Market Access Uncertainty and Trade in Services*

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ABSTRACT: We develop an analytical/empirical framework bridging the decision under uncertainty and recent gravity-based empirical trade literature. We examine the impact of policy uncertainty on services trade, focusing on binding overhang,the gap between market access commitments and actual applied policy). The government's ability to change policies within this gap yields uncertainty for firms regarding market access. Our findings reveal average Most Favored Nation (MFN) services trade costs ranging from 12.38% for low or medium-income countries to 14.08% for high-income countries, comparable to other regulatory trade barriers. We embed our estimates in a general equilibrium model to quantify the effects of removing market-access uncertainty in services. Results show substantive economic effects on trade and overall economic performance. Globally, we estimate a 0.72% increase in real GDP and a 12.65% increase in services trade volumes from removal of binding overhang. This fits into the range of estimates for deep multilateral and preferential trade liberalization for goods.

Keywords: gravity equation, services trade, bindings, policy uncertainty, market access
JEL codes: F14, F17

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1 Introduction

Market access security is a basic objective of treaty-based trade negotiations and international economic law. What this entails is not only reduction in barriers for firms operating in overseas markets, but also certainty about the barriers they face. Tariffs on goods trade have been significantly reduced since the first treaty negotiations under the General Agreement on Tariffs and Trade (GATT) in 1947. This has also included negotiated reductions in the scope for policy-driven market access uncertainty for goods. The process itself has been driven by repeated GATT-based negotiation rounds, the creation of the World Trade Organization (WTO) in 1994, and a range of preferential trade agreements (PTAs) since then. Most recently, there has been a shift in trade policy focus from tariffs alone to non-tariff measures (NTMs), including policy-driven market access for services firms. (Hofmann et al., 2019). However, unlike trade in goods, where tariffs continue to play an important role, access to the market for services strictly involves NTMs (Francois and Hoekman, 2010). The situation for service firms is further complicated by the spillover of trade wars, once focused on tariffs for goods, into retaliatory measures against foreign service firms, such as China targeting U.S. information service firms in response to Trump administration tariffs (Lin and Huang, 2025).

The hesitance by national governments to commit to locking-in prevailing policies in services has led to a wide range of bound market access commitments that do not reflect actual levels of market access. In other words, while negotiating parties may commit themselves not to exceed a specified threshold level of trade restrictions in services, there is typically a substantial gap between commitments made (both in the WTO and in regional PTAs) and actual applied policies (Borchert et al., 2011). This means that while governments may have committed to minimum levels of market access, these commitments do not reflect actual market access conditions, leaving governments free to increase barriers to services trade (including the operation of foreign affiliates) at any time while still meeting market access commitments to trading partners, thereby creating conditions of uncertainty for the firms involved.

In the early years of the post-war trading system, trade and uncertainty were primar-

ily an issue insofar as commodity price volatility impacted the prospects of developing countries, and more broadly, as terms of trade uncertainty impacted the logic of trade policy and the gains from trade.[1] Trade policy bindings and market access uncertainty are a more recent focus of the literature, following both the preponderance of substantial tariff binding overhang (i.e., the difference between the binding commitment and the applied rates) in the accession protocols of a large number of developing countries to the GATT/WTO in the 1980s and 1990s (Blackhurst et al., 1995), and the increasing importance of North-South trade agreements (Hofmann et al., 2019). The emphasis here has been placed particularly on tariff uncertainty (WTO, PTAs), and less so on NTMs for goods and services.[2]

Early papers on WTO bindings include Francois and Martin (2004) and Francois (2001), while both Baldwin et al. (1997) and Francois (1997) focus on policy bindings and uncertainty in PTAs. Both Baldwin et al. (1997) and Handley and Limão (2015) estimate the impact of reductions in risk premiums stemming from countries joining the EU. Handley (2014), Handley and Limão (2017), and Crowley et al. (2018b) investigate the impact of the reduction in trade policy uncertainty through WTO accession, in particular China's accession to the WTO. While Davies and Studnicka (2018), Crowley et al. (2018a), Ahmad et al. (2023), Steinberg (2019), Caldara et al. (2020) and Graziano et al. (2018), Poilly and Tripier (2025), Alessandria et al. (2024) all look at the expected impact of trade policy uncertainty. Like the earlier literature, De Sousa et al. (2020) and Nguyen (2012) both study the impact of demand uncertainty on firms' exports. Recent related theoretical work includes Limão and Maggi (2015) focusing on the potential trade policy uncertainty reductions stemming from trade agreements, and Bloom (2009) who looks at the impact of more general (i.e., non-trade related) uncertainty shocks on the economy. Novy and Taylor (2020) combine Bloom's representation of demand and productivity

[1] This includes the early agenda set out for the UN Committee on Trade and Development (UNCTAD) (Tinbergen, 1968, Corea et al., 1976). It also includes a focus on trade under price uncertainty (Pomery, 1984).

[2] For NTMs on goods, see Conconi et al., 2018, Dhingra et al., 2023, and Steinberg, 2019. There is also long-standing evidence that procedures related to the calculation of anti-dumping and countervailing duties can also expose exporting firms to contingent duties and uncertainty.In some cases, ex post changes to dumping duties have resulted in costs sufficient to bankrupt importers who made decisions based on preliminary duty bond rates (Boltuck et al., 1991).

shocks with trade, finding a strong link between demand and productivity shocks and fluctuations in international trade relative to output fluctuations. Caldara et al. (2020) also focuses on the macroeconomic effects of trade policy uncertainty linked to goods trade.

While the literature on trade policy uncertainty has made substantial progress, including in frameworks linked to gravity-based trade modeling, it has generally not provided a direct and general translation of policy uncertainty into the structural gravity model that underpins much of recent empirical trade analysis Head and Mayer (2014).[3] We aim to fill this gap here. To better link the empirics of policy uncertainty together with standard forms of gravity-based policy modeling, we work with a specification of trade cost uncertainty closely related to the mean-variance models of capital allocation (following from the classic Arrow-Pratt approximation based on the mean and variance contributions to expected utility), the related negligible third derivative (NTD) generalized functional form approach to expected utility (Barseghyan et al., 2018), and the recent literature on optimized certainty equivalence (Barseghyan et al., 2018, Eeckhoudt et al., 2011, and Eeckhoudt et al., 2016).

Our contributions to the literature encompass two main aspects. First, we develop an analytical bridge that connects the decision under uncertainty literature, particularly certainty equivalence, with the modern structural gravity-based empirical literature. Second, we apply this framework to quantify the influence of market access uncertainty specifically related to non-tariff measures (NTMs) on services trade. We are interested in market access in services, related to reducing the policy uncertainty that confronts exporting firms. The basis for this uncertainty is the binding overhang, the gap between bound commitments on policy and actual applied policy in international trade agreements covering services. Binding overhang is a well-documented feature of the WTO system for

[3] For example, Handley and Limão (2017) and Handley and Limao (2022) incorporate policy uncertainty into a dynamic firm-level model with uncertainty increasing fixed costs and embed the effects into a gravity-style empirical framework. Handley and Limao (2022) also offer a way to quantify effects in their fixed cost setup. In contrast, the current paper develops a more general method for integrating policy uncertainty directly into a more generic (and standard) gravity equation using a certainty-equivalence framework, incorporating both the first- and second-moments influencing both the intensive and extensive margin of trade.

both goods (Blackhurst et al., 1995, Francois and Martin, 2003) and services (Francois and Hoekman, 2010, Borchert et al., 2011). An important point of this literature is that the significant gap between commitments made and actual applied policy in services implies that governments retain substantial discretion to increase the restrictiveness of trade policies without violating the obligations they have undertaken in their trade agreements.[4] As preferential trade agreements often mirror WTO commitments, similar gaps between bound and actual market access levels for services are also a major feature of the landscape for preferential trade and investment agreements.

To assess the impact of uncertainty stemming from the binding overhang, we first develop an analytical framework that builds on the decision under uncertainty literature, allowing us to incorporate market access uncertainty into the standard trade gravity model based on certainty equivalence. By doing so, we develop a relatively general method for introducing trade cost uncertainty into the modern gravity equation that follows from a broad range of different underlying trade models (e.g., Armington based models of national differentiation, Ethier-Krugman-Melitz based models, and Eaton-Kortum models (Head and Mayer, 2014). Note that our extension of the standard gravity equation contrasts with more model-specific frameworks, such as cost uncertainty specific to fixed costs in Melitz-type models (e.g., Handley and Limão, 2017). We then apply this framework in a gravity-based econometric exercise based on the Eaton-Kortum model, where we include a measure of services market access uncertainty linked to NTMs. While this approach is related to the recent work of Bloom (2009) and Novy and Taylor (2020) we focus instead on market access (policy) shocks. Additionally, while we focus here on services trade, our approach can be applied to incorporating market access uncertainty into gravity-based modeling of goods trade as well as services.[5]

The gravity model in the empirical analysis incorporates recent work on modelling

[4] Our analysis is limited to the effects of binding overhang for discriminatory policies, i.e., measures that target foreign services suppliers and restrict their market access. We abstract from the effects of domestic regulation and differences in domestic regulatory regimes. In practice, regulatory heterogeneity will have trade effects that may be substantial, but to date, trade agreements have done little to address this dimension of international services trade costs.

[5] See Bekkers and Francois (2018) for a structural comparison of the interpretation of gravity-based coefficients and associated trade-cost estimates for Eaton-Kortum, Ethier-Krugman, and Melitz models of trade, with an emphasis on *ad valorem* costs.

NTM costs (Heid et al., 2021) and associated reductions in PTAs (e.g., Egger et al., 2015, Bekkers and Rojas-Romagosa, 2019). Within the econometric exercise, we address the endogeneity of services trade agreements (PTAs inclusive of services, and the EU single market for services), using a two-stage control function approach. The recent literature has shown that such endogeneity can be quite important when estimating the effects of trade agreements on trade flows (Egger et al., 2015). We apply a technique introduced by Wooldridge (2021) known as the two-way Mundlak (TWM) estimator.[6]

We find that NTM-based trade policy uncertainty in the form of binding overhang matters substantively for bilateral services flows. There is a significant negative relationship between binding overhang and services trade. In other words, the higher the gap between bound commitments and the actually applied policy, and hence the larger the scope for changes in trade barriers and hence market access uncertainty, the less the bilateral trade in services is between country-pairs. In terms of magnitudes, the current pattern of policy bindings on market access relative to actual market access conditions (existing rules and procedures) mean bilateral services trade is reduced by around 68.04% in the case of low and medium-income country importers and around 58.43% for high-income country importers on an MFN (most-favored nation) basis.

These effects are comparable to recent estimates of MFN-based NTM costs for goods trade (see e.g., Bekkers and Rojas-Romagosa, 2019). We find the strongest evidence for the overall impact of services market integration within the EU single market for services with an estimated 6.73% trade cost reduction for intra-EU trade compared to trade with third countries. Beyond the European single market, we find no significant evidence that the current crop of trade agreements in services has a significant effect on trade volumes. The trade law literature stresses that both 'GATS-minus commitments' and 'GATS-plus commitments' are a common feature of bilateral services agreements. This is consistent with our results as reported here, meaning we should not be surprised that preferential services agreements have so far yielded minimal effects, especially in contrast

[6] Wooldridge (2021) extends the Mundlak device (Mundlak, 1978) to reproduce two-way fixed effect (TWFE) estimates, and offers discussion of the equivalence between the TWFE estimator and what he calls the two-way Mundlak (TWM) estimator. As Wooldridge notes, the TWM estimator is easily adapted to nonlinear models such as exponential models and logit and probit models.

to the relatively ambitious EU single market program for services (see, e.g., Adlung and Morrison, 2010, and Adlung, 2015).[7]

Finally, we obtain estimates of the macroeconomic impact of removing uncertainty linked to current market access commitments, locking in actual current market access levels. We embed estimated trade elasticities (for goods as well as services) along with our services trade cost estimates into a structurally estimated computational general equilibrium model built around Eaton-Kortum based trade.[8] Computational results point to substantive increases in gross domestic product, with about 0.72% increase in world real GDP. In addition, real services trade volume is estimated to increase by 12.65% at the world level, comparable to estimates of the effect of trade agreements for goods.

