).

Second, Equation (4) contains various unobserved components. In particular, the objects Π_j and P_k, termed "multilateral resistances" by Anderson and van Wincoop (2003), are unobserved. Baldwin and Taglioni (2006) show the importance of sufficiently accounting for these terms in order to achieve consistent estimation of the parameters in a gravity model. We overcome this issue by leveraging the panel nature of our data set and including *exporter-time* and *importer-time* fixed effects, π_{jt} and p_{kt}, in all our empirical specifications. Note that including these fixed effects also absorbs the country and world nominal income terms as well as the destination expenditure variable, as they cannot be separately identified. In addition to the multilateral resistance terms being unobserved, bilateral trade costs given by t_{jkt} are also unobserved. We proxy for this unobserved variable using a number of

trade flows of a specific industry. Fortunately, the gravity model is separable, and therefore Equation (4) holds for any specific industry l, noting that every variable (including σ or θ) is then l specific.

[8]PPML is a weighted non-linear least squares estimator where the weights are constructed under the assumption that $\mathbb{E}[y|x] \propto \mathbb{V}[y|x]$. This captures the well-known property of trade data that higher means are associated with higher variances. This assumption leads to equal weighting and Poisson distributed errors. In general, the following set of FOCs are solved to find $\hat{\beta}_{PPML}$: $\sum_i \left(y_i - \exp\left(x_i \hat{\beta}_{PPML}\right)\right) x_i = 0$.

observed variables traditionally used in empirical gravity equations, namely the geographical distance between the exporting country (country of the underwriter) and the importing country (country of the issuer), whether the exporter and importer share a border, whether the exporter and importer share a language, and whether the exporter and importer have a common colonial history. We augment the set of explanatory variables with a measure of institutional quality in the exporting country (Rule of Law) and three dyadic measures of connectivity based on ownership and syndication ties. We also control for the level of development in the exporting country (GDP per capita) as this is likely to be highly correlated with institutional quality. A detailed description of variables is given in Section 3.

Third, a potential problem with including exporter-time and importer-time fixed effects to deal with the multilateral resistance terms is that we can no longer estimate the effect of certain variables. Importantly, this prevents us from exploring the role of information barriers and institutional factors when the variables proxying them are country-time specific (such as the rule of law in the exporting country). Not including the fixed effects is not an option as this would render our estimates statistically and theoretically inconsistent. In order to retain the theoretically and empirically necessary importer-time and exporter-time fixed effects, and simultaneously identify the impact of country-time specific variables of interest, we use an approach suggested by Heid et al. (2017). Specifically, we rely on the fact that our data set contains both domestic (intranational) and cross-border (international) trade flows. We multiply all the explanatory variables with a dummy for *international* trade, INT_{jk}, which takes the value one whenever $j \neq k$.[9] The resulting coefficients should therefore be interpreted as capturing the impact of the variables on international trade *relative* to domestic trade.

Taking all the above into consideration, our baseline empirically tractable version of Equation (4) is given by the following equation:

$$X_{jkt} = \exp\{\pi_{jt} + p_{kt} + Z_{jkt}\Gamma\} + \varepsilon_{jkt} \tag{5}$$

where π_{jt} are exporter-time fixed effects and p_{kt} are importer-time fixed effects. Z_{jkt} represents the control variables of interest, and ε_{jkt} is an idiosyncratic error term.

3 Data sources and descriptive statistics

3.1 Trade flows in equity underwriting services

Our source of data on trade flows is Dealogic's Equity Capital Market (ECM) database. Our dependent variable is a measure of trade flows based on revenues earned by banks from underwriting

[9] Without data on intranational trade, we would only be able to include importer-time fixed effects given that we are interested in variables that are exporter-time specific (Rule of Law for example). Earlier papers using panel data sets suffered from that shortcoming. For example, Papaioannou (2009) uses BIS panel data on cross-border bank holdings. Because the author is interested in the effect of time-varying institutional characteristics in the recipient country, they can only include time-specific fixed effects for the source country.

equity securities for their clients (issuers). Revenues are reported in current USD (nominal). Our data set covers 91,511 issues of equity securities offerings during the 2000-2015 period. These can be divided into 23,136 initial public offerings (IPOs), 58,454 follow-on offerings, and 9,921 convertible debt securities. We identify the key parties for each transaction – the underwriter(s) and the issuer. An offering can be underwritten by a single underwriter or a group of underwriters, so called underwriting syndicates (Pollock et al., 2004). These are groups of underwriters organized for the purpose of bringing a single issue of equity securities to the market and dissolved thereafter. Every offering has as many revenue flows as there are underwriters involved. The 91,511 offerings in our data set constitute 306,512 revenue flows among underwriters and their clients. 57.3% of the offerings in our data set are underwritten by a single underwriter. The remaining transactions are underwritten by underwriting syndicates. When more than one underwriter is involved in an offering, revenue is apportioned by Dealogic's proprietary apportioning model among underwriting syndicate members. This is done based on their role in the underwriting syndicate (bookrunner, lead manager, co-manager, underwriter) and their level of participation in the deal, given by the fraction of newly issued securities allocated to them for selling to primary market investors.

In order to aggregate these individual revenue flows to a country-dyadic level, we need to identify the country of the underwriter(s) (exporting country/countries) and the country of the issuer (importing country) for each transaction. We adopt two conventions. First, the country of both the underwriter and the issuer is assigned based on their respective headquarters of operations, i.e. where their de-facto head office is located, rather than where each company is registered for tax or legal purposes.[10] Second, if the underwriter directly involved in a transaction is a subsidiary company, the exporting country is determined by the nationality of its parent company - in line with international trade statistics conventions. We link the 91,511 offerings in our data set to 46,408 clients and 7,326 underwriter subsidiaries, controlled by 4,287 parent companies.

Dealogic's ECM database contains information on the country of headquarters of operations for all the 46,408 issuers in our data set. The ECM database, however, does not include data on the location of underwriters. To fill this gap, we hand-collect data on addresses of headquarters of operations of underwriters' parent companies from corporate websites and databases, including Bureau van Dijk Orbis, Nexis UK and Bloomberg. We were able to collect data on countries of HQ of operations for 4,176 parent companies (97.4%) in our data set. Data on revenue earned from underwriting equity securities in Dealogic's ECM database is either directly reported by underwriters or is estimated by Dealogic. Revenue data is directly disclosed for 45.1% of transactions by the underwriters involved in them. Revenue data is not disclosed by the underwriters for the remaining 54.9% of transactions. However, Dealogic's ECM database offers proprietary estimates of revenue earned for 47.7% of transactions. We therefore have a combination of disclosed and estimated fees available for 92.8% of transactions. Finally, 7.2%

[10]The reason behind this is to avoid any biases caused by companies registered or formally headquartered outside of the countries of their operations. For example, it is very popular for Chinese companies to register in the British Virgin Islands.

of transactions do not have disclosed or estimated revenue data available, and are therefore omitted from our sample. The missing geographical and revenue data means that we cannot observe 7,710 out of the 306,512 revenue flows (2.52%) in our data set. In terms of the pattern of missing data, we were less likely to find geographical data for very small and no longer operating underwriters with no traceable online footprint. We would however not expect this to affect specific countries disproportionately. To create our aggregated country-dyadic trade flows, we combine data reported by underwriters with Dealogic's estimates for those transactions where hard data is not available. This is preferable to omitting transactions for which hard data on revenue earned is not available. While the use of estimates for a fraction of transactions may be a source of random measurement error, the exclusion of transactions for which hard data is not available is likely to bias our results against countries that do not require underwriters to disclose revenue earned from equity underwriting for individual deals.[11]

