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Quantifying Services-Trade Liberalization: The Impact of Binding Commitments

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Abstract: It has long been established in theory that uncertainty impacts on firm behaviour. However, the empirical basis for quantifying the uncertainty-reducing effects of trade agreements has not been firmly established. In this paper, we develop estimates of the effect of reducing uncertainty regarding market access on cross-border services trade by making commitments that are bound under a trade agreement. Specifically, we identify the effect of services trade restrictions on cross-border services trade, as measured by the OECD's Services Trade Restrictiveness Index (STRI), and the separate effect of "water" in countries' WTO bindings, as assessed by the difference between their commitments under the General Agreement on Trade in Services and their applied level of market access, as captured by their STRI scores. Using a gravity model, we find that services trade responds positively but inelastically to reductions in services trade barriers, as measured by the STRI, and that the response to actual restrictions is about twice as strong as the response to comparable reductions in uncertainty, as measured by water. Responses are highly heterogeneous across services sectors. We suggest how these results can be used provisionally to quantitatively assess the impact of trade agreements in CGE modelling frameworks, taking into account not only actual liberalization of market access terms and conditions, but also the extent of binding of those commitments.

Keywords: Services trade, bindings, GATS commitments, STRI

JEL Codes: F13, F14, F68

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Introduction and Background

Liberalizing services market access is difficult (Sauvé, 2013). This was demonstrated at the multilateral level in the now effectively-defunct Doha Round (Gootiiz and Mattoo, 2009) and continues to be true in the slow-moving plurilateral Trade in Services Agreement (TiSA) negotiations (ICTSD, 2015). Even in ambitious bilateral/regional trade agreements, such as the Trans-Pacific Partnership (TPP), the main achievements have been to bind existing market access (Ciuriak et al., 2015, 2016). If the main impact of trade agreements is not to liberalize services market access, but to bind existing access, the question of the value of bindings moves front and centre for public policy evaluation.

Bindings reduce uncertainty for firms about future market access. In theory, reducing uncertainty should induce greater trade. This is brought out by firm-level trade theory, which takes into account the fixed costs of foreign market entry (Melitz, 2003; Bernard et al., 2003). Fixed costs of foreign market entry include obtaining market intelligence, identifying foreign partners, dealing with foreign regulatory requirements, and so forth. New exporting firms must confront uncertainty about success in their foreign ventures, as they have less knowledge than established firms about foreign markets and the local partners or agents they must engage (information asymmetries). Undertaking the exploratory and preparatory work to access foreign markets thus involves sunk costs. In the face of uncertainty about market access, not all firms capable of exporting or investing abroad will make those investments and, of those that do, many will make the necessary market-entry investments in fewer markets than they might optimally serve.

Conceptualizing uncertainty about market access as an investment issue sharpens the thought. In the investment literature, firms are understood as making state-contingent decisions; given uncertainty about future states and at least partial irreversibility of investment decisions, the opportunity cost of immediate investment (i.e., the option value of delaying and accumulating additional information) is included in the firm's cost of investment. As Dixit and Pindyck (1994) emphasize, "hurdle rates" for firm investments are substantially higher than the cost of capital[1]; they suggest that the value of real options is thus very significant, implying uncertainty is also a very significant factor inhibiting investment. Bloom et al. (2007) make the case that uncertainty does indeed make firms more cautious and, further, that this effect is large.

There is some documentary evidence that sunk costs of market entry in services are significant. Kox and Lejour (2006) make the case that set-up costs are particularly high for small and medium-sized enterprises (SMEs), even for EU firms entering into services trade in the EU single market. As they note,

> " In a survey among a large number of business-services firms in the EU (CSES 2001:190), 78 per cent of the responding firms mention that setup costs of selling services in other EU states are "significant" or "very significant" trading barriers. The setup cost effects are largest for small and medium-sized enterprises (SME). According to CSES (2001): "Evidence collected from SMEs and SME-supporting organisations suggests that many SMEs back off after initial inquiries about administrative requirements and procedures because they feel they do not have the necessary resources to deal with the current complexity" (6).

Accordingly, uncertainty about the terms and conditions of future market access, which puts sunk costs at risk, likely deters market entry. By the same token, binding commitments should unambiguously trigger new market entry at the margin.

1 Internal decision-making in firms is based on so-called "hurdle" rates of return that the prospective investment must promise in order for the firm to commit funds. Such hurdle rates are typically substantially higher than the cost of capital to the firm, inviting the question of why would firms not undertake investments with prospective rates of return below the hurdle rate, but above the cost of capital.

A growing literature suggests that trade agreements induce additional trade by reducing uncertainty. Handley and Limão (2012) and Lakatos and Nilsson (2015) provide confirmatory evidence from alternative natural experiments: the expansion of Portugal's trade with EU Member States upon accession and the expansion of EU-Korea trade anticipating the coming into force of the EU-Korea FTA.

Studies on the impact of bilateral investment treaties (BITs) have also reached generally confirmatory conclusions that a reduction of risk impacts on investment decisions. The Economist Intelligence Unit and the Columbia Program on International Investment (2007) report that the majority of multinationals surveyed take BITs into account in making an investment decision. Yackee (2010) reports that providers of political risk insurance only inconsistently take BITs into account when making underwriting decisions and the majority of the providers he surveyed did not, in fact, view BITs as relevant to their underwriting decisions. At the same time, his results indicate that at least some underwriters take BITs into account in assessing political risk. Thomas Waelde argues that "it would be a sign of negligent management and counsel if political risk management and investment protection were not planned with the potential of investment-treaty based arbitration in mind" (cited in Orr, 2007). As argued above, the findings of this literature are at least tangentially relevant to the question of the impact of services bindings.

If binding market access reduces uncertainty and reduced uncertainty increases trade by inducing market-entry-related investments at the firm level, we then must address the following question: what are the metrics by which we measure uncertainty and – more particularly – what are the metrics by which we measure the reduction of uncertainty through a trade agreement? This paper takes up this question in respect of bindings of services commitments.

We approach this issue by drawing on recent advances in measuring services trade restrictions in a highly-granular fashion in the OECD's Services Trade Restrictiveness Index (STRI). As regards the STRI, the OECD has developed a database on measures affecting services trade in 18 services sectors and 40 countries as of end-2013 (OECD, 2014). The specific measures used to develop the index include measures affecting cross-border services flows, movement of persons, and commercial presence. As regards uncertainty, the OECD has also undertaken work to provide first estimates of the difference between the STRI, which measures restrictiveness in applied policy, and an index of countries' bindings under the WTO General Agreement on Trade in Services (GATS). This latter difference – the "water" in the GATS bindings – provides a measure of the extent to which existing market access restrictions could be increased without violating WTO commitments (Miroudot and Pertel, 2015). Importantly, the GATS Trade Restrictiveness Index (GTRI) has the useful feature that both actual restrictions and uncertainty are measured by the same indicators and the same weighting scheme as the STRI.

We develop a gravity model to estimate the impact on services trade of actual restrictions, as measured by the STRI, and of policy uncertainty, in terms of the scope for countries to legally withdraw that market access without penalty. We contribute to the literature by separately quantifying the impact of actual restrictions on cross-border services trade and of uncertainty. To preview our main conclusions, water in services bindings is associated with less cross-border trade; the effect of reducing water is about half the effect of reducing actual restrictions. The response of services trade to reductions of both the STRI and water is inelastic: the relevant point estimates for the elasticities are about 0.4 for the STRI and 0.2 for water. We suggest how these results can be incorporated as stylized facts for impact assessments in a computable general equilibrium (CGE) modelling context.

The rest of this paper is organized as follows. Section 2 reviews the literature on services trade restrictions and liberalization, with particular focus on gravity model frameworks. Section 3 describes the data and empirical strategy. Section 4 presents the results. Section 5 discusses the results and concludes. Annex 1 documents the many experiments we conducted in arriving at our final estimating equation.

Review of the Literature

Quantitative analysis of services trade remains much less well developed than the comparable analysis of goods trade. The reasons are well known: poor quality services data and significant challenges in quantifying barriers to services trade (Francois et al., 2007). The survey by Francois and Hoekman (2010) identifies only scattered and inconclusive research in these areas prior to the 2000s. Since about 2000, the literature devoted to both measuring services trade barriers and to their impact on trade has expanded markedly. Dee (2005), Dihel and Shepherd (2007), Francois and Hoekman (2010), and Van der Marel and Shepherd (2013) provide useful surveys of this growing literature; Nordås and Rouzet (2015) cover the more recent contributions.

The most relevant study for our work is Nordås and Rouzet (2015). This study provides the first estimates of the STRI's impact on trade in services, including a variety of indicators that hint at reduced services supply in the presence of higher restrictions on services trade. The study finds that higher STRI scores are associated with lower levels of services trade at the aggregate level and further that there are negative spillovers from reduced services trade to reduced goods trade.

Overall, it appears fair to conclude that gravity "works" for services trade – that is, services trade patterns appear to broadly conform to the expected patterns in the gravity model literature for goods; at the same time, it would also be fair to say that there is little consensus in the emerging literature on the stylized facts concerning coefficient values for important determinants of services trade. Moreover, there are several major areas that constitute active areas of investigation.

