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Mega-regional trade agreements and Asia: An application of structural gravity to goods, services, and value chains

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ABSTRACT

We use a flexible estimation and simulation platform built on the standard structural gravity model to analyze the trade and welfare implications of mega-regional trade agreements for Asian countries. Our counterfactuals suggest that all current mega-regional scenarios have the potential to generate significant export gains for Asian economies, but that welfare improvements are much lower relative to baseline. This finding suggests a political economy problem, as trade-related reallocations of labor and capital would have to be justified politically on the basis of relatively small improvements in real GDP. Second, our simulations show that market size matters for mega-regionals: FTAAP has larger trade and welfare effects than other agreements. Finally, we show that mega-regionals have significant potential to deepen value chain trade in the Asia-Pacific: FTAAP could see Japan and China increase their shares of intermediates in total goods and services exports at a rate equivalent to around five years of value chain deepening, taking the average rate of change observed worldwide.

1. Introduction

With the signature of the hastily renamed Comprehensive and Progressive Trans-Pacific Partnership (CPTPP) in March 2018, mega-regional trade deals are again near the top of the trade policy agenda in Asia. In the presence of an unpredictable US trade regime, efforts to promote further integration within Asia over the medium term gain greater political attractiveness. From an economic point of view, mega-regionals also have the potential virtue of harmonizing and simplifying rules across a range of fragmented agreements, thus reducing the famous "noodle bowl" effect (e.g., Kawai and Wignaraja, 2009).

Within Asia, four initiatives are of particular interest. The first is the CPTPP itself. The second relates to the hope—still alive in some quarters—that the USA might be induced at some point to rejoin the agreement it itself pushed for before abandoning. We term that scenario CPTPP12. Whereas the CPTPP's predecessor, TPP, was led by the US until its decision to withdraw under the Trump administration, the other two mega-regional initiatives in Asia involve China in a strong leadership role. The first is the Regional Comprehensive Economic Partnership (RCEP), centered on ASEAN, but designed to consolidate and unify the network of agreements that has grown up around that organization, and which currently involves China, India, Australia, New Zealand, Korea, and Japan. The final initiative is the Free Trade Area of the Asia Pacific (FTAAP), which would potentially involve all members of the Asia Pacific Economic Cooperation (APEC). Although an FTAAP-like initiative has long been floated in policy circles, China was the motivating force behind the decision taken by APEC members in 2014—China's host year— to launch a strategic study on issues related to FTAAP.

A final initiative that should be of interest to Asian countries, even though it does not involve them, is the Trans-Atlantic Trade and Investment Partnership (TTIP). Although progress has been limited to date, the possibility of concluding such an agreement in the medium term cannot be excluded. Of interest to Asian countries is the prospect that their firms will have to compete on differential terms with European rivals in the large US market, and similarly with US firms in the European market. These two large markets are important destinations of Asian exports, and as such there is the potential for substantial trade effects if they decide to integrate.

With the exception of CPTPP, which now has a definitive text, the other initiatives—CPTPP12, RCEP, FTAAP, and TTIP—remain somewhat speculative. FTAAP and CPTPP12 are the most uncertain, as negotiations are not yet underway, and in the latter case may never happen at all. RCEP and TTIP have seen some level of negotiating activity, but progress has hit roadblocks in both cases. While TTIP is unlikely to proceed under the current US administration, that factor, as well as the signature of CPTPP, will perhaps give a fillip to the RCEP negotiations. In any case, these policy issues need to remain on the

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radar of Asian policymakers for the time being.

Against that background, it is important to know what the trade and welfare implications of the different agreements are for Asian countries, ranging from high income countries like Korea and Japan, to lower income members of ASEAN. That is the task this paper undertakes in a transparent and tractable way, which is nonetheless highly informative in terms of the relative dynamics of different scenarios. We exploit recent developments in the trade literature to estimate and simulate a simple but theoretically-grounded model of bilateral trade based on the structural gravity model (Anderson and Van Wincoop, 2003, 2004), combined with the Poisson Pseudo-Maximum Likelihood (PPML) estimator (Santos Silva and Tenreyro, 2006). This approach has been termed GE PPML (Anderson et al., 2015; Yotov et al., 2017). It provides a consistent platform for estimating parameters of interest, and for conducting counterfactual simulations, thus avoiding the need to estimate elasticities in one setting (an econometric model) but conduct trade and welfare simulations in a completely different framework (a computable general equilibrium, CGE, model), often built on different theoretical foundations.

A number of previous papers have modeled the effects of particular mega-regional initiatives in Asia. Kim et al. (2013) use a computable general equilibrium (CGE) model to consider the impacts of FTAAP on member and non-member economies. They consider tariff liberalization, reduction in services barriers, and improved trade facilitation; however, their data on services, for example, is based on an analysis of Uruguay Round commitments, which are typically much more restrictive than observed policies. They do not provide fresh estimates of services barriers. Similarly, their approach to trade facilitation is not strictly data driven, but simply assumes a given reduction in trade costs. Taking these points together, a key limitation is that this work is not based on an empirical estimate of the ways in which trade agreements have historically affected either trade costs or trade flows, but instead on assumptions as to what is likely.

Petri and Plummer (2016) similarly use a CGE model to examine the impacts of the then current TPP proposal, which we refer to here as CPTPP12. They consider reductions of tariff barriers and non-tariff barriers in goods, and non-tariff barriers in services. In the latter case, they use estimates of service sector restrictiveness due to Fontagne et al. (2011) as their baseline, and assume that the agreement would reduce particular percentages of the total number of restrictions, subject to minimum level of barriers that is assumed to reflect necessary regulatory provisions. As in the case of Kim et al. (2013), Petri and Plummer (2016) do not directly assess the impact of trade agreements on trade costs or trade flows based on historical experience, but instead move forward from assumptions as to what CPTPP12 would be likely to do.

Petri et al. (2017) use CGE modeling to compare various scenarios of Asian integration following the US decision to withdraw from TPP. For current purposes, their analysis of RCEP is particularly relevant. They use a similar model to that of Petri and Plummer (2016) to analyze these scenarios, and so our comments above apply with equal force.