2 Bindings and market access uncertainty

Customary gravity models of international trade as covered by and addressed in Deardorff (1998); Head and Mayer (2014); Arkolakis et al. (2012) exhibit the generic multiplicative form as follows:

$$X_{i,j} = S_i B_{i,j} D_j, \tag{1}$$

where $X_{i,j}$ is the services trade volume between exporting country i and importing country j, S_i captures the supply potential of the exporting country i, D_j captures the demand potential of the customer market j, and $B_{i,j}$ is inversely related to the frictions or obstacles to demand in j from i. The specific makeup of S_i depends on the model specification with the frameworks of Eaton and Kortum (2002); Anderson and Van Wincoop (2003); Melitz (2003); Arkolakis et al. (2012) being well known examples. The formulation of the trade-freeness parameter $B_{i,j}$ is typically multiplicative with K

[7] There have been proposals to go beyond current commitments made under the GATS and existing preferential services agreements, also in a plurilateral context – in particular (the TiSA or Trade in Services Agreement) – have ground to a halt, while both regional provisions and TiSA proposed provisions sometimes including backslide elements relative to GATS commitments (see Adlung, 2015).

[8] See Bekkers et al. (2023) and Bekkers et al. (2018) on the Eaton-Kortum model specification we use here. We discuss the mapping from gravity to computation in what follows below.

elements:

$$B_{i,j} = \prod_{k=1}^{K} Z_{k,i,j}^{\beta_k}, \tag{2}$$

where $Z_{k,i,j}$ is the kth observable trade-cost or trade-freeness measure and $\beta_k = \delta_k \theta$ is the unknown parameter which links it to the value of exports. The parameter θ is the so-called trade elasticity, whose interpretation depends on the microfoundations invoked in the aforementioned classes of trade models (see Arkolakis et al., 2012). The parameter δ_k converts $Z_{k,i,j}$ to an ad-valorem (inverse) trade cost. In practice, the measures $Z_{k,i,j}$ broadly fall into two domains: policy-related and not-policy-related. Leading examples of the former are ad-valorem tariff rates for goods and equivalents to those for services (for those, $\delta_k = 1$), trade agreement membership, and similar measures. Leading examples of the latter are measures related to geography (distance, common borders), common culture (language), common history (colonial relationships, legal origins), etc. Using θ permits establishing a compact metric of pairwise composite ad-valorem trade costs as $T_{i,j} = B_{i,j}^{-1/\theta}$. For the sake of simplicity, suppose that $T_{i,j}$ is a compact metric of policy trade costs. $T_{i,j}$ is proportional to ad-valorem trade-cost rates which matter specifically for exports from i to j (depending on MFN clauses, trade agreement status, etc.). In essence, this means that bilateral exports in (1), with the specification of the trade-freeness function in (2), depend on realized trade costs.

It is customary to assume that the economic agents exhibit not only rational expectations, but perfect foresight about the measures $B_{i,j}$ and $Z_{k,i,j}$. While this is relatively unproblematic for trade-cost or trade-freeness measures that do not fall into the policy domain, trade policy is affected by a non-trivial degree of uncertainty. Examples from the past decades have been the enlargement of the WTO (e.g., by China), the formation of new and enlargement of existing trade agreements (and the opposite thereof; see Brexit Steinberg, 2019), the tariffs imposed by the U.S. on China and other countries under the Trump administration, the pursuit of numerous antidumping cases at the WTO, etc.

With risk-averse agents (primarily suppliers), such uncertainty imposes a cost for planning and entails a risk on future profits. In the present paper, we put risks associated

with the realizations of trade policy in the limelight of the analysis.[9] Work on the economic effects of risk is two-pronged. One strand elaborates on nonlinear effects in the context of simulation models (Pratt et al., 2013; Herweg and Mierendorff, 2013; Ma et al., 2023). Another one proposes approximations of nonlinear effects based on so-called certainty equivalents of risk-related costs (see Barseghyan et al., 2018; Eeckhoudt et al., 2011). In the present paper, we build on the latter to proceed with estimation, then integrating the resulting estimates into a model along the lines of the former.

From the literature on decision making under uncertainty (Barseghyan et al., 2018, Eeckhoudt et al., 2011, and Eeckhoudt et al., 2016) the certainty equivalent $\tilde{T}_{i,j}$ of the trade cost $T_{i,j}$ when subject to uncertainty will be parameterized additively based on a second-order approximation[10] using $\mu_{T_{i,j}}$ and $\sigma^2_{T_{i,j}}$ for the mean (expectation) and the variance (uncertainty) characterizing policy trade costs in $T_{i,j}$. For a counterfactual involving bindings, we are interested in both the mean and the variance effect. We start with the unbound certainty equivalent.

$$CE\left(T_{i,j}\right) = \tilde{T}_{i,j} = \mu_{T_{i,j}} + 0.5h\sigma^2_{T_{i,j}} \tag{3}$$

where h is the Arrow-Pratt measure of absolute risk aversion. We can rewrite equation (3) in terms of the index of dispersion $\Delta_{T_{i,j}}$, the ratio of variance to mean of trade cost, as follows:

$$CE\left(T_{i,j}\right) = \tilde{T}_{i,j} = \mu_{T_{i,j}}\left(1 + 0.5h\Delta_{T_{i,j}}\right) \tag{4}$$

$$\ln \tilde{T}_{i,j} = \ln \mu_{T_{i,j}} + \ln\left(1 + 0.5h\Delta_{T_{i,j}}\right). \tag{5}$$

How do bindings affect the certainty-equivalent term $T_{i,j}$? When we introduce bindings at rate γ, we introduce a one-sided Winsorization on the distribution of costs $T_{i,j}$

[9] The economic costs of uncertainty and risk averse agents are the subject of a wider literature in economics. Related research anchors risk in various economic aggregates such as investment, productivity, and demand. This is related to the approaches of both Novy and Taylor (2020) and Bloom (2009) (who emphasize demand, investment, and productivity shocks) and Francois (2001), Francois and Martin (2004) (who emphasize policy shocks linked to market access). The literature on policy uncertainty is a specific domain in this regard.

[10] By the negligible third derivative (Barseghyan et al., 2018) second-order Taylor-series-expansion-based approximations are sufficient. Alternatively we can assume constant absolute risk aversion based preferences for decision making agents.

at the binding, reducing both the expected (or the mean observed) cost $\mu_{T_{i,j}}$ and the variance $\sigma^2_{T_{i,j}}$ (Francois and Martin, 2004). It is clear that the mean or expected cost of protection will fall as bindings become tighter. The probability mass of protection above the binding falls on the bound rate. The variance will also fall.[11] This means the certainty-equivalent term $\tilde{T}_{i,j}$ in equations (3), (4), and (5) will fall with the binding. This is driven by the impact on both the mean and the variance of the trade cost. In formal terms we have

$$\mu_{T_{i,j}}\Big|^{\gamma} < \mu_{T_{i,j}}, \quad \sigma^2_{T_{i,j}}\Big|^{\gamma} < \sigma^2_{T_{i,j}}, \quad \tilde{T}_{i,j}\Big|^{\gamma} < \tilde{T}_{i,j}. \tag{6}$$

Through winsorisation of the distribution of NTM costs, bindings reduce both mean costs and associated uncertainty. As such, the certainty equivalent trade cost (or, identically, the risk premium) will fall with tighter bindings. In summary we can include a trade cost measure and an uncertainty measure (such as binding overhang) directly to a gravity equation. Together these capture the contribution of the mean and variance to the certainty equivalent NTM trade cost.

In the present exercise, we place the uncertainty about $T_{i,j}$ at the binding overhang of services trade policy – in essence, the equivalent for services to the gap between MFN bound versus applied tariffs charged on the part of importers (Francois and Martin, 2004). This difference or gap entails a risk for exporters, as they cannot count on a continuation of current levels of market access also in the future. Specifically, we focus empirically on the question of how bindings affect $\tilde{T}_{i,j}$ through their impact on the terms on the right hand side of equation (5). Towards integrating this into an estimating equation, we use lower-case letters to denote logs, $u_{i,j}$ for a stochastic term, and specify the gravity

[11] Assume a set of n policy outcomes, each associated with a trade-cost value T (and where different events may be associated with the same outcome value for T). Using k and l to index events, we then have $\mu_{T_{i,j}} = n^{-1}\sum_k T_{k,ij}$ and $\sigma^2_{T_{i,j}} = \left(2n^2\right)^{-1}\sum_k\sum_l \left(T_{k,ij} - T_{l,ij}\right)^2$. Now introduce a binding at rate γ. The mean clearly falls as values $T_{k,i,j} > \gamma$ are re-assigned the value γ, while the squared distance between pairs, $\left(T_{k,ij} - T_{l,ij}\right)^2$, is also reduced when one or both values exceed γ.

equation based on equation (1) in exponential form as

$$X_{i,j} = \exp[s_i + b_{i,j} + d_j + u_{i,j}] = \exp[s_i + (\sum_{k=1}^{K} \beta_k z_{k,i,j}) + d_j + u_{i,j}], \tag{7}$$

where $\sum_{k=1}^{K} \beta_k z_{k,i,j}$ is the (negative) log-additive trade-cost function which includes, among others, trade-policy risk-related costs and where s_i and d_j are captured by exporter and importer fixed effects.[12] Note that with the transformation leading to equation (5), our binding overhang measure for the cost of uncertainty enters log-additively in Equation (7). The trade cost elasticity θ is an element of the coefficient vector β_k and maps exactly to the dispersion parameter in the Eaton-Kortum model used in the next section. (See the gravity equation, Equation A1, in the technical annex in Bekkers et al. (2023)).[13]

3 Empirical analysis

In this section, we present estimates of a gravity equation that includes policy uncertainty terms in subsection 3, and we quantify their importance in a general equilibrium model in subsection 4.

3.1 Estimating equation

Our outcome variable in the gravity equation (7) is bilateral services exports in a large cross-section of country-pairs. We follow Santos Silva and Tenreyro (2006) and Egger et al. (2011) in employing a generalized-linear exponential-family model for estimating the gravity model.

[12] Note that lower-case letters are logs of upper-case ones.

[13] Following the notation in Bekkers et al. (2023), the value of trade is $X_{i,j} = exp(d_i + d_j - \theta ln\tau_{i,j} + (\sum_{k=1}^{K} \zeta_k GRAV_{k,i,j}))$ where θ is the trade cost elasticity, $ln\tau_{i,j}$ is the log of the iceberg trade cost coefficient and ζ_k are coefficents that apply to natural gravity trade costs $GRAV_{k,i,j}$. Collecting iceberg and natural trade costs into the term z_k and the corresponding coefficients into β_k brings us back to Equation (7) in the text, where the elements of vector β include both θ and the terms of ζ.

Trade cost function: Four issues matter for market access. First, domestic sellers may have a disproportionate advantage over foreign ones for historical or institutional reasons. To address this issue, earlier work proposed including binary indicators for domestic sales to capture this asymmetry (see, e.g., Yotov, 2022). Second, PTAs (here, for services) may facilitate market access beyond the MFN treatment. The latter calls for the use of services trade agreement (STA) membership indicators to capture said preferential market access. Third, the EU treaty grants particularly deep provisions for services market access, which demands a differentiation in the effect of intra-EU over other intra-STA memberships. Fourth, as is the case for goods, the effect of STAs (EU or non-EU) depends on the unilateral, MFN provisions in place. In contrast to the one for goods, the latter vary across countries for services even within customs unions.

We address these issues in terms of regressors included in the estimating equation as follows. Regarding the first three issues, we include separate indicators for domestic sales ($\text{Home}_{i,j}$), EU membership ($\text{EU}_{i,j}$), and non-EU STA membership ($\text{Non-EU STA}_{i,j}$). Regarding the last issue, we include average measures of MFN market access in services (STRI Applied_j) as well as overhang (STRI Overhang_j) measures.[14] The main effects of these variables are captured by the importing country fixed effects. Therefore, we include them only in interaction with domestic sales ($\text{Home}_{i,j} \times \text{STRI Applied}_j$) as well as with non-EU STA sales ($\text{Non-EU STA}_{i,j} \times \text{STRI Applied}_j$).

In addition, it should be noted that STRI_j as an MFN measure of (applied) market access applies to all members of the GATS. However, EU members, consistent with WTO rules, allow market access to other EU members which may be more liberal than the MFN access (i.e., $\text{STRI Applied EU}_j \leq \text{STRI Applied}_j$). Thus the EU STRI is calculated as: $\text{EU STRI Margin}_{i,j} = \text{EU}_{i,j} \times (\text{STRI Applied}_j - \text{STRI Applied EU}_j)$.

We expect the latter to assume a positive parameter in regressions, as granting more liberal market access to EU members should boost services trade (deflect services trade towards intra-EU relations). Moreover, we include the STRI overhang interacted with

[14] STRI Overhang_j is defined as the difference between the bound market access at an MFN basis, STRI Bound_j, and the applied MFN market access, namely $\text{STRI Overhang}_j = \text{STRI Bound}_j - \text{STRI Applied}_j$.

the EU indicator to allow that there is a specific preferential deflection associated with market-access overhang within the EU. Accordingly, we define EU STRI Overhang Margin$_{i,j}$ = EU$_{i,j}$ × STRI Overhang$_j$. The latter explicitly measures preferential services market access within the EU relative to non-EU STAs.