One general theme in the literature is sectoral heterogeneity. Intuitively, construction services trade might fall off steeply with increasing distance, but maritime transportation services trade might grow with distance. Exporter GDP need not be positively related to services export sales in all service sectors – the counter example is small island states that export tourism services intensively (see Walsh, 2008, who includes a temperature variable to identify sun destinations). Neglecting this heterogeneity may lead to biased and inconsistent estimates of gravity model parameters (Haque et al., 2000). Cheng and Wall (2005) provide a detailed discussion of the importance of taking into account sectoral heterogeneity in the gravity model.

A second general theme concerns the specifics of the econometrics of the gravity model. There are several issues that have generated active debate.

Taking into account multilateral resistance is particularly problematic. Multilateral trade resistance (MTR) terms capture bilateral trade costs relative to the rest of the world (Anderson and van Wincoop, 2003). MTRs are not observed, but, if omitted from a model, can lead to biased and inconsistent estimates of the impact of explanatory variables. Gravity studies frequently include country or country-year fixed effects as proxies for MTRs; however, this approach can be problematic for a variety of technical reasons[2]. Alternatively, rough proxies of MTRs are used in the literature. However there are issues about them too. Suvankulov (2015), for example, finds that exporter and importer remoteness (MTR proxies) are collinear. Nordås and Rouzet (2015) address the MTR issue by checking the robustness of their results, while omitting MTR terms from the model using several alternative model specifications that include some, but not all fixed, effects.

The large number of zeros in the bilateral trade matrix for cross-border services constitutes another problem. Since the influential paper by Santos Silva and Tenreyro (2006), the PPML estimator has become a popular estimation technique to address this issue (e.g., Nordås and Rouzet, 2015; Suvankulov, 2015).

2 For example, convergence issues can be encountered in the presence of many variables when using the Poisson pseudo-maximum likelihood (PPML) estimator, a frequently used estimator; and collinearity of the fixed effects with explanatory variables of interest can be a problem in some specific configurations of the gravity model.

Heteroscedasticity in panel data is also problematic. Santos Silva and Tenreyro (2006) showed that the PPML estimator outperforms Ordinary Least Squares (OLS) when heteroscedasticity is present in the gravity model; in particular, the OLS estimator produces potentially biased and inconsistent estimates in the presence of heteroscedasticity because of the log-linearization. However, the PPML estimator has its own issues. It may not converge in the presence of many dummies. Walsh (2008) considers various alternatives and advocates the Hausmann-Taylor Model (HTM), which was previously suggested by Egger (2002, 2005).

Of critical importance, the results for important coefficients change markedly in these various studies with different estimators – all of which have their problems. Accordingly, the as-yet-unsettled state of econometrics means that empirical estimates in the literature remain open to question.

Empirical Approach

We develop a gravity model to estimate the impact on services trade of actual restrictions, as measured by the STRI, and of policy uncertainty, as measured by water. The estimated coefficients can be used to evaluate the impact of the introduction of new services bindings under a trade agreement. In future research, these impacts can be incorporated in CGE simulations to take account of general equilibrium effects, including the spillover effects on trade in goods identified by Nordås and Rouzet (2015).

Estimation Technique

Following Nordås and Rouzet (2015) and other recent gravity studies, we adopt the PPML estimator, because it provides unbiased and consistent estimates in the presence of heteroscedasticity in a non-linear gravity model. Another key PPML advantage is that it can deal with zeros in the trade data, because the dependent variable is kept in levels. Multiple zero data points in bilateral trade flows may reflect important information on existing barriers to trade; however, this information is lost with conventional log-linear specifications, since these zeros require truncation of the dataset.

The Poisson regression model assumes that the count variable y, given a vector of explanatory variables $\mathbf{x}$, has Poisson distribution. In order to maximize a log-likelihood function associated with the Poisson regression model, an assumption regarding the functional form of a conditional mean of dependent variable, $E(y|\mathbf{x})$, has to be made. A conventional assumption, including one that is adopted in Stata (Stata, 2013), is that the expected value of y is an exponential function of $\mathbf{x}$:

$$(1)\ E(y|\mathbf{x}) = \exp(\mathbf{x}\beta)$$

where β is a vector of parameters. On the basis of this assumption, a log-likelihood function is specified and then maximized to obtain estimates of β. The estimator that maximizes the function is referred to as Poisson maximum likelihood estimator.

A useful property is that the estimator that maximizes the log-likelihood function is consistent even if the dependent variable does not have Poisson distribution (Santos Silva and Tenreyro, 2006; Wooldridge, 2002: Ch. 19). In this case, the estimator is referred to as the PPML estimator[3].

3 As noted in Santos Silva and Tenreyro (2006), model (1) can be estimated straightforwardly using the Stata command *poisson* or a modified version of the code *ppml*, introduced in Stata by Santos Silva and Tenreyro (see the "Log of Gravity" website, Santos Silva and Tenreyro, 2015). The latter estimator may help resolve convergence problems. This was not a problem in the present study and we continued with the standard *poisson* command.

To clarify the interpretation of coefficients in the gravity model that we estimate, we can use a simplified model from Santos Silva and Tenreyro (2006):

$$(2)\ T_{ij} = \alpha_0 Y_i^{\alpha_1} Y_j^{\alpha_2} D_{ij}^{\alpha_3}$$

where T_{ij} is export from country i to country j; Y_i and Y_j denote GDP of countries i and j; and D_{ij} is distance or a more general form of trade resistance between the countries. Parameters $\alpha_1, \alpha_2,$ and α_3 are elasticities of T_{ij} with respect to the income and distance variables. Using properties of logarithm and exponential functions, the model can be written as:

$$(3)\ T_{ij} = \exp\left(\ln\alpha_0 + \alpha_1 \ln Y_i + \alpha_2 \ln Y_j + \alpha_3 \ln D_{ij}\right)$$

A stochastic specification of model (3) implies that the conditional mean of T_{ij} is an exponential function of the regressors. This is what we need in order to apply the PPML estimator in Stata using the poisson command. Coefficients of the variables in (3) are the same as in the original multiplicative specification of gravity in (2) and they are to be interpreted as elasticities.

We run the PPML estimator on the full set including the zero trade observations. Given the concerns about choice of estimators, as a robustness check, we also use OLS on a truncated dataset that drops the zeros in the trade matrix and we also compare the OLS results for the coefficients of interest to those obtained using PPML on the same truncated dataset. This allows us to track how estimator and sample choices affect coefficient values.

Finally, to address the heterogeneity issue, we use our PPML results to calculate the Mean Group Estimates of the coefficients of interest across services sectors, which we consider to be the most reliable estimates of the effect of STRI and water on cross-border services trade.

Data

Our data on services trade restrictions are drawn from the OECD's STRI database, which covers measures affecting services trade restrictions in 18 services sectors and 40 countries as of end-2013 (OECD, 2014).

The specific measures used to develop the STRI indexes include measures affecting cross-border services flows, movement of persons, and commercial presence. As noted by Nordås and Rouzet (2015), comparatively few of the measures covered in the STRI database involve explicit restrictions on cross-border trade in most sectors, transport and finance being the exceptions; services trade restrictions in most other sectors primarily impact on movement of people and on commercial presence.

As regards uncertainty, the OECD has provided first estimates of the difference between the STRI, which measures restrictiveness in applied policy, and countries' bindings under the WTO GATS. This difference – the "water" in the GATS bindings – provides a measure of the extent to which existing market access restrictions could be increased without violating WTO commitments (Miroudot and Pertel, 2015). Accordingly, data are now available on both actual restrictions and uncertainty that are measured by the same indicators and that apply the same weighting scheme.

For commercial banking and insurance sectors, the GATS indexes are not available and, therefore, these sectors are not included in the analysis. Also, after preliminary analysis, we dropped transportation and construction from the sample. In the case of transportation, road and rail services are traded only within continents. Air services and maritime services are not likely to follow the gravity model logic for a number of reasons. In fact, our experimentation showed that the behavior of the maritime service model is not in line with the gravity model (reflecting perhaps the cartelized framework for commercial shipping). Construction features little trade across borders and regressions result in wrong signs, also suggesting mis-specification of equations (i.e., failure to account for important structural economic features).

Data on services trade from the OECD's Trade in Services database are available for 12 of the 18 sectors covered by the STRI, namely: computer services, construction, accounting, legal services, telecoms, transport (air, maritime, road, and rail), courier services, commercial banking, and insurance. Following Nordås and Rouzet (2015), we use the 2008-2012 data to cover the period in which STRI captures regulations and laws. We use mirror trade data (i.e., data reported by the trade partner) if direct data are missing. Exploration of the sample revealed several outliers that we drop for the purposes of our analysis[4].

Note that the trade data do not cover trade in services through commercial presence (foreign direct investment, FDI). However, this does not mean that restrictions on commercial presence included in the STRI are irrelevant for trade in services. In fact, FDI and cross-border trade in services may be strongly related as complements or substitutes, as discussed by Nordås and Rouzet (2015).

