Practical NTM estimation for CGE Modelling using best practice gravity: Clustering with Chapter-Sector Heterogeneity and Staggered Difference in Difference

Joseph Carr, Isa-Louise Clarke, Ben Fraser, Sam Jones

September 2025

Abstract

"Quantifying the liberalising impact of non-tariff measures (NTM) is widely considered one of the biggest challenges in trade economics. NTM assumptions drive the results from trade simulation modelling, determine FTA negotiation positions, and therefore the narrative of the winners and losers of a prospective trade agreement. Our paper demonstrates how recent innovations in the gravity literature can be applied to the sectoral level to produce empirically estimated NTM liberalisation changes considering granular policy information and sector-specific effects. Firstly, we use a UMAP clustering algorithm to build a set of FTA archetypes using the World Bank Contents of Deep Trade Agreements 2.0 Mattoo et al (2020)[1]. Secondly, we apply Nagengast & Yotov (2025) to the sectoral level to account for forbidden comparisons. Finally, we apply both these innovations in operable gravity models at the GTAP 65 sector level[2], using Global Tariff Data (new GTD) provided by Teti (2020) as a robust control for the identification of NTMs. We conclude that whether an FTA is expected to be goods-dominated or services dominated is contingent on how tariffs and FTAs have been controlled for."

Motivation

Reductions in non-tariff measures (NTMs) represent a core focus for policymakers in free trade agreement (FTA) negotiations, particularly given that tariffs are now relatively low across most products (Ederington & Ruta, 2016). More recent FTAs have been shown to have deeper liberalising impacts on NTMs (Mattoo, Rocha, et al., 2020).

Government trade economists are relatively fortunate in the availability of data, theory and academic literature they can draw on. However, estimating NTMs to simulate the impact of trade policies ex-ante, they face several challenges:

- Challenge 1: How to operationalise data on the contents of FTAs to produce heterogeneity in NTM estimates.
- Challenge 2: How to apply developments in the gravity modelling literature to the sectoral level.
- Challenge 3: How to disentangle the impact of tariffs from NTMs.

This paper represents our attempt to implement the vanguard of the academic literature to solve these practical problems. We do this through exploring four key innovations: (i) Gravity modelling at sectoral level; (ii) Controlling for tariffs using a new Global Tariff dataset created by Teti (2020); (iii) Utilising the World Bank's Deep Trade Agreements Dataset to characterise FTAs; and (iv) Implementing Extended-Two-Way-Fixed-Effects.

[1]This discussion paper is meant for feedback on ongoing technical research and development by the researchers and in no way represents the views or policy of DBT or the UK government. These are the early view of the individual authors and are open to debate and critique. This leans heavily on earlier work from colleagues and previous post holders who we'd like to thank for ongoing support (Ryan Dornan, Fergus Boyd-Jones, Elizabeth Dalgliesh and Fruzsina Gajdos).

[2]https://www.gtap.agecon.purdue.edu/databases/contribute/detailedsector.asp

Background and Literature

Estimating NTMs

Trade practitioners can estimate NTM changes 'bottom-up', combining surveys with firm and sectoral expertise to estimate changes to trade barriers Francois et al. (2013). Such methods require a deep knowledge of the baseline and counterfactual trade costs, such as in Brexit AHDB (2019), and can fail to capture NTM impacts not directly linked to the trading costs of the current trader.

Another approach is to derive the level of Ad-valorum equivalent (AVE) NTMs for countries and then apply to a reduction in barriers. Price gap methods use deviations in comparable price data or unit values to infer NTM levels; however, these suffer from issues with pass through and measurement error (Cadot & Gourdon, 2014 and Kee et al., 2009). Quantity gap methods are useful at identifying NTMs when they are prohibitive but may misattribute demand shocks to NTMs (Fontagne, 2011), while combining price and quantity methods allows for estimation of both the intensive and extensive margin. However, all these approaches are severely limited by the quality and coverage of NTM incident data across (Cadot et al., 2018). Fontange (2013) demonstrates it is also possible to estimate a country's most-favoured nation NTM levels from the importer-time fixed effects of a gravity model.

Converting NTM levels into NTM changes proves challenging. One method assumes the proportion of NTMs that were actionable within a trade agreement (DBT) then assume a percentage reduction of the remainder (Ecorys, 2009), however this lacks an empirical basis and proves difficult to engage trade negotiations with how large the assumptions should be. Alternatively actionable barriers can be scaled by changes to an indicator such as the Services Trade Restrictiveness Index (STRI), although this must a one-to-one mapping between the index and the barrier.