Apart from the above services-policy variables, our estimating equation includes a number of other customary variables for $z_{k,i,j}$. First, there are several natural (non-policy) trade-cost variables. Those include, log bilateral distance (Bilateral distance$_{i,j}$) which is zero for Home$_{i,j}$ = 1, log internal distance (Internal distance$_{i,j}$) which is zero for Home$_{i,j}$ = 0, binary indicators for common land border (Common border$_{i,j}$), common colonial relationships (Common colony$_{i,j}$), former colony (Former colony$_{i,j}$), common ethnic language (Common ethnic language$_{i,j}$), common official language (Common official language$_{i,j}$).

In the interest of bridging between this section and the previous one, we parameterize policy-related first-moment terms in trade costs, $\mu_{T,i,j}$, as a log-linear function of observable measures. In the absence of any uncertainty about natural trade costs at least in the medium run, all geo-historical variables will inform only the first-moment term, $\mu_{T,i,j}$, but not the second-moment term, $\sigma^2_{T,i,j}$. Only the (binding) overhang terms inform both $\mu_{T,i,j}$ and $\sigma^2_{T,i,j}$. The list of variables used in the regression and their contribution to both first-, and second-moment term is made explicit in Table 4.

Endogeneity and incidental parameter problem: Among the observable trade-cost measures, the presence of trade agreements poses particular endogeneity concerns, because they vary across country pairs $\{i, j\}$ (i.e., they are discriminatory) rather than across countries. Two leading approaches exist to address said endogeneity of trade agreements. One relies on the selection of observables, where the researcher knows the universe of joint determinants of bilateral trade flows and bilateral trade agreements. Propensity-score matching (see Rosenbaum and Rubin, 1983; Blundell and Dias, 2009) as well as entropy balancing (Egger and Tarlea, 2015) had been applied in the context of trade agreements and selection-on-observables frameworks. A second approach relies on instrumental-variables estimation with its two versions of plug-in versus control-function

estimation, the former being confined to the application of linear regression models (Egger et al., 2015).

Since two types of binary trade-agreement indicators are among the variables $z_{k,i,j}$ and trade agreement membership is not random, we pursue an instrumental-variables estimation strategy using a control-function approach (see Egger et al., 2011). This approach is inspired by the seminal work of Baier and Bergstrand (2004) on the systematic selection of countries into such membership. These authors and subsequent work documented that PTA membership can be well explained by market-size and natural trade-cost variables alone. Egger et al. (2011) and Baier and Bergstrand (2009), Larch and Yotov (2023) demonstrate that political variables add some explanatory power in this regard and that the self-selection of countries into them needs to be addressed in empirical work to avoid selection-related parameter biases.

This approach rests on the following assumptions (Wooldridge, 2010, and Egger et al., 2011). First, the stochastic terms in the outcome equation (10) and the selection equation specifying the propensity of services trade agreement membership and EU pairwise membership are bivariate (log-)normal. Hence, the selection equations can be specified as probit models with a log-linear index.[15] Second, the regressors included in the selection equations are jointly relevant and exogenous. Third, a set of exclusion restrictions can be placed on the model, whereby the selection equations for services trade agreement membership and EU membership includes variables that are excluded from equation (10).[16] In the present context, we use the first principal component of the political distance measured by 14 variables in the Polity IV dataset (Polity distance$_{i,j}$), and a trade-geography homophily index (Partner overlap$_{i,j}$) as identifying instruments for Non-EU STA membership and, alternatively, EU and separately non-EU membership.

We model the selection into trade-agreement membership based on a nonlinear prob-

[15] Bivariate normality can be dispensed with and only requires a polynomial form of the linear prediction of the probit selection equations to be included in the control function (see Helpman et al., 2008).

[16] However, Vella (1998) notes that with treatment rather than sample selection exclusion restrictions are not necessary and identification from the nonlinear control function form is sufficient for identification. In general, the need for exclusion restrictions declines with the size of the sample. Hence, with selection into treatment such as trade agreement membership and with large sample size the nonlinear form of the selection equation is sufficient to overcome the selection bias in the outcome equations.

ability model, assuming normality of the stochastic term in a probit model as in Baier and Bergstrand (2004) and Egger et al. (2011). It is customary in selection models to condition on the residual part responsible for (self-selection and) endogeneity by way of a control function (see Helpman et al., 2008). A leading practice with probit selection models is including a nonlinear index referred to as the inverse Mills' ratio, $q_{i,j}$. It can be included as one or several regressors in the estimating equation (1) can absorb the self-selection bias about trade-agreement membership of the parameters β_k in the trade-cost function. More precisely, using some function $g(q_{i,j})$ about $q_{i,j}$ in equation (1) can absorb the self-selection bias about trade-agreement membership of the parameters β_k in the trade-cost function provided that instruments predicting trade-agreement membership are relevant and valid.[17] We use a 2nd-degree polynomial of $q_{i,j}$ to account for some degree of heteroskedasticity in the disturbances (see Helpman et al., 2008). Moreover, whenever dependent variables in the first stage probits interact with a vector of variables in the second stage, say, $w_{i,j}$, we follow Wooldridge (2010) to include also $q_{i,j}w_{i,j}$ in the control function.[18]

Specifically, with a probit model the inverse Mills' ratio regarding self-selection into (trade-agreement-membership-)treatment is a function of instruments $f_{i,j}$ and parameters a_q and is based on the normal density $\phi(\cdot)$ and cumulative density $\Phi(\cdot)$ of agreement membership. Using $d_{i,j}$ for binary variables indicating trade-agreement membership, the ratio can be defined compactly for treated as well as non-treated country pairs through

$$q_{i,j} = \phi(f_{i,j}a_f)\frac{d_{i,j} - \Phi(f_{i,j}a_f))}{\Phi(f_{i,j}a_f)(1 - \Phi(f_{i,j}a_f))}, \tag{8}$$

where $f_{i,j}a_f$ denotes the linear index of the probit (regressors times parameters).

We refer to the regressors included in the first-stage model by the row vector $f_{i,j}$ for country pair $\{i, j\}$. Let us use $\bar{f}_{i,.}$ for the counterpart of that vector that contains

[17] E.g., when using a linear function $g(\cdot)$ this represents the textbook approach as described in Heckman and Robb Jr (1985) or Semykina and Wooldridge (2010). When using moments of the distribution of $q_{i,j}$ one obtains an even more flexible approach, as used, e.g., in Helpman et al. (2008) in the context of selection into export markets rather than trade agreement membership.

[18] Please see Egger et al. (2011) and Francois and Manchin (2013) for similar examples and some discussion.

averages of all the elements across partner countries j. While $\bar{f}_{.,j}$ is a vector that contains averages of all the elements across partner countries i. Then, including $f_{i,j}$ along with $\bar{f}_{i,.}$ and $\bar{f}_{.,j}$ in the first-stage model corresponds to a two-way Mundlak-type parameterization of i- and j-specific fixed effects (see Mundlak, 1978; Wooldridge, 2021; Baltagi, 2023). Wooldridge (2021) extends the results in Lin and Wooldridge (2019) from one-way to two-way FE (TWFE) showing the equivalence in the estimated coefficients of the two-way fixed-effects model and the two-way Mundlak model. While with linear models two-way fixed-effects estimation can be efficiently done by a within transformation, nonlinear models (such as probit models for selection into trade-agreement membership) cannot be based on a within transformation and need a Mundlak-type approach to account for fixed effects. This technique can be applied via pooled OLS or in non-linear models with binary outcomes as in our case.[19]

In contrast to the above generic treatment in (8), we are faced with two membership indicators which we define in a mutually exclusive way. Using $d_{i,j} = (d_{1,i,j}, d_{2,i,j})$ with the specification of the latter being (EU membership$_{i,j}$, Services PTA$_{i,j}$). Mutual exclusivity of the agreements means $d_{1,i,j} \cdot d_{2,i,j} = 0$. Without loss of generality, we can then define a set of instruments $(f_{1,i,j}, f_{2,i,j})$ as well as parameters $(a_{1,f}, a_{2,f})$ for each membership type separately and obtain associated inverse Mills' ratio terms $(q_{1,i,j}, q_{2,i,j})$ for each of them. Accordingly, our control function $g(\cdot)$ includes both of those terms or moments thereof.

Combining our definition of $g(q_{i,j})$ with the residual term in equation (7), we obtain our final specification of the residual term and our final estimating equation.

$$u_{i,j} = g(q_{i,j}) + v_{i,j}. \tag{9}$$

$$X_{i,j} = \exp[s_i + (\sum_{k=1}^{K} \beta_k z_{k,i,j}) + d_j + g(q_{i,j}) + v_{i,j}], \tag{10}$$

[19] Baltagi (2023) also shows this equivalence proving that the estimation can be done with generalized least squares (GLS). While Arkhangelsky and Imbens (2018), develops the technique further to construct a Generalized Mundlak Estimator to capture group differences through the group averages in a flexible way in the spirit of the modern causal literature (Goodman-Bacon, 2021 and (De Chaisemartin and d'Haultfoeuille, 2020). This also avoids the incidental parameters problem of the two-way fixed-effects dummy-variable estimator in nonlinear models (see Mundlak, 1978). Finally, as suggested by the theory, we adjust the standard errors in the two-step estimation via a panel bootstrap.

3.2 Data

We first provide a detailed discussion of the data sources and variable construction. A summary overview of the sources and the definition of policy, geography, and political variables used in the empirical analysis below are provided in Table 4 of Appendix A .

Services Trade Data: Trade data for 2014 come from the Trade in Services Database available from the World Bank, which we combine with 2014 data from Global Trade Analysis Project (GTAP10) on domestic sales. The resulting combined database includes the value of bilateral services sales (exports) from country i to j, $X_{i,j}$, including domestic flows, where $j = i$. Altogether, we cover data for 120 countries, so that the number of observations is $14,400 = 120^2$.

Trade Policy Variables: We utilize the World Bank Services Trade Restriction Index Database (STRI) for 103 countries (Borchert et al., 2014).[20] In the World Bank STRI database, regulatory data are used to assign numerical scores indicating relative degrees of impact on openness.[21] Such scores of regulatory measures are classified based on the GATS modes of supply. The scores are then combined to yield STRIs by mode, and then also overall. The STRI data provide valuable information linking regulation (inherently qualitative) to quantitative market access measures. They provide estimated values, in the form of indexes, for both applied market access and bound market access that vary at the country level. The STRI ranges from 0 (fully open) to 1 (fully closed) for both applied and bound market access.[22]

We measure binding overhang as the difference between actual and bound market access for all services per country captured by the STRI values (Borchert et al., 2011, Borchert et al., 2014). In the absence of bindings, countries would be entitled to unilat-

[20] The OECD Services Trade Restriction Index Database would be an alternative. However, it only covers 51 countries. Moreover, unlike the World Bank's STRI, it does not provide data on both applied and bound GATS commitments which are critical to calculate the measure of binding overhang, the key uncertainty variable employed here. Finally, it mixes discriminatory market access measures with non-discriminatory regulatory measures, unlike the World Bank data, which focus on market access.

[21] This may include for example ownership share restrictions when establishing an affiliate operation, or limits on the right to provide professional services based on nationality.

[22] Note that while the years for our trade data and the STRI data are not exactly the same, they are very close, and the STRI has arguably not changed between 2011 and 2014.

erally change market access conditions at their liberty on an MFN basis. We could refer to this as the maximum-uncertainty case. The commitment to bind market access at a more open level entails a limit to the scope for countries to exploit said liberty and in this way reduces market access uncertainty.

This can be observed in Figure 1, which depicts the actual vs. bound market access in services in our database, using actual market access and GATS commitments. There is a somewhat smaller gap between the actual and bound market access for richer countries, though overall there is a consistent pattern of gaps between bound and applied market access for services trade across the sample. The histogram in Figure 2 depicts the distribution of overhang in the data (bound minus applied market access). The sample mean overhang is 0.24 with a standard deviation of 0.11.