Finally, we exclude intra-EU observations since the STRI values are not appropriate for intra-EU trade. This is so, because the index of GATS bindings used in measurement of water refers to the WTO commitments, while intra-EU trade in services is regulated by EU treaties. While there are other countries in the dataset that are connected through international treaties covering trade in services, the degree to which trade in services has been, in fact, liberalized in these treaties is very limited.

Our sample thus covers 40 countries and 5 service sectors: accounting, computer services, courier services, legal services, and telecommunications. On this sample, we estimate a panel data model in which trade data vary over time, sector, and country, while STRI and water are time-invariant, but vary over sector and country.

As regards the sources of the gravity data, GDP in current US dollars is from the IMF, World Economic Outlook Database. Other gravity variables come from the CEPII gravity dataset.

4 Specifically, export of courier services from the United States to Germany in 2012 was more than two times higher than the second top export value of this service, reaching US$3 billion. Also export of telecommunication services from the United States to Brazil was about US$1.5 billion in two years and US$2.6 billion in another year, while all other export values were below one billion.

Table 1 provides a summary of the size of the sample, the number of missing observations and the percentage of the observations on exports that are zero. Table 2 provides the list of countries in the sample.

Table 1: Sample Size

	Full Sample	Telecom	Legal	Computer	Accounting	Courier
Dataset Size	28,500	5,700	5,700	5,700	5,700	5,700
Missing	12,320	2,329	2,308	2,042	2,722	2,919
Observations	16,180	3,371	3,392	3,658	2,978	2,781
– *of which Zero*	4,212	536	854	472	1,077	1,273
			Percent			
Missing as percent of sample	43.2	40.9	40.5	35.8	47.8	51.2
Observations as percent of sample	56.8	59.1	59.5	64.2	52.2	48.8
– *of which Zero*	26.0	15.9	25.2	12.9	36.2	45.8

Source: Calculations by the authors.

Table 2: Countries in the Sample

EU Member States	Other Economies
Austria	Australia
Belgium	Brazil
Czech Republic	Canada
Denmark	Chile
Estonia	China
Finland	Iceland
France	India
Germany	Indonesia
Greece	Israel
Hungary	Japan
Ireland	Korea
Italy	Mexico
Luxembourg	New Zealand
Netherlands	Norway
Poland	Russia
Portugal	South Africa
Slovakia	Switzerland
Slovenia	Turkey
Spain	United States
Sweden	
United Kingdom	

Source: Calculations by the authors.

Table 3 provides summary data for services exports, STRI, and water. On average, there is roughly the same level of applied restrictiveness (0.28) as there is of water (0.25) across the sectors. Note that the telecommunications sector has little water, which is an important factor, given the performance of the sector-specific regressions for this sector.

Table 3: Average Exports, STRI and "Water", by Service Sector, Across Countries, 2008-2012

	Services Exports *(Millions USD)*	STRI	Water
Computer	87.3	0.19	0.19
Telecom	31.4	0.25	0.08
Legal	14.7	0.33	0.45
Courier	8.5	0.31	0.25
Accounting	4.6	0.31	0.29
Total	31.6	0.28	0.25

Source: Calculations by the authors.

Regressors

We estimate a panel model in which the dependent variable is bilateral exports of services by sector with data for five years, 2008-2012. Our regressors of interest are the following:

- The sector-specific STRI index; and
- A measure of sector-specific water drawn from Miroudot and Pertel (2015).

In addition to the core gravity model variables – distance and GDP – we include the conventional gravity variable of common language, along with year and sector dummies (the latter in the regressions that pool the sectoral data).

Several gravity variables often used in the literature are problematic in our context or performed poorly in preliminary regressions and are omitted in the final model.

First, Nordås and Rouzet (2015) include time difference between trading partners, but we drop this variable as it very strongly correlated with distance.

Second, common legal origins, contiguity, and common colony were tested, but performed poorly and were also dropped. Their behavior is shown in the Annex and it emphasizes the difference between the goods gravity model, where these variables are more stable, and the services gravity model.

Third, some studies include GDP per capita and population to capture the mass term in the gravity. We experimented with this but opted for the more parsimonious approach and used GDP as the explanatory variable for economic mass in the gravity equation. A major reason is the collinearity between the log of STRI and the log of GDP per capita: the simple correlation coefficient is -0.5, suggesting that more developed countries have liberalized trade in services to a greater extent.

Fourth, in order to avoid convergence issues with the PPML estimator because of including many variables, we do not include exporter and importer dummies to control for MTRs. One alternative suggested by Baier and Bergstrand (2009) is to use a linear approximation of MTRs that includes a number of elements of trade costs besides remoteness. We did not attempt this, because it is unknown how proxies of trade costs perform in the services gravity model. Instead, we settled on a remoteness index, which has been used to proxy MTRs in various studies (Drzewoszewska, 2014). Remoteness is a weighted average of distance between a country and its trading partners. However, the coefficient estimates for remoteness of origin and destination countries proved unstable and difficult to interpret (shown in the Annex); they were dropped from the final estimating equation.

Fifth, our observations include a number of bilateral trade flows in which cross-border services trade is affected by services chapters of regional trade agreements (RTAs)[5]. Both STRI and water levels are presumably lower for trade within these bilateral relationships than externally, but again it is not clear by how much without coding each of the RTAs to determine post-RTA STRI and water readings. Including a dummy variable for RTAs resulted in inconsistent and unstable coefficient estimates. The RTA variable was not, therefore, included in the final regressions.

Sixth, we also experimented with incorporating a measure of country risk that might determine the extent to which water matters to firms engaged in cross-border trade. For example, it seems intuitively plausible that water might matter less in countries where there is little likelihood of reversion to increased protectionism. To test this hypothesis, we used the Economist Intelligence Unit's (EIU) risk measure[6], which covers ten risk categories: security risk; political stability risk; government effectiveness risk; legal and regulatory risk; macroeconomic risk; foreign trade and payments risk; financial risk; tax policy risk; labour market risk; and infrastructure risk. Several of these risk categories do not intuitively bear on the policy risk that countries might directly or indirectly reverse liberalization in services. We experimented with various combinations and settled on an average of three of the risk measures: trade, macroeconomic, and political risk. Because of the correlation of the risk element in water and the EIU risk measure, as well as correlation between STRI and EIU risk, the latter indicating that countries with lower risk have liberalized trade in services more, we regress this composite country risk on STRI and water in order to obtain what we term "Residual Risk", which is country risk stripped of influence from water or STRI. We report the regressions results in Table 4. Note that the Residual Risk so-derived is based on a truncated sample excluding trade zeros for use in equations estimated by OLS and is based on the full sample for use in equations estimated by PPML.

5 Data on RTAs were drawn from the WTO RTA database. The following RTAs were included in our RTA dummy: Australia-New Zealand-Indonesia (ASEAN-Australia-New Zealand); Chile agreements with Australia, China, Canada, Japan, Mexico, Korea, European Union, United States, and New Zealand; European Free Trade Association (EFTA) agreements with Korea, Chile, and Mexico; European Union agreements with Korea, Mexico, and European Economic Area countries; Japan agreements with India, Indonesia, Mexico, and Switzerland; Korea agreements with India, Indonesia, and United States; North American Free Trade Agreement (NAFTA); China agreements with Switzerland, Indonesia, and New Zealand; and Australia-United States. The inference from the poor performance of the RTA variable is that services liberalization has not been possible to any significant degree in FTAs.

6 We considered, but passed, on an alternative measure for country risk, namely the Fraser Institute's index of economic freedom. This latter index has 31 indicators, of which 7 explicitly address international transactions (including non-tariff barriers, NTBs), and 7 others that address ownership of firms in terms of issues that are addressed in services trade agreements.

Table 4: Estimation of Residual Risk

	Truncated Sample	Full Sample
ln STRI (Destination)	0.210* (0.006)	0.245* (0.004)
Ln Water * (Destination)	-0.002 (0.003)	-0.011* (0.002)
Constant	-0.414* (0.011)	-0.405* (0.007)
Observations	10,500	26,168
R2_adj	0.105	0.132

Notes: 1) dependent variable is log of normalized risk (average of trade, political and macro), where the normalization sets the riskiest country in the sample to equal 1; 2) standard errors in parentheses 3) *, **, *** denote significance at 1 per cent level; 5 per cent level and 10 per cent level respectively. Residuals from model (1) are used as a risk measure in OLS and PPML (truncated models). Zero trade observations are excluded from the sample. Residuals from model (2) are used as a risk measure in PPML (full sample) regressions.

We introduced Residual Risk into the equations seeking to identify the impact of the STRI and water both independently and in the interaction variable water*Residual Risk. Again, problems with stability of the coefficients and often wrong signs on the interaction variable ruled out the latter strategy. Sorting out the interaction will be important for applications where the parties to the agreement are dissimilar in their country risk profiles.

Thus, we settle on the following relatively simple, but reasonably robust, estimating equation: Trade = f[log GDP origin, log GDP destination, log distance, common language dummy, log STRI destination, and log water destination]. We also include log Residual Risk in some specifications to bring out the role it plays in the estimation of the impact of policy uncertainty and regulatory barriers on trade in services.

Results

Table 5 summarizes the key results. We identify a statistically significant effect of water on services trade. This effect is smaller, but of a similar order of magnitude as that of the actual barriers to services trade measured by the STRI.