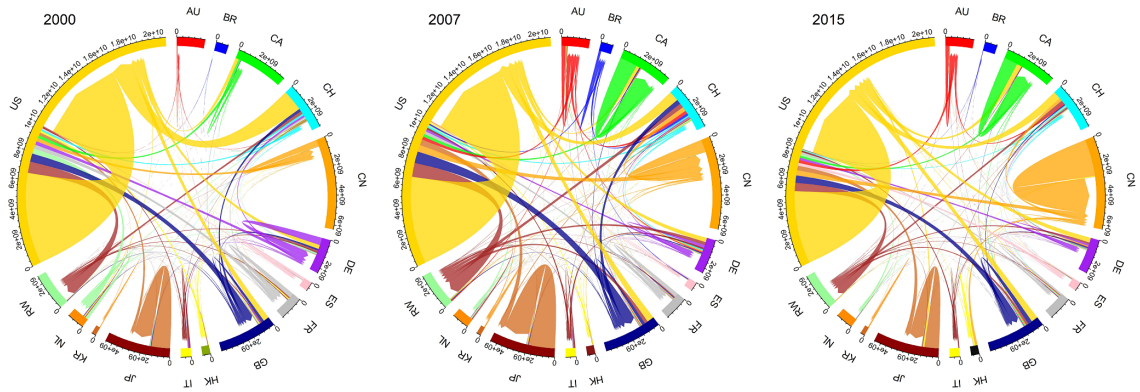
After aggregating individual revenue flows into country-dyadic flows, we merge the latter with the CEPII distance data set. The country of origin is the country of the underwriter (exporting country), and the country of destination is the country of the issuer (importing country). Our country-dyadic flows derived from Dealogic data cover 122 countries of origin and 145 countries of destination. We replace any unmatched observations in the trade matrix with zeros. This is justified by the comprehensive nature of Dealogic's Equity Capital Markets database, which allows us to treat unobserved trade flows as true zeros with a very high level of confidence. Naturally, it cannot be ruled out that some of the zero trade flows in our data set may be the consequence of missing data, but we estimate that the proportion of "false zeros" is likely to be very small. All the missing data combined represent 7,710 revenue flows among underwriters and clients, which we are either unable to pinpoint geographically or for which do not have data on revenue earned. We would expect that the vast majority of these missing revenue flows will be associated with country-dyads that have non-zero trade flows and only a small fraction of the 7,710 missing revenue flows is likely to fall on country-dyads for which we report zero trade flows. Therefore, the fraction of "false zeros" resulting from the missing data is likely to be very small. Even in the worst case scenario where all the missing revenue flows would fall exclusively on country-dyads for which we report zero trade flows, they would only create a small fraction of "false zeros" because the 7,710 missing revenue flows represent only 2.8% of all zero trade flows (271,205 trade flows in total). In other words, a maximum of 2.8% of our zero trade flows would be misreported, instead of reporting small trade flows. This means that our zero trade flows can be

[11]To get a sense of the quality of Dealogic's revenue estimates, we contacted Dealogic and inquired about their estimation method. We learned that Dealogic employs a designated data analytics team, which focuses on modelling fees earned from investment banking transactions, including equity underwriting. Dealogic develops pricing models similar to those used by investment banks to price these transactions in the first place. The parameters of these models are not estimated from data on other transactions, but they are instead derived from regular expert interviews with industry practitioners responsible for pricing investment banking deals. We also inquired about the accuracy of such estimates and were advised that Dealogic's interviews with industry practitioners indicate that their estimates are within a 5% margin of error. Further reassurance on the reliability of the estimates comes from the fact that Dealogic serves as a platform for investment banks to collate their data on capital market transactions into a single data set that they rely on for market share calculations, ranking tables, and industry reports.

most accurately interpreted as a mix of mostly true zeros and some censored observations (at most 2.8% of the true zeros) that are very close to zero. For this reason we maintain that our zero trade flows are informative and should not be treated as missing data, but as true zeros / right censored observations. We drop country pairs that do not display any variation in revenue flows (i.e. trade flows are always zero), as they are not informative for the estimation of the gravity equations. We obtain a sample of 132 countries that have at least one non-zero revenue flow during the 2000-2015 period (see list of countries in Appendix). This leaves us with a very sparse matrix of trade flows, containing 7,579 non-zero trade flows out of a total of 278,784 entries. This means that 97.3% of our trade flows are zeros. However, the PPML estimation method is capable of handling such sparse trade matrices (Santos Silva and Tenreyro, 2006).

Unlike conventional international trade statistics, our data construction approach allows us to obtain data on both domestic and cross-border revenue flows. Domestic (cross-border) flows are defined such that the underwriter and client are headquartered in the same country (different countries). On a revenue weighted basis, 42.8% of our measured flows are cross-border, while the remainder are domestic. Having consistent data on both domestic and cross-border trade is an advantage for the estimation of coefficients on time varying country-specific variables despite the inclusion of country-year fixed effects. There is systematic evidence of home bias in the provision of investment banking services, although despite this, the industry is highly internationalized and cross-border deals are very common (Wójcik, 2011). Wójcik et al. (2018a) document that a fairly steady fraction of approximately 45% of global investment banking revenue was associated with cross-border deals during 2000 - 2015. This is comparable to the 42.8% of revenue from cross-border equity deals documented in this study. It is also noteworthy that the home bias, or lack thereof, varies significantly across countries. For example, approximately 75-80% of fees were from cross-border flows for EMEA, 20-35% for Asia-Pacific and 20-30% for the Americas (Wójcik et al., 2018a).

Figure 1: Trade flows in equity underwriting services 2000, 2007, and 2015



This figure shows trade flows in equity underwriting services measured in current USD for 2000, 2007 and 2015. Countries are labeled using their ISO 3166 codes and RW stands for "rest of the world".

Figure 1 above presents flow charts representing the evolving trade flows in equity securities underwrit-

ing services among the leading exporters and importers. The United States are the leading exporter of equity securities underwriting services with an estimated $3,476m of exports in 2000, followed by $2,427m for Switzerland, $753m for Germany, $709m for the United Kingdom and $265m for Canada. This ordering of the top exporting countries has remained remarkably stable over the 2000-2015 period, with only occasional reshuffling of ranks within this group. In 2007, US exports of equity underwritting services totalled $4,808m, followed by $3,006 for Switzerland, $1,272m for the United Kingdom, $1.229m for Germany, and $467m for Canada, closely mirroring the top of the ranking table in 2000. Finally, despite lower levels of fees earned, these five countries retained their dominant position as the leading exporters of equity securities underwriting services in 2015 with $3,037m in exports for the US, $1,494m for Switzerland, $881m for the United Kingdom, $812m for Germany and $440m for Canada.

In contrast to the very stable ordering of the leading exporters of equity securities underwriting services, there has been a good degree of change among the leading importers of these services. The United States have dominated as a leading importer of underwriting services during this period with imports of $2,537m (2000), $2,514m (2007) and $1,972m (2015) respectively. In 2000, the remainder of the top 5 importers was dominated by European countries - the United Kingdom ($1,067m), the Netherlands ($557m), Germany ($540m) and France ($536m). This changed markedly in 2007 with China rising to the second highest rank with total estimated imports of $1,980m, up from $329m in 2000. Similarly, Brazil ranked as the fourth largest importer of equity securities underwriting services in 2007 with an estimated $666m of imports, followed by Australia with $607m. Finally, the US and China retained their dominant positions in 2015 with $1,972m and $947m of imports respectively, followed by the United Kingdom ($718m), Australia ($386m) and Japan ($377m).

We now zoom in on the country dyads with the highest volume of trade flows. Perhaps unsurprisingly, all of the top 10 country dyads in 2000 feature the United States either as an exporter or an importer. Swiss exports of equity underwriting services to the United States in 2000 are the highest recorded trade flow in that year ($1,520m). This is followed by US exports to the UK ($589m), UK exports to the US ($406m), US exports to the Netherlands ($374m) and German exports to the US ($287m). In 2007, exports from Switzerland to the United States ($1,071m) remained the dominant trade flow. However, trade flows with emerging economies including China and Brazil rose significantly. Specifically, US exports to China were a close second largest trade flow in 2007, totaling $965m. This was followed by UK exports to the US ($638m), Swiss exports to China ($534m) and US exports to the UK ($501m). Exports from the United States to Brazil ($282m) and Switzerland to Brazil ($264m) ranked 9th and 10th respectively in 2007. Finally, in 2015 Swiss exports to the US retained their dominance, albeit on a smaller scale ($575m). US exports to the UK came as a close second at $516m, followed by UK exports to the US ($475m), US exports to China ($378m) and Canadian exports to the US ($353m). Swiss exports to China ranked 8th in 2015, totaling $211m.