Figure 1: Actual and Bound Market Access in Services

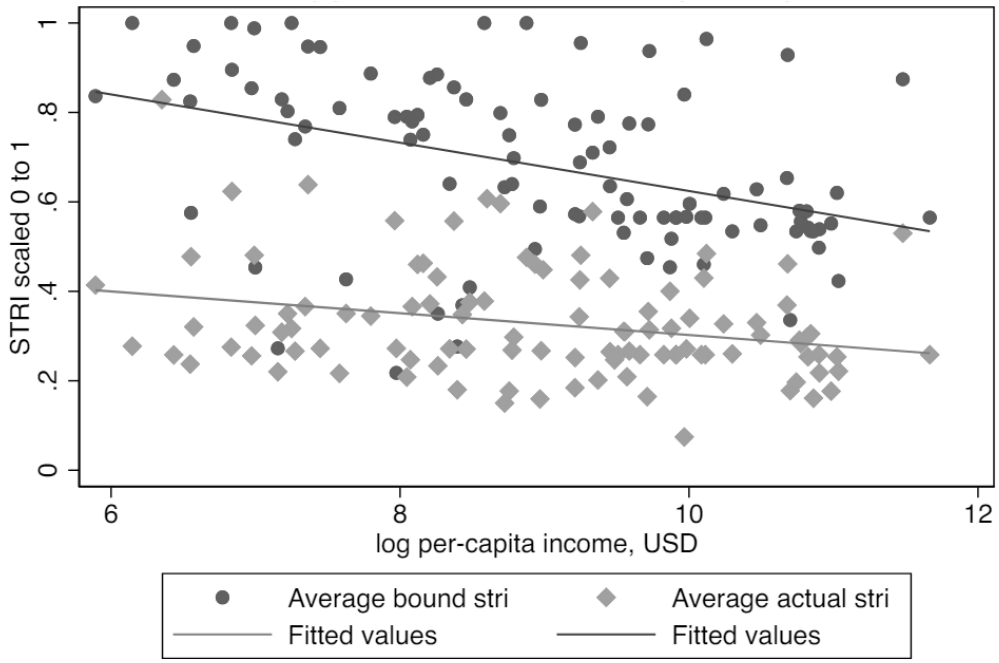
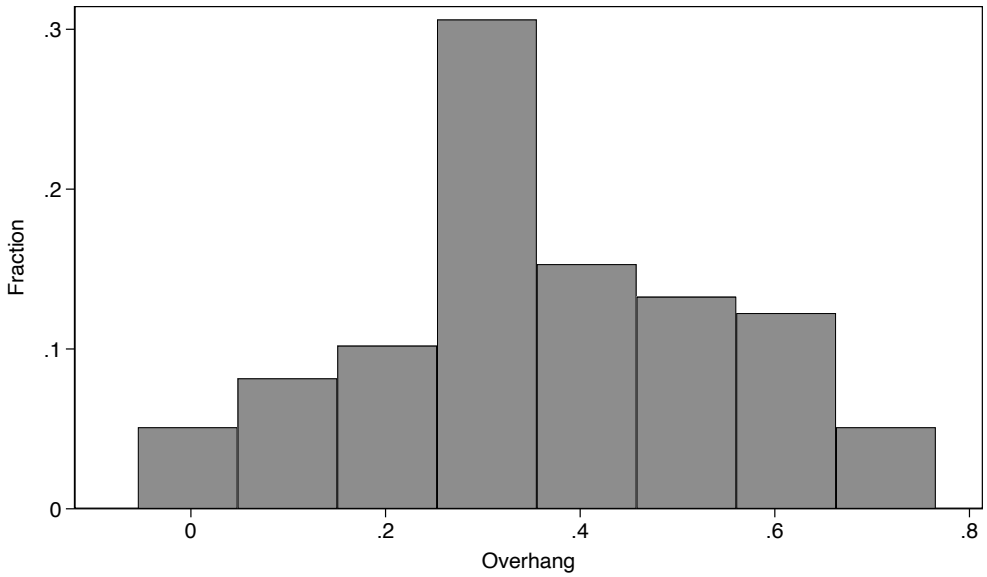


Figure 2: Sample distribution of binding overhang for MFN trade



In the case of EU Member States, the original STRI data from the World Bank report a blended index, reflecting a weighted average of intra- vs. extra-EU market access conditions. As detailed below, we are interested in the distinction between intra- vs. extra-EU market access, rather than an average of the two. For this reason, in calculating the overhang and applied STRI values for EU members, we work with an extension of the STRI data from Francois and Manchin (2018) who report both intra- and extra-EU index values for the EU Member States, following the original scoring methodology of the World Bank STRI project. As a result, for the EU Member States, we have STRI indicators of market access for other EU firms, as distinct from third-country providers to a Member State. This is required because EU firms benefit from the Single Market, which provides better market access for EU firms when selling in other EU markets. However, the Single Market is not complete, as EU Member States continue to maintain some restrictions on intra-EU trade in services (see for example Monteagudo et al., 2012).

In addition to the STRIs, the World Bank also released estimates of services trade costs. These trade costs for applied market access are expressed as *ad valorem* tariff equivalents (AVEs) for all countries in the database (Jafari and Tarr, 2017). They are estimates of the costs of restrictions on market access for services as a percent of the cost

of delivery of those services. We use those AVEs in some specifications as alternative measures to the STRIs. One benefit of doing so is that they deliver estimates of α, the trade elasticity (recalling that the parameter on an AVE is $\beta_k = \delta_k \alpha = \alpha$, as $\delta_k = 1$ in that case). We assume that the ratio of intra- vs. extra-EU market access AVEs is the same as those for STRIs.[23]

Furthermore, we employ two binary indicator variables stating whether countries i and j were both members of the same services trade agreement or of the EU's single market for services. We call those variables *STA* and *EU*, respectively. Services trade agreement membership is defined according to the information contained in the Depth of Trade Agreements database (see Hofmann et al., 2019). Lastly, we also obtain data on MFN tariffs for trade in goods, which is used in our first stage regressions, from the World Bank's World Integrated Trade Solution (WITS) database.[24]

Other Trade Cost Data: In addition to the above variables, we use pairwise geo-historical variables from the CEPII database, which includes (log) bilateral distance between country pairs where $i = j$, (log) internal distance (when $i = j$),[25] and binary indicator variables for common language (ethnic and official), common border, common colony and former colony (Mayer and Zignago, 2011). Moreover, we define a binary indicator variable, Home, which is unity, whenever $i = j$. Data on bilateral polity distance is a principle component based composite index of Freedom House and Quality of Governance indicators.[26] Lastly, we define a variable called partner overlap, which is a supply-chain-network similarity index for countries i and j. It measures the fraction of countries in all importers from i and j that are common relative to the total set.

Identifying Instruments for Preferential Trade Agreement Membership: All terms $\sum_k \beta_k z_{k,i,j}$ in equation (1) are included in the first-stage probit models. On top of

[23] See Appendix A on how this variable is calculated.

[24] https://wits.worldbank.org/

[25] We define these distance concepts as mutually exclusive variables and estimate separate parameters on them.

[26] See Graham and Tucker (2019). The PCA-based index is a composite of Freedom of the press, Political liberties, and Civil liberties indexes from Freedom House (sr_fhp, pl_fh, cl_fh, and rulelaw_fh) and Voice and accountability, Political stability, and Rule of law indexes from the WGI World Bank (va_est_wgi, pv_est_wgi, rl_est_wgi).

those, ones excluded in the second stage are present. The latter include the joint economic mass of countries $\{i, j\}$, the log sum of country pair GDP in current dollars obtained from the World Bank's World Development Indicators (Joint economic mass$_{i,j}$); the average MFN tariff for goods charged by countries $\{i, j\}$ (Pairwise MFN tariff$_{i,j}$); the interaction of the partner overlap index with pairwise MFN tariffs on goods for countries $\{i, j\}$, dubbed Partner overlap$_{i,j}$ $\times$ Pairwise MFN tariff$_{i,j}$; and an indicator for two countries $\{i, j\}$ being OECD Members (OECD$_{i,j}$). The last three of the mentioned instruments are not included in the probit model for EU membership, as the average MFN tariff is the same for all countries and all EU Members are OECD Members, too.[27]

3.3 Estimation results

Table 1 summarizes estimation results for three variations of equation (10) based on second-stage PPML regressions following first-stage probit models for non-EU STA membership and EU membership (i.e., joint membership in the single market for services).[28]

In the first specification in column A of Table 1, we exclude interaction terms. Here, the coefficients on Home$_{i,j}$, EU$_{i,j}$ and non-EU STA$_{i,j}$ capture the average bias toward sales within those blocs. As expected, we find a positive coefficients on these variables, with home sales exhibiting the highest positive effects.

In column B, we provide a breakout of the level of STRI-indexed policies and associated binding overhang from effective NTM preference margins captured by the Home$_{i,j}$ coefficient interacted with the STRI itself and with the associated overhang, as well as our estimated intra- vs-extra-EU levels for the STRI and STRI overhang. Both coefficients (home interaction and intra-EU preference margins) capture the marginal effect of variations in the STRI and overhang. In a sense, the intra-EU margin is a variation on home bias for the broader EU internal market. The interaction terms of binding Overhang and STRI with Home$_{i,j}$ (and the intra-EU preference) reveal the differential impact of these measures for international trade (imports) applied at the border.[29] The results indicate

[27] Note that the last binary indicator, Home$_{i,j}$ cannot be included in the first stage, as the first-stage model is only run for observations $i \neq j$.

[28] The first-stage probit regression results are shown in Appendix A, Table 5.

[29] As indicated above, when we have interactions the control function includes interactions with the

Table 1: Stage-2 PPML regressions with control function from stage 1

AVGs	Column A	Column B	Column C
$\text{Home}_{i,j}$	4.783	4.179	4.177
	(0.339)***	(0.401)***	(0.388)***
Non-EU $\text{STA}_{i,j}$	0.408	0.313	0.338
	(0.197)**	(0.458)	(0.415)
$\text{EU}_{i,j}$	0.262	-0.292	-0.507
	(0.126)**	(0.182)	(0.189)***
$\boldsymbol{Home_{i,j} \times STRI\ Overhang_j / EU\ STRI\ Overhang\ Margin_{i,j}}$		1.942	1.798
		(0.386)***	(0.377)***
Non-EU $\text{STA}_{i,j}$ x STRI $\text{Overhang}_{i,j}$		0.463	0.353
		(0.682)	(0.704)
$Home_{i,j}\ x\ STRIApplied_j$		1.450	1.205
		(0.571)**	(0.526)**
$EU_{ij}\ STRIMargin_j$		1.450	
		(0.571)**	
Non-EU $\text{STA}_{i,j}$ x STRI $\text{Applied}_{i,j}$		0.323	0.212
		(1.006)	(0.944)
EU AVE Margin$_{i,j}$			3.941
			(1.391)***
Bilateral $\text{distance}_{i,j}$	-0.186	-0.173	-0.176
	(0.024)***	(0.026)***	(0.026)***
PCA based Polity $\text{distance}_{i,j}$	-2.701	-2.999	-3.310
	(1.131)**	(1.280)**	(1.270)***
Partner $\text{overlap}_{i,j}$	4.953	4.965	4.946
	(0.218)***	(0.284)***	(0.274)***
Common $\text{colony}_{i,j}$	0.001	-0.123	-0.154
	(0.182)	(0.216)	(0.215)
Common ethnic $\text{language}_{i,j}$	0.080	0.149	0.138
	(0.119)	(0.108)	(0.111)
Common official $\text{language}_{i,j}$	0.500	0.376	0.384
	(0.128)***	(0.134)***	(0.136)***
Common $\text{border}_{i,j}$	0.246	0.303	0.308
	(0.092)***	(0.096)***	(0.093)***
Former $\text{colony}_{i,j}$	0.198	0.231	0.231
	(0.127)	(0.148)	(0.149)
N	14,400	14,400	14,400
PseudoR2	0.993	0.993	0.993
Chi2 control function	9.594	11.705	13.021
P-value control function	0.048	0.008	0.005

* $p < 0.1$; ** $p < 0.05$; *** $p < 0.01$

Notes: Estimates are bootstrapped. Standard errors in parentheses: * $p < 0.1$; ** $p < 0.05$; *** $p < 0.01$. All specifications include exporter and importer fixed effects. STRI denotes the services trade restrictiveness index measuring the level of services trade barriers. Overhang measures the gap between commitments and applied policy (i.e., the binding overhang). AVE margin is the ad valorem tariff equivalent that reflects trade costs for applied market access as discussed in the text. Note that the variables in bold contribute to both $\mu_{T_{i,j}}$ and $\sigma^2_{T_{i,j}}$ (the mean and variance of trade costs from overhang). STA stands for Services Trade Agreement. The control function terms (CF) for endogeneity corrections are based on estimates in Table 5 (see Wooldridge, 2021). It includes a 4th-degree polynomial about the linear prediction in the CF probit (to address heteroskedasticity) and with Mills-ratio interaction with binary interaction variables above.

that market access uncertainty has a significant negative impact on services trade. In particular, the coefficient for the STRI Overhang Margin (home/single market bias) is significant and positive and remains stable across the alternative versions of the equation (10). The larger the overhang the more you will trade with yourself (or with other EU partners not exposed to overhang). Interestingly, we also find no evidence for trade volume effects in services agreements in PTAs (i.e., those outside the EU single market for services). This is not entirely surprising given that services agreements tend to include both 'GATS-minus' and 'GATS-plus' market access commitments (Adlung and Morrison, 2010).