The gravity variables perform in a manner consistent with the literature. The coefficients on the GDP and distance variables are smaller in the PPML estimates than in the OLS estimates, echoing the results in Santos Silva and Tenreyro (2006).

The Residual Risk variable takes away some explanatory power from common language and more importantly from water. In the PPML sample that includes zeros, the water coefficient drops from-0.160 to -0.104 when Residual Risk is included.

Finally, using the Mean Group Estimator, which is essentially a mean of separate sector-specific PPML regressions based on samples that include zeros, the STRI coefficient is substantially larger, more than doubling from the -0.16 range to over -0.38, with similar scores whether Residual Risk is included or not. Importantly, taking into account sectoral heterogeneity through the Mean Group Estimator increases the spread between the STRI and water coefficients, as well as raising the levels. When Residual Risk is included, the coefficient on water falls from -0.210 to -0.115.

Table 5: Summary of Results

	Without Residual Country Risk				With Residual Country Risk			
	PPML	PPML (Zeros Omitted)	OLS (Zeros Omitted)	Mean Group Estimator (PPML,)	PPML	PPML (Zeros Omitted)	OLS (Zeros Omitted)	Mean Group Estimator (PPML,)
Ln GDP Origin	0.746* (0.027)	0.715* (0.026)	0.914* (0.013)	1.082* (0.033)	0.749* (0.028)	0.718* (0.027)	0.953* (0.013)	1.084* (0.030)
Ln GDP Destination	0.868* (0.025)	0.838* (0.025)	0.960* (0.013)	0.985* (0.031)	0.827* (0.024)	0.795* (0.025)	0.959* (0.013)	0.961* (0.026)
Ln Distance	-0.506* (0.053)	-0.471* (0.052)	-1.075* (0.020)	-0.848* (0.042)	-0.515* (0.054)	-0.479* (0.053)	-1.070* (0.020)	-0.843* (0.041)
Common Language	1.307* (0.117)	1.309* (0.115)	1.607* (0.053)	0.607* (0.096)	1.166* (0.127)	1.166* (0.125)	1.371* (0.054)	0.454* (0.104)
Residual Ln Country Risk	–	–	–	–	-0.662* (0.083)	-0.613* (0.076)	-1.093* (0.046)	-0.570* (0.092)
Ln STRI (Destination)	-0.171* (0.055)	-0.161* (0.055)	-0.390* (0.034)	-0.386* (0.076)	-0.164** (0.066)	-0.124*** (0.066)	-0.225* (0.037)	-0.381* (0.079)
Ln Water (Destination)	-0.160* (0.048)	-0.168* (0.048)	0.035 (0.024)	-0.210* (0.055)	-0.104*** (0.056)	-0.116** (0.056)	0.092* (0.025)	-0.115*** (0.061)
Constant	-5.740* (0.557)	-5.308* (0.548)	-4.918* (0.194)	-6.167* (0.456)	-5.145* (0.592)	-4.662* (0.583)	-4.588* (0.195)	-5.831* (0.441)
Observations	16,028	11,896	11,896		14,567	10,500	10,500	

Notes: 1) dependent variable is level of export in PPML regressions and log of export in OLS regressions;
2) samples used in regressions involving country risk measure exclude Russia;
3) risk is an average of trade, macro and political EIU risks; it equals 1 for most risky country; the residual risk is obtained as a residual from regressions of log of the normalized risk on log of STRI and log of Water using OLS estimator;
4) year and sector dummies are included in the models but the coefficients are not reported here;
5) robust standard errors in parentheses;
6) *, **, *** denote significance at 1 per cent level; 5 per cent level and 10 per cent level respectively.

The results reported here are provisional and so is our conclusion. As noted earlier, there is no established state of the art in this area and no consensus on stylized facts. Accordingly, the results from this exercise will be refined through further empirical analysis addressing the various outstanding methodological issues, the specification of the equation, and the sample used for the analysis.

Theory suggests that water has an effect; we find evidence for such an effect. The size of the water coefficient, which can be interpreted as an elasticity, is low – generally in the range between -0.1 and -0.2. For services sectors where the water in WTO commitments is significant, this nonetheless implies a significant impact on trade flows from binding commitments under trade agreements.

The main factor influencing the size of the water coefficient is the inclusion of country risk measures. It may be argued that, since water is specifically related to services trade, it is reasonable to give it priority of claim in affecting trade in services, rather than a more diffuse and less specific measure of risk. In any event, the size of the water coefficient – the principal outcome of this analysis – is of a similar order of magnitude, regardless of the inclusion of country risk, meaning that incorporating a bindings effect in CGE analyses of trade agreements would be only modestly affected by using the coefficient from the alternative specifications.

From the perspective of choice of estimator, the Mean Group Estimator, which takes into account sectoral heterogeneity, assigns a substantially larger coefficient to the STRI than to water – two to almost four times the size depending on the inclusion of country risk. This is more in line with intuition than the pooled PPML result, which has less of a difference between the two coefficients. Since services sectors are known to be heterogeneous, the Mean Group Estimator is also the preferred choice on a priori grounds.

These considerations lead to the conclusion that the size of the water and STRI coefficients should be read from the Mean Group Estimator, excluding Residual Risk. On this basis, we conclude that the elasticity of business services trade to water is about -0.2 and to the STRI is about -0.4.

Discussion and Conclusions

Robustness

Are these estimates sufficiently robust to use in policy-relevant evaluation of trade agreements in a CGE model context? We would make several observations in this regard.

First, the results are in line with theory, general empirical evidence on the effect of uncertainty on trade, and the intuition of trade negotiators who assign a high value to obtaining binding commitments. Our findings are not overturning conventional wisdom, but rather providing a specific quantification of that conventional wisdom. For example, the European Commission routinely includes a bindings effect in its CGE estimates of the impact of trade agreements; this is based on a notional 3% reduction in services trade costs due to reduction of uncertainty (see, e.g., European Commission, 2013).

Second, the specific point estimate on which we settle for water is reasonably related to the size of the estimate we settle on for the STRI. There is an internal consistency here that is reassuring. Further, our preferred point estimate for the effect of STRI is reasonably consistent with the Nordås and Rouzet (2015) estimate of the effect of STRI in the pooled regression (-0.308), the Mean Group Estimate for their regressions (-0.305), and their Mean Group Estimate for the five sectors that we study (-0.262).

Third, we follow the general advice of econometrics as to choice of estimators in obtaining our most satisfactory and preferred results. Again, there is a reassuring internal consistency in the results in this respect.

Applying the Results for CGE Analysis

As developed in this paper, the estimates of the effect of water on services trade do not lend themselves readily to incorporation in practical applied analysis of trade agreements. Below, we suggest how this can be done on a provisional basis.

The key takeaway point in our view from the regression analysis conducted on the effect of bindings is that it establishes that actual market restrictions, as measured by the OECD's STRI, have approximately twice the restrictive power as an equivalent amount of "water". That is, our recommended coefficient on the effect of a reduction in the STRI is 0.4 and for binding is 0.2.

NTBs, as quantified by gravity-based analysis, implicitly reflect both the effect of actual restrictions and of water. We note that both the STRI and water are measured on the basis of the same index and have approximately equal mean values in the dataset. This is very useful for combining the effects into a single measure of change in the aggregate.

Suppose that both the initial STRI and the initial water are 0.4. If both are eliminated by an FTA, the effect of eliminating the STRI would be twice as strong as the effect of eliminating the water. The combined effect would thus be the same as reducing an NTB index of 0.6 = 0.4 +0.5*0.4

Thus, the suggestion is to use the bindings analysis to enable a decomposition of currently estimated NTBs on the basis of the following simple formula: Total NTB = α(STRI + 0.5*water), where α is a coefficient that scales the index-based measure to the ad valorem equivalent (AVE).

With this method, we can calculate the percentage change in the aggregate NTB for services sectors implied by an FTA text based on calculated STRI and water changes. However, we still need to relate the percentage change in the NTB in its index form to the height of the AVE by sector in any given economy, which we cannot produce from our limited gravity modelling. For example, the reduction in the NTB might be 25% for two sectors, but one sector might have an AVE that is substantially larger than the other. So the liberalization shock will be greater for the sector with the larger AVE.

This issue can be addressed by mobilizing the rich data from the World Bank on AVEs by service sector (Jafari and Tarr, 2014), supplemented by other sources, such as Berden and Francois (2015). The percentage changes in sector-specific NTBs implied by an FTA text can be applied to these available estimates of the NTBs' size to generate an impact estimate in AVE terms.

We emphasize that this should be considered a "stylized" treatment of the issue – much like the convention under which the Armington elasticity of substitution between competing sources of imports is set at twice the value of the elasticity between imports and domestic products.

We observe that the response of trade is inelastic to both services trade liberalization, as reflected in changed STRI scores, and to binding commitments, as reflected in squeezed water. The integration of these results into CGE simulations of trade agreements will thus be muted compared to the sometimes large impacts generated by alternative methods of measuring the impact of reductions of services sectors NTBs, but far from negligible. For example, if water is eliminated by 100% in an FTA – i.e., if signatories commit to current applied levels of restrictions – the results imply a 21% expansion of cross-border services trade. This relatively modest effect is consistent with the results of gravity modelling on the effect of trade agreements on services trade – see, for example, the performance of the services RTA variable in Nordås and Rouzet (2015), as well as in the regressions reported in the Annex to this paper where we test the RTA variable ourselves. Our results appear, in this light, to be realistic.