By contrast, top-down gravity modelling can identify changes in NTMs directly by observing changes to trade flows and trade policy variables, including EU membership (Dhingra et al., 2023) or measures of FTA depth such as the DESTA database (Aichele et al., 2016). These approaches are appealing for trade practitioners as they empirically derive the NTM changes associated with intuitive precedent agreements, which can be used as benchmarks to judge ex-ante policy assumptions. Petri et al. (2012) use a policy coefficient matrix to map issues within an agreement to sectoral NTMs, however they only distinguish between goods and services NTMs.

Past studies have struggled with poor quality and inconsistent tariff data across time, while ranking of FTA depth such as a DESTA score of 1-7 (Egger et al., 2015) doesn't sufficiently capture heterogeneity in the contents of FTAs, particularly as the sectoral level.

Moving from FTA Impacts to NTM Impacts

We draw our tools for NTM estimation from recent developments in the literature which tends to focus on innovations to the case of total trade and total trade costs. However, to fulfil the needs of government, trade policy analysts are required to focus more on sectoral impacts and the distinction between tariffs and NTMs.

The development of comprehensive gravity modelling datasets such the International Trade and Production Database for Estimation/Simulation (ITPD-E/ITPD-S) (Borchet et al., 2022) has allowed for practitioners to implement advances in the gravity modelling literature such as 3-way fixed effects to control for endogeneity, the inclusion of domestic consumption, of domestic production, and a globalisation trend variable, and others (Larch et al., 2025).

Considering both tariffs and NTMs, Yotov et al., (2019) estimate 908 unique bilateral trade effects from FTAs and found that only 54% of trade agreements have had a positive impact on trade, median estimated FTA effect on trade is a 24% increase and there is significant asymmetry of trade effects between partners. USITC (2021) found around 1/3 of US agreements since 1984 have failed to have any noticeable effect in the data for trade in goods. For FTAs that contain services provisions they find an average AVE reduction of the traded GTAP sectors ranging from 18.4% (communication) to 6% (wholesale), although there is no significant AVE reduction found for construction or insurance.

Felbermayer & Teti (2023) use the Global Tariff database (GTD) to robustly control for tariffs and follow Yotov et al. (2019) to identify the NTM impacts of FTAs at the aggregate level. They find only FTAs (23%) significantly reduce NTMs, but for this subset the average trade increase due to the FTA is large (60%). 9% of FTAs may even restrict trade from reducing regulatory distortions to comparative advantage. Their results suggest that NTMs may boost services trade, particularly for deep trade agreements. Our first contribution is to extend the work of this paper by applying best practice gravity and the GTD to the disaggregated GTAP sectoral level for NTM estimation and simulation within a CGE framework.

Given the aim to use these results as NTM inputs in a CGE model, we have used GTAP sectors in the gravity modelling. GTAP trade data itself is largely constructed and therefore unsuitable for use in regressions. We therefore take ITPD-E and concord its trade data to the GTAP level. ITPD-E is well-suited to gravity modelling, given that it includes data on domestic trade and doesn't statistically impute flows where they are missing. While ITPD-E offers a more granular sectoral decomposition that GTAP in most instances, we map a single trade flow from the former to multiple trade flows in the latter in a few cases[3].

We additionally include bilateral tariff data as a control variable, as a means of isolating the NTM-specific effects of FTAs. The specification for WITS - FTA and GTD – FTA is given in equation (1).

$$Y_{i,j,t} = \exp\left[\delta \cdot \text{FTA}_{i,j,t} + \ln\left(1 + \tau_{i,j,t}\right) + \pi_{i,t} + \chi_{j,t} + \phi_{i,j} + \theta_{ii,t}\right] \cdot \epsilon_{i,j,t} \tag{1}$$

The term $Y_{i,j,t}$ represents nominal trade flows from country i to country j in year t for each GTAP sector. $FTA_(i,j,t)$ is a dummy that is 1 where the given trade flow is impacted by a free trade agreement in the given year, and 0 otherwise. $\tau_{i,j,t}$ represent the tariff between the bilateral pair; $\pi_{i,t}$ and $\chi_{j,t}$ represent the exporter and importer time fixed effects respectively; $\phi_{i,j}$ represents a fixed effect for each bilateral pair; and $\theta_{ii,t}$ captures the impact of international trade over time, equalling 1 for international trade flows and 0 for domestic, with a separate international dummy fitted in each year of the panel. The specification is run separately for each sector.