We build on the existing literature in two main ways. The first is methodological, as set out in the previous paragraph. Concretely, we demonstrate that readily available data and straightforward programming can yield a flexible and informative platform that brings estimation and simulation closer together than is possible within a CGE framework. We use exactly the same data for estimation that we use for reproducing the model's baseline equilibrium, which is not typically the case in CGE models. In addition, our approach does not require extensive collected data on non-tariff barriers in goods and services, which is frequently unavailable. Overall, we expect our approach to be of significant interest to applied researchers and policy professionals in Asia. Second, our analysis of different scenarios proceeds from a concrete analysis of the effects of trade agreements all around the world on trade in goods and services. We derive our impact assessments from estimates of the impacts of trade agreements, not from assumptions about how their terms will affect various estimated inputs into the model, as in the case of the CGE estimates above. Third, we conduct counterfactual simulations of the main mega-regional initiatives—CPTPP, CPTPP12, RCEP, FTAAP, and TTIP—at the aggregate level (combining goods and services), then separately for agricultural products, manufactured goods, services, and final and intermediate manufactured goods. The latter simulations are important for understanding the implications of mega-regionals for value chain activity: a greater proportion of intermediates in manufactured goods trade following passage of an agreement would be consistent with the deepening of value chains, which rely heavily on the internationalization of production and frequent and intense movements of intermediates. To our knowledge, the value chain dimension has not been addressed at all by the existing literature on mega-regionals.

A core finding of our analysis, which sits well with previous work, is that Asian mega-regionals are beneficial in trade and welfare terms to participants, and do not have significant negative effects on non-participants. The same is largely true for Asian countries with respect to TTIP. Second, we find that the benefits of a mega-regional are larger the broader its membership base, and in particular according to whether or not it includes China. As such, FTAAP has the largest impact of any of the agreements we consider, as it includes all large Asia-Pacific markets except India, which is comparatively less open to trade than most other Asian countries.

There is evidence of sectoral heterogeneity in terms of the estimated impact of a trade agreement on trade flows, which turns into differences in estimated counterfactual impacts. The manufacturing sector sees the strongest impact of a trade agreement, followed by agriculture, and then services. This result is interesting because services are clearly the frontier for most comprehensive trade agreements: one implication of our finding is that the services provisions of trade agreements are relatively less effective than those dealing with goods, which partly reflects the difficulty of negotiating market access for intangibles where barriers come in the form of complex regulations rather than simple discriminatory taxes.

Our results are most novel in the area of value chains. We find that trade agreements tend to promote trade in intermediates more strongly than trade in final goods. As a result, our counterfactuals in all cases show a shift towards a greater proportion of intermediates in total exports. Changes are relatively small for most countries, but large in some scenarios for China and Japan, perhaps equivalent to five years of deepening value chain activity based on what has been observed in recent years worldwide. As a result, we conclude that Asian mega-regionals have considerable scope to deepen value chains in the region.

In line with previous work, we find that mega-regionals can have substantial trade effects, but limited welfare implications. Taking our results on aggregate goods and services trade as a benchmark, we find sometimes large trade effects, such as a 13% increase in exports for Japan under FTAAP, but the largest impact on real GDP is only 0.19%, for Australia-New Zealand under FTAAP. This difference in size between trade and welfare effects suggests that the political economy of mega-regionals may continue to be challenging: the larger welfare gains reported in the CGE literature typically rely on aspects of the agreement that are harder to quantify, such as dynamic growth effects driven by investment decisions, but the displacement effects due to large export and import effects are well known and easy to observe in practice. This disjuncture was part of the political economy story behind the US decision to withdraw from TPP, and suggests that at least some Asian countries will find it difficult to move forward on mega-regionals in the short term.

Against this background, the paper proceeds as follows. The next section discusses our dataset. Section 3 presents the econometric model, and discusses the simulation methodology. Section 4 presents results, focusing first on econometric estimates, then simulation results. The final section concludes and discusses policy implications.

Table 1
Data and sources.

Variable	Definition	Years	Source
Colony	Dummy variable equal to one for country pairs that were ever in a colonial relationship.	N/A.	CEPII
Common Border	Dummy variable equal to one for countries that share a common land border.	N/A.	CEPII.
Common Colonizer	Dummy variable equal to one for country pairs that were colonized by the same power.	N/A.	CEPII
Common Language	Dummy variable equal to one for countries that have a common official language.	N/A.	CEPII
Exports	Total merchandise exports from country i to country j in time period t.	2011.	OECD-WTO TiVA.
International	Dummy variable equal to one if country i and country j are not the same.		
Log(Distance)	Distance between country i and country j.	N/A.	CEPII.
RTA	Dummy variable equal to one for country pairs that are members of the same regional trade agreement.	1995, 2000, 2005, 2010, and 2011.	Mario Larch.

2. Data

Table 1 presents a summary of the data used in this paper. Sources are standard for gravity control variables, and we use Mario Larch's RTA dataset to source a dummy variable equal to one when both countries are members of the same trade agreement (Egger and Larch, 2008).

The standard source for trade data is UN Comtrade. However, it does not include data on self-trade, i.e. goods and services that are produced and consumed within the same country. Yotov et al. (2017) show that such data should ideally be included in gravity models, which rely for their theoretical basis on summing exports across all destinations—including the home country—to produce aggregates like total output and expenditure. Not including intra-national trade can potentially bias gravity model estimates, and in this case would prevent us from presenting welfare calculations, which are predicated on summing all trade flows—including intra-national trade—to produce quantities like real output and GDP.

In light of these considerations, we therefore use the OECD-WTO TiVA dataset. It has balanced gross trade data by ISIC sector, along with gross production data at the same level of disaggregation. By subtracting world exports from total production, we can obtain a measure of self-trade. (For intermediate and final goods, we work directly with the input-output tables to obtain the required figures). We emphasize that we work with trade and production data in gross, not value added, terms. Although trade in value added would be an interesting extension for our work, the theoretical foundation does not lend itself as easily to modeling in a gravity framework, and in particular to the same combined approach to estimation and simulation that we use here (see Noguera, 2012, for an attempt to embed value added trade in gravity logic).

The TiVA data are available for 63 exporting and importing countries (see Appendix for a list), which account for over 90% of world GDP. Although the data focus on OECD countries, they also include developing countries from all regions, and as such can be informative about bilateral trade patterns beyond the developed world, and between developed and developing regions. As far as coverage of Asian countries is concerned, the OECD dataset covers 20 out of 21 APEC economies (all except Papua New Guinea), and eight out of ten ASEAN countries (missing only Myanmar and Lao PDR), which means that it covers all RCEP countries except the two just listed. In addition, it includes partner countries such as all EU members, the USA, and Canada.