Concluding Comment

The results that we obtain and the suggested CGE modelling application are provisional. However, it is far from obvious that the empirical evidence for the specific parameter estimates we obtain in respect of the size of the water (and the STRI) coefficients are significantly less open to question than many parameter estimates in CGE modelling. For example, in the database that underlies the Global Trade Analysis Project (GTAP) model, a workhorse of applied trade policy analysis, the Armington parameters follow the "rule of two", which assigns a value to the elasticity of substitution between competing sources of imports that is twice that of the elasticity of substitution between composite imports and domestic products. While this rule has survived econometric testing, it is clearly a round-figure generalization.

Overall, we believe our results represent a way to improve empirical assessments of trade agreements. However, there is an extensive agenda of further work to help refine the methodology.

- The impact of reducing water is likely to be heterogeneous across countries due to varying levels of risk of increase in the restrictiveness of regulations. The value of a trade agreement in binding to a trading firm is like the value of an insurance policy: for a given face value of risk (water), the insurance value (the premium) falls as the likelihood of the risk being actuated falls.[7]
- The impact of reducing water is also likely to be heterogeneous across sectors as well, due to different industry structures.
- Regulatory heterogeneity is also likely to be an issue – that is, differences in regulatory mixes between importing and exporting countries might represent a trade cost even if the total STRI values are the same.
- AVEs based on STRI/GTRI composites need to be developed; at present, it is a strong assumption that the STRI/GTRI composite maps 100% to gravity-model-based estimates of AVEs.
- Services restrictions need to be differentiated by whether they impact price or simply behaviour (in the latter case, the implication is that the impact should be modelled with a "phantom tax" that affects behaviour, but not trade costs).
- The interaction between modes needs to be taken into account – for example, cross-border trade might be facilitated by improvements in Mode 4.

OECD trade in services data does not cover commercial presence. While the effect of applied restrictions and binding can be captured through the impact on FDI, to the extent that the restrictions affect foreign affiliate sales, that element cannot be captured.

Finally, to facilitate the evaluation of the impact of the STRI/GTRI composite, existing agreements that significantly liberalize trade in services, such as the EU treaty, have to be systematically coded.

There is much work to be done to integrate the role of uncertainty into measures of trade restriction and to calibrate the effect of this element in measured AVEs. This paper suggests a way forward on this work. Next steps will include addressing outstanding concerns about the choice of estimators (including developing estimates using the HTM estimator that has been recommended for use in a context like ours).

7 We are indebted for this point to Zornitsa Kulinova-Dmitrova.

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Annex: Additional Regression Results

A1. Pre-screening Gravity Variables for Services – Individual Regressions

To test how variables that are conventionally used to proxy trade costs in a goods gravity model context perform within a services gravity context, we first run basic gravity equations regressing exports against GDP of the origin and destination economies, bilateral distance, year and sector dummies, plus each of the standard gravity regressors in turn.

Given that the literature in the latter area is relatively underdeveloped, we test the individual variables prior to specifying the model. Do colonial ties impact on the intensity of cross-border services trade, given that trade in services is a relatively new development as compared to trade in goods, for which patterns of trade were established in the colonial era? Does contiguity matter, given that the nature of services (and, thus, other aspects of trade, such as logistics) differs from the nature of goods? And so forth.

We run this exercise first with OLS and then using the PPML estimator. This also provides a basis for comparison of the two estimators in simple gravity specifications. Tables A1a to A1c report the results.

Table A1a: Conventional Gravity Regressors – OLS Estimator

	Basic	Common language	Common colony	Contiguity	Legal origin	RTA	Remoteness (origin)	Remoteness (destination)
ln (GDP_origin)	0.957* (0.013)	0.924* (0.013)	0.950* (0.013)	0.949* (0.013)	0.950* (0.013)	0.965* (0.013)	0.962* (0.013)	0.977* (0.013)
ln (GDP_destin)	0.990* (0.013)	0.961* (0.013)	0.983* (0.013)	0.982* (0.013)	0.985* (0.013)	0.998* (0.013)	0.985* (0.013)	0.963* (0.013)
ln (distance)	-1.116* (0.020)	-1.057* (0.020)	-1.098* (0.020)	-1.067* (0.023)	-1.097* (0.020)	-1.109* (0.020)	-1.093* (0.024)	-1.208* (0.022)
Gravity variables		1.649* (0.054)	1.202* (0.084)	0.473* (0.076)	0.471* (0.047)	0.194* (0.045)	-0.165*** (0.088)	0.741* (0.089)
Observations	11,966	11,966	11,966	11,966	11,966	11,966	11,966	11,966
R2 adjusted	0.540	0.562	0.546	0.541	0.544	0.540	0.540	0.543

Notes: 1) dependent variable in OLS regressions is log of exports and the sample is truncated by excluding observations where trade is zero; in PPML regressions, the dependent variable is the level of exports and the sample includes or excludes observations where trade is zero as indicated in the table's title;
2) year and sector dummies are included but not reported;
3) robust standard errors in parentheses;
4) *, **, *** denote significance at 1 per cent level; 5 per cent level and 10 per cent level respectively.

Table A1b: Conventional Gravity Regressors – PPML Estimator

	Basic	Common language	Common colony	Contiguity	Legal origin	RTA	Remoteness (origin)	Remoteness (destination)
ln (GDP_origin)	0.802* (0.031)	0.746* (0.027)	0.788* (0.029)	0.788* (0.032)	0.801* (0.028)	0.802* (0.031)	0.856* (0.042)	0.803* (0.031)
ln (GDP_destin)	0.957* (0.034)	0.886* (0.026)	0.943* (0.036)	0.939* (0.033)	0.951* (0.031)	0.957* (0.034)	0.951* (0.034)	0.948* (0.038)
ln (distance)	-0.747* (0.054)	-0.498* (0.055)	-0.736* (0.054)	-0.649* (0.068)	-0.655* (0.055)	-0.739* (0.052)	-0.710* (0.049)	-0.754* (0.058)
Gravity variables		1.337* (0.119)	0.324** (0.127)	0.356* (0.118)	0.886* (0.110)	0.054 (0.077)	-0.701* (0.247)	0.119 (0.199)
Observations	16,178	16,178	16,178	16,178	16,178	16,178	16,178	16,178

Notes: See Table A1a

Table A1c: Comparison of Gravity Variable Coefficient Estimates, Individual Regressions

	OLS	PPML
GDP Origin (ave.)	0.954*	0.798*
GDP Destination (ave.)	0.981*	0.942*
Distance (ave.)	-1.106*	-0.686*
Common language	1.649*	1.337*
Common colony	1.202*	0.324**
Contiguity	0.473*	0.356*
Legal origin	0.471*	0.886*
RTA	0.194*	0.054
Remoteness (origin)	-0.165***	-0.701*
Remoteness (destination)	0.741*	0.119

Note: Coefficient estimates are taken from tables A1a and A1b.

Two observations are in order concerning these results. First, consistent with the findings in Santos Silva and Tenreyro (2006), PPML coefficient estimates for GDP and distance are consistently lower than those obtained using OLS, as well as those for most other regressors. Second, the coefficient estimates of GDP and distance are stable when we add other regressors. This suggests that, at least individually, these elements of trade costs are not closely related to the key gravity relation between economic mass, distance, and trade. This is important, given the uncertainty regarding relevant regressors discussed above.

A2. Pre-screening Gravity Variables for Services – Ensemble Regressions

We next examine how the variables perform in ensemble regressions. We adopt a general-to-specific approach, starting with an extended specification including the following: distance, common language, colonial ties, contiguity, common legal origins, RTA dummy, and remoteness of destination and origin countries. We then sequentially drop variables that have a statistically-insignificant coefficient or a coefficient that has a wrong sign. If omitting a variable results in only a marginal change in the explanatory power of the equation and minimal change in the coefficients of the main gravity variables, we conclude it is safe to drop it. We conduct this analysis by estimating models using OLS (Table A2a) and PPML (Table A2b).

Table A2a: General-to-specific Screening in Ensemble Regressions – OLS estimator

	(1)	(2)	(3)	(4)
ln (GDP_origin)	0.953* (0.013)	0.953* (0.013)	0.950* (0.013)	0.933* (0.013)
ln (GDP_destin)	0.952* (0.013)	0.952* (0.013)	0.949* (0.013)	0.968* (0.013)
ln(distance)	-1.103* (0.035)	-1.103* (0.035)	-1.073* (0.032)	-1.038* (0.020)
Common language	1.573* (0.066)	1.549* (0.061)	1.522* (0.060)	1.556* (0.055)
Common colony	0.870* (0.086)	0.860* (0.085)	0.827* (0.084)	0.818* (0.083)
RTA	0.291* (0.044)	0.285* (0.043)	0.278* (0.043)	0.271* (0.044)
ln (remote_origin)	-0.104 (0.103)	-0.107 (0.103)	-0.142 (0.102)	
ln (remote_destin)	0.459* (0.106)	0.454* (0.106)	0.421* (0.105)	
Contiguity	-0.212* (0.080)	-0.224* (0.079)		
Legal origin	-0.045 (0.048)			
Constant	-7.557* (1.440)	-7.491* (1.435)	-7.114* (1.430)	-4.963* (0.187)
Observations	11,966	11,966	11,966	11,966
R2 adjusted	0.568	0.568	0.568	0.566

Notes: See Table A1a.