We can take our estimated δ of interest from the results and convert it into an ad-valorem equivalent for shocking the CGE model. For consistency, we do this using the trade elasticities from the GTAP database[4].

The specification WITS – FTA takes HS6 level applied tariff data from WITS and use a networked approach to create a single consistent nomenclature over the 2000-2018 period covered by our analysis. Our approach to create consistent HS nomenclatures over time is similar to that employed by Pierce & Schott (2012) on US 10-digit product codes, with our "networks" corresponding with the "families" of product codes they describe. We then weight these HS6 tariffs into the GTAP sectors for our regressions. This approach creates an operatable gravity modelling tariff dataset overtime however is subject to some of the biases discussed in Teti (2020). For GTD – FTA and the remainder of the specifications we opt for the GTD as a more robust control for isolating the impact of NTMs, therefore extending the work of Felbermayer & Teti (2023) to the sectoral level.

Clustering

Our second contribution seeks to extend the growing body of research leveraging the World Bank's (WB) Contents of Deep Trade Agreements 2.0 database by operationalising it in a disaggregated sectoral model for NTM estimation.

This database codes up the presence of nearly 1000 separate provisions across 283 agreements signed between 1958 and 2017 and provides an unmatched range of FTA policy variables[5]. The core difficulty

[3]Processing/preserving of meat feeds into both cmt and omt in GTAP; Transport feeds into each of otp, atp, wtp, and whs. By calculating AVEs from these trade flows at the more aggregated level, we effectively impose homogeneity of FTA effects at the more aggregated level

[4]AVEs are calculated using the standard formula, i.e

$$\text{AVE} = \exp\left(\frac{\delta}{-\sigma}\right) - 1 \tag{2}$$

[5]We use a pre-released updated version of the dataset which includes 312 agreements signed between 1958 and 2020.

associated with leveraging this dataset in gravity is its dimensionality; the dataset comprises too many variables to include directly on the right-hand-side in regressions. Furthermore, many of these variables tend to co-occur across past FTAs, leading to collinearity concerns even when only looking at a small subset of the provisions.

Breinlich et al. (2022) and Felbermayer & Teti, (2023) use LASSO to select FTA provision variables into a gravity specification. Their work is performed at the aggregate goods trade level, however, meaning that it is not able to capture the nuance of interactions between the contents of FTA chapters and individual sectors, which is valuable for inputs into CGE analysis. Furthermore, it becomes difficult to attribute causality to the coefficients on individual provision variables selected by LASSO when they correlate so highly with other provision variables.

Borchert & Di Ubaldo, (2021) use a combination of policy judgement and inspection of the frequency distribution of provisions across the sample of past agreements to build policy configurations for trade in services from the WB dataset. These are then operationalised in a gravity model to estimate the trade effects of each services chapter configuration. This represents a highly promising avenue for further work but requires the deployment of specialist policy knowledge across the whole contents of FTAs, if it is to be generalised to an economy-wide set of CGE inputs. Being so reliant on policy judgement, it also can be prone to elements of subjectivity.

Fontagne et al., (2021) instead uses a more agnostic statistical procedure. This involves k-means clustering to group past FTAs with similar contents and produces three distinct groupings. Membership of each of these groupings is then operationalised with dummy variables in an aggregate gravity model, with these groupings found to broadly correspond with different levels of depth in barrier reductions.

This paper looks to build on the clustering approach in Fontagne (2021)by allowing for sectoral heterogeneity in clusters and their effects on trade.
We use sector clusters which look across multiple chapters that we judge to feed into a given sector. That is, the similarities within and differences between our clusters are driven by provisions from multiple chapters, but not all of those found in the database.

Our judgements as to which chapters feed into which sectors are as follows:

- Agricultural sectors are affected by provisions on Trade Facilitation, Rules of Origin, Sanitary and Phytosanitary measures, Investment, Technical Barriers to Trade, and Public Procurement.
- Manufacturing sectors are affected by provisions on Trade Facilitation, Rules of Origin, Investment, Technical Barriers to Trade, and Public Procurement.
- Services sectors are affected by provisions on Services, Migration, Investment, and Public Procurement.
- Financial services and Insurance sectors are affected by provisions on Movement of Capital, Services, Migration, Investment, and Public Procurement.