In column C, we have used the World Bank's STRI-based AVE estimates discussed above to convert preferential EU market access into the AVEs of preference margins. We do this to obtain a trade price elasticity estimate. In this last case,the coefficient on the EU AVE margin of preference provides a direct estimate of the price elasticity for traded services which we then use for converting estimated trade volume effects into corresponding trade cost effects and for the numerical estimates that follow. The STRI Margin coefficient now applies to home bias, but not to the intra-EU bias, as the latter is now captured by the intra-EU AVE preference margins discussed above. As should be the case, the coefficient estimates for the STRI Margin are similar in columns B and C. [30] Based on the EU term in the first column of Table 1 and using the estimated price elasticity from the last column, trade within the EU implies trade cost reductions of 6.73% and higher intra-European trade volumes of 29.26%.

To better gauge the magnitude of the impact of uncertainty on bilateral services trade, Table 6 in the annex shows both estimated volume effects and trade cost equivalents of MFN-based market access uncertainty for both (i) high and (ii) low and medium income

inverse Mills' ratio with those terms as well. The Home and EU binary variable coefficients capture average effects (home bias and EU), while the Overhang and STRI-related measures then enter the regressions in columns B and C as deviations from average levels, providing a breakout of individual variation from average values for the Home and EU groupings measured by the associated binary variable coefficients.

[30] It is worth stressing that, unlike tariff bindings, market access commitments by EU Member States in the GATS are not identical. Finland has different market access commitments in the GATS than Italy for example. This adds to the variation of intra-EU vs extra-EU market access conditions for EU importers.

countries. These estimates are based on column C estimates in Table 1. Note that we use the coefficient for AVEs, which is an estimated price elasticity, to convert volume effects to trade cost effects. When evaluated around sample mean values for Overhang, the estimated volume effect of market access uncertainty ranges from 58.43% for high-income countries (given current overhang levels) to 68.04% for low and middle-income countries according to the World Bank classification. These translate to trade costs, or AVEs, ranging from 12.38% to 14.08% of the value of delivered services. These are comparable to the range of recent estimates of MFN-level NTM-related trade costs for trade in goods (see, e.g., Egger et al., 2015 and Bekkers and Rojas-Romagosa, 2019).

4 Market-access uncertainty effects in general equilibrium

In this section, we analyze the economy-wide effects of market access uncertainty, working with a structurally estimated computable general equilibrium (SECGE) model, with our trade equation and its parameterization being based on Table 1 and Equation 10). The exercise involves the removal of overhang-related trade costs for services trade.

4.1 Summary of the quantitative general-equilibrium model

In our general equilibrium assessment we use an Eaton-Kortum based SECGE model as explained in full detail in Bekkers et al. (2023). We provide a brief non-technical overview of the model here. Full technical details with the required computer code for implementation are available with Bekkers et al. (2023).

The model set-up and calibration combine features of the older class of CGE models (cf. Dixon and Jorgenson, 2013), with the micro-foundations and econometric underpinnings of the more recent class of quantitative trade models (see Costinot and Rodríguez-Clare, 2014, for an overview). Across countries and sectors, production is linked through intermediate input coefficients (based on national input-output and social accounting data) as well as competition in primary factor markets. More specifically, the model

builds on the basic structure of version 11 of the Global Trade Analysis Project (GTAP) Model (Aguiar et al., 2022). The GTAP consortium produces a regularly updated and widely used database suitable for CGE-type modeling. The consortium also supplies a set of CGE models with extensions (e.g., firm heterogeneity, carbon pricing, and recursive dynamic extensions). Unlike new quantitative trade (NQT) models, which typically use exact hat algebra expressions solely for trade values, the GTAP class of CGE models (and CGE models more generally) incorporate expressions for both trade volumes and values, as well a rich representation of cross-sector and cross-border production linkages. The version we work with here embodies trade equations based on the Eaton-Kortum model (Bekkers et al., 2023) extended to include systematic sensitivity analysis (SSA) of our model outcome estimates as discussed below.

On the *final expenditure* side, demands for final-products sectors are generated from a representative regional household with expenditures allocated in fixed shares over personal consumption, public consumption, and savings (i.e., a Cobb-Douglas structure).[31] Consumption in turn is allocated over sectoral composites in fixed shares (again a Cobb-Douglas structure). The regional household owns endowments of factors of production and receives income by selling the value-added services of these factors to firms. It also receives income from taxes. See Aguiar et al. (2022) for a more detailed discussion of the database structure.[32]

On the *production* side, firms produce output, employing capital and labor, combining these with intermediate inputs within each region/country.[33] In technical terms, we model a combination of value added and intermediate inputs, where intermediates (both

[31] Two choices common to the quantitative/calibrated static models of international trade are: (i) investments and capital goods are treated as (non-durable) intermediate goods (see, e.g., Costinot and Vogel, 2015, and (ii) trade imbalances are treated as fixed parameters (see, e.g., Dekle et al., 2008). To maintain macro theory-consistent linkages between investment in capital goods on the one hand and the gap between income and consumption on the other in general equilibrium (i.e., macroeconomic closure), which also determines the trade imbalance, a well established assumption is fixed, calibrated savings rates per country. See, e.g., Bekkers et al. (2020) and Robinson (1991). In general equilibrium trade theory, which is unemcumbered by the need to fit to actual data, a further simplifying assumption is to start with fixed zero trade imbalances

[32] See Table 10 in Appendix D for the aggregation.

[33] From the database aggregation, capital includes value added services from land, and natural resources while value added from labor includes technicians, associated professionals, clerks, service shop workers, officials and managers, and agricultural and unskilled workers.

imported and domestic) are combined in fixed shares (i.e., Cobb-Douglas technologies) along with value added. Value added itself (e.g., labor and capital) is also a Cobb-Douglas composite. Firm output is then purchased by consumers, government, the investment sector, other firms, and also sold for export.

In the model, *trade* is determined by technological differences, also referred to as Ricardian differences in productivity between countries and sectors. A country exports less of the varieties for which it has low productivity. The bilateral trade equation for quantities in the model, in log or percent change terms, follows directly from the specification of equation (7), where we have split the bilateral trade costs into two components:

$$x_{i,j} = s_i + d_j + b_{i,j} = s_i + d_j + (1 - \theta)\,\tau_{i,j}, \tag{11}$$

where we have endogenously determined changes in exporter and importer terms s_i and d_j (for example total expenditure and price are included in d_j), and changes in policy-driven iceberg costs $\tau_{i,j}$, [34][35]

The initial *equilibrium* condition is that supply and demand are in balance at some equilibrium set of prices and quantities where workers are satisfied with their wages and employment, consumers are satisfied with their basket of goods, producers are satisfied with their input and output quantities, and savings are fully expended on investments. Adjustments to a new equilibrium, governed by behavioral equations and parameters in the model, are driven by price equations that link all economic activity in the market. For any perturbation to the initial equilibrium, all endogenous variables (i.e., prices and quantities) adjust simultaneously until the economy reaches a new equilibrium across all markets. Constraints on the adjustment to a new equilibrium include a suite of

[34] Note that in the gravity econometrics, we solve for pairwise variations in trade flows controlling for prices p_j and $p_{i,j}$ through the importer and exporter fixed effect terms. In the general equilibrium model, the functional relationship is the same but these price terms are now endogenous. Note also that changes the general price p_j are included in the term d_j. Because equation (7) is estimated with value data, subtracting θ from one gives us the quantity-based price elasticity. In other words $(1 - \theta)$ is the estimated trade cost elasticity. In the Eaton-Kortum model this is also the dispersion parameter of the Frechet distribution of productivity, as well as the elasticity of import demand across sources in the CGE model.

[35] In terms of the actual GEMPACK code for the computational Eaton-Kortum model, the trade equation maps directly to our estimating equation in the previous section. Again see the technical annex of Bekkers et al. (2023).

accounting relationships that dictate that in aggregate the supply of intermediate and final products equals the demand for those products, total exports equals total imports, all (available) workers and capital stock are employed, and global savings equals global investment.[36] Economic behavior drives the adjustment of quantities and prices. This occurs as households maximize their utility subject to budget constraints, and producers minimize costs based on input prices, output levels, and production technologies.

To obtain confidence intervals for numerically based GE model outcome variables, we apply systematic sensitivity analysis (SSA), meaning we use numerical methods to estimate the value of the GE-based integrals defining the variance of the GE model outcome values. In particular as is common in the computational general equilibrium model literature we use quadrature-based methods (DeVuyst and Preckel, 1997; Villoria and Preckel, 2017).[37] SSA also applies to our experiment definition, meaning that Equation 12 below, the definition of the policy experiment, is itself part of the SECGE system of equations.[38]

4.2 Mapping from gravity to general equilibrium

When moving from the gravity estimates to general equilibrium estimation, beyond the parameters obtained from the gravity estimates using services trade, we also need to paramaterize the goods trade side of our model to allow for economy-wide reallocation of resources between sectors. The estimated trade parameters for the goods sector that feed into our general equilibrium estimates are discussed in Appendix C. This, similarly to the services trade estimation, involves estimating Equation 10, again controlling for endogeneity of trade agreements. The difference with respect to the services trade estimations

[36] See the discussion under footnote 31.

[37] Quadrature involves approximating an integral as a weighted sum of the integrands to obtain a well-specified set of points called nodes. Polynomial-based quadrature is often both more accurate and computationally more efficient. For larger models, like integrated climate assessment models, Monte Carlo methods can be computationally prohibitive, while alternative rotations of Stroud-type quadratures can improve accuracy while being less computationally demanding than Monte Carlo methods to obtain numerical estimates (in this case GE-based integrals defining the variance of the GE model outcome values). For comparisons see Chatzivasileiadis et al. (2019).

[38] The computational model is solved using the GEMPACK software package, and the underlying data are from the GTAP database (Aguiar et al., 2022). Full datasets and the code needed for replication are available on request. The rest of the structure of the model is kept as in Bekkers et al. (2023).

is that the trade cost term includes tariffs.

The trade elasticities (goods and services) and the NTM overhang volume elasticity (services) needed for the SECGE model come from our gravity estimates (See Table 1 and Appendix C). The parameters obtained are summarized in Table 2.

For our general equilibrium counterfactuals we calculate the ad valorem equivalents of the overhang-related trade costs as follows:

$$AVE\ reduction = \left[exp\left[\frac{\alpha\beta}{\sigma}\right] - 1\right] * 100 \tag{12}$$

where α is the country-level overhang index (i.e., the difference between the binding commitment and the applied rates), β is the $STRI\ Overhang\ Margin_{i,j}$, and σ is the estimated trade cost elasticity for services ($EU\ AVE\ Margin_{i,j}$) while for goods is estimated using tariff rates ($Tariff\ Margin_{i,j}$). Our experiment assumes the full removal of overhang between all countries, with the exception of intra-EU, intra-EFTA and EU-EFTA trade.[39]

Table 2: Parameters from gravity used in Eaton-Kortum general equilibrium model

Variable	Definition	Parameter estimate
Services		
$STRI\ Overhang\ Margin_{i,j}$	NTM overhang or market access uncertainty elasticity	1.875
		(0.383)***
$EU\ AVE\ Margin_{i,j}$	CES elasticity for domestic/imported services	10.102
		(2.632)***
Goods		
$Tariff\ Margin_{i,j}$	CES elasticity for domestic/imported goods	7.778
		(1.584)***

Note: Parameters retrieved from Table 1 and Table 7 in Appendix C.

4.3 Simulation results

While our model, consistent with our gravity estimates, provides results for 120 individual countries, below we provide aggregate results for nine regions: East Asia and Pacific, South East Asia, South Asia, North America, Central and South America, European

[39] This is because intra-European trade is governed by a set of binding commitments (directives) that harmonize levels of cross-border access across national markers without the overhang element found in the GATS. The European Economic Area (EEA) follows EU regulations for services, and to quote from the EEA website "The EEA Agreement guarantees the freedom to provide services on a non-discriminatory basis anywhere in the European Economic Area.