Next, we zoom in on the trading partners (export markets) of the three dominant exporters of se-

curities underwriting services during our sample period, namely the United States, Switzerland and the United Kingdom. US exports in 2000 were directed primarily to the UK ($589m - 17%), the Netherlands ($374m - 11%), France ($287m - 8%), Germany ($259m - 7%) and China ($248m - 7%). In 2007 there had been a significant reshuffling of US export markets, with China ($965m - 20%) topping the list, followed by the UK ($501m - 10%), Greece ($355m - 7%), Brazil ($291m - 6%) and Australia ($264m - 6%). In 2015, US exports to the UK ($516m - 17%) surpassed those to China ($378m - 12%), followed by Japan ($326m - 11%), Spain ($208m - 7%) and Australia ($200m - 7%). Swiss exports in 2000 were directed primarily to the US ($1,520m - 63%), the UK ($202m - 8%), Germany ($136m - 6%), France ($98m - 4%) and the Netherlands ($56m - 2%). Similarly as for the US, Swiss exports in 2007 were in good part rerouted towards emerging markets with China ($534m - 18%) and Brazil ($282m - 9%) in the lead, overshadowed only by the US ($1,071m - 36%) and followed by those to Australia ($198m - 7%) and the UK ($88m - 3%). Finally, Swiss exports to the US totaled $575m (38%) in 2015, followed by China ($211m - 14%), Australia ($121m - 8%), the UK ($76m - 5%) and Spain ($64m - 4%). In 2000, British exports were directed primarily to the US ($406m - 57%), followed by Germany ($55m - 8%), France ($51m - 7%), Hong Kong ($42m - 6%) and the Netherlands ($27m - 4%). In 2007, we witnessed a shift towards emerging markets similar to that observed for the US and Switzerland. The dominant US market ($638m) was followed by Russia ($103m), China ($89m), India ($57m) and Australia ($39m). Finally in 2015, British exports were dominated by the US ($475m - 54%) and China ($65m - 7%), followed by Israel ($45m - 5%), Canada ($40m - 5%) and France ($26m - 3%).

Finally, we want to emphasize that our data set has several advantages over data sources used in the existing literature. Unlike data sets on financial services trade that rely on balance of payments statistics, our data does not require any harmonization, such as mirroring. It is recorded by a single data vendor, Dealogic, in a consistent manner across countries for every offering of equity securities. In contrast to other related research, which relies on the IMF's Coordinated Portfolio Investment Survey (CPIS) data, our dependent variable is built using revenue earned from the provision of financial services, rather than financial holdings. As explained above, this enables us to estimate a gravity equation, which is consistent with a variety of models of international trade. Unlike CPIS data, the data used here does not omit transactions from any countries and the data collection process is globally consistent. In contrast, CPIS excludes some important countries, including China, and relies on surveys with varying levels of coverage of institutional investors across participating countries. As a result, the resultant dyadic observations of cross-border financial holdings captured by CPIS data are not necessarily measured consistently across countries and there are many missing values. By contrast, due to the comprehensive and consistent nature of the Dealogic ECM database, the zero trade flows in our data set can be interpreted as "real zeros" with a very high degree of confidence. Unlike missing values, they carry useful information about the structure of trade flows among countries.

3.2 CEPII data set

To control for trade costs, we use the classical explanatory variables used in empirical gravity equations, sourced from the Centre d'Études Prospectives et d'Informations Internationales (CEPII) GeoDist distance data set (Mayer and Zignago, 2011). We begin with a bilateral population weighted distance variable. To account for the physical contiguity of countries, we include an indicator variable that equals one if countries share a political border and zero otherwise (*Shared border*). We also control for whether the trading partners share a language (*Shared language*) and whether they have a common colonial history (*Shared colonial history*). There are several variables available in the CEPII distance data set that capture the colonial history of countries. We opt for a non-directional specification. Specifically, *Shared colonial history* is equal to one for countries that were in a colonial relationship at any point in history, and is equal to zero otherwise. We do this to reflect the stylized fact that former colonies are not necessarily only importers, but can also be major exporters of financial services, the U.S. being the most prominent example.

3.3 Institutional quality and economic development

One of the main variables of interest in our study is the quality of the institutional environment in the exporting country. The literature on international cross-listing (Doidge, 2004; Doidge et al., 2004, 2007, 2009) suggests a crucial role for institutional factors in affecting where firms choose to list their shares. Therefore, the quality of the institutional environment in the exporting country acts as a factor *motivating* cross-border equity issuance. We use the Worldwide Governance Indicators database, which offers indices as well as rankings of countries in terms of the quality of their institutions. Kaufmann et al. (2011) offer a detailed explanation of the methodology used to aggregate survey data from government agencies, NGOs, private businesses, and households to derive the indices and rankings in the database. We select Rule of Law from a set of six governance indicators proposed by Kaufmann et al. (2011), as it captures institutions that are vital for the financial services industry, such as the legal environment. Specifically, Rule of Law is designed to measure "the extent to which agents have confidence in and abide by the rules of society, and in particular the quality of contract enforcement, property rights, the police and the courts, as well as the likelihood of crime and violence" (Kaufmann et al., 2011, p.4). We use annual country ranks rather than the raw index values, as the relative positioning of countries in terms of Rule of Law is expected to drive decision making among issuers (Doidge et al., 2009).

When examining the role of institutional quality, we distinguish between revenue flows for which the underwriter is headquartered in the same country as the stock exchange on which the offering is listed and those for which the underwriter is headquartered elsewhere. As explained above, this distinction enables us to examine the "bonding hypothesis" in the literature on foreign listings (Coffee, 1999). We build a dummy variable equal to one when the country of the exchange is the same as that of the underwriter ($E = U$), and zero otherwise. We interact Rule of Law with this dummy to allow the coefficients to differ across different types of transactions, depending on whether the underwriter

is located in the same country as the stock exchange and consequently involved in arranging the stock exchange listing, or located in another country and tasked primarily with marketing shares to local investors. 59% of trade flows in our data set are associated with underwriters headquartered in the same country as the stock exchange of the listing.

We also control for the level of economic development in the exporting country, as this is likely to be highly correlated with Rule of Law. We include normalized GDP per capita (USD) sourced from the World Bank - World Development Indicators database.[12]

3.4 Information frictions

3.4.1 Ownership ties

The economic geography literature proposes that trade frictions, such as information frictions, may be reduced through the strategic business activities of multinational companies, which operate networks of offices or subsidiaries across multiple countries (Taylor and Derudder, 2016). The expectation is that the more a country-dyad is connected through the office or subsidiary networks of multinational companies, the lower the information frictions will be between the two countries, ceteris paribus. To operationalize this proposition, we obtain data on the parent-subsidiary ties among underwriters from Dealogic's ECM database. We identify 26,965 parent-subsidiary ties by identifying unique dyads of underwriter parents and subsidiaries involved in underwriting of equity issues in the 2000-2015 period. We then complement these ties with data on country of headquarters of operations for 6,469 of subsidiaries (88.3%), which we hand-collected from corporate websites, Bureau van Dijk Orbis, Nexis UK and Bloomberg. We then discard ties for which we do not have data on country of headquarters of operations available for subsidiaries, leaving us with 25,229 (93.6%) ties. The Dealogic ECM database, however, continuously updates the parent-subsidiary ties with the most recent ownership data available. This means that while the records on underwriter subsidiaries for each transaction are historically accurate, the correspoding parent companies are overwritten with the current, rather than historical, ownership of said subsidiaries. To allow our connectivity measure to vary over time, we correct for any changes in these subsidiary-parent ties between 2000 and 2015 using records of mergers and acquisitions from Dealogic's M&As database and from Nexis UK. This leads to a data set of time-varying parent-subsidiary ties recorded annually, which features 25,229 ownership ties among 6,469 underwriter subsidiaries controlled by 3,741 parent companies for the 2000-2015 period. To create these time-varying parent-subsidiary ties, we corrected the records of parent companies linked to subsidiaries on an annual basis for 2,256 ties (8.9% of the total).