This yields clusters which vary according to the sector-relevant policy content of texts but ensures that there is only a single set of clusters feeding into each GTAP sector. A single set of sectoral clusters represents a less demanding way of specifying our treatment variable than alternatives which allow for more flexibility in chapter-level configurations and effects, as we explore in the annex.

The method by which the clusters are made is as follows:

First, we remove provisions that we see do not target trade barrier reductions. Then, in keeping with Fontange et al. (2021), we normalise provisions across dataset by their average value across agreements, to put all scores on the same scale and account for their relative frequency of given provisions. This gives provisions, which are less common across the sample of past agreements, at a higher score.

Second, we reduce the number of dimensions in the data to 3 using UMAP [McInnes et al., 2018] before clustering, to avoid Bellman's "curse of dimensionality"[6]. In our case, the unreduced WB data consists of just

[6]This looks to avoid Bellman's "curse of dimensionality", in the sense that distance metrics used within clustering algorithms become meaningless as the number of attributes upon which we cluster grows relative to the number of units in our data.

312 agreements but hundreds of different provisions to cluster them on. UMAP is well-suited to dimensionality reduction ahead of clustering, since it does well to preserve global structure (unlike e.g. principal component analysis). As with any dimensionality reduction, however, we do lose some of the underlying variation in the source data through this step. Furthermore, UMAP does not perfectly preserve density, although it does so better than available alternatives.

Whereas Fontagne (2021) uses k-means as the algorithm to produce the clustering, we instead use DBSCAN (Ester et al., 1996) – a density based clustering method – as it's well suited to identifying clusters of all shapes, including those which are elliptical and where alternative algorithms like k-means are likely to struggle[7].

DBSCAN takes in a number of user-defined parameters: MinPts determines the minimum number of observations that can make up an eventual cluster, whereas epsilon defines the distance threshold used to determine whether a given observation belongs to a given cluster. We set MinPts to 8 for our clustering, but do not specify a value for epsilon. We instead employ HDBSCAN (Campello et al., (2013) , which produces clusters for all the possible values of epsilon and treats them as hierarchies, before using a persistence criterion to choose a single stable, flat set of clusters from within these hierarchies, before using a persistence criterion to choose a single stable, flat set of clusters from within these hierarchies. We also set the parameter min_samples to 1. The intuition behind this variable is that the higher the value the more conservative clustering will be, that is more agreements will be assigned to the residual cluster.

This process yields a variable number of clusters, influenced by the underlying structure of the data. These can be found in the tables in the annex. For a given chapter or sector, we could end up with as few as 2 clusters or as many as 39[8]. Where individual agreements are not assigned to a final cluster by the algorithm, they are treated as noise points and assigned to a residual cluster.

We operationalise our own FTA clusters directly in a standardised best practice gravity model in the following specification:

$$Y_{i,j,t} = \exp\left[\sum_{a=1}^{n_s} \delta_{a,s} \cdot CLUSTER_{a,t,s} + \ln\left(1+\tau_{i,j,t,s}\right) + \pi_{i,t,s} + \chi_{j,t,s} + \phi_{i,j,s} + \theta_{ii,t,s}\right] \cdot \epsilon_{i,j,t,s} \qquad (3)$$

Where $Y_{i,j,t,s}$ denotes bilateral trade flows in sector s. $CLUSTER_{a,t,s}$ denotes our curated FTA clusters, which vary by time t, and sector s and of which there are n_s in each sector. $\tau_{i,j,t,s}$ represents the applied bilateral GTD tariffs in sector s.

Extended Two-Way Fixed Effects

The third contribution of the paper is to follow Nagengast & Yotov (2025) and apply innovations made in Wooldridge (2023) to a gravity setting, this time for sectoral NTMs. The authors provide a framework for implementing extended two-way fixed effect (ETWFE) estimator to the non-linear PPML used as best practice in gravity (Santos Silva & Tenreyro, 2006). They find that trade increased because of an average FTA by about 46%, compared to 18% in a previous best practice specification.

Wooldridge (2021) suggests that both average and clustered FTA identification is biased when treatment impacts of FTAs are heterogenous: through maturation effects over time, or across cohort. This is known as the 'forbidden comparison' problem, in which staggered treatment causes early treated units to act as a control for later treated units.