Economic Area, Rest of Europe and Central Asia, Africa and the Middle East and an average for the World. Detailed country specific results are presented in the Appendix D, Table 11.[40]

Table 3 displays the estimated changes in real GDP volumes, real services exports and equivalent ad valorem iceberg trade cost changes in all regions using our Eaton-Kortum general equilibrium model. In parentheses, below each estimate, we have the standard errors obtained using the Gaussian quadrature, providing robustness of the estimates with respect to the underlying uncertainty in our estimates of key parameters. Removing uncertainty and locking in the bindings of already applied services trade policies boosts GDP and services exports across all regions (mostly due to a productivity boost).

Table 3: Services by Region: GDP, Exports, and AVE (in %)

Region	GDP	Services Exports	AVE
East Asia and Pacific	0.471	14.472	2.675
	(0.051)	(1.601)	(0.96)
SouthEast Asia	0.919	14.658	1.601
	(0.112)	(1.246)	(0.552)
South Asia	0.578	19.928	3.882
	(0.087)	(2.724)	(1.154)
North America	0.765	22.852	4.894
	(0.161)	(4.16)	(1.691)
Central and South America	1.175	23.798	7.48
	(0.096)	(1.995)	(2.717)
European Economic Area	0.867	5.173	4.888
	(0.072)	(0.445)	(1.846)
Rest of Europe, Central Asia	0.106	15.152	0.119
	(0.013)	(1.681)	(0.03)
Africa and Middle East	0.701	19.357	1.785
	(0.037)	(0.962)	(0.434)
World	0.716	12.653	3.98
	(0.007)	(0.113)	(0.331)

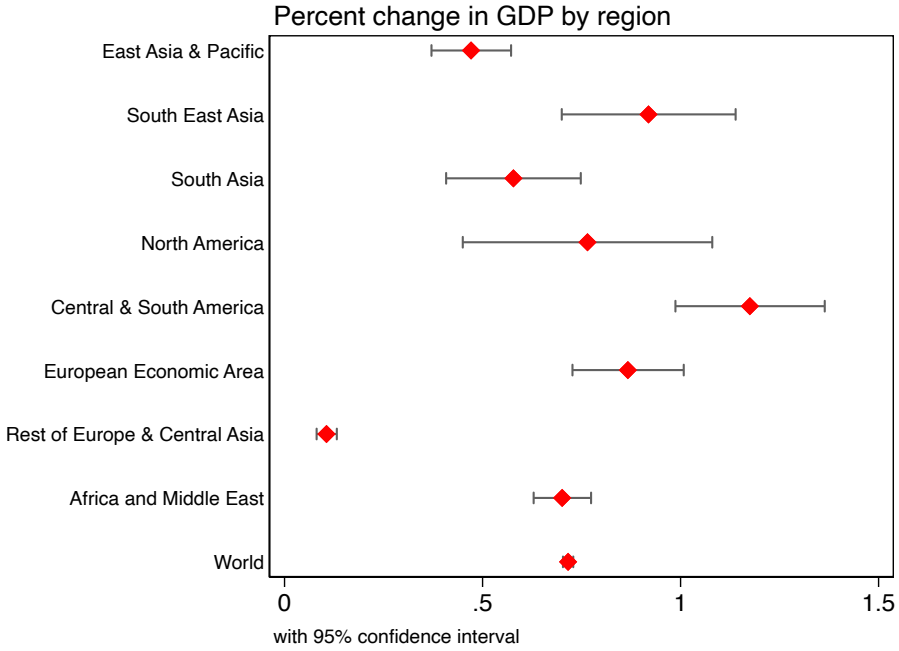
Notes: Country-level results are aggregated into nine regions. For more details on the country grouping please see Table 9 in Appendix D. AVE stands for ad valorem equivalents of the overhang-related trade costs. Mean and standard deviation obtained via Gaussian quadrature. Mean changes are calculated as percent changes relative to the initial year. Standard errors in parenthesis below. Table 11 presents the result at the country level in Appendix D.

The results are shown in Figure 3 and Figure 4, providing also the 95% confidence intervals based on the application of Gaussian quadrature. The largest gains in real GDP are estimated to occur in Central and South America, and South East Asia with increases between 0.92% and 1.17% (See Figure 3). Figure 4 shows the percent changes in services exports highlighting that Central and South America also experience the largest services exports increases, followed by North America and South Asia, with the increase being

[40] Details on the country grouping are in Appendix Table 9. To calculate the aggregate effects at regional level, the country-level mean and standard deviation are weighted by their share in gross domestic product (GDP), exports or imports depending on the measure we study.

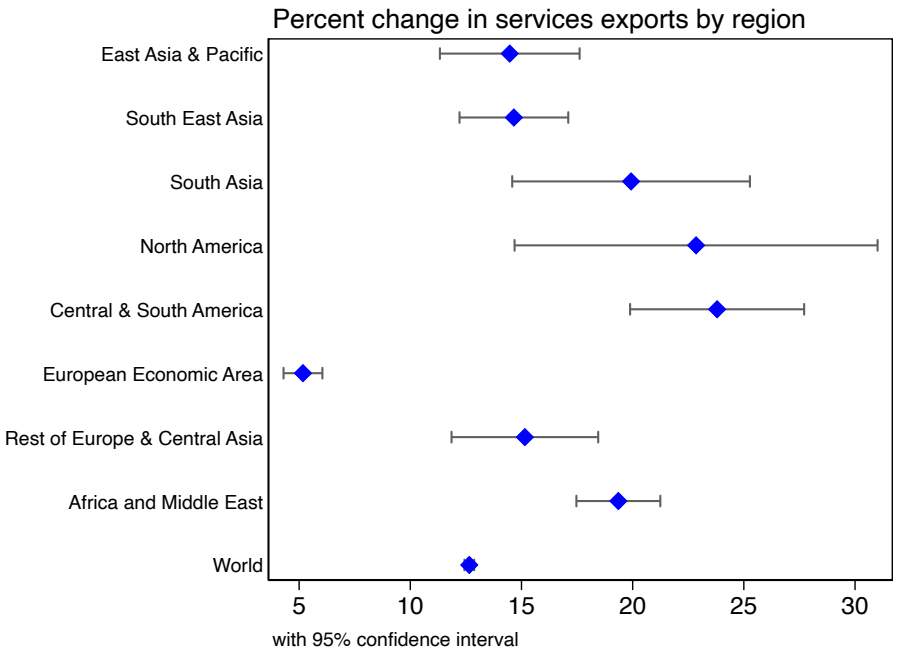
around 20%. These regions possibly benefit considerably due to services outsourcing (and to the underlying levels of market access uncertainty in these regions). Regarding the European Economic Area, GDP gains are estimated at around 0.9% and services exports increases of 5.2%.

Figure 3: Percent change in real GDP by region



Note: Results obtained with 95% confidence interval. Country-level results are aggregated into nine regions. For more details on the country grouping please see Table 9 in Appendix D. Each country in an aggregate is GDP-weighted. Mean changes are calculated as percent changes relative to the initial year. The mean is obtained via Gaussian quadrature.

Figure 4: Percent change in Services exports by region



Note: Results obtained with 95% confidence interval. Country-level results are aggregated into nine regions. For more details on the country grouping please see Table 9 in Appendix D. Each country in an aggregate is GDP-weighted. Mean changes are calculated as percent changes relative to the initial year. The mean is obtained via Gaussian quadrature.

5 Summary and discussion

While services are a dominant feature of high-income economies and are also an increasingly important component of international commerce, the conditions of market access, meaning the rules under which firms can actually sell services in overseas markets, are not well guaranteed. Indeed the system of treaty-based commitments to market access in services is deliberately vague, leaving a great deal of room for maneuver in the definition of commitments to market access found in multilateral treaties and also in PTAs. This applies across high, middle, and low-income countries. Most recently, we have also seen wholesale violation of market access commitments for tariffs by the US against almost all of its trading partners.

To quantify the effect of this lack of commitment with respect to market access guarantees on corresponding trade flows, we have developed a novel framework that integrates moment-based representation of uncertain trade costs into the gravity model of trade,

bridging recent developments in the empirical trade literature and the recent macroeconomic literature on demand and productivity uncertainty. This yields an analytical basis for including not only measures of applied policy (market access in the present context) but also measures of uncertainty surrounding that policy into the modern gravity model of trade. Our findings indicate that the uncertainty stemming from the overhang margin represents an important trade cost, ranging from 12.38% (for low or medium-income countries) to 14.08% (for high-income countries) of the value of delivered services. General equilibrium analysis points to increases in gross domestic product, services exports, and economic performance overall if countries lock in actual current market access levels, removing uncertainty in the process. The largest gains in real GDP are estimated to occur in Central and South America, and South East Asia with increases between 0.9% and 1.2%. Whereas in services exports, Central and South America also experience the largest services exports increases. These regions possibly benefit considerably due to services outsourcing (and to the underlying levels of market access uncertainty in these regions).

While we focus on services trade in this paper there is clear scope for the application of the approach developed here when studying market access for goods as well, linked for example to uncertainty surrounding the application of regulatory requirements to foreign goods, as well as the application of trade safeguards, unfair trade remedies, and a range of other discretionary regulatory controls on imports within recent formulations of the gravity model. In this regard we provide a relatively general theoretical basis for integration of bindings and broader market access based on certainty equivalence into empirical trade models (especially the workhorse gravity and computational models) found in recent literature.[41]

[41] See for example Bekkers (2025), Osnago et al. (2018), and Caldara et al. (2020).

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A Gravity model variable definitions

Table 4: Variable descriptions and sources

Variable label	Description	Source
Trade-cost variables $z_{k,i,j}$		
Variables $z_{k,i,j}$ informing the mean $\mu_{T_{i,j}}$ only		
$\text{Home}_{i,j}$	dummy for domestic trade (trade with self)	
$\text{Home}_{i,j} \times \text{STRI Applied}_j$	interaction of Home and STRI level	STRI database
$\text{Non-EU STA}_{i,j}$	dummy for pairwise non-EU services trade agreement	DESTA database
$\text{Non-EU STA}_{i,j} \times \text{STRI Applied}_j$	interaction of services agreement and STRI level	STRI database
$\text{EU}_{i,j}$	dummy for intra-EU trade	EU
$\text{EU STRI Margin}_{i,j}$	intra-EU STRI margin vis-a-vis external trade	STRI database
$\text{EU AVE Margin}_{i,j}$	intra-EU AVE margin vis-a-vis external trade	STRI database
$\text{Bilateral distance}_{i,j}$	log of distance between capitals	CEPII
$\text{Internal distance}_{i,j}$	log of surface distance	CEPII
$\text{Common colony}_{i,j}$	dummy for shared colonial ruler	CEPII
$\text{Common ethnic language}_{i,j}$	dummy for a shared ethnic language	CEPII
$\text{Common official language}_{i,j}$	dummy for a shared official language	CEPII
$\text{Common border}_{i,j}$	dummy for a shared border	CEPII
$\text{Former colony}_{i,j}$	dummy when one was colonist of other	CEPII
$\text{Polity distance}_{i,j}$	$ABS(polity_i - polity_j)/(polity_i + polity_j)$ polity is a principle components based composite of Freedom House and Quality of Governance data	World Bank, Freedom House
$\text{Partner overlap}_{i,j}$	log of the overlap count of common third country export destinations	COMTRADE
Variables $z_{k,i,j}$ informing the mean $\mu_{T_{i,j}}$ as well as the variance $\sigma^2_{T_{i,j}}$		
$\text{Home}_{i,j} \times \text{STRI Overhang}_j$	interaction of Home and STRI overhang	STRI database
$\text{Non-EU STA}_{i,j} \times \text{STRI Overhang}_j$	interaction of services agreement and STRI overhang	DESTA, STRI database
$\text{EU STRI Overhang Margin}_{i,j}$	interaction of EU and STRI overhang	STRI database
Exclusion variables (Table 2 additional explanatory variables)		
$\text{Joint economic mass}_{i,j}$	the log of combined GDP in US dollars	CEPII
$\text{Partner overlap}_{i,j} \times \text{Pairwise MFN tariff}_{i,j}$	interaction of the partner overlap index and pairwise average MFN tariff	COMTRADE, WITS
$\text{Pairwise MFN tariff}_{i,j}$	the average pairwise MFN tariff	WITS
$\text{OECD}_{i,j}$	dummy =1 when both countries are in OECD	OECD

Note: Where variables involve transformations or calculations based on source data, such transformations and calculations are described in the text. STRI database refers to the combination of the original STRI database, underlying regulatory data, calculations described in the text based on these data, and the AVE estimates from Jafari and Tarr (2017).