In addition to the availability of carefully constructed data on self-trade, the TiVA dataset has the advantage of linking to rigorously assembled inter-country input-output table. We can use this table to assemble measures of goods and services used as intermediates and those used in final consumption. The distinction is important from a policy point of view, because global value chains trade heavily in intermediate relative to final goods, and are particularly prominent in the Asian region. This approach is superior to catalogues based on standard trade classifications (e.g., Saslavsky and Shepherd, 2014), as it takes account of dual use goods, i.e. it allows for part of a sector's production to be destined for final consumption, and another part to be destined for use as intermediate inputs. It represents the most sophisticated method available for identifying trade in intermediate goods, and thus for quantifying changes in the trading environment due in part to value chains.

For our empirical analysis, we use data on total trade (goods and services), then split the sample to consider agriculture (ISIC sectors 1–5), manufactured goods (ISIC sectors 15–37), services (ISIC sectors 50–74), and final and intermediate goods and services (aggregated across all ISIC sectors) separately. We use a balanced panel of 63 exporters and importers in each sector aggregate for the years 1995, 2000, 2005, and 2010 to estimate models of the RTA effect on bilateral trade. We then conduct counterfactual simulations using the same parameter estimates, but applied to the latest available data (2011).

Fig. 1 presents a basic breakdown of the trade data by sector, grouping countries into the same regions we will use for the counterfactual simulations. First, we see that manufactures dominate in most Asian sub-regions, although Australia stands out for the importance of its "other" sector, primarily mining. Services are also an important component of total exports in all sub-regions, ranging from about 20% in Korea to over 40% in India. We emphasize that services trade in the TiVA dataset is limited to pure cross-border transactions recorded in the Balance of Payments, and does not include any other modes of supply under the WTO General Agreement on Trade in Services (GATS).

Fig. 2 presents an alternative breakdown of the trade data. It takes total trade data, aggregating across all goods and services sectors, and uses the TiVA input-output table to distinguish between goods that enter into final consumption, and those that are used as intermediates. In all sub-regions, intermediate goods are dominant, but observed ratios in total trade differ noticeably from one group to another. If it is indeed the case in these data that final and intermediate goods respond differently to trade agreements, this breakdown suggests that dynamic could be of substantial importance in Asia—thus confirming our choice to use that breakdown as part of our empirical work.

3. Econometric model

Theory-consistent gravity models are well known in the trade literature. Anderson et al. (2015) develop a simple method for conducting theory-consistent policy simulations using the familiar structural gravity model derived from CES preferences across countries for national varieties differentiated by origin (the Armington assumption). The model takes the following form:

$$X_{ij} = \left(\frac{t_{ij}}{\Pi_i P_j}\right)^{1-\sigma} Y_i E_j \tag{1}$$

$$P_j^{1-\sigma} = \sum_i \left(\frac{t_{ij}}{\Pi_i}\right)^{1-\sigma} Y_i \tag{2}$$

$$\Pi_i^{1-\sigma} = \sum_j \left(\frac{t_{ij}}{P_j}\right)^{1-\sigma} E_j \tag{3}$$

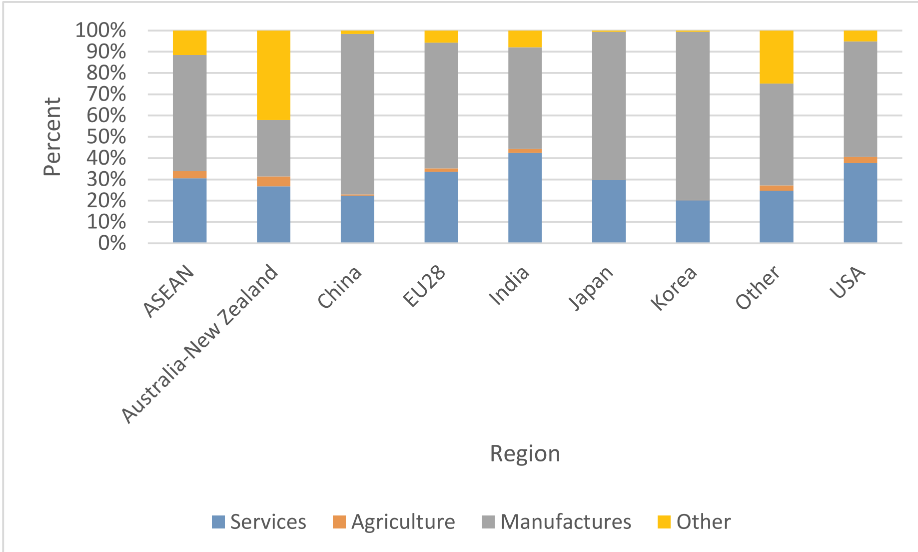

Fig. 1. Breakdown of exports by sector, 2011, percent of total.

$$p_j = \frac{Y_j^{\frac{1}{1-\sigma}}}{\gamma_j \Pi_j} \quad (4)$$

where: X is exports in value terms from country i to country j; E is expenditure in country j; Y is production in country i; t captures bilateral trade costs; sigma is the elasticity of substitution across varieties; P is inward multilateral resistance, which captures the dependence of bilateral shipments into j on trade costs across all inward routes; Π is outward multilateral resistance, which captures the dependence of bilateral shipments out of i on trade costs across all outward routes; p is the exporter's supply price of country i; and gamma is a positive distribution parameter of the CES function. Full details of the model's solution and characteristics are provided by Anderson et al. (2015), and Yotov et al. (2017). We do not repeat them here, but direct interested readers to those papers for further details.

Most commonly, the model represented by (1) through (4) is estimated by fixed effects, which collapses it into the following empirical setup:

$$X_{ij} = exp(T_{ij}\beta + \pi_i + \chi_j)e_{ij} \quad (5)$$

where: T is a vector of observables capturing different elements of trade costs; π is a set of exporter fixed effects; χ is a set of importer fixed effects; and e is a standard error term.

The model has a number of salient features, which are well known, but which need restating. First, its structure makes clear that the elasticity of trade with respect to particular bilateral trade costs—such as membership of an RTA—specified within t is not an accurate summary of the impact of a change of trade costs on trade. The reason is that the multilateral resistance indices depend on trade costs across all partners, which means that the model takes account of general equilibrium effects. This point is typically recognized at the estimation stage, when fixed effects by exporter and by importer are included to account for multilateral resistance. However, when a counterfactual simulation is conducted, the effects need to be passed through the two price indices, not simply extracted from the relevant regression coefficient. This point is much less commonly appreciated in the literature.