We correct for this by grouping FTAs into cohorts based on the first year of treatment and allowing for a different treatment impact in each year post-implementation, as set out by Nagengast & Yotov (2025). This means replacing the average FTA variable with a full set of cohort-year treatment dummies as below.

[7]This page provides a fuller explanation of this: https://towardsdatascience.com/dbscan-clustering-explained-97556a2ad556/
[8]Since we are dividing 312 agreements into clusters with a minimum size of 8 agreements

$$\sum_{g=q}^{T}\sum_{z=g}^{T}\delta_{g,z}\cdot D_{g,z} \tag{4}$$

Treatment effects are represented by the set of dummies $D_{g,z}$, in which g indexes the cohort and z indexes the year. A country-pair belongs to the treatment cohort g when the FTA is first implemented in year g. The first year of treatment is indexed by q. This dummy is equal to one for cohort g in year z in post-treatment years, and 0 otherwise. The full set of treatment impacts for cohort g in year z are given as $\delta_{g,z}$.

As with Nagengast & Yotov (2025) we continue to use best practice from the gravity literature. The specifications above are adjusted to reflect extended-two-way-fixed-effects in equation 3 below, which is run separately for each sector.

$$Y_{i,j,t} = \exp\left[\sum_{g=q}^{T}\sum_{z=g}^{T}\delta_{g,z}\cdot D_{g,z} + \ln\left(1+\tau_{i,j,t,s}\right) + \pi_{i,t,s} + \chi_{j,t,s} + \phi_{i,j,s} + \theta_{ii,t,s}\right]\cdot\epsilon_{i,j,t,s} \tag{5}$$

Finally, to compare to the ETWFE estimate with the basic GTD - FTA estimate, we take the weighted sum of all estimated treatment coefficients. We derive a set of weights using the number of total treated observations in each sector. and the number of treated units in each cohort-year[9].

$$\bar{\hat{\delta}} = \sum_{g=q}^{T}\sum_{z=g}^{T}\frac{N_{g,z}}{N_D}\cdot\hat{\delta}_{g,z} \tag{6}$$

N_D is the total number of treated observations in the panel. $N_(g,z)$ is the total number of treated observations informing the parameter estimate for cohort g in year z. The aggregator is the sum of all parameter estimates multiplied by their weight.

We also examine whether later cohorts have differing impacts different impacts to early cohorts. The formula to weight the estimates by cohort is given below, where N_g refers to the total number of treated observations within a given cohort and sector.

$$\bar{\hat{\delta}}_g = \sum_{z=g}^{T}\frac{N_{g,z}}{N_g}\cdot\hat{\delta}_{g,z} \tag{7}$$

Results: Core Specification

Table 1 shows some basic meta-statistics that compare the four specifications. WITS – FTA and GTD – FTA detail the results from specification (1) for tariffs from the two sources of tariff data, respectively. GTD – Cluster Weighted Average summarises the weighted average of the clustering results form (2) and the full set of results can be found in the annex. GTD – ETWFE shows the results from the extended difference in difference procedure. Tables 2 and 3 show the converted AVE results for the implied aggregate sector impacts. Results that generally of similar orders of magnitudes across sectors, with similar patterns of positive and significant coefficients[10].

[9] We also use this weighted approach to compare an average of the clustering methodology to the other specifications in Table-1

[10] Although NTMs are widely assumed to be trade liberalising, there are also cases where they can increase trade costs in FTAs (e.g. through SPS standards) Limao (2007). Our top-down econometric approach also lends to a broader definition of NTMs as anything trade inhibiting not captured by the controls, most notably the tariff variable. This means issues with tariff data, complex tariffs or rules of origin which means the incidence of changes to tariff barriers in an FTA will not be fully captured by the tariff variable coefficient and will impact the NTM variable. Whilst we believe recovered trade inhibiting or insignificant estimates contain important information that feeds into our NTM judgement decisions for CGE modelling, for the purpose of this CGE modelling exercise we focus on sectors which report positive uplifts in trade

Table 1: Meta Statistics Comaring Sector Aggregated Coefficents Across Methodologies

Table 1 meta comparison table	WITS FTA	GTD FTA	GTD Cluster	GTD ETWFE
Total number of treatment coefficients	52	52	735	22,206
Number of sectors	52	52	52	52
All Sectors				
% of sectors with positive impact	69%	73%	73%	71%
% of sectors with positive and significant impact	47%	52%	25%	35%
Mean positive aggregate coefficient by sector	0.17	0.19	0.24	0.2
Goods				
% of sectors with positive impact	68%	73%	68%	75%
% of sectors with positive and significant impact	23%	25%	28%	45%
Mean positive aggregate coefficient by sector	0.11	0.14	0.12	0.15
Services				
% of sectors with positive impact	75%	75%	92%	58%
% of sectors with positive and significant impact	67%	67%	17%	0
Mean positive aggregate coefficient by sector	0.37	0.37	0.54	0.37

*Significance is reported at 10% level.