B Analysis for services trade

Table 5: Stage-1 probit model results

	CF Probit		CF Probit	
	services agreement		joint EUN members	
Bilateral distance$_{i,j}$	-0.056	0.015***	0.507	0.058***
Joint economic mass$_{i,j}$	0.032	0.006***	0.010	0.021
Common border$_{i,j}$	0.663	0.106***	0.794	0.165***
Partner overlap$_{i,j}$	-1.675	0.237***	-3.949	1.939**
Common ethnic language$_{i,j}$	0.255	0.093***	0.235	0.230
Common official language$_{i,j}$	0.139	0.095	-0.348	0.254
Common colony$_{i,j}$	0.014	0.085	0.659	0.389*
Former colony$_{i,j}$	-0.141	0.123	0.248	0.246
PCA based Polity distance$_{i,j}$	-1.798	0.739**	-20.867	2.201***
Bilateral distance$_{i}$	-0.516	0.080***	-5.618	0.308***
Joint economic mass$_{i}$	-0.038	0.006***	-0.057	0.023**
Common border$_{i}$	0.333	1.078	-13.194	2.591***
Partner overlap$_{i}$	2.673	0.374***	12.856	2.374***
Common ethnic language$_{i}$	-0.307	0.236	0.123	0.660
Common official language$_{i}$	1.554	0.247***	-5.241	0.832***
Common colony$_{i}$	0.449	0.187**	0.382	0.557
Former colony$_{i}$	-0.379	0.440	9.327	0.966***
PCA based Polity distance$_{i}$	8.777	9.348	-261.906	26.690***
Bilateral distance$_{j}$	-0.233	0.077***	-5.616	0.315***
Joint economic mass$_{j}$	-0.042	0.006***	-0.059	0.022***
Common border$_{j}$	2.497	1.085**	-12.466	2.033***
Partner overlap$_{j}$	2.847	0.398***	12.463	2.457***
Common ethnic language$_{j}$	0.654	0.318**	-0.004	0.727
Common official language$_{j}$	0.821	0.340**	-5.118	0.808***
Common colony$_{j}$	-1.161	0.202***	0.153	0.570
Former colony$_{j}$	-0.475	0.456	9.554	0.797***
PCA based Polity distance$_{j}$	-24.533	10.894**	-251.761	22.892***
Partner overlap x pairwise MFN tariff$_{i,j}$	1.669	0.938*	0.664	0.214***
Pairwise avg MFN tariff$_{i,j}$	-8.623	4.143**		
OECD members$_{i,j}$	-2.265	0.070***		
Partner overlap x pairwise MFN tariff$_{i}$	-13.222	2.646***	-8.557	0.726***
Partner overlap x pairwise MFN tariff$_{j}$	-11.645	2.776***	-6.480	0.718***
Pairwise avg MFN tariff$_{i}$	64.271	10.975***		
Pairwise avg MFN tariff$_{j}$	55.851	11.629***		
OECD members$_{i}$	6.258	0.216***		
OECD members$_{j}$	5.005	0.198***		
N	14,400		14,400	
Pseudo R2	0.2696		0.7427	

* $p < 0.1$; ** $p < 0.05$; *** $p < 0.01$

Note: Estimates are bootstrapped. The specification corresponds to a two-way Mundlak-type parameterization of i- and j-specific fixed effects (see Mundlak, 1978; Wooldridge, 2021). Endogeneity corrections used in second-stage estimates in Table 1 are based on the estimates reported here. Tags i and j reference the means of each variable.

Table 6: MFN volume and price effects from removing services overhang costs

	trade volumes	tariff equivalent
With a high income country	58.43%	12.38%
With a low or medium-income country	68.04%	14.08%

Note: The basis is coefficients from the last column of Table 1 combined with mean sample values.

C Analysis for goods trade

In this section we discuss the estimated elasticities for goods trade to be used in the general equilibrium model. We follow the same methodology as we used for services trade. Thus, we control for endogeneity as in Wooldridge (2021) who extends the Mundlack parametrization to a setting with two-way fixed effects. In this case, the first stage predicts the overall probability of having a preferential trade agreement.[42]

We again estimate our gravity equation outlined in Equation 10 where the trade costs in $\sum_{k=1}^{K} \beta_k z_{k,i,j}$ now include the tariff margin (relative to MFN rates) instead of the STRI measure. In addition, instead of the non-EU services trade agreement variable, we have non-EU preferential trade agreements. All the other variables included in the services trade specification are also included here. The tariff margin is the trade-weighted MFN tariff interacted with either the Home or the PTA dummy.[43] It measures the tariff effects relative to home trade for all pairs or relative to within EU trade.

All terms $\sum_k \beta_k z_{k,i,j}$ in Equation 10 are included in the first-stage probit models. On top of those, ones excluded in the second stage are present. The latter include the joint economic mass of countries $\{i, j\}$, the log sum of country pair GDP in current dollars obtained from the World Bank's World Development Indicators (Joint economic mass$_{i,j}$); the average MFN tariff for goods charged by countries $\{i, j\}$ (Pairwise MFN tariff$_{i,j}$); the interaction of the partner overlap index with pairwise MFN tariffs on goods for countries $\{i, j\}$, dubbed Partner overlap$_{i,j}$ $\times$ Pairwise MFN tariff$_{i,j}$; and an indicator for two countries $\{i, j\}$ being OECD Members (OECD$_{i,j}$). The last three of the mentioned instruments are not included in the probit model for EU membership, as the average MFN tariff is the same for all countries and all EU Members are OECD Members.[44]

[42] Data on PTAs were obtained from the Depth of Trade Agreements database (Hofmann et al., 2019).

[43] The procedure to obtain it is as follows:

$$MFN\ weighted_i = \frac{\sum_i MFN * imports}{\sum_i imports}$$

$$Tariff\ margin_i = -ln(1 + MFN\ weighted_i)\ if\ ij\ \epsilon\ PTA\ or\ home\ trade$$

where the PTA also includes the EU agreements.

[44] Note that the last binary indicator, Home$_{i,j}$ cannot be included in the first stage, as the first-stage model is only run for observations $i \neq j$.

Results for the second stage are shown in Table 7. As expected, higher tariffs considerably reduce trade in goods. The tariff margin is the estimated trade cost elasticity introduced in the general equilibrium model for goods. The other controls present the expected sign by theory similar to Table 1 for the services analysis above. Table 8 below presents the results for the first stage.

Table 7: **Stage-2 PPML regressions with control function from stage 1 for goods trade**

Sector	goods
Tariff margin$_{i,j}$	-8.552
	(1.625)***
Non-EU PTA$_{i,j}$	0.204
	(0.253)
EU$_{i,j}$	0.742
	(0.171)***
Home$_{i,j}$	2.809
	(0.137)***
Bilateral distance$_{i,j}$	-0.398
	(0.038)***
PCA based Polity distance$_{i,j}$	0.056
	(0.145)
Partner overlap$_{i,j}$	4.855
	(0.273)***
Common colony$_{i,j}$	0.098
	(0.174)
Common ethnic language$_{i,j}$	0.427
	(0.178)**
Common official language$_{i,j}$	-0.282
	(0.192)
Common border$_{i,j}$	0.441
	(0.122)***
Former colony$_{i,j}$	0.182
	(0.102)*
N	14,400
Pseudo R2	0.9865

Note: Estimates are bootstrapped. Standard errors in parentheses: * $p < 0.1$; ** $p < 0.05$; *** $p < 0.01$. All specifications include exporter and importer fixed effects. Tariff margin denotes the trade-weighted MFN tariff interacted with either the Home or the PTA dummy. The control function terms (CF) for endogeneity corrections are based on estimates in Table 8 (see Wooldridge, 2021). It includes a 4th-degree polynomial about the linear prediction in the CF probit to address possibilities for heteroskedasticity further.

Table 8: **Stage-1 probit model results goods trade**

	Stage 1 PTA no EU members		Stage 1 EUN members	
Bilateral distance$_{i,j}$	-0.349	0.014***	-0.307	0.034***
Joint economic mass$_{i,j}$	0.032	0.005***	-0.007	0.020
Common border$_{i,j}$	0.549	0.094***	0.357	0.170**
Partner overlap$_{i,j}$	-0.643	0.138***	-4.004	1.328***
Common ethnic language$_{i,j}$	0.046	0.068	0.118	0.226
Common official language$_{i,j}$	0.458	0.075***	-0.242	0.231
Common colony$_{i,j}$	-0.001	0.063	-0.263	0.296
Former colony$_{i,j}$	0.124	0.116	-0.335	0.254
PCA based Polity distance$_{i,j}$	-0.014	0.061	0.099	0.453
Bilateral distance i	-0.268	0.062***	-3.197	0.208***
Joint economic mass i	-0.036	0.005***	-0.029	0.022
Common border i	1.382	0.931	-17.158	2.305***
Partner overlap i	0.918	0.236***	13.480	1.774***
Common ethnic language i	-0.132	0.225	-2.095	0.578***
Common official language i	1.218	0.245***	-0.779	0.763
Common colony i	0.697	0.173***	0.980	0.542*
Former colony i	-0.854	0.447*	6.825	0.746***
PCA based Polity distance i	-5.433	0.860***	-1.932	2.259
Bilateral distance j	-0.122	0.060**	-3.247	0.225***
Joint economic mass j	-0.037	0.005***	-0.029	0.021
Common border j	1.949	0.855**	-17.385	1.877***
Partner overlap j	1.191	0.227***	13.098	1.656***
Common ethnic language j	0.571	0.218***	-2.192	0.658***
Common official language j	0.791	0.250***	-0.700	0.741
Common colony j	-0.422	0.171**	0.925	0.573
Former colony j	-1.360	0.464***	6.851	0.653***
PCA based Polity distance j	-4.811	0.821***	-3.919	2.297*
Partner overlap x pairwise MFN tariff$_{i,j}$	0.222	0.570	0.769	0.185***
Pairwise avg MFN tariff$_{i,j}$	-1.922	2.399		
OECD members$_{i,j}$	-1.755	0.058***		
Partner overlap x pairwise MFN tariff i	-3.116	2.102	-6.761	0.445***
Partner overlap x pairwise MFN tariff j	-4.517	2.018**	-5.871	0.536***
Pairwise avg MFN tariff i	27.527	8.534***		
Pairwise avg MFN tariff j	29.343	8.301***		
OECD members i	3.931	0.146***		
OECD members j	2.837	0.123***		
N	14,400		14,400	
Pseudo R2	0.1935		0.6969	

Note: Estimates are bootstrapped. Standard errors in parentheses: * $p < 0.1$; ** $p < 0.05$; *** $p < 0.01$. The specification corresponds to a two-way Mundlak-type parameterization of i- and j-specific fixed effects (see Mundlak, 1978; Wooldridge, 2021). Endogeneity corrections used in second-stage estimates in Table 7 are based on the estimates reported here. Tags i and j reference the means of each variable.

D General Equilibrium appendix

Table 9 shows the aggregation we used to reduce the number of regions and align it with our gravity estimates.

Table 9: Country aggregates

Country aggregate	Countries
East Asia and Pacific	Australia, New Zealand, China, Hong Kong, Japan, South Korea, Mongolia, Taiwan
South East Asia	Brunei, Cambodia, Indonesia, Laos, Malaysia, Philippines, Singapore, Thailand, Vietnam
South Asia	Bangladesh, India, Nepal, Pakistan, Sri Lanka
North America	Canada, United States, Mexico
Central and South America	Argentina, Bolivia, Brazil, Chile, Colombia, Ecuador, Paraguay, Peru, Uruguay, Venezuela, Costa Rica, Uruguay, Venezuela, Costa Rica, Guatemala, Honduras, Nicaragua, Panama, El Salvador, Dominican Republic, Jamaica, Trinidad and Tobago
Europe and EFTA	Austria, Belgium, Bulgaria, Croatia, Cyprus, Czech Republic, Denmark, Estonia, Hungary, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, Netherlands, Finland, France, Germany, Greece, Poland, Portugal, Romania, Slovakia, Slovenia, Spain, Sweden, United Kingdom, Switzerland, Norway
Rest of Europe	Albania, Belarus, Russia, Ukraine, Kazakhstan, Kyrgyzstan, Tajikistan, Armenia, Azerbaijan, Georgia
Africa and Middle East	Bahrain, Iran, Israel, Jordan, Kuwait, Oman, Qatar, Saudi Arabia, Turkey, United Arab Emirates, Egypt, Morocco, Tunisia Benin, Burkina Faso, Cameroon, Ivory Coast (Côte d'Ivoire), Ghana, Guinea, Nigeria, Senegal, Togo, Ethiopia, Guinea, Nigeria, Senegal, Togo, Ethiopia, Kenya, Madagascar, Malawi, Mauritius, Mozambique, Rwanda, Tanzania, Uganda, Zambia, Zimbabwe, Botswana, Namibia, South Africa, rest of the world aggregate
World	Every country included

In order to map into our gravity estimates, we map all services sectors into one services sectors. In addition, we also aggregate all goods sector. The sectors which we aggregated are shown in Table 10.