Second, if the model is estimated by PPML with fixed effects as

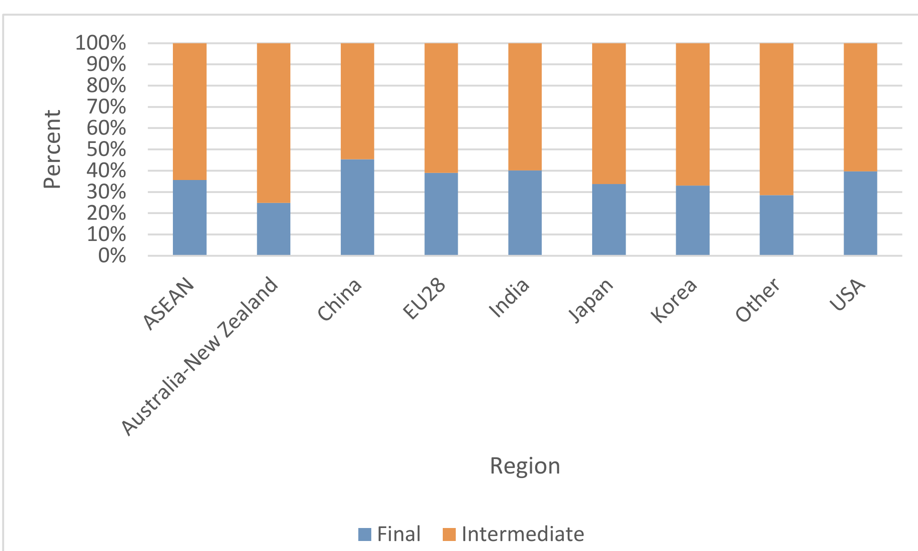

Fig. 2. Breakdown of exports by use, 2011, percent of total.

recommended by Santos Silva and Tenreyro (2006), then Fally (2015) shows that the estimated fixed effects correspond exactly to the terms required by the structural model. In other words, if (5) is estimated correctly, then it follows that:

$$\hat{\Pi}_i^{1-\sigma} = E_0 Y_i \exp(-\pi_i) \tag{6}$$

$$\hat{P}_j^{1-\sigma} = \frac{E_j}{E_0}\exp(-\pi_i) \tag{7}$$

where E0 corresponds to the expenditure of the country corresponding to the omitted fixed effect (typically an importer fixed effect) in the empirical model, and the normalization of the corresponding price terms in the structural model.

Let $\hat{\beta}$ be the PPML estimates of the trade cost parameters in (5). To see the impact of a counterfactual change in trade costs, such as the elimination of an RTA between two trading partners, we can re-estimate (5) imposing $\hat{\beta}$ as a constraint and with counterfactual trade costs T_{ij}^c:

$$X_{ij} = exp(T_{ij}^c\hat{\beta} + \pi_i + \chi_j)e_{ij} \tag{8}$$

Estimating (8) with PPML and the original trade data means that output and expenditure remain constant, so the PPML fixed effects adjust to take account of changes in multilateral resistance brought about by the change in bilateral trade costs. Once estimates have been obtained, counterfactual values of relevant indices can be calculated, but they are conditional on fixed output and expenditure although they take account of general equilibrium reallocations. In particular, $\hat{X}_{ij}$ from (8) provide counterfactual values of bilateral trade that are consistent with the general equilibrium restrictions of theory, but which still sum to give observed output and expenditure, consistent with a remarkable property of the PPML estimator (Arvis and Shepherd, 2013; Fally, 2015).

It is possible to push the model further, by allowing counterfactual changes in factory-gate prices to drive changes in output and expenditure, which in turn lead to additional changes in trade flows, until the system converges. Specifically, endogenous responses in output and expenditure are as follows in an endowment economy where trade imbalance ratios $\phi_i = E_i/Y_i$ remain constant:

$$Y_i^c = \left(\frac{p_i^c}{p_i}\right)Y_i \tag{9}$$

$$E_i^c = \left(\frac{p_i^c}{p_i}\right)E_i \tag{10}$$

Anderson et al. (2015) propose an iterative approach to solving the system. First, use structural gravity to translate changes in output and expenditure into changes in trade flows:

$$X_{ij}^c = \frac{(t_{ij}^{1-\sigma})^c}{t_{ij}^{1-\sigma}}\frac{Y_i^c E_j^c}{Y_i E_j}\frac{\Pi_i^{1-\sigma}P_j^{1-\sigma}}{(\Pi_i^{1-\sigma})^c(P_j^{1-\sigma})^c} \tag{11}$$

where superscript c indicates counterfactual values obtained from constrained estimation of (8) and calculation of relevant indices. Counterfactual values of output and expenditures come from applying market clearing conditions $p_i = (\frac{Y_i}{Y})^{1/1-\sigma}\frac{1}{\gamma_i\Pi_i}$, which makes it possible to translate changes in the fixed effects between (8) and (5) into first order changes in factor-gate prices:

$$\frac{p_i^c}{p_i} = \frac{\exp\left(\hat{\pi}_i^c\right)}{\exp(\hat{\pi}_i)} \tag{12}$$

further changes occur in a second order sense, as changes in prices lead to further changes in output and expenditure, which in turn drive changes in trade. By iterating the PPML estimation and calculation of changes until convergence, it is possible to obtain full endowment general equilibrium estimates of trade flows and relevant indices.

To summarize, Anderson et al. (2015) show that starting with the standard structural gravity model, it is possible to design a simple approach for first estimating the model's parameters, and then using the estimated parameters to perform counterfactual simulations in a way that is fully consistent with the general equilibrium implications of gravity theory. The methodology can be broken down as follows:

1 Estimate the model using PPML and fixed effects to obtain estimates of trade costs and trade elasticities for the baseline.
2 Solve the gravity system using the output from step 1 to provide baseline values of all indices.
3 Define a counterfactual scenario in terms of an observable trade cost variable.
4 Solve the counterfactual model in conditional general equilibrium, i.e. direct and indirect changes in trade flows at constant output and expenditure.
5 Solve the counterfactual model in full general equilibrium, i.e. direct and indirect changes in trade flows with endogenous output and expenditure driven by trade-induced changes in factory-gate prices.