Where coefficients are positive, three methodologies report 100% of sectors with a value between 0 and 1, with the clustering specification giving a figure of 97%. Furthermore, positive coefficients are almost always less than 0.5, with 90% of sectors falling in this range across the four specifications. Where coefficients are positive, 71%, 34% and 49% are statistically significant from 1% - 10% level for GTD - FTA, GTD – Cluster Weighted Average, and GTD - ETWFE, respectively.

The introduction of extended-two-way-fixed effects changes the story between goods and services. WITS - FTA report 68% of goods sectors showing positive uplifts in trade. GTD – FTA, in switching the tariffs to GTD, shows a greater finding of positive uplifts in trade for the goods sector to 73%. This is likely driven by more robust tariff data allowing for more precise identification of NTM changes within trade agreements. GTD - FTA and GTD - Cluster Weighted Average regressions report 75 and 92% of services sectors showing a positive uplift in trade from FTAs, which is greater than the findings for goods sectors. For GTD - ETWFE this falls to 58%, with none of them achieving statistical significance at the 10% level, while goods increase the number of sectors reporting positive effects.

This is particularly poignant with the change in the Other Financial Services result from -6.7% in the GTD - FTA specification significant at the 0.1% level, to a statistically insignificant estimate of 53.2% in GTD - ETWFE, which is a large, traded sector for countries like the UK and US.

Interestingly, although both services and goods sectors see a small increase in the average impact of the FTAs when adding cohort-time dummies in GTD – ETWFE, the uplift is much smaller than reported in Yotov (2023). This goes against the findings Felbermayer & Teti (2023) and USITC (2021) and suggests an area for future research. It may be the case that FTAs are less liberalising than goods NTMs once other FTAs and sectoral heterogeneity are appropriately accounted for.

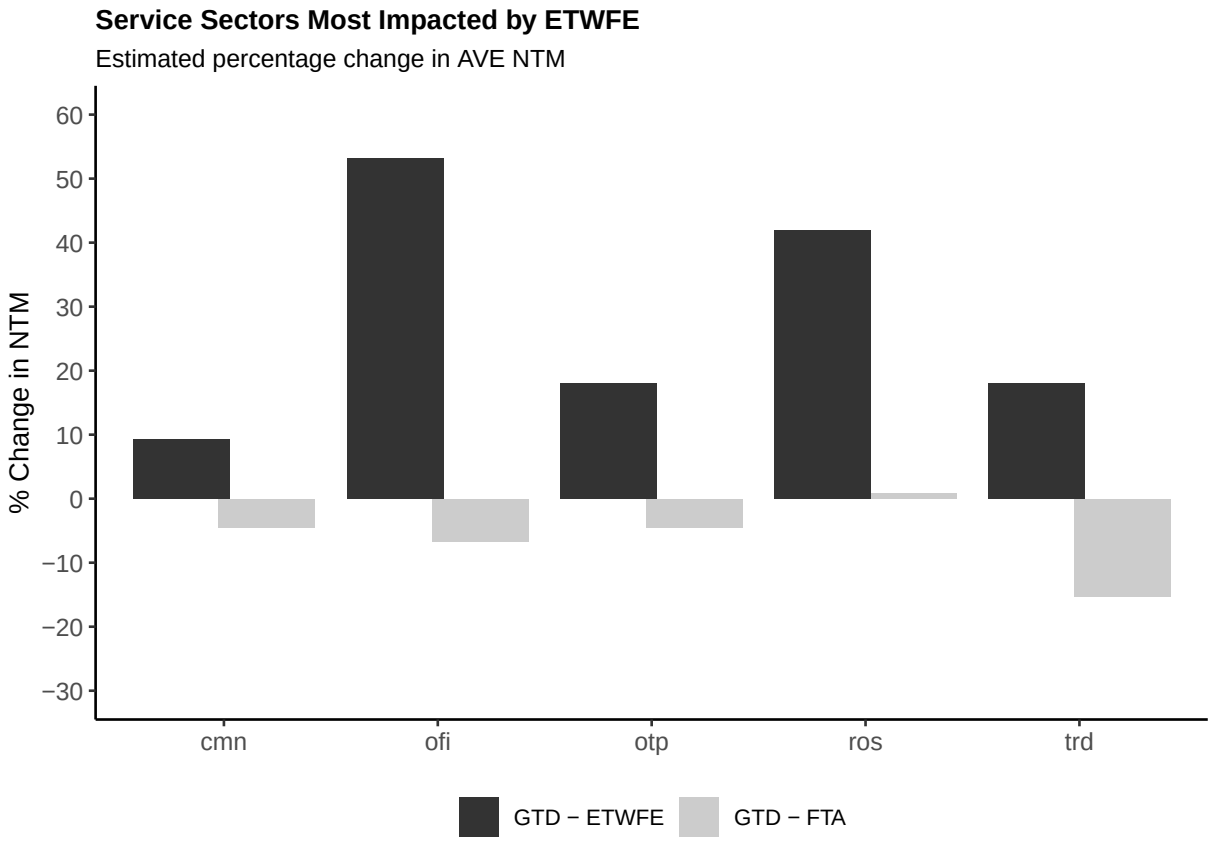
Regressing on a generic FTA dummy yields 52 coefficients, one for each sector. Compared to WITS –