Table A2b: General-to-specific Screening in Ensemble Regressions – PPML Estimator

	(1)	(2)	(3)	(4)
ln(GDP_origin)	0.861* (0.029)	0.861* (0.029)	0.818* (0.034)	0.805* (0.035)
ln(GDP_destin)	0.949* (0.039)	0.949* (0.040)	0.909* (0.030)	0.895* (0.029)
ln(distance)	-0.557* (0.058)	-0.557* (0.058)	-0.541* (0.060)	-0.387* (0.060)
Common language	1.455* (0.147)	1.456* (0.155)	1.304* (0.116)	1.238* (0.116)
ln(remote_origin)	-1.161* (0.174)	-1.165* (0.168)	-0.930* (0.202)	-1.063* (0.190)
ln(remote_destin)	-0.494* (0.188)	-0.497** (0.194)	-0.299*** (0.155)	-0.443* (0.160)
Legal origin	0.279* (0.064)	0.277* (0.060)	0.240* (0.060)	0.224* (0.058)
Contiguity	-0.688* (0.146)	-0.693* (0.165)	-0.450* (0.117)	
colony	-0.466* (0.177)	-0.465* (0.174)		
RTA	-0.009 (0.078)			
Constant	8.370* (2.120)	8.429* (2.076)	5.082** (2.215)	6.385* (2.162)
Observations	16,178	16,178	16,178	16,178

Notes: See Table A1a.

In the OLS sequence of regressions, we end up with GDP, distance, language, colony, and RTA dummies as our base model. Repeating this sequence with PPML, we end up with a somewhat different set of variables: GDP, distance, language, remoteness, and legal origin. As in the previous tests, the PPML estimator reduces the effect of GDP and distance.

Table A2c: Comparison of Gravity Variable Coefficient Estimates, Ensemble Regressions		
	OLS	PPML
GDP Origin (average)	0.933*	0.805*
GDP Destination (average)	0.968*	0.895*
Distance (average)	-1.038*	-0.387*
Common language	1.556*	1.238*
Common colony	0.818*	—
EU member	—	—
RTA	0.271*	—
Remoteness (origin)	—	-1.063*
Remoteness (destination)	—	-0.443*
Legal origin	—	0.224*

Source: Tables A2a and A2b.

As can be seen, different estimators and different samples select somewhat different final regression models. Moreover, coefficient estimates shift in ensemble compared to in individual regressions, alerting to risks of missing variables in our specification. We continue with the full sample OLS and PPML base models for further analysis, adding in risk, STRI, and water for the next round.

A3. Introducing STRI and Water

The next set of tables report the introduction of STRI and water into the base OLS and PPML models.

Table A3a: Introducing STRI and Water into the OLS Base Model

	Base	Base with STRI	Base with Water	Base with STRI & Water	Base with STRI & Water	Base with STRI & Water
	OLS	OLS	OLS	OLS	PPML Truncated Sample	PPML Full Sample
ln(GDP_ origin)	0.933* (0.013)	0.922* (0.013)	0.933* (0.013)	0.922* (0.013)	0.727* (0.025)	0.759* (0.025)
ln(GDP_ destin)	0.968* (0.013)	0.965* (0.013)	0.969* (0.013)	0.966* (0.013)	0.847* (0.029)	0.878* (0.029)
ln(distance)	-1.038* (0.020)	-1.055* (0.020)	-1.048* (0.020)	-1.059* (0.020)	-0.478* (0.050)	-0.514* (0.051)
Common Language	1.556* (0.055)	1.525* (0.054)	1.541* (0.055)	1.519* (0.055)	1.367* (0.142)	1.374* (0.144)
Common Colony	0.818* (0.083)	0.765* (0.084)	0.815* (0.083)	0.767* (0.084)	-0.170 (0.143)	-0.183 (0.144)
RTA	0.271* (0.044)	0.214* (0.044)	0.278* (0.044)	0.221* (0.044)	-0.206** (0.101)	-0.251** (0.100)
ln(STRI_ destin)		-0.372* (0.033)		-0.352* (0.034)	-0.193* (0.055)	-0.206* (0.055)
ln(water_ destin)			0.099* (0.023)	0.047*** (0.024)	-0.179* (0.051)	-0.171* (0.051)
Constant	-4.963* (0.187)	-5.262* (0.189)	-4.712* (0.188)	-5.126* (0.192)	-5.460* (0.644)	-5.883* (0.650)
Observa-tions	11,966	11,966	11,896	11,896	11,896	16,028
R2 Adjusted	0.566	0.570	0.567	0.571		

Notes: See Table A1a.

Table A3b: Introducing STRI and Water into the PPML Base Model

	Base	Base with STRI	Base with Water	Base with STRI & Water
ln(GDP_origin)	0.805* (0.035)	0.809* (0.036)	0.805* (0.035)	0.809* (0.036)
ln(GDP_destin)	0.895* (0.029)	0.871* (0.030)	0.886* (0.028)	0.859* (0.029)
ln(distance)	-0.387* (0.060)	-0.394* (0.061)	-0.400* (0.058)	-0.409* (0.059)
ln(remote_origin)	-1.063* (0.190)	-1.114* (0.197)	-1.044* (0.191)	-1.097* (0.198)
ln(remote_destin)	-0.443* (0.160)	-0.266*** (0.161)	-0.404** (0.157)	-0.206 (0.157)
Common language	1.238* (0.116)	1.212* (0.119)	1.230* (0.114)	1.202* (0.117)
Legal origin	0.224* (0.058)	0.219* (0.058)	0.218* (0.057)	0.211* (0.057)
ln(STRI_destin)		-0.201* (0.059)		-0.219* (0.059)
ln(water_destin)			-0.126* (0.045)	-0.145* (0.046)
Constant	6.385* (2.162)	5.188** (2.030)	5.821* (2.156)	4.439** (2.015)
Observations	16,178	16,178	16,028	16,028

Notes: See Table A1a.

The key difference between the OLS base model and the PPML model is that OLS assigns a much smaller role for water relative to STRI than does PPML. When the OLS base model is re-estimated in PPML, the STRI variable has a smaller effect and the water variable gains significantly.

A4. Introducing Country Risk

As we discussed in the main body of the paper, there are ten different EIU risk measures. We normalize the risk measures, such that the riskiest country has a value equal to one. The correlations between the normalized EIU risk variables are shown in Table A4a below. We settled on a variable risk that is an average of the EIU trade, macroeconomic, and political risks, based on a priori considerations as to the relevance of the specific risks to the issue at hand: the likelihood that water, which is a measure of the potential for retraction of market access, would be actualized by change in government policy.

Table A4a: Correlations between Normalized EIU Risk Measures

	Finance	Government Efficiency	Infrastructure	Labour	Legal	Macro	Political	Security	Tax	Trade
Finance	1.000									
Government efficiency	0.744 (0.000)	1.000								
Infrastructure	0.692 (0.000)	0.860 (0.000)	1.000							
Labour	0.645 (0.000)	0.715 (0.000)	0.724 (0.000)	1.000						
Legal	0.744 (0.000)	0.931 (0.000)	0.850 (0.000)	0.829 (0.000)	1.000					
Macro	0.101 (0.540)	0.339 (0.035)	0.189 (0.248)	0.123 (0.458)	0.258 (0.114)	1.000				
Political	0.646 (0.000)	0.784 (0.000)	0.610 (0.000)	0.602 (0.000)	0.707 (0.000)	0.281 (0.083)	1.000			
Security	0.501 (0.001)	0.772 (0.000)	0.758 (0.000)	0.740 (0.000)	0.749 (0.000)	0.257 (0.114)	0.645 (0.000)	1.000		
Tax	0.450 (0.004)	0.727 (0.000)	0.675 (0.000)	0.536 (0.000)	0.717 (0.000)	0.300 (0.063)	0.448 (0.004)	0.533 (0.001)	1.000	
Trade	0.737 (0.000)	0.738 (0.000)	0.673 (0.000)	0.688 (0.000)	0.791 (0.000)	0.252 0.122	0.499 0.001	0.520 0.001	0.714 (0.000)	1.000

Note: p-values in parenthesis.

The correlations between the STRI, water, and normalized EIU risk measures are provided in Table A4b.

Table A4b: Correlations between STRI, Water and Normalized EIU Risk Measures

	Finance	Government Efficiency	Infrastructure	Labour	Legal	Macro	Political	Security	Tax	Trade	Average of Trade Macro Political
STRI	0.352 (0.000)	0.485 (0.000)	0.492 (0.000)	0.510 (0.000)	0.562 (0.000)	0.090 (0.000)	0.364 (0.000)	0.456 (0.000)	0.430 (0.000)	0.449 (0.000)	0.398 (0.000)
Water	-0.148 (0.000)	-0.075 (0.000)	-0.024 (0.078)	-0.054 (0.000)	-0.084 (0.000)	0.049 (0.000)	-0.053 (0.000)	-0.060 (0.000)	-0.088 (0.000)	-0.164 (0.000)	-0.070 (0.000)

Note: P-values in parentheses.