Yotov et al. (2017) provide a detailed explanation of the above steps, as well as Stata code for implementing them in a general setting. We adopt their approach and freely adapt their code here. Concretely, we use PPML to estimate (8) on a balanced panel of 63 exporters and importers for the years 1995, 2000, 2005, and 2010. This setup allows us to introduce importer-time, exporter-time, and country-pair fixed effects to account for multilateral resistance, expenditure, output, and pair-varying trade costs. Use of panel data attenuates simultaneity bias and produces credible estimates of the impact of trade agreements on bilateral trade. Given the rigor of the fixed effects setup, we can use a very simple trade costs function with just a dummy variable for RTAs in addition to the fixed effects (suppressed for clarity, but included in all models):

$$T_{ij}\beta = \beta_0 rta_{ij}$$

The coefficient of interest is β_0, which gives the elasticity of bilateral trade flows with respect to membership of a trade agreement. Because of the pair fixed effects, our claim to identification lies on within sample variation in trade agreement membership.

Once we have isolated β_0 from the panel regression, we use data for 2011 only to conduct the counterfactual simulations. The PPML approach requires us to re-estimate the model for a single year, imposing the panel estimate of the RTA coefficient as a constraint, but letting all other parameters vary freely. We include standard gravity controls, and use the methodology described above to run the simulations.

4. Results

This section presents the results of our analysis. We first discuss our econometric results, and then move to a consideration of the trade and welfare effects of mega-regionals through our counterfactual simulations.

4.1. Estimation results

Table 4 presents estimation results for the panel data regressions. The dummy variable for joint membership of the same trade agreement is always positive and statistically significant at the 5% level or better, which is in line with expectations. However, effect sizes differ somewhat across sectors: the strongest effect of trade agreements is in manufacturing, compared with agriculture and services; moreover when we aggregate total trade but distinguish end use, we find that bilateral trade is more sensitive to the existence of a trade agreement in intermediate, as opposed to final, goods and services. Although the differences are large in some cases in economic terms, they are not statistically significant at the 5% level.

As noted above, the first step in conducting the simulations is to re-estimate the models using data for 2011 only, but including gravity controls and constraining the coefficient on the trade agreements variable to its value in the panel data regressions. Results from this exercise are in Table 5. Coefficients on the gravity controls are always in line with expectations in terms of sign and magnitude, and they are statistically significant at the 10% level or better in all but three individual cases. Overall, the models clearly provide a close fit to the data, and we can be sure that imposing the RTA coefficient from the panel regressions is not inappropriate, as it has not wrought substantial changes in typical gravity variables.[2]

4.2. Counterfactual simulations

With the estimating platform in place, we can proceed to conduct counterfactual simulations. Each simulation considers enactment of one mega-regional. For countries that are part of the mega-regional, we set their counterfactual RTA dummy equal to unity if they are not already part of the same trade agreement. We then simulate as set out in Section 3 to produce trade and welfare impacts.

Our first counterfactual simulation uses the model for total trade—i.e., all goods sectors and all services sectors together—and considers the impact of different integration scenarios. Concretely, we consider CPTPP, CPTPP12, RCEP, and FTAAP as plausible scenarios of Asian integration. In the interests of having a base of comparison, and in keeping with the mega-regionals theme, we also conduct a simulation for a TTIP agreement between the EU28 and the USA. The simulation is conducted using data on all 63 exporters and importers, but for reporting purposes, we group them together into selected individual countries and aggregate regions (see Appendix for a mapping).

Against this background, results for total trade are in Table 6. For each scenario, we record percentage changes in exports, imports, and real GDP as a measure of welfare. The first point to note is that changes in the last variable—real GDP—are small in all cases, whether slightly negative or slightly positive. The largest effect is a gain of 0.19% for Australia-New Zealand under the FTAAP scenario. This finding is in keeping with much of the recent literature on the gains from trade integration, which has argued that the welfare gains from increasing integration from already historically low levels of protection is relatively small. For example, Arkolakis et al. (2012) argue that for a wide class of trade models, the welfare gains to the United States from the totality of its international trade—not just trade occurring under one preferential agreement—is between 0.7% and 1.4%. Against that background, our figures for the impact of individual agreements, even mega-regionals, does not appear unreasonable.

Trade effects are much larger than real GDP effects, as would be expected. In each case, exports and imports increase significantly for included countries, while excluded countries see modest falls. Moving across the table, the size of trade gains for included countries is increasing in the number of countries in the agreement, as well as their relative sizes. Although RCEP includes in the two largest countries in population terms—India and China—trade effects are larger for FTAAP, given the larger integrated market. India only benefits in trade terms under the RCEP scenario, as it is not a part of any of the other initiatives, but its gains are relatively small due to its largely domestically focused economy. Under FTAAP, the scenario with the largest trade effects, export gains range from 2.6% for the "other" category, which includes countries like Canada, Chile, and Peru that are part of the initiative, as well as numerous other countries that are not, to 13.4% for Japan.

Table 2
Summary statistics.

Variable	Observations	Mean	Std. dev.	Min.	Max.
Colony	19,845	0.026	0.160	0.000	1.000
Common Border	19,845	0.034	0.182	0.000	1.000
Common Colonizer	19,845	0.019	0.137	0.000	1.000
Common Language	19,845	0.073	0.260	0.000	1.000
Exports	19,845	21.773	416.869	0.000	23,577.430
International	19,845	0.984	0.125	0.000	1.000
Log(Distance)	19,845	1.519	1.115	−5.008	2.986
RTA	19,845	0.387	0.487	0.000	1.000

Note: Summary statistics based on the aggregate goods and services sample, covering data for all available years.

The comparison between CPTPP and CPTPP12 is instructive. While there are trade gains for included countries in both scenarios, they are significantly larger when the US market is included, in particular for Japan. The importance of the US market, combined with China, is reflected in the large numbers for the FTAAP simulation.

As a point of comparison, the TTIP scenario shows that Asian countries stand to have small trade losses as a result of the agreement. The included regions—EU28 and the USA—see significant trade gains, particularly in the case of the USA. Indeed, the real GDP gain for the USA under TTIP is larger than for any scenario involving an Asian mega-regional.

Tables 7–9 move from aggregate to sectoral results, distinguishing between agricultural products, manufactured goods, and services. The general pattern of trade effects is similar to those in Table 6, in that FTAAP has the largest effects, followed by RCEP, and then the two CPTPP scenarios. Looking across the sectoral tables, percentage changes are typically larger in manufactured goods than in services. This result was already foreshadowed in the regressions in Table 5, but the counterfactual simulations confirm it. The case of agriculture is interesting, however. Japan stands out as having very large percentage export gains in scenarios involving integration with China. It is unlikely that Japan has a strong comparative advantage in agriculture relative to other countries in the Asia-Pacific region, so these results are in fact capturing modest dollar gains from a very low baseline.