FTA, GTD – FTA tariffs have slightly more that are positive; WITS have 36 (69%) that are positive, contrary to Teti with 38 (73%). However, the basic regression with Teti tariffs have significantly more with statistical significance at 10% level – that is, WITS – FTA has 23 (44%) contrary to Teti with 34 (65%). The regression also suggests a higher average impact for services sectors over goods. Service sectors show 75% positive coefficients, compared to 73% for goods; the mean positive coefficient for services is 0.37, compared to only 0.14 for goods.

The GTD – ETWFE specification yields over 22 thousand coefficients. Of these, 54% are positive across all sectors, with 79% having values ranging between -1 and 1. Aggregating a weighted average for each of the 52 sectors gives 37 (71%) positive coefficients and 18 (35%) both positive and significant at the 10% level.

However, this regression reverses the finding between goods and services. Service sectors now show only 58% positive coefficients, compared to an increased 75% for goods. All significant coefficients at 10% level are in goods sectors, with 60% of their positive coefficients being significant at the 10% level. In contrast all service sectors have p-scores clearly indistinguishable from zero. Although note that the spot coefficients are still higher in services: the mean positive coefficient for services is 0.37, compared to only 0.15 for goods.

Table 4 below shows those service sectors most impacted by the switch to ETWFE. All sectors shown here are statistically significant at the 0.1% level in under specification 1 using the general FTA dummy, and none of these achieve statistical significance at even the 10% level under ETWFE.



Finally, we group by cohort to review Yotov's (2023) finding that earlier FTAs had more impact than those singed later. Looking at 1,703 coefficients we take out outliers and restrict to only positives. We regress coefficient on cohorts grouped by decade. For all sectors together, compared to FTA's first implemented in the 1990's, the 2000's were 1.8% less effective, and the 2010's were 2.5% less effective. When looking at goods only, this climbs to 6% and 6.6% less effective respectively. While looking at services only the relationship disappears. This would support findings in the wider literature that the role of goods NTMs vis-à-vis services

liberalisation is diminishing over time Mattoo et al (2020), OECD (2022).

Conclusion

This paper offers examples of how the rich gravity literature at the aggregate level can be practically applied to one of the key demands made of government trade economists – evaluating the potential economic consequences of trade policy ex-ante. We demonstrate through our clustering methodology that only focusing on average FTA impacts can mask a wide range of heterogenous impacts at the sectoral level driven by differences in FTA contents. The GTD is a promising development in facilitating econometric identification of goods NTMs. The introduction of staggered difference-in-difference raises question marks on the relative magnitude services liberalisation vis-à-vis goods liberalisation in FTAs. This is of paramount importance to the negotiation, resourcing and strategic decisions of governments and a priority for future research.