Using this corrected data, we first construct a count variable based on the number of underwriter

[12] Alternatively, we control for the development of the informational and communication technology (ICT) infrastructure of the exporting country by including the fraction of population with access to the internet - internet users (%) sourced from the World Bank - World Development Indicators database. The results are robust to using this alternative variable to proxy for economic development.

parents with subsidiaries located across each country-dyad. Specifically, we construct a count measure for each country-dyad, which is equal to the number of underwriters for each country-dyad that have subsidiaries in both countries. We therefore obtain an undirected measure of underwriter overlaps measured at the level of country-dyads.[13] Our data set contains 800 country-dyads (3.2% of all dyads)[14] that are connected by underwriter overlaps in at least one year of the sample period. The number of overlapping underwriters ranges from 1 to 30 and is time-varying. Finally, we normalize the count variable by dividing by the sum of ownership ties for each exporter-year (i.e. the number of ties between the exporting country and the rest of the world). We refer to this variable as *Ownership ties*, and it is meant to capture connectivity among countries facilitated by networks of underwriters' subsidiaries.

3.4.2 Syndication ties

Second, we build measures of multinational connectivity based on ties formed by co-membership of underwriting syndicates (Pažitka et al., 2019). We refer to them as syndication ties. To operationalise variables based on syndication ties, we use data on issues of equity securities from Dealogic ECM database with more than one underwriter ("underwriting syndicates"). Out of the total of 91,511 equity securities issues underwritten in the 2000-2015 period, 39,051 (42.7%) deals involved more than one underwriter. The number of underwriters per deal varies from 1 to 89 with a mean value of 2.8 for our sample of offerings. We build two different measures of syndication ties. First, *syndication ties count* is defined as the number of ties formed by the co-membership of underwriting syndicates among underwriter parents headquartered in country v with those headquartered in country w in a given year. Formally, we begin with an underwriter-deal affiliation matrix D, which records the membership of underwriter parents in underwriting syndicates (deals). We then multiply D by its transpose D^T to arrive at an adjacency matrix U with elements u_{ij}, which represent the numbers of syndication ties among individual underwriters i and j, as shown in the equation below.

$$U = D(D^T); u_{ij} = 0 \text{ if } i = j$$

We then sum the number of syndication ties among individual underwriters for country dyads vw as shown in the equation below, to arrive at an adjacency matrix C with elements c_{vw}, representing the number of syndication ties for country-dyad vw.

$$c_{vw} = \sum_{i \in v, j \in w} u_{ij}$$

Second, we build a measure called *unique syndication ties count*. It is defined as a group degree

[13] For example, if say JPMorgan (parent) has subsidiaries in both the US and the UK, that counts as one ownership tie, regardless of how many subsidiaries JPMorgan has in each country. If for example JPMorgan, Morgan Stanley and Goldman Sachs have some subsidiaries in the US and the UK, regardless of their number, this would be three ownership ties between the US and the UK. Every parent company counts only once at most.

[14] Given that our specification of ownership ties is undirected, we only count each country-dyad once here.

centrality measure (Everett and Borgatti, 1999). For each exporter-importer-year observation, we identify the number of unique syndication partners that underwriters in the exporting country have in the importing country in that year. This means that each underwriter in the importing country is counted only once, even if multiple underwriters in the exporting country had co-syndicated with that underwriter. This specification is therefore directed from exporting to importing country and is not necessarily symmetric for country dyads.

Finally, we transform the counts and unique counts into percentages by normalizing them by their respective sums for each exporter-year. This normalization is necessary as larger exporters have more ties, and therefore the raw count measures are not informative about the intensity of the relationships. The final measures (*Syndication ties* and *Unique syndication ties*) reflect the relative intensity of syndication ties between the exporting and importing countries.

4 Empirical gravity equations

4.1 Institutional quality

4.1.1 Baseline results

In this section, we explore the impact of institutional quality in the exporting country, as proxied by Rule of Law, on trade in equity securities underwriting services. In addition to all the control variables that are standard in the gravity framework, we also control for the level of development in the exporting country, proxied by normalized GDP per capita, as development is likely to be highly correlated with Rule of Law. The empirical model is given in Equation (6):

$$X_{jkt} = \exp\left\{\beta \ln(Dist_{jk}) + A_{jkt}\Gamma + \pi_{jt} + p_{kt}\right\} + \varepsilon_{jkt} \tag{6}$$

where X_{jkt} are bilateral trade flows from country j to country k, $ln(Dist_{jk})$ is the logarithm of physical distance between the trading partners, π_{jt} are exporter-time fixed effects, p_{kt} are importer-time fixed effects, and A_{jkt} is a vector of control variables, including normalized GDP per capita in the exporting country, the Rule of Law rank of the exporting country, a shared border, a shared language, and a shared colonial history. All the explanatory variables are interacted with an international trade dummy. The coefficients are therefore to be interpreted as the impact of the relevant variables on international trade relative to domestic trade.

In addition, we separately examine the extensive and intensive margins of trade. When considering the extensive margin, we replace trade flows X_{jkt} with an indicator variable $Exten_{jkt} = 1[X_{jkt} > 0]$. It is equal to one, when a dyad reports positive trade flows and zero otherwise. For the intensive margin, we estimate Equation (6) on the sub-sample of non-zero trade flows, i.e. X_{jkt} where $\text{Exten}_{jkt} = 1$. In all regressions standard errors are clustered at the exporter level. The estimated coefficients from all three specifications are given in Table (1).

A significantly negative coefficient on the Rule of Law rank (with a smaller number indicating higher institutional quality) indicates that Rule of Law has a significantly positive effect on international trade relative to domestic trade. According to the coefficient of -0.972 in column (1), moving down one rank (indicating a deterioration in institutional quality) is associated with a decrease in international trade relative to domestic trade by 62.2%. These results are in line with the economic geography literature. For example, Wójcik et al. (2018b) find that international financial centers (IFCs) emerge from well-developed cities in countries with strong Rule of Law and cost efficient contract enforcement. Rule of Law matters along both the extensive and intensive margins of trade, even after controlling for the level of development in the exporting country. However, the effect is slightly stronger along the intensive margin. The effect on the extensive margin of trade is -36.1% (column (2)) and the effect on the intensive margin is -51.8% (column (3)). As expected, the normalized GDP per capita of the exporting country is also highly positively significant, but only at the extensive margin, reflecting that international financial centers (IFCs) tend to emerge in already well-developed economies. A coefficient of 0.999 in column (2) indicates that a one standard deviation increase in GDP per capita is associated with an increase in the probability of international trade relative to domestic trade by 171.6%.

Table 1: PPML gravity estimates: Rule of Law

	(1) Base	(2) Extensive margin	(3) Intensive margin
Norm GDP per capita	1.210***	0.999***	0.478*
	(0.392)	(0.304)	(0.267)
Rule of Law rank	-0.972***	-0.448***	-0.729***
	(0.102)	(0.0692)	(0.0716)
Log distance	-0.150	-0.458***	-0.0853
	(0.153)	(0.0856)	(0.123)
Shared language	0.155	0.524***	0.105
	(0.383)	(0.167)	(0.360)
Shared border	0.138	0.0563	0.0231
	(0.434)	(0.118)	(0.354)
Shared colonial history	1.085***	0.419***	0.801***
	(0.230)	(0.108)	(0.219)
Observations	73,612	73,612	7,369

Notes: Standard errors in parentheses. * $p < 0.1$, ** $p < 0.05$, and *** $p < 0.01$

There are clear reasons why the institutional framework of the exporting country matters for firms issuing equity securities. Firms that list their shares abroad take advantage of good institutional frameworks to increase their valuations. Coffee (1999) suggests that foreign firms from jurisdictions with relatively weaker investor protection can increase their valuation by "bonding" themselves to superior institutions through cross-listing ("bonding hypothesis"). Cross-listing firms subject themselves to stricter standards of regulation, disclosure, and enforcement to signal their commitment to respecting the rights of shareholders. The added protection and the reputational effects make investors more willing to buy the shares of foreign firms that "tie their hands" in this manner (Siegel, 2005). Cross-listing firms are thereby able to achieve a higher market valuation. Reese and Weisbach (2002), Doidge, Karolyi, and Stulz (2004), and Doidge (2004) find support for this bonding hypothesis. It is also consistent with the analysis by Doidge et al. (2007) who suggest that country-level protection of investors is crucial to firms that aspire to improve their corporate governance. The authors find that access to global capital markets sharpens the incentives of firms in less-developed countries to achieve better governance.