Our final counterfactual simulations are for final goods and services versus intermediates. Table 10 reports summary results merging both sets of simulations. Starting from the baseline and dealing separately with each scenario, we report the relevant percentages of total exports by region accounted for by intermediates. The intuition is that a larger proportion of intermediates in total trade is consistent with a deepening of regional and global value chains, which are characterized by intensive trade in intermediates relative to final goods.

Table 10 shows that changes are typically relatively small in percentage point terms in each scenario. In particular, there is little evidence that either of the two CPTPP scenarios would significantly deepen value chain activity in Asia. Changes are larger for RCEP, and in particular for FTAAP. The presence of China within the trade agreement is clearly key for understanding its effects on value chains. RCEP and FTAAP both increase the percentage of intermediates in total trade for all regions, even those that are not included within the liberalizing blocs in each scenario. This is an important result, going beyond the aggregate findings in Table 6, which suggested that effects on excluded countries' exports are typically very small. In this case, we find that increased value chain activity is the norm rather than the exception for all regions considered. Among member countries in the various scenarios, Japan and China stand out as having particularly strong value chain effects under RCEP and particular FTAAP. In the latter scenario, China's proportion of intermediates in total exports increases by 1.7 percentage points, while the corresponding figure for Japan is 1.6 percentage points. Although these may sound like small changes, it is important to keep them in perspective. 1.7 percentage points is

[2] In additional results, available on request, we re-estimate the 2011 only models with no constraints on coefficients. Results for the control variables are highly similar in terms of sign, magnitude, and statistical significance.

Table 3
Correlation matrix.

	Colony	Common border	Common colonizer	Common language	Exports	International	Log(Dist)	RTA
Colony	1.000							
Common Border	0.177	1.000						
Common Colonizer	−0.023	0.075	1.000					
Common Language	0.257	0.160	0.159	1.000				
Exports	−0.006	−0.002	−0.007	−0.010	1.000			
International	0.021	0.024	0.018	0.036	−0.362	1.000		
Log(Distance)	−0.076	−0.340	−0.041	−0.031	−0.097	0.378	1.000	
RTA	0.010	0.180	−0.008	0.023	−0.035	0.101	−0.513	1.000

Note: Correlations based on the aggregate goods and services sample, covering data for all available years.

Table 4
Estimation results using panel data.

	(1) Total	(2) Agriculture	(3) Manufacturing	(4) Services	(5) Final	(6) Intermediate
RTA	0.246 ***	0.302 ***	0.331 ***	0.143 **	0.166 **	0.263 ***
	(0.089)	(0.082)	(0.100)	(0.072)	(0.076)	(0.093)
Observations	15,876	15,876	15,876	15,876	15,876	15,876
R2	1.000	1.000	1.000	1.000	1.000	1.000
Pair Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes
Exporter-Time Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes
Importer-Time Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes

Note: Estimation is by PPML in all cases. Robust standard errors corrected for clustering by country pair appear in parentheses below coefficient estimates. Statistical significance is indicated as follows: * (10%), ** (5%), and *** (1%).

Table 5
Estimation results using data for 2011 only.

	(1) Total	(2) Agriculture	(3) Manufacturing	(4) Services	(5) Final	(6) Intermediate
RTA	0.246	0.302	0.331	0.143	0.166	0.263
Log(Distance)	−0.560 ***	−0.785 ***	−0.659 ***	−0.420 ***	−0.539 ***	−0.587 ***
	(0.049)	(0.074)	(0.044)	(0.053)	(0.059)	(0.043)
Common border	0.295	0.753 **	0.235	0.292 **	0.439 **	0.216
	(0.183)	(0.332)	(0.228)	(0.146)	(0.212)	(0.175)
Colony	0.281 **	0.085	0.375 ***	0.298 **	0.218 *	0.347 ***
	(0.123)	(0.198)	(0.118)	(0.134)	(0.131)	(0.123)
Common colonizer	0.719 ***	0.327 *	0.368 *	1.041 ***	0.691 ***	0.715 ***
	(0.176)	(0.183)	(0.223)	(0.215)	(0.170)	(0.179)
Common language	0.303 **	−0.013	0.292 **	0.562 ***	0.324 **	0.325 **
	(0.134)	(0.167)	(0.142)	(0.130)	(0.150)	(0.129)
International	−4.145 ***	−4.771 ***	−3.077 ***	−4.743 ***	−4.551 ***	−3.843 ***
	(0.148)	(0.195)	(0.130)	(0.162)	(0.173)	(0.130)
Observations	3969	3969	3969	3969	3969	3969
R2	0.999	1.000	0.998	1.000	1.000	0.999
Exporter fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Importer fixed effects	Yes	Yes	Yes	Yes	Yes	Yes

Note: Estimation is by PPML in all cases. Robust standard errors corrected for clustering by country pair appear in parentheses below coefficient estimates. Statistical significance is indicated as follows: * (10%), ** (5%), and *** (1%). Standard errors and significance are not reported for the RTA dummy, as coefficient values are imposed as constraints, based on results in Table 4.

Table 6
Counterfactual simulation results for total trade, percentage change over baseline.

	CPTPP			CPTPP + USA			RCEP			FTAAP			TTIP		
	Exports	Imports	Real GDP	Exports	Imports	Real GDP	Exports	Imports	Real GDP	Exports	Imports	Real GDP	Exports	Imports	Real GDP
ASEAN	0.147	0.173	0.007	0.634	0.764	0.029	0.249	0.278	0.009	3.263	3.823	0.138	−0.094	−0.106	−0.002
Australia-NZ	2.964	3.092	0.070	3.420	3.584	0.081	6.071	6.234	0.143	8.046	8.276	0.190	−0.160	−0.170	−0.003
China	−0.017	−0.024	0.000	−0.037	−0.046	−0.001	2.931	3.349	0.030	8.056	9.267	0.083	−0.117	−0.134	−0.001
EU28	−0.008	−0.009	0.000	−0.019	−0.021	−0.001	−0.012	−0.016	−0.001	−0.120	−0.134	−0.005	1.527	1.636	0.060
India	−0.018	−0.018	−0.001	−0.045	−0.037	−0.001	0.895	0.786	0.023	−0.249	−0.231	−0.008	−0.127	−0.121	−0.002
Japan	1.931	1.847	0.016	4.298	4.199	0.036	8.430	7.892	0.070	13.357	12.632	0.112	−0.125	−0.126	−0.001
Korea	−0.012	−0.017	0.000	−0.019	−0.026	−0.001	3.441	3.907	0.076	6.850	7.794	0.149	−0.095	−0.107	−0.001
Other	0.252	0.268	0.011	0.227	0.240	0.010	−0.021	−0.027	−0.001	2.555	2.771	0.111	−0.171	−0.191	−0.005
USA	−0.078	−0.064	−0.001	1.478	0.951	0.013	−0.033	−0.027	0.000	5.821	3.722	0.051	8.503	5.588	0.075

Table 7
Counterfactual simulation for trade in agricultural products, percentage change over baseline.