We next experiment with including risk in the model. Table A4c starts with a basic OLS model based on Table A3a (base OLS with STRI and water), with one difference, namely that observations involving Russia were excluded. We then develop the various permutations with log of risk and the interaction between log of risk and log of water and we experiment with the RTA variable that appeared to be not stable in the analysis. OLS assigns a large negative effect to the risk variable, while STRI, water, and the interaction term has the wrong sign.

Table A4c: OLS Regressions, Introducing Log of Risk

	(1)	(2)	(3)	(4)	(5)	(6)
Ln GDP (Origin)	0.922* (0.013)	0.929* (0.013)	0.949* (0.013)	0.952* (0.013)	0.949* (0.013)	0.952* (0.013)
Ln GDP (Destination)	0.970* (0.013)	0.976* (0.013)	0.954* (0.013)	0.957* (0.013)	0.954* (0.013)	0.957* (0.013)
Ln (Distance)	-1.037* (0.021)	-1.028* (0.021)	-1.069* (0.020)	-1.064* (0.020)	-1.069* (0.020)	-1.064* (0.020)
Common Language	1.447* (0.056)	1.465* (0.056)	1.246* (0.057)	1.257* (0.057)	1.246* (0.057)	1.257* (0.057)
Common Colony	0.677* (0.101)	0.683* (0.100)	0.827* (0.100)	0.830* (0.100)	0.827* (0.100)	0.830* (0.100)
Ln(STRI_destin)	-0.286* (0.037)	-0.271* (0.037)	0.077*** (0.039)	0.082** (0.039)	0.076*** (0.039)	0.082** (0.040)
Ln(Water_destin)	0.020 (0.025)	0.027 (0.025)	0.095* (0.025)	0.098* (0.025)	0.100** (0.042)	0.101** (0.042)
RTA		0.159* (0.045)		0.082*** (0.044)		0.082*** (0.044)
Ln(risk)			-1.335* (0.055)	-1.327* (0.055)	-1.320* (0.105)	-1.318* (0.105)
Ln (risk)* ln (Water_destin)					0.008 (0.052)	0.005 (0.052)
Constant	-4.925* (0.204)	-5.083* (0.206)	-5.067* (0.193)	-5.149* (0.195)	-5.057* (0.204)	-5.143* (0.206)
Observations	10,500	10,500	10,500	10,500	10,500	10,500
R2_adj	0.582	0.582	0.603	0.603	0.603	0.603

Note: 1) dependent variable is log of export 2) sample excludes Russia 3) risk measure equals 1 for most risky country 3) year and sector dummies are included in the models 3) robust standard errors in parentheses 4) *, **, *** denote significance at 1 per cent level; 5 per cent level and 10 per cent level respectively.

Performing the same experiment with the PPML models (but excluding Russia) results in wrong signs for water and the interaction term and a complete loss of explanatory power of STRI. The addition of the interaction term sharply reduces the coefficient of the risk variable. Accordingly, there is a complex interaction amongst STRI, water, risk, and the RTA variable.

Table A4d: PPML Regressions, Introducing Log of Risk, Truncated Sample

	(1)	(2)	(3)	(4)	(5)	(6)
Ln GDP (Origin)	0.718* (0.025)	0.726* (0.025)	0.719* (0.026)	0.734* (0.025)	0.723* (0.026)	0.738* (0.025)
Ln GDP (Destination)	0.835* (0.027)	0.841* (0.030)	0.796* (0.027)	0.800* (0.028)	0.791* (0.027)	0.795* (0.028)
Ln (Distance)	-0.465* (0.055)	-0.477* (0.051)	-0.479* (0.055)	-0.503* (0.049)	-0.484* (0.054)	-0.510* (0.048)
Common language	1.300* (0.133)	1.341* (0.145)	1.170* (0.139)	1.223* (0.149)	1.179* (0.139)	1.233* (0.148)
Common colony	-0.114 (0.122)	-0.192 (0.145)	-0.023 (0.126)	-0.136 (0.147)	-0.027 (0.126)	-0.142 (0.147)
Ln (STRI_destin)	-0.176* (0.061)	-0.200* (0.062)	0.026 (0.068)	0.017 (0.067)	0.007 (0.068)	-0.002 (0.067)
Ln (Water_destin)	-0.178* (0.056)	-0.185* (0.057)	-0.120** (0.058)	-0.125** (0.058)	0.149*** (0.081)	0.164** (0.081)
RTA		-0.225** (0.098)		-0.356* (0.103)		-0.364* (0.102)
Ln (risk)			-0.727* (0.092)	-0.843* (0.092)	-0.012 (0.206)	-0.074 (0.207)
Ln (risk)* ln (Water_ destin)					0.361* (0.090)	0.390* (0.093)
Constant	-5.224* (0.673)	-5.268* (0.687)	-4.988* (0.655)	-5.033* (0.664)	-4.463* (0.625)	-4.460* (0.626)
Observations	10,500	10,500	10,500	10,500	10,500	10,500

Note: dependent variable is level of export; see Table A4c for other notes.

Table A4e: PPML Regressions, Introducing Log of Risk, Full Sample

	(1)	(2)	(3)	(4)	(5)	(6)
Ln GDP (Origin)	0.751* (0.026)	0.759* (0.025)	0.750* (0.027)	0.766* (0.025)	0.754* (0.027)	0.770* (0.026)
Ln GDP (Destination)	0.867* (0.027)	0.874* (0.029)	0.828* (0.027)	0.831* (0.028)	0.823* (0.027)	0.826* (0.027)
Ln (Distance)	-0.500* (0.057)	-0.514* (0.053)	-0.514* (0.057)	-0.541* (0.051)	-0.520* (0.056)	-0.548* (0.049)
Common language	1.303* (0.135)	1.352* (0.147)	1.170* (0.142)	1.230* (0.151)	1.179* (0.141)	1.241* (0.150)
Common colony	-0.112 (0.123)	-0.206 (0.146)	-0.021 (0.128)	-0.150 (0.148)	-0.026 (0.128)	-0.157 (0.148)
Ln (STRI_destin)	-0.191* (0.061)	-0.218* (0.062)	0.014 (0.068)	0.007 (0.067)	-0.005 (0.068)	-0.011 (0.067)
Ln (Water_destin)	-0.170* (0.056)	-0.178* (0.056)	-0.113** (0.058)	-0.117** (0.058)	0.174** (0.080)	0.191** (0.081)
RTA		-0.270* (0.097)		-0.405* (0.102)		-0.412* (0.101)
Ln (risk)			-0.737* (0.093)	-0.871* (0.093)	0.028 (0.209)	-0.052 (0.209)
Ln (risk)* ln (Water_ destin)					0.387* (0.091)	0.416* (0.094)
Constant	-5.715* (0.683)	-5.746* (0.692)	-5.467* (0.665)	-5.481* (0.667)	-4.905* (0.632)	-4.868* (0.627)
Observations	14,567	14,567	14,567	14,567	14,567	14,567

Note: dependent variable is level of export; see Table A4c for other notes.

Tables A4f through A4h repeat the above exercise, but with the residual of the log of normalized risk instead of the log of risk. The residual risk excludes the effects of STRI and water.

Table A4f: OLS Regressions, Residual Log of Risk

	(1)	(2)	(3)	(4)	(5)	(6)
Ln GDP (Origin)	0.922* (0.013)	0.929* (0.013)	0.949* (0.013)	0.952* (0.013)	0.949* (0.013)	0.952* (0.013)
Ln GDP (Destination)	0.970* (0.013)	0.976* (0.013)	0.954* (0.013)	0.957* (0.013)	0.954* (0.013)	0.957* (0.013)
Ln (Distance)	-1.037* (0.021)	-1.028* (0.021)	-1.069* (0.020)	-1.064* (0.020)	-1.069* (0.020)	-1.064* (0.020)
Common language	1.447* (0.056)	1.465* (0.056)	1.246* (0.057)	1.257* (0.057)	1.246* (0.057)	1.257* (0.057)
Common colony	0.677* (0.101)	0.683* (0.100)	0.827* (0.100)	0.830* (0.100)	0.827* (0.100)	0.830* (0.100)
Ln(STRI_destin)	-0.286* (0.037)	-0.271* (0.037)	-0.203* (0.037)	-0.196* (0.037)	-0.203* (0.037)	-0.195* (0.037)
Ln(Water_destin)	0.020 (0.025)	0.027 (0.025)	0.098* (0.025)	0.101* (0.025)	0.098* (0.025)	0.101* (0.025)
RTA		0.159* (0.045)		0.082*** (0.044)		0.082*** (0.044)
Residual Ln(risk)			-1.119* (0.046)	-1.112* (0.046)	-1.117* (0.095)	-1.117* (0.095)
Residual Ln(risk)*ln(Water_ destin)					0.001 (0.048)	-0.003 (0.048)
Constant	-4.925* (0.204)	-5.083* (0.206)	-4.514* (0.194)	-4.599* (0.195)	-4.515* (0.194)	-4.599* (0.195)
Observations	10,500	10,500	10,500	10,500	10,500	10,500
R-squared	0.583	0.583	0.604	0.604	0.604	0.604
R2_adj	0.582	0.582	0.603	0.603	0.603	0.603

Note: 1) dependent variable is log of export 2) sample excludes Russia 3) risk measure equals 1 for most risky country; the residual risk is obtain as a residual from the regression of log of normalized risk on log of STRI and log of water using OLS estimator 4) year and sector dummies are included in the models 5) robust standard errors in parentheses 6) *, **, *** denote significance at 1 per cent level; 5 per cent level and 10 per cent level respectively.