Turning to distance, we find that the latter only matters at the extensive margin. A coefficient of -0.458 in column (2) implies that a 10% increase in bilateral distance translates into a 4.58% decrease in the probability of international trade relative to domestic trade. The coefficients in the overall sample and on the intensive margin are insignificant, indicating that once countries have entered a trade relationship, distance no longer matters. These results are noteworthy for several reasons. First, we find that distance does not matter for volumes of trade. It is not surprising given the non-physical nature of trade in financial services. This is in sharp contrast to the goods trade literature where the distance elasticity varies between -0.9 and -1.1 (Head and Mayer, 2014). More importantly, it is also in contrast with the literature on international finance, where many authors find elasticities close to those for goods trade (e.g. Portes and Rey, 2005, for equities). This is potentially due to the fact that we use PPML, properly account for multilateral resistance with exporter-time and importer-time fixed effects, and account for institutional quality, which appears to be a major determinant of trade in financial services. Nevertheless, it might appear puzzling that physical distance still matters at the extensive margin. The consensus in the literature on gravity in international finance is that this reflects information fictions. In Section 4.2, we augment our estimation model to account for information frictions, and indeed find that our estimate of the distance elasticity at the extensive margin decreases further.

We now turn to the bilateral time-invariant variables, namely a shared language, a shared border and a shared colonial history, which are traditionally considered in gravity equations. A shared border does not attract any significance. This result is in contrast to the goods trade literature where a shared border is usually highly significant, with an average coefficient of 0.7 (Head and Mayer, 2014). A shared language has a significantly positive effect on the extensive margin of trade. In other words, two countries that share a common language are more likely to trade with each other. Having the same language implies that countries are 68.9% more likely to trade at all. This appears to provide

evidence that communication costs are large in this setting. Our coefficient of 0.524 is higher than the average coefficient (for volume) of 0.4 in the goods trade literature (Head and Mayer, 2014). Finally, a shared colonial past has a significantly positive impact at both margins, especially the intensive one. A coefficient of 1.085 in column (1) indicates that being a previous colonial partner increases international trade relative to domestic trade by 195.9%. This coefficient is higher than magnitudes previously found in the goods trade literature (0.75) (Head and Mayer, 2014). The apparent importance of a shared colonial history is intuitive. Countries that have been in a colonial relationship are more likely to share common institutional and legal frameworks, which are paramount for trade in financial services.

4.1.2 Controlling for services free trade agreements

Our baseline results of Table (1) do not account for free trade agreements in services (SFTAs). Few free trade agreements cover financial services, and specific national and regional regulations are still strong impediments to trade. However, we check the robustness of our results to the inclusion of SFTAs and examine whether those have any effect at all.[15] Because of endogeneity concerns, we instrument for SFTAs with the dummy for whether trading partners share a common border. We follow a two-step control function approach. First, we run PPML on:

$$SFTA_{jkt} = \exp\{\beta \ln(Dist_{jk}) + A_{jkt}\Gamma + \pi_{jt} + p_{kt}\} + \varepsilon_{jkt} \tag{7}$$

where $SFTA_{jkt}$ is a dummy variable equal to one when countries j and k are in a SFTA in year t, and zero otherwise. We use PPML in the first stage to overcome the problems prevalent with other estimation strategies discussed in Section 2. However, our dependent variable is now a dummy, rather than continuous. Therefore, we actually estimate a log-linear probability model. This is superior to a linear probability model in this case because the fitted values lie mainly between zero and one. The main motivation for using PPML rather than more traditional binary variable models, such as Probit or Logit, lies in the computational difficulties of estimating the latter with a large number of fixed effects. Due to the non-linear nature of our modeling procedure, we take a control function approach whereby the estimated residuals from the first stage, $\hat{\varepsilon}_{jkt}$, are introduced as a control variable in the second stage (*response residual*) to overcome endogeneity concerns. The first stage is strong with a z-statistic on a shared border of -3.88.

Second, we run PPML on:

$$X_{jkt} = \exp\left\{\gamma^{CF}\hat{\varepsilon}_{jkt} + \gamma SFTA_{jkt} + \beta \ln(Dist_{jk}) + \tilde{A}_{jkt}\Gamma + \pi_{jt} + p_{kt}\right\} + u_{jkt} \tag{8}$$

where $\tilde{A}_{jkt}$ is the same vector of control variables as A_{jkt} without our instrumental variable (shared border) and $\hat{\varepsilon}_{jkt}$ is the response residual from the first stage. The results from the second-stage regressions are in Table (2).

[15] The list of SFTAs is included in Appendix Section B.

Our results of Table (1) are robust to the inclusion of SFTAs. The distance elasticity decreases further to -0.379 at the extensive margin. Interestingly, SFTAs themselves appear to matter at the extensive margin of trade. A coefficient of 0.430 in column (2) indicates that countries that share an SFTA are 53.7% more likely to trade in equities underwriting services. While a lot of SFTAs do not explicitly cover financial services, countries that enter into such agreements might be more likely to lower their bilateral barriers to trade in financial services.

Table 2: PPML gravity estimates: Rule of Law and SFTAs

	(1) Base	(2) Extensive margin	(3) Intensive margin
Norm GDP per capita	1.156***	0.949***	0.437*
	(0.310)	(0.247)	(0.244)
Rule of Law rank	-0.900***	-0.397***	-0.696***
	(0.0730)	(0.0417)	(0.0662)
Log distance	-0.121	-0.379***	-0.0624
	(0.105)	(0.0463)	(0.0997)
Shared language	0.139	0.508***	0.0786
	(0.241)	(0.0919)	(0.212)
Shared colonial history	1.243***	0.537***	0.901***
	(0.246)	(0.110)	(0.241)
SFTA	0.473*	0.430***	0.239
	(0.242)	(0.0943)	(0.247)
Response residual	-0.267*	-0.221***	-0.147
	(0.152)	(0.0535)	(0.168)
Constant	20.44***	-0.257	20.75***
	(0.251)	(0.254)	(0.229)
Observations	71,213	71,213	6,541

Notes: Standard errors in parentheses. * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

4.1.3 The Bonding Hypothesis

To provide further support to the relevance of institutional quality, we exploit differences in the sensitivity of certain transaction types to the latter. This strategy has been used among others in Portes et al. (2001), Daude and Fratzscher (2008), and Brei and von Peter (2017) who compare different types of assets (e.g. equities, bonds, and loans). The nature of our data set enables us to

contrast different types of transactions within the same asset category, namely equity securities. Our strategy relies on the fact that equity underwriting services are provided by syndicates of underwriters, not all of which will be geographically located in the country of the stock exchange where the shares are listed. Underwriters located in the country of the stock exchange typically help with the listing itself. By contrast, underwriters located in other countries are typically used to help sell shares in the offering to local institutional investors (Pollock et al., 2004). According to the "bonding hypothesis", firms signal their commitment to investor protection by listing their shares in a jurisdiction with superior institutional quality (Doidge et al., 2007, 2009). Hence the latter should matter more for listing transactions, i.e. transactions where the underwriter is located in the country of the stock exchange where the shares are issued. We interact Rule of Law with a dummy variable $E = U$ equal to one when the country of the underwriter is the same as the country of the stock exchange where the shares are listed. Structural gravity is separable in industries and so conceptualising $E = U$ and $E \neq U$ as two separate industries denoted by m, we estimate the theoretically consistent gravity equation as follows:

$$X_{jktm} = \exp\left\{\beta \ln(Dist_{jk}) + A_{jktm}\Gamma + \pi_{jtm} + p_{ktm}\right\} + \varepsilon_{jktm} \tag{9}$$

The results are in Table (3).