	CPTPP			CPTPP + USA			RCEP			FTAAP			TTIP		
	Exports	Imports	Real Output	Exports	Imports	Real Output	Exports	Imports	Real Output	Exports	Imports	Real Output	Exports	Imports	Real Output
ASEAN	−0.229	−0.359	−0.002	−0.167	−0.021	−0.001	−0.177	−0.131	−0.003	0.497	1.755	0.009	0.079	−0.005	−0.002
Australia-NZ	0.640	7.326	0.021	1.586	6.815	0.000	4.428	17.614	0.003	4.357	18.197	−0.001	0.071	−0.523	−0.002
China	−0.849	−0.267	−0.002	−1.164	−0.419	−0.004	5.071	1.921	0.012	10.331	4.432	0.027	−0.230	0.081	−0.001
EU28	−0.106	−0.059	−0.002	−0.163	−0.105	−0.005	−0.120	−0.080	−0.003	−0.555	−0.350	−0.016	0.816	0.394	0.020
India	−0.306	−0.333	−0.002	−0.443	−0.505	−0.004	0.311	0.688	0.004	−1.674	−1.880	−0.014	−0.034	−0.059	−0.001
Japan	4.718	−0.595	0.005	6.965	0.868	0.011	25.390	1.586	0.031	30.629	2.168	0.039	−0.479	0.248	−0.001
Korea	−1.037	−0.043	−0.003	−1.451	−0.109	−0.006	6.746	0.709	0.023	9.082	1.096	0.035	−0.129	0.212	−0.001
Other	0.078	0.182	0.003	0.001	0.031	−0.003	−0.193	−0.202	−0.004	2.067	2.829	0.028	−0.307	−0.375	−0.009
USA	−0.225	−0.784	−0.003	0.857	1.655	−0.001	−0.140	−0.413	−0.002	3.445	7.149	0.002	1.835	8.270	0.031

Table 8
Counterfactual simulation for trade in manufactured goods, percentage change over baseline.

	CPTPP			CPTPP + USA			RCEP			FTAAP			TTIP		
	Exports	Imports	Real Output	Exports	Imports	Real Output	Exports	Imports	Real Output	Exports	Imports	Real Output	Exports	Imports	Real Output
ASEAN	0.076	0.089	0.007	0.519	0.622	0.047	0.065	0.071	0.002	2.798	3.241	0.236	−0.245	−0.254	−0.009
Australia-NZ	4.436	2.202	0.241	4.977	2.528	0.280	11.866	5.598	0.642	13.559	6.584	0.745	−0.512	−0.349	−0.018
China	−0.058	−0.090	−0.001	−0.144	−0.199	−0.003	3.567	5.051	0.072	8.767	12.804	0.176	−0.301	−0.374	−0.003
EU28	−0.021	−0.026	−0.002	−0.064	−0.068	−0.005	−0.050	−0.060	−0.005	−0.376	−0.428	−0.034	1.402	1.691	0.143
India	−0.056	−0.055	−0.004	−0.140	−0.121	−0.009	0.606	0.618	0.035	−0.837	−0.789	−0.056	−0.320	−0.311	−0.011
Japan	1.406	2.181	0.033	3.483	5.456	0.083	12.305	17.605	0.290	16.369	23.788	0.385	−0.289	−0.360	−0.003
Korea	−0.024	−0.054	−0.002	−0.048	−0.109	−0.005	3.424	5.982	0.183	5.758	10.132	0.299	−0.216	−0.282	−0.004
Other	0.197	0.169	0.022	0.095	0.078	0.014	−0.106	−0.101	−0.009	3.415	2.941	0.338	−0.478	−0.436	−0.030
USA	−0.286	−0.185	−0.006	1.928	0.891	0.040	−0.193	−0.121	−0.004	8.803	4.146	0.185	10.662	5.434	0.226

Table 9
Counterfactual simulation for trade in services, percentage change over baseline.

	CPTPP			CPTPP + USA			RCEP			FTAAP			TTIP		
	Exports	Imports	Real Output	Exports	Imports	Real Output	Exports	Imports	Real Output	Exports	Imports	Real Output	Exports	Imports	Real Output
ASEAN	0.123	0.123	0.005	0.543	0.540	0.021	0.145	0.137	0.005	2.449	2.371	0.090	−0.032	−0.036	−0.001
Australia-NZ	1.807	1.668	0.032	2.170	2.004	0.039	2.800	2.585	0.050	4.203	3.863	0.075	−0.050	−0.052	−0.001
China	−0.009	−0.011	0.000	−0.019	−0.023	0.000	1.680	1.661	0.017	4.804	4.772	0.048	−0.040	−0.046	0.000
EU28	−0.005	−0.007	0.000	−0.008	−0.011	0.000	−0.006	−0.009	0.000	−0.048	−0.061	−0.002	1.086	1.157	0.030
India	−0.010	−0.011	0.000	−0.022	−0.023	−0.001	0.698	0.632	0.017	−0.145	−0.133	−0.004	−0.045	−0.046	−0.001
Japan	1.156	1.281	0.008	2.590	2.857	0.018	3.147	3.481	0.022	6.056	6.653	0.041	−0.040	−0.050	0.000
Korea	−0.009	−0.008	0.000	−0.017	−0.015	0.000	2.477	1.868	0.041	5.412	4.076	0.089	−0.041	−0.036	−0.001
Other	0.196	0.190	0.006	0.190	0.183	0.006	−0.010	−0.012	0.000	1.543	1.505	0.049	−0.054	−0.060	−0.002
USA	−0.027	−0.033	0.000	0.839	0.830	0.006	−0.012	−0.016	0.000	2.702	2.689	0.020	4.834	4.805	0.036

Table 10
Counterfactual simulation results, percentage of intermediates in total exports, by scenario.