Table 10: Sectoral aggregates

Aggregate sector	Sectors
Goods	Paddy rice; Wheat; Cereal grains; Vegetables, fruit, nuts; Oil seeds; Sugar cane, sugar beet; Plant-based fibers; Crops; Bovine cattle, sheep and goats; Animal products; Raw milk; Wool, silk-worm cocoons; Forestry; Fishing; Coal; Oil; Gas; Other extraction (minerals); Bovine meat products; Meat products; Vegetable oils and fats; Dairy products; Processed rice; Sugar; Food products; Beverages and tobacco products; Textiles; Wearing apparel; Leather products; Wood products; Paper products, publishing; Petroleum, coal products; Chemical products; Basic pharmaceutical products; Rubber and plastic products; Mineral products; Ferrous metals; Metals; Metal products; Computer, electronic and optical products; Electrical equipment; Machinery and equipment; Motor vehicles and parts; Transport equipment; Manufactures; Electricity;
Services	Gas manufacture, distribution; Water; Construction; Trade; Accommodation, food and services; Transport, Water transport; Air transport; Warehousing and support activity; Communication; Financial services; Insurance; Real estate activities; Business services; Recreational and other services; Public administration and defense; Education; Human health and social work activities; Dwellings

Table 11: GDP, Services Exports and AVE % change, all countries

Country	GDP, %	Services Exports, %	AVE, %	Country	GDP, %	Services Exports, %	AVE, %
Albania	3.013	21.145	2.737	Laos	0.198	16.993	1/.
	(0.41)	(2.537)	(0.384)		(0.035)	(2.148)	
Argentina	0.961	26.9	6.839	Latvia	0.667	1.056	6.263
	(0.155)	(3.841)	(0.978)		(0.128)	(0.351)	(0.893)
Armenia	1.804	13.669	3.865	Lithuania	0.629	0.413	5.365
	(0.29)	(1.851)	(0.545)		(0.135)	(0.314)	(0.762)
Australia	0.826	19.279	3.39	Luxembourg	4.491	3.24	4.671
	(0.134)	(2.587)	(0.477)		(0.682)	(0.444)	(0.661)
Austria	0.43	1.354	4.908	Madagascar	2.651	23.108	10.887
	(0.071)	(0.325)	(0.695)		(0.383)	(3.151)	(1.585)
Azerbaijan	0.102	16.144	1/.	Malawi	1.155	25.35	6.398
	(0.02)	(2.039)			(0.203)	(3.501)	(0.913)
Bahrain	2.773	21.039	5.362	Malaysia	1.35	16.998	3.156
	(0.405)	(2.66)	(0.761)		(0.222)	(2.286)	(0.443)
Bangladesh	0.701	21.355	6.555	Malta	5.056	5.437	4.671
	(0.126)	(3.023)	(0.936)		(0.706)	(0.621)	(0.661)
Belarus	0.097	6.219	1/.	Mauritius	8.883	29.903	8.589
	(0.026)	(0.881)			(1.336)	(3.74)	(1.238)
Belgium	0.995	3.344	4.951	Mexico	0.719	27.004	5.383
	(0.163)	(0.529)	(0.702)		(0.114)	(3.661)	(0.764)
Benin	0.646	17.187	1/.	Mongolia	2.972	14.218	7.52
	(0.111)	(2.074)			(0.512)	(2.105)	(1.078)
Bolivia	2.453	31.949	9.387	Morocco	2.366	20.2	7.932
	(0.362)	(4.722)	(1.357)		(0.361)	(2.688)	(1.139)
Botswana	0.614	22.543	7.569	Mozambique	5.119	20.971	9.467
	(0.091)	(2.979)	(1.086)		(0.809)	(3.121)	(1.369)
Brazil	1.06	24.733	7.796	Namibia	2.566	24.933	7.771
	(0.17)	(3.74)	(1.119)		(0.401)	(3.491)	(1.116)
Brunei	0.104	11.112	1/.	Nepal	1.056	17.637	1.942
	(0.017)	(1.415)			(0.138)	(2.074)	(0.271)
Bulgaria	0.928	2.802	6.376	Netherlands	1.902	6.606	6.109
	(0.154)	(0.539)	(0.91)		(0.315)	(1.019)	(0.87)
Burkina Faso	0.058	13.949	1/.	New Zealand	1.304	20.407	3.724
	(0.032)	(1.802)			(0.198)	(2.627)	(0.525)
Cambodia	1.564	22.037	3.233	Nicaragua	2.567	27.72	9.809
	(0.231)	(2.815)	(0.454)		(0.4)	(3.881)	(1.421)
Cameroon	2.428	19.283	9.509	Nigeria	0.776	20.719	6.395
	(0.415)	(3.056)	(1.376)		(0.131)	(3.134)	(0.912)
Canada	1.309	24.185	4.813	Norway	0.058	3.593	1/.
	(0.211)	(3.301)	(0.682)		(0.011)	(0.501)	
Chile	1.357	17.996	7.458	Oman	0.08	19.618	1/.
	(0.22)	(2.599)	(1.069)		(0.016)	(2.439)	
China	0.21	16.06	1.79	Pakistan	0.731	24.189	7.268
	(0.032)	(2.196)	(0.25)		(0.125)	(3.374)	(1.041)
Colombia	1.214	25.793	8.999	Panama	3.505	19.966	3.059
	(0.213)	(3.851)	(1.299)		(0.451)	(2.262)	(0.43)
Costa Rica	2.125	23.512	8.528	Paraguay	1.055	20.397	9.452
	(0.297)	(3.036)	(1.228)		(0.175)	(3.004)	(1.367)
Côte d'Ivoire	1.468	16.273	6.864	Peru	1.205	27.192	7.754
	(0.261)	(2.405)	(0.981)		(0.187)	(3.791)	(1.113)
Croatia	0.612	0.693	4.671	Philippines	0.895	19.753	3.076
	(0.107)	(0.267)	(0.661)		(0.133)	(2.513)	(0.432)
Cyprus	4.498	3.161	4.671	Poland	0.384	1.27	7.473
	(0.793)	(0.61)	(0.661)		(0.067)	(0.336)	(1.071)

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Table 11: GDP, Services Exports and AVE % change, all countries

Country	GDP, %	Services Exports, %	AVE, %	Country	GDP, %	Services Exports, %	AVE, %
Czech Republic	0.483	1.59	4.795	Portugal	0.597	3.785	5.207
	(0.082)	(0.364)	(0.679)		(0.094)	(0.58)	(0.739)
Denmark	1.511	1.84	5.687	Qatar	0.861	21.578	3.157
	(0.273)	(0.439)	(0.809)		(0.131)	(2.783)	(0.444)
Dominican Republic	1.86	23.833	7.686	Rest of World	0.463	20.563	1/.
	(0.249)	(2.888)	(1.103)		(0.078)	(2.413)	
Ecuador	2.026	19.798	10.384	Romania	0.451	3.019	6.129
	(0.317)	(3.049)	(1.508)		(0.072)	(0.531)	(0.873)
Egypt	0.692	14.323	3.314	Russia	0.06	17.098	1/.
	(0.099)	(1.827)	(0.466)		(0.016)	(2.211)	
El Salvador	0.387	24.644	1/.	Rwanda	1.558	27.01	7.771
	(0.07)	(3.021)			(0.29)	(4.103)	(1.115)
Estonia	1.041	1.712	6.263	Saudi Arabia	0.181	20.19	0.484
	(0.176)	(0.396)	(0.893)		(0.027)	(2.656)	(0.067)
Ethiopia	0.255	16.254	1/.	Senegal	2.279	22.683	9.174
	(0.054)	(2.053)			(0.356)	(3.184)	(1.325)
Finland	0.636	4.924	4.523	Singapore	1.748	11.167	1/.
	(0.107)	(0.776)	(0.64)		(0.232)	(1.168)	
France	0.658	4.623	4.998	Slovakia	0.294	0.516	4.671
	(0.114)	(0.75)	(0.708)		(0.05)	(0.23)	(0.661)
Georgia	1.31	15.505	2.706	Slovenia	0.555	0.71	4.671
	(0.196)	(1.956)	(0.379)		(0.104)	(0.289)	(0.661)
Germany	0.667	5.276	5.431	South Africa	0.943	19.89	3.992
	(0.113)	(0.826)	(0.771)		(0.155)	(2.647)	(0.563)
Ghana	3.752	22.323	7.914	Spain	0.526	4.281	5.299
	(0.631)	(3.207)	(1.137)		(0.084)	(0.647)	(0.752)
Greece	0.805	2.88	5.503	Sri Lanka	1.054	22.108	6.327
	(0.137)	(0.52)	(0.782)		(0.165)	(2.904)	(0.902)
Guatemala	1.682	26.205	9.68	Sweden	0.955	3.612	5.811
	(0.264)	(3.78)	(1.401)		(0.167)	(0.648)	(0.827)
Guinea	0.58	22.602	1/.	Switzerland	0.365	5.365	1/.
	(0.084)	(2.775)			(0.052)	(0.659)	
Honduras	2.569	26.74	9.175	Taiwan	0.279	19.614	1/.
	(0.377)	(3.774)	(1.325)		(0.052)	(2.367)	
Hong Kong	2.219	9.487	1/.	Tajikistan	0.121	9.397	1/.
	(0.29)	(0.926)			(0.03)	(1.249)	
Hungary	0.681	2.681	4.881	Tanzania	1.073	15.287	8.783
	(0.113)	(0.481)	(0.691)		(0.158)	(2.095)	(1.267)
India	0.526	19.558	3.239	Thailand	1.385	16.217	3.925
	(0.078)	(2.482)	(0.455)		(0.221)	(2.117)	(0.554)
Indonesia	0.403	17.034	3.092	Togo	0.761	17.097	1/.
	(0.067)	(2.296)	(0.434)		(0.133)	(2.038)	
Iran	0.477	19.68	1/.	Trinidad y Tobago	3.3	31.491	10.545
	(0.085)	(2.37)			(0.508)	(4.758)	(1.532)
Ireland	4.101	6.05	6.088	Tunisia	1.6	17.141	5.071
	(0.659)	(0.92)	(0.867)		(0.241)	(2.132)	(0.719)
Israel	0.621	14.937	1/.	Turkey	0.743	16.854	4.578
	(0.099)	(1.606)			(0.107)	(2.176)	(0.648)
Italy	0.352	5.261	4.686	Uganda	1.876	23.874	7.609
	(0.056)	(0.797)	(0.663)		(0.313)	(3.444)	(1.092)
Jamaica	3.918	12.656	1/.	Ukraine	0.304	12.45	1/.
	(0.829)	(1.742)			(0.06)	(1.601)	
Japan	0.578	14.655	4.575	UAE	0.199	20.3	1/.
	(0.1)	(2.108)	(0.647)		(0.038)	(2.537)	

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Table 11: GDP, Services Exports and AVE % change, all countries

Country	**GDP, %**	**Services Exports, %**	**AVE, %**	**Country**	**GDP, %**	**Services Exports, %**	**AVE, %**
Jordan	0.369	17.076	1/.	UK	1.565	8.688	5.746
	(0.072)	(2.011)			(0.257)	(1.279)	(0.817)
Kazakhstan	0.024	7.573	1/.	Uruguay	2.856	24.767	8.478
	(0.005)	(1.093)			(0.471)	(3.592)	(1.221)
Kenya	1.33	19.294	6.757	USA	0.712	22.456	4.873
	(0.205)	(2.594)	(0.966)		(0.112)	(2.934)	(0.69)
Korea	1.237	13.912	5.548	Venezuela	0.644	19.224	5.538
	(0.208)	(1.976)	(0.788)		(0.118)	(2.937)	(0.787)
Kuwait	1.439	14.98	4.843	Viet Nam	0.292	18.269	0.164
	(0.249)	(2.263)	(0.686)		(0.047)	(2.34)	(0.023)
Kyrgyztan	1.457	9.456	1.981	Zambia	1.415	20.291	9.865
	(0.256)	(1.375)	(0.277)		(0.22)	(2.931)	(1.429)
				Zimbabwe	1.038	20.848	2.872
					(0.156)	(2.696)	(0.403)

Note: AVE stands for ad valorem equivalents of the overhang-related trade costs. Counties with AVE= 1/. are countries not included in the STRI database.