Table 3: PPML gravity estimates: The Bonding Hypothesis

	(1) Base	(2) Extensive margin	(3) Intensive margin
Norm GDP per capita	2.739***	0.842***	2.371***
	(0.484)	(0.242)	(0.431)
Rule of Law rank	-0.135	-0.160***	-0.102
	(0.0872)	(0.0550)	(0.0757)
Rule of Law rank,	-2.519***	-0.930***	-1.875***
× E=U	(0.319)	(0.0715)	(0.221)
Shared language	0.154	0.711***	0.0701
	(0.264)	(0.179)	(0.267)
Shared border	0.260	-0.0751	0.196
	(0.342)	(0.111)	(0.290)
Shared colonial history	0.716***	0.464***	0.567***
	(0.201)	(0.0973)	(0.207)
Log distance	-0.229	-0.482***	-0.116
	(0.173)	(0.0867)	(0.136)
Observations	104,422	104,422	8,531

Notes: Standard errors in parentheses. * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

The standalone Rule of Law variable loses most of its significance, except at the extensive margin. According to the coefficient of -0.16 in column (2), moving down one rank (indicating a deterioration in institutional quality) is associated with a decrease in the probability of international trade relative to domestic trade by 14.8%. By contrast, the interaction term between Rule of Law and the dummy variable $E = U$ is significant at both margins. This result indicates that Rule of Law is an important determinant of where firms choose to list their shares, and matters less when firms simply market their shares to local investors. A coefficient of -2.519 in column (1) indicates that moving up one rank is associated with a decrease in international trade relative to domestic trade by 91.9% for transactions where the underwriter is located in the country where the shares are listed.

4.2 Information barriers

We now turn to the role of information barriers, as proxied by our various connectivity measures. We augment the specification of Equation (6) with the variables Z_{jkt}, denoting our measure of ownership

ties and our two measures of syndication ties. We include them separately in the specification of Equation (6), but also together to examine whether one connectivity dimension matters more than the others. The estimating equation becomes:

$$X_{jkt} = \exp\{\beta \ln(Dist_{jk}) + X_{jkt}\Gamma + Z_{jkt}\psi + \pi_{jt} + p_{kt}\} + \varepsilon_{jkt} \tag{10}$$

The results are in Table (5). All three connectivity measures have a significantly positive impact on international trade relative to domestic trade. A coefficient of 0.103 on ownership ties in column (1) suggests that a one percentage point increase in ownership ties is associated with a 10.8% increase in bilateral trade. This result is in line with the economic geography literature which proposes that trade frictions (such as information frictions) may be reduced through the strategic business activities of multinational companies, which operate networks of offices or subsidiaries across multiple countries (Taylor and Derudder, 2016). The results on syndication ties however suggest that physical presence is not necessary to break down information barriers. Indeed, columns (2) and (3) show that a one percentage point increase in syndication ties (unique syndication ties) is associated with a 6.5% (9.4%) increase in international trade relative to domestic trade.

The coefficient on Rule of Law decreases noticeably in magnitude when we include the connectivity variables based on syndication ties. Moving down one rank (indicating a deterioration in institutional quality) is associated with a decrease in international trade relative to domestic trade by 32.2% in column (2) and 42.8% in column (3) - compared to 62.2% in Table (1). In addition, the coefficient on a shared colonial history also decreases substantially in magnitude compared to Table (1). This is the case when we include both ownership ties and syndication ties. The coefficients imply that being a previous colonial partner increases international trade relative to domestic trade by 79.3% (column (1)), 78.6% (column (2)), and 151.9% (column (3)) - compared to 195.9% in Table (1). The fact that Rule of Law and a shared colonial history matter less once we account for ownership and syndication ties could indicate that (physical or relational) networks might help overcome issues associated with weaker, or different, institutional frameworks. In column (4), we report the results when we include all three connectivity measures in the model. All three connectivity measures remain significant. The impact of ownership ties is much larger in magnitude, suggesting that the physical presence of subsidiaries in the importing country has some value added beyond syndication connections.

Table 5: PPML gravity estimates: Information barriers

	(1)	(2)	(3)	(4)
Syndication ties		0.0632***		0.0451***
		(0.00442)		(0.00428)
Unique syndication ties			0.0895***	0.0545***
			(0.0140)	(0.0113)
Ownership ties	0.103***			0.0925***
	(0.0197)			(0.0133)
Norm GDP per capita	0.821**	0.961***	0.483	0.379
	(0.387)	(0.287)	(0.337)	(0.257)
Rule of Law rank	-0.993***	-0.388***	-0.559***	-0.354***
	(0.0906)	(0.0882)	(0.0910)	(0.0784)
Log distance	-0.252*	0.101	-0.108	-0.0502
	(0.146)	(0.133)	(0.128)	(0.108)
Shared language	-0.506	0.358	0.395	-0.164
	(0.314)	(0.272)	(0.396)	(0.209)
Shared border	0.0571	0.489	-0.484	0.0914
	(0.308)	(0.407)	(0.323)	(0.201)
Shared colonial history	0.584***	0.580***	0.924***	0.155
	(0.155)	(0.176)	(0.270)	(0.184)
Observations	73,612	73,612	73,612	73,612

Notes: Standard errors in parentheses. * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Next, we look at the impact of our connectivity measures on the extensive and intensive margins of trade. The results are in Table (6) below.

Table 6: PPML gravity estimates: Information barriers and margins of trade

	(1) Base	(2) Base	(3) Base	(4) Extensive	(5) Extensive	(6) Extensive	(7) Intensive	(8) Intensive	(9) Intensive
Ownership ties	0.103***			0.0217			0.0806***		
	(0.0197)			(0.0182)			(0.0165)		
Syndication ties		0.0632***			0.0421***			0.0509***	
		(0.00442)			(0.00498)			(0.00376)	
Unique syndication ties			0.0895***			0.0687***			0.0555***
			(0.0140)			(0.00415)			(0.0124)
Norm GDP per capita	0.821**	0.961***	0.483	0.926***	0.911***	0.393*	0.245	0.329**	0.221
	(0.387)	(0.287)	(0.337)	(0.316)	(0.300)	(0.212)	(0.237)	(0.150)	(0.258)
Rule of Law rank	-0.993***	-0.388***	-0.559***	-0.454***	0.00516	-0.0106	-0.756***	-0.277***	-0.529***
	(0.0906)	(0.0882)	(0.0910)	(0.0688)	(0.0794)	(0.0559)	(0.0675)	(0.0608)	(0.0733)
Log distance	-0.252*	0.101	-0.108	-0.464***	-0.386***	-0.376***	-0.185	0.127	-0.0679
	(0.146)	(0.133)	(0.128)	(0.0865)	(0.0802)	(0.0730)	(0.121)	(0.108)	(0.115)
Shared language	-0.506	0.358	0.395	0.468***	0.522***	0.509***	-0.406	0.249	0.270
	(0.314)	(0.272)	(0.396)	(0.159)	(0.163)	(0.154)	(0.304)	(0.266)	(0.360)
Shared border	0.0571	0.489	-0.484	0.0519	0.0240	-0.168	-0.0860	0.379	-0.367
	(0.308)	(0.407)	(0.323)	(0.115)	(0.102)	(0.122)	(0.244)	(0.336)	(0.306)
Shared colonial history	0.584***	0.580***	0.924***	0.385***	0.354***	0.361***	0.450***	0.431**	0.745***
	(0.155)	(0.176)	(0.270)	(0.110)	(0.110)	(0.0907)	(0.167)	(0.192)	(0.244)
Observations	73,612	73,612	73,612	73,612	73,612	73,612	7,369	7,369	7,369

Notes: Standard errors in parentheses. * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Ownership ties appear to matter only at the intensive margin of trade, while the connectivity measures based on syndication ties matter for both the extensive and intensive margins of trade. It is not surprising that networks of subsidiaries matter only at the intensive margin, as such networks build up over time and potentially as the result of trade. By contrast, syndication ties can be build quickly and without the need for physical infrastructure. While a shared colonial history continues to matter both at the intensive and extensive margins when we include ownership or syndication ties, the Rule of Law now appears to matter primarily at the intensive margin. In Appendix Table (2), we show that these results on information barriers are robust to controlling for SFTAs (instrumented as before).