Table A4g: PPML Regressions, Residual Log of Risk, Truncated Sample

	(1)	(2)	(3)	(4)	(5)	(6)
Ln GDP (Origin)	0.718* (0.025)	0.726* (0.025)	0.719* (0.026)	0.734* (0.025)	0.721* (0.026)	0.737* (0.025)
Ln GDP (Destination)	0.835* (0.027)	0.841* (0.030)	0.796* (0.027)	0.800* (0.028)	0.792* (0.027)	0.795* (0.028)
Ln (Distance)	-0.465* (0.055)	-0.477* (0.051)	-0.479* (0.055)	-0.503* (0.049)	-0.482* (0.055)	-0.509* (0.048)
Common language	1.300* (0.133)	1.341* (0.145)	1.170* (0.139)	1.223* (0.149)	1.177* (0.139)	1.233* (0.149)
Common colony	-0.114 (0.122)	-0.192 (0.145)	-0.023 (0.126)	-0.136 (0.147)	-0.022 (0.126)	-0.138 (0.146)
Ln(STRI_destin)	-0.176* (0.061)	-0.200* (0.062)	-0.127*** (0.065)	-0.160** (0.065)	-0.149** (0.065)	-0.186* (0.064)
Ln(Water_destin)	-0.178* (0.056)	-0.185* (0.057)	-0.118** (0.058)	-0.123** (0.058)	-0.114** (0.057)	-0.120** (0.057)
RTA		-0.225** (0.098)		-0.356* (0.103)		-0.366* (0.103)
Residual Ln(risk)			-0.610* (0.077)	-0.707* (0.077)	-0.203 (0.183)	-0.227 (0.185)
Residual Ln(risk)*ln(Water_destin)					0.203** (0.083)	0.242* (0.085)
Constant	-5.224* (0.673)	-5.268* (0.687)	-4.687* (0.666)	-4.684* (0.665)	-4.713* (0.668)	-4.709* (0.666)
Observations	10,500	10,500	10,500	10,500	10,500	10,500

Note: 1) dependent variable is level of export; for other notes see Table A4f.

Table A4h: PPML Regressions, Residual Log of Risk, Full Sample

	(1)	(2)	(3)	(4)	(5)	(6)
Ln GDP (Origin)	0.751* (0.026)	0.759* (0.025)	0.750* (0.027)	0.766* (0.025)	0.752* (0.027)	0.768* (0.026)
Ln GDP (Destination)	0.867* (0.027)	0.874* (0.029)	0.828* (0.027)	0.831* (0.028)	0.824* (0.027)	0.826* (0.027)
Ln (Distance)	-0.500* (0.057)	-0.514* (0.053)	-0.514* (0.057)	-0.541* (0.051)	-0.518* (0.057)	-0.546* (0.050)
Common language	1.303* (0.135)	1.352* (0.147)	1.170* (0.142)	1.230* (0.151)	1.177* (0.141)	1.240* (0.151)
Common colony	-0.112 (0.123)	-0.206 (0.146)	-0.021 (0.128)	-0.150 (0.148)	-0.020 (0.127)	-0.151 (0.148)
Ln(STRI_destin)	-0.191* (0.061)	-0.218* (0.062)	-0.166** (0.065)	-0.206* (0.065)	-0.190* (0.065)	-0.234* (0.065)
Ln(Water_destin)	-0.170* (0.056)	-0.178* (0.056)	-0.106*** (0.058)	-0.107*** (0.058)	-0.106*** (0.057)	-0.109*** (0.056)
RTA		-0.270* (0.097)		-0.405* (0.102)		-0.414* (0.102)
Residual Ln(risk)			-0.658* (0.083)	-0.778* (0.083)	-0.227 (0.195)	-0.262 (0.196)
Residuals Ln(risk)*ln(Water_destin)					0.216** (0.088)	0.260* (0.091)
Constant	-5.715* (0.683)	-5.746* (0.692)	-5.169* (0.676)	-5.128* (0.668)	-5.213* (0.679)	-5.175* (0.671)
Observations	14,567	14,567	14,567	14,567	14,567	14,567

Note: 1) dependent variable is level of export; for other notes see Table A4f.

A5. Sector-Specific Regressions – The Mean Group Estimates

We next generate sector-specific regressions and calculate the Mean Group Estimates using the final model. Note that in the regressions with country risk, the residual risk also comes from sector-specific regressions – i.e., the risk variable is regressed on sector STRI and water in the sample covering only the sector under consideration.

The sectors show considerable heterogeneity for all gravity variables, as well as for STRI and water. Notably, the Mean Group Estimates have GDP and distance coefficients in the familiar range from the gravity modelling literature on goods trade of close to unity.

Table A5a: Sector-specific PPML Regressions, Without Residual Country Risk

	Accounting	Computer	Courier	Legal	Telecom	Mean group
Ln GDP (Origin)	0.959* (0.043)	0.577* (0.029)	1.551* (0.143)	1.381* (0.055)	0.943* (0.035)	1.082* (0.033)
Ln GDP (Destination)	0.972* (0.047)	0.800* (0.032)	1.362* (0.133)	0.922* (0.035)	0.870* (0.035)	0.985* (0.031)
Ln (Distance)	-1.140* (0.062)	-0.429* (0.065)	-1.303* (0.174)	-0.525* (0.063)	-0.845* (0.053)	-0.848* (0.042)
Common Language	-0.105 (0.177)	1.413* (0.145)	-0.031 (0.374)	0.886* (0.125)	0.871* (0.153)	0.607* (0.096)
Ln STRI (Destination)	-0.792* (0.154)	0.003 (0.099)	-0.762** (0.309)	-0.280* (0.094)	-0.098 (0.077)	-0.386* (0.076)
Ln Water (Destination)	-0.127** (0.053)	-0.700* (0.091)	-0.443** (0.185)	0.072 (0.133)	0.146 (0.108)	-0.210* (0.055)
Constant	-3.485* (0.658)	-3.533* (0.783)	-10.758* (1.751)	-10.563* (0.695)	-2.499* (0.777)	-6.167* (0.456)
Observations	2,904	3,658	2,704	3,392	3,370	

Note: 1) dependent variable is level of export 2) year dummies are included in the models 3) robust standard errors in parentheses 6) *, **, *** denote significance at 1 per cent level; 5 per cent level and 10 per cent level respectively.

Table A5b: Sector-specific PPML Regressions, with Residual Country Risk

	Accounting	Computer	Courier	Legal	Telecom	Mean group
Ln GDP (Origin)	0.997* (0.046)	0.583* (0.029)	1.525* (0.123)	1.370* (0.058)	0.945* (0.039)	1.084* (0.030)
Ln GDP (Destination)	1.026* (0.053)	0.764* (0.032)	1.212* (0.105)	0.949* (0.036)	0.854* (0.036)	0.961* (0.026)
Ln (Distance)	-1.121* (0.060)	-0.432* (0.065)	-1.326* (0.164)	-0.506* (0.065)	-0.828* (0.054)	-0.843* (0.041)
Common Language	-0.274 (0.183)	1.322* (0.153)	-0.499 (0.408)	0.865* (0.133)	0.854* (0.165)	0.454* (0.104)
Residual Ln Country Risk	-0.658* (0.124)	-0.433* (0.085)	-1.406* (0.353)	-0.225 (0.184)	-0.130 (0.179)	-0.570* (0.092)
Ln STRI (Destination)	-0.786* (0.171)	-0.149 (0.108)	-0.595*** (0.306)	-0.251** (0.101)	-0.122 (0.105)	-0.381* (0.079)
Ln Water (Destination)	-0.034 (0.067)	-0.568* (0.110)	-0.238 (0.194)	0.127 (0.144)	0.140 (0.131)	-0.115*** (0.061)
Constant	-4.093* (0.618)	-3.297* (0.837)	-8.484* (1.587)	-10.701* (0.711)	-2.582* (0.873)	-5.831* (0.441)
Observations	2,628	3,358	2,422	3,086	3,073	

Note: 1) dependent variable is level of export 2) sample excludes Russia 3) risk measure is an average of trade, macro and political EIU risks; it equals 1 for most risky country; the residual risk is obtain as a residual from the sector-specific regressions of log of normalized risk on log of STRI and log of water using OLS estimator 4) year dummies are included in the models 5) robust standard errors in parentheses 6) *, **, *** denote significance at 1 per cent level; 5 per cent level and 10 per cent level respectively.