	Baseline	CPTPP	CPTPP + USA	RCEP	FTAAP	TTIP
ASEAN	62.480	62.498	62.561	62.512	62.804	62.486
Australia-NZ	74.033	73.977	73.972	74.130	74.158	74.052
China	54.348	54.341	54.340	55.070	56.158	54.341
EU28	62.847	62.847	62.851	62.853	62.867	62.954
India	59.073	59.074	59.083	59.181	59.121	59.080
Japan	62.065	62.211	62.343	63.290	63.638	62.074
Korea	60.435	60.430	60.429	61.068	61.550	60.435
Other	67.950	67.954	67.962	67.961	68.159	67.965
USA	61.401	61.397	61.533	61.412	62.086	62.179

approximately the increase of worldwide exports of intermediates in total trade between 2000 and 2005, a period of rapid development of value chains in Asia and elsewhere. In context, therefore, the changes we are suggesting as plausible from FTAAP would be on a par with five rapid years of value chain deepening—clearly a significant outcome.

5. Conclusion and policy implications

This paper has used the latest developments in the gravity model literature, specifically the GE PPML approach of Anderson et al. (2015), to analyze the trade and welfare implications of mega-regional trade agreements in Asia. Our approach will be of interest to applied researchers because it uses exactly the same data for estimation and simulation of the baseline equilibrium, and does not require extensive information on non-tariff barriers in goods or services in order to provide an estimate of the impact of a trade agreement. The approach has shown itself to be both rigorous and flexible, and it has allowed us to conduct a comparative analysis of different integration scenarios, as well as to disaggregate by sector.

One key finding is that although the trade effects of mega-regionals can be substantial, their welfare implications are typically small. Our estimates are on the low side in light of the CGE literature, but also are based on an impact effect, not dynamic adjustment over time, and particularly do not take account of investment. Broadly speaking, our finding of a substantial difference in effect size between trade and welfare is in keeping with the CGE literature. From a political economy point of view, it suggests that mega-regionals may prove difficult to conclude, as large trade effects are synonymous with significant dislocations of capital and labor within economies, but the overall gains from doing so are relatively low proportional to baseline GDP. In part, this finding reflects the success of existing regional integration structures in Asia, which have reduced tariff and non-tariff rates of protection substantially in most countries over recent years.

Second, the inclusion of large markets in mega-regionals has a significant impact on the size of our estimated trade effects. For example, including the US in an expanded CPTPP is important in terms of boosting export gains for Asian countries, particularly Japan. Following this logic through, it comes as no surprise that the strongest trade effects are under FTAAP, which brings together two large markets—China, the US, and Japan—as well as a significant number of smaller ones. FTAAP's political prospects are highly uncertain, both due to the controversy its recent discussion unearthed within APEC, and also because of the current attitude of the US administration. In the absence of FTAAP, the largest and perhaps most likely gains are from RCEP. That agreement includes China, India, and Japan among large economies, as well as ASEAN and its partners in the small to mid-sized category. India remains relatively separate from other countries in the analysis of further Asian integration, as its economy is substantially more focused on the domestic market. However, our estimates suggest that RCEP could bring substantial trade benefits—assuming that it in fact turns out to be a comprehensive agreement, similar in scope to what has been observed in other settings, so that our estimate of the average RTA effect is appropriate. This point remains to be seen, partly because India has less experience with and appetite for comprehensive trade agreements than the other countries involved, and although negotiations have made substantial progress, it is not clear that they will conclude in the near future.

Third, our results show for the first time that mega-regional trade agreements can give a significant boost to value chain integration. We find generally that mega-regionals push the composition of trade towards intermediate goods and services, which is consistent with a deepening of value chain activity. Whereas our aggregate results indicate that negative trade and welfare effects are quite small for excluded countries, our value chain results go even further: in the case of FTAAP, value chain deepening takes place even in countries outside the agreement. This is an important point, as it suggests that concerns about excluded countries may be less relevant in a world of value chain-based trade than has historically been the case.

In policy terms, our results show that mega-regionals can produce substantial economic benefits for Asian countries, but that the political economy of moving forward may continue to be challenging. The politics of the various agreements is a very important factor in analyzing the extent to which the effects we have simulated may in fact be realized in practice. We leave that question to other analysts, and specifically political scientists, as we have chosen to focus here more narrowly, on trade and welfare effects. Despite the unaccommodating attitude of the current US administration, the size of the trade effects suggested by our simulations means that Asian countries will continue to pursue mega-regional trade agreements in the short to medium term.

In terms of further research, an important extension to our work is to incorporate the dynamic aspects of the model in

Anderson et al. (2015b). Trade agreements are typically implemented over long periods, so there is good reason to believe that once dynamics of investment and capital accumulation are integrated into the analysis, effects on real GDP could be larger than those we have found here. We therefore see our results as lower bounds on the true estimates. Future work could continue with the insights of Anderson et al. (2015b) to embed the structural gravity model in a dynamic growth framework, although there are significant data problems involved in implementing the model for a wide range of countries, including developing countries. (Tables 2, 3 and 8).

Appendix

Country	Mapped region
Argentina	Other
Australia	Australia-New Zealand
Austria	EU28
Belgium	EU28
Brazil	Other
Brunei Darussalam	ASEAN
Bulgaria	EU28
Cambodia	ASEAN
Canada	Other
Chile	Other
China	China
Colombia	Other
Costa Rica	Other
Croatia	EU28
Cyprus	EU28
Czech Republic	EU28
Denmark	EU28
Estonia	EU28
Finland	EU28
France	EU28
Germany	EU28
Greece	EU28
Hong Kong	Other
Hungary	EU28
Iceland	EU28
India	India
Indonesia	ASEAN
Ireland	EU28
Israel	Other
Italy	EU28
Japan	Japan
Korea	Korea
Latvia	EU28
Lithuania	EU28
Luxembourg	EU28
Malaysia	ASEAN
Malta	EU28
Mexico	Other
Morocco	Other
Netherlands	EU28
New Zealand	Australia-New Zealand
Norway	EU28
Peru	Other
Philippines	ASEAN
Poland	EU28
Portugal	EU28
Romania	EU28
Russian Federation	Other
Saudi Arabia	Other
Singapore	ASEAN
Slovakia	EU28
Slovenia	EU28
South Africa	Other
Spain	EU28
Sweden	EU28
Switzerland	Other

Taiwan	Other
Thailand	ASEAN
Tunisia	Other
Turkey	Other
United Kingdom	EU28
United States of America	USA
Viet Nam	ASEAN

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