Another interesting finding in Table (6) is that our estimate of the distance elasticity for the extensive margin decreases further compared to Table (1) when we include the syndication ties variables. The coefficient decreases from -0.458 in Table (1) column (2) to -0.386 in column (5) and -0.376 in column (6) in Table (6). These coefficients imply that a 10% increase in bilateral distance translates into a 3.86% and 3.76% decrease in the probability of bilateral trade, respectively. This supports the conjecture of the previous literature on international finance that the continued relevance of distance is indicative of information barriers, rather than a real effect of physical distance. As an illustration of the power of institutional quality and information barriers to account for the continued relevance of distance, we replicate Table (1) without Rule of Law. In other words, the model does not control for institutional quality or information barriers at all. The results are in Appendix Table (3). The coefficients on distance are now significantly negative and large along both the intensive and extensive margins of trade. They stand at -1.134 in the overall sample, -0.760 on the extensive margin, and -0.959 on the intensive margin - reaching magnitudes closer to those found previously in the literature.[16] Our finding of a small distance elasticity on the extensive margin when we control for institutions and information frictions is likely due to the fact that our variables do not capture all the factors that matter for trade in equity securities underwriting services, particularly restrictions on the listing of foreign shares and foreign asset holdings. Comparative international data on these regulations is unfortunately very scarce.

5 Conclusions

We shed some new light on the determinants of international trade in financial services using the gravity framework. The interest in gravity in international finance is not new, but the literature suffers from several shortcomings that we try to address. We build a novel panel data set that has several advantages over other data sets based on balance of payments statistics. We proceed "bottom up" by aggregating transaction-level data on domestic and cross-border equity securities underwriting transactions from the Dealogic Equity Capital Market (ECM) database. Having access to transaction-level data enables us to aggregate the data in a flexible manner (e.g. to look at different types of transac-

[16] Interestingly, a shared border receives a negative coefficient in this simple gravity model without institutional and information variables. This is probably driven by the fact that international financial centres (IFCs) are quite distant from each other.

tions) and to build innovative measures of connectivity between trading partners to explore the role of information barriers. In addition, we observe both domestic and cross-border transactions, which enables us to estimate theory-consistent gravity equations. This represents a departure from the existing literature on gravity in international finance, where most contributions fail to apply theory-consistent methods. In addition to accounting properly for multilateral resistance with country-time fixed effects, we apply state-of-the-art econometric methods (PPML).

Our novel data set and methods combined allow us to shed light on the role of information barriers and institutional quality in determining trade patterns in financial services. We find that institutional quality of the exporting country (proxied by Rule of Law) has a significantly positive impact on international trade relative to domestic trade. Thanks to the disaggregated nature of our data set, we explore whether institutional quality matters relatively more for certain types of transactions. We find evidence in support of the "bonding hypothesis" in the literature on the determinants of foreign listings (Coffee, 1999; Doidge, 2004; Doidge et al., 2004, 2007, 2009). To capture information barriers, we borrow concepts from the economic geography literature and build three novel measures of connectivity based on banks' parent-subsidiary networks and syndication ties across trading partners (Taylor and Derudder, 2016; Pažitka and Wójcik, 2019; Pažitka et al., 2019). To the best of our knowledge, our paper is the first to examine the impact of business networks on trade in financial services in a gravity framework. We find that better connections significantly encourage international trade relative to domestic trade.

A stable finding of the literature on gravity in international finance is that distance matters. This is surprising since there are no transportation costs involved. The consensus is that distance is a proxy for informational and institutional frictions. Interestingly, we find a very limited role for physical distance on the extensive margin of trade. This result is in contrast with the previous literature and is driven both by our methods and the inclusion of relevant institutional and informational variables.

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Appendix

A Countries included in the sample

The countries included in the sample are Algeria, Argentina, Armenia, Australia, Austria, Bahamas, Bahrain, Bangladesh, Barbados, Belgium, Bermuda, Bosnia and Herzegovina, Botswana, Brazil, British Virgin Islands, Bulgaria, Cambodia, Canada, Cayman Islands, Central African Republic, Chile, China, Colombia, Costa Rica, Cote d'Ivoire, Croatia, Cyprus, Czech Republic, Denmark, Dominican Republic, Ecuador, Egypt, Estonia, Faeroe Islands, Fiji, Finland, France, Georgia, Germany, Ghana, Greece, Hong Kong, China, Hungary, Iceland, India, Indonesia, Iraq, Ireland, Israel, Italy, Jamaica, Japan, Jordan, Kazakhstan, Kenya, South Korea, Kuwait, Lao PDR, Latvia, Lebanon, Lithuania, Luxembourg, Macao SAR, China, Macedonia, Madagascar, Malawi, Malaysia, Mauritius, Mexico, Mongolia, Morocco, Myanmar, Namibia, Netherlands, New Zealand, Nigeria, Northern Mariana Islands, Norway, Oman, Pakistan, Papua New Guinea, Peru, Philippines, Poland, Portugal, Puerto Rico, Qatar, Reunion, Romania, Russian Federation, Rwanda, Saudi Arabia, Sierra Leone, Singapore, Slovak Republic, Slovenia, South Africa, Spain, Sri Lanka, St. Kitts and Nevis, Sweden, Switzerland, Syrian Arab Republic, Taiwan, Tanzania, Thailand, Togo, Trinidad and Tobago, Tunisia, Turkey, Uganda, Ukraine, United Arab Emirates, United Kingdom, United States, Uruguay, Vietnam, Zambia, and Zimbabwe.

B Services free trade agreements

To control for free trade agreements in services (SFTAs), we build a time-varying dyadic indicator variable which is equal to one if both trading partners are members of a free trade agreement that covers services, and zero otherwise. We use data from the World Trade Organization (WTO) Regional Trade Agreements database summarized in Table (1) below. This database covers 311 FTA notifications, which document countries joining FTAs, including bilateral FTAs and multilateral trading blocks. We exclude 153 notifications that do not cover trade in services and 16 notifications associated with FTAs that came into force after the end of 2015, leaving us with 158 notifications. Our final data set covers 17 multilateral trading blocks, 44 instances of outside agreements between individual countries and multilateral trading blocks, and 94 bilateral FTAs. We identify the signatories of each FTA, and the year in which the agreement came into force for each signatory, to build our indicator variable.

Table 1: Services Free Trade Agreements

Trade agreement	Year of entry into force	Signatories
Multilateral trade agreements		
ASEAN	2010-2012	Australia, Brunei, India, Malaysia, Myanmar, New Zealand, Philippines, Singapore, South Korea, Vietnam, Thailand, Leo PDR, Cambodia , Indonesia
CAFTA-DR	Costa Rica, Dominican Republic, El Salvador, Guatemala, Honduras, Nicaragua, United States of America	
CARICOM	2002	Antigua and Barbuda, Bahamas, Barbados, Belize, Dominica, Grenada, Guyana, Haiti, Jamaica, Montserrat, Saint Kitts and Nevis, Saint Lucia, Saint Vincent and the Grenadines, Suriname, Trinidad and Tobago
Dominican Republic - Central America	2001	Costa Rica, Dominican Republic, El Salvador, Guatemala, Honduras, Nicaragua
EAC	2012	Burundi, Kenya, Rwanda, Uganda, Tanzania
EAEU	2014-2015	Armenia, Belarus, Kazakhstan, Kyrgyz Republic, Russian Federation
EEA	1994	Iceland, Liechtenstein, Norway, European Union,Austria,Belgium,Bulgaria,Croatia,Cyprus,Czech Republic,Denmark,Estonia,Finland,France,Germany,Greece,Hungary, Ireland,Italy,Latvia,Lithuania,Luxembourg,Malta,Netherlands,Poland, Portugal,Romania,Slovak Republic,Slovenia,Spain,Sweden,United Kingdom
EFTA	2002	Iceland, Liechtenstein, Norway, Switzerland
El Salvador - Honduras - Taiwan	2008	El Salvador, Honduras, Taiwan
EU	1958-2013	Austria, Belgium, Bulgaria, Croatia, Cyprus, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, Netherlands, Poland, Portugal, Romania, Slovak Republic, Slovenia, Spain, Sweden, United Kingdom
GUAM	2003	Azerbaijan, Georgia, Moldova, Republic of, Ukraine
GCC - Singapore	2013	Singapore, Bahrain, Kuwait, Oman, Qatar, Saudi Arabia, United Arab Emirates
Colombia - Northern Triangle	2009	Colombia, El Salvador, Guatemala, Honduras
Mercosur	2005	Argentina, Brazil, Paraguay, Uruguay
Mexico - Central America	2012	Costa Rica, El Salvador, Guatemala, Honduras, Mexico, Nicaragua
NAFTA	1994	Canada, Mexico, United States of America
Trans-Pacific Strategic Economic Partnership	Brunei, Chile, New Zealand, Singapore	

EFTA's outside agreements: Costa Rica (2014), Panama (2014), Hong Kong (2012), Ukraine (2012), Colombia (2011), South Korea (2006), Chile (2004), Singapore (2003), Mexico (2001).
EU's outside agreements: Bosnia and Herzegovina (2015), Georgia (2014), Moldova (2014), Ukraine (2014), Serbia (2013), Costa Rica (2013), El Salvador (2013), Guatemala (2013), Honduras (2013), Nicaragua (2013), Panama (2013), Colombia (2013), Peru (2013), Ecuador (2013), South Korea (2011), Montenegro (2010), Albania (2009), Antigua and Barbuda (2008), Bahamas (2008), Barbados (2008), Belize (2008), Dominica (2008), Dominican Republic (2008), Grenada (2008), Guyana (2008), Jamaica (2008), Saint Kitts and Nevis (2008), Saint Lucia (2008), Saint Vincent and the Grenadines (2008), Suriname (2008), Trinidad and Tobago (2008), Chile (2005), North Macedonia (2004), Mexico (2000).
Bilateral agreements: Australia - China (2015), China - South Korea (2015), South Korea - New Zealand (2015), South Korea - Vietnam (2015), Chile - Thailand (2015), Mexico - Panama (2015), Japan - Australia (2015), Canada - South Korea (2015), South Korea - Australia (2014), Hong Kong - Chile (2014), Canada - Honduras (2014), Iceland - China (2014), Switzerland - China (2014), Singapore - Taiwan (2014), New Zealand - Taiwan (2013), Costa Rica - Singapore (2013), Costa Rica - Peru (2013), Canada - Panama (2013), Malaysia - Australia (2013), Ukraine - Montenegro (2013), United States - Panama (2013), Chile - Nicaragua (2012), United States - Colombia (2012), Panama - Peru (2012), South Korea - United States (2012), Japan - Peru (2012), Peru - Mexico (2012), Canada - Colombia (2011), China - Costa Rica (2011), India - Japan (2011), Peru - South Korea (2011), India - Malaysia (2011), Hong Kong - New Zealand (2011), Chile-China (2010), New Zealand - Malaysia (2010), Chile - Guatemala (2010), Peru - China (2010), India - South Korea (2010), Pakistan - China (2009), Nicaragua - Panama (2009), Japan - Vietnam (2009), Japan - Switzerland (2009), Canada - Peru (2009), Peru - Singapore (2009), Guatemala - Panama (2009), Chile - Colombia (2009), Australia - Chile (2009), Chile - Peru (2009), Peru - United States (2009), Honduras - Panama (2009), China - Singapore (2009), Oman - United States (2009), Japan - Philippines (2008), Costa Rica - Panama (2008), China - New Zealand (2008), Brunei - Japan (2008), Chile - Honduras (2008), Indonesia - Japan (2008), Chile - Panama (2008), Taiwan - Nicaragua (2008), Malaysia - Pakistan (2008), Japan - Thailand (2007), Chile - Japan (2007), Faeroe Islands - Iceland (2006), Bahrain - United States (2006), Panama - Singapore (2006), Japan - Malaysia (2006), Taiwan - Guatemala (2006), South Korea - Singapore (2006), Morocco - United States (2006), Jordan - Singapore (2005), India - Singapore (2005), New Zealand - Thailand (2005), Japan - Mexico (2005), Australia - Thailand (2005), Australia - United States (2005), Mexico - Uruguay (2004), Chile - South Korea (2004), Chinese Taipei - Panama (2004), Chile - United States (2004), Singapore - United States (2004), China - Macao (2003), Australia - Singapore (2003), China - Hong Kong (2003), El Salvador - Panama (2003), Japan - Singapore (2002), Chile - El Salvador (2002), Chile - Costa Rica (2002), Jordan - United States (2001), New Zealand - Singapore (2001), Chile - Mexico (1999), Canada - Chile (1997), Colombia - Mexico (1995), Australia - New Zealand (1989).

C Supplementary tables - Section 4

The two tables below are supplementary tables for Section 4. Table (2) replicates Table (6) in the text but controls for SFTAs, instrumented with a shared border as described in the text. Table (3) replicates Table (1) in the text without the Rule of Law variable.

Table 2: PPML gravity estimates: Information barriers and SFTAs

	(1) Base	(2) Base	(3) Base	(4) Extensive	(5) Extensive	(6) Extensive	(7) Intensive	(8) Intensive	(9) Intensive
Ownership ties	0.0944***			0.0148			0.0749***		
	(0.0116)			(0.0142)			(0.0108)		
Syndication ties		0.0665***			0.0432***			0.0536***	
		(0.00883)			(0.00407)			(0.00641)	
Unique syndication ties			0.0856***			0.0687***			0.0526***
			(0.0123)			(0.00318)			(0.0111)
Norm GDP per capita	0.761**	0.811***	0.373	0.882***	0.846***	0.323*	0.187	0.179	0.142
	(0.299)	(0.272)	(0.245)	(0.241)	(0.248)	(0.178)	(0.240)	(0.184)	(0.211)
Rule of Law rank	-0.949***	-0.192**	-0.572***	-0.403***	0.0627	0.0172	-0.742***	-0.115	-0.544***
	(0.0688)	(0.0882)	(0.0844)	(0.0414)	(0.0605)	(0.0448)	(0.0617)	(0.0765)	(0.0734)
Log distance	-0.231**	0.107	-0.00725	-0.383***	-0.298***	-0.292***	-0.155	0.121	0.00739
	(0.102)	(0.0920)	(0.107)	(0.0449)	(0.0483)	(0.0424)	(0.0986)	(0.0786)	(0.0993)
Shared language	-0.483**	0.482***	0.211	0.461***	0.506***	0.441***	-0.423**	0.344**	0.130
	(0.208)	(0.176)	(0.248)	(0.0922)	(0.0889)	(0.0814)	(0.183)	(0.155)	(0.217)
Shared colonial history	0.671***	0.831***	1.158***	0.510***	0.456***	0.449***	0.527***	0.633***	0.898***
	(0.190)	(0.188)	(0.268)	(0.112)	(0.100)	(0.0976)	(0.178)	(0.187)	(0.253)
SFTA	0.260	0.960***	0.263	0.428***	0.431***	0.293***	0.132	0.733***	0.142
	(0.230)	(0.217)	(0.268)	(0.0949)	(0.0975)	(0.0943)	(0.240)	(0.205)	(0.260)
Response residual	-0.242*	-0.720***	-0.289	-0.240***	-0.281***	-0.231***	-0.164	-0.599***	-0.152
	(0.135)	(0.193)	(0.205)	(0.0549)	(0.0535)	(0.0500)	(0.160)	(0.177)	(0.198)
Constant	20.79***	16.22***	18.35***	-0.197	-2.284***	-1.772***	20.97***	17.27***	19.42***
	(0.213)	(0.454)	(0.444)	(0.245)	(0.312)	(0.236)	(0.198)	(0.377)	(0.413)
Observations	71,213	71,213	71,213	71,213	71,213	71,213	6,541	6,541	6,541

Notes: Standard errors in parentheses. * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Table 3: PPML gravity estimates: No institutional or information variables

	(1) Base	(2) Extensive margin	(3) Intensive margin
Log distance	-1.134***	-0.760***	-0.959***
	(0.221)	(0.111)	(0.164)
Shared language	0.142	0.364**	-0.0349
	(0.389)	(0.142)	(0.378)
Shared border	-1.585***	-0.373***	-1.506***
	(0.283)	(0.0963)	(0.278)
Shared colonial history	0.979***	0.473***	0.791***
	(0.297)	(0.121)	(0.304)
Observations	76,766	76,766	74,89

Notes: Standard errors in parentheses. * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

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