Table 2: NTM Results - GTAP Agri-Food and Goods Sectors

Sector	WITS FTA NTM	GTD FTA NTM	Cluster NTM	ETWFE NTM
pdr	-1.2%	-0.9%	1.3%	-3.1%**
wht	-0.6%	-3.2%	-2.9%*	-4.9%***
gro	-12.6%**	-15.3%**	-2.7%	-13.1%***
v_f	-2.5%***	-3.8%***	-4.1%**	-3.0%*
osd	-3.6%***	-1.5%***	-2.5%*	-3.8%**
c_b	-3.0%	-4.0%	-2.3%	-3.6%
pfb	-1.1%	-5.2%	-4.5%**	-4.1%
ocr	-0.8%	-1.8%	-1.2%	-1.8%**
ctl	4.2%*	4.1%*	6.3%*	6.6%***
oap	-1.2%	1.1%	-1.7%	2.9%
wol	1.3%*	1.2%*	0.7%	1.1%
frs	4.4%	4.5%	6.5%***	4.3%*
fsh	-6.4%*	-7.3%*	-10.5%**	-0.5%
cmt	-0.5%	-1.5%	-0.4%	-2.4%**
omt	-0.6%	-1.1%	-0.4%	-2.1%*
vol	-2.0%	-3.2%	-2.2%	-4.0%***
mil	-2.7%***	-2.9%***	-1.1%	-3.7%***
pcr	1.9%	-1.1%	2.5%	-1.2%
sgr	-0.9%	-1.0%	-0.2%	-4.5%**
ofd	-0.9%	-1.8%	0.5%	-2.3%**
b_t	-8.8%***	-9.1%***	-14.3%***	-10.7%**
tex	2.5%*	0.6%*	0.0%	-0.8%
wap	4.4%***	2.3%***	-1.5%	1.2%
lea	4.5%***	1.8%***	-1.4%*	-0.2%
lum	0.1%	0.0%	0.3%	-0.2%
ppp	0.6%	-0.1%	-3.5%***	-0.5%
p_c	-1.8%	-3.9%	-3.8%**	-2.0%
chm	-0.2%	-0.8%	-1.1%	0.0%
bph	-1.4%	-1.9%	-3.0%**	-2.5%***
rpp	-0.8%	-1.1%	-0.7%	-1.2%**
nmm	-0.5%	-0.6%	-2.8%***	-1.7%**
i_s	-0.9%	-2.9%	-1.5%	-1.8%**
nfm	-3.7%**	-2.4%**	3.3%***	-1.2%
fmp	-2.2%***	-0.4%***	-0.5%	0.1%
ele	1.2%	0.7%	0.8%	0.3%
eeq	0.4%	0.4%	0.4%	1.2%**
ome	-1.5%***	-0.4%***	-0.2%	0.4%
mvh	-0.5%	-2.2%	-0.7%	-1.7%
otn	1.5%*	1.4%*	4.0%***	1.8%**
omf	1.8%	-1.2%	0.6%	-2.7%***

Sectors with limited international trade or poor data coverage - results treated with caution and not shocked in CGE model.

***, **, and * represent 1%, 5% and 10% statistical significance respectively.

Table 3: NTM Results - GTAP Services Sectors

Sector	WITS FTA NTM	GTD FTA NTM	Cluster NTM	ETWFE NTM
cns	-3.1%	-3.1%	-8.9%	-9.9%
trd	-15.3%***	-15.3%***	-22.0%	18.0%
afs	-17.0%***	-17.0%***	-23.0%	-22.0%
otp	-4.5%***	-4.5%***	-6.4%**	18.1%
cmn	-4.5%***	-4.5%***	-0.7%	9.3%
ofi	-6.7%***	-6.7%***	-24.7%	53.2%
ins	-8.6%*	-8.6%*	-18.0%***	-13.7%
rsa	1.0%*	1.0%*	-0.2%	-0.1%
obs	-14.2%***	-14.2%***	-20.2%	-12.9%
ros	0.8%	0.8%	-3.6%	41.9%
osg	2.0%	2.0%	0.5%	-3.0%
edu	-8.8%**	-8.8%**	-13.3%	-2.0%

Sectors with limited international trade or poor data coverage - results treated with caution and not shocked in CGE model.
***, **, and * represent 1%, 5% and 10% statistical significance respectively.

Table 4: Agri-food AVE Results by FTA Cluster and GTAP Sector

GTAP Sector	0	1	2	3	4	5	6	7	8	9	10	11
pdr (Rice)	-2.80%	-2.10%	-3.30%	-0.20%	4.50%	-1.90%	3.00%	-3.00%	-2.00%	-4.40%	-2.70%	-2.80%
wht (Wheat)	-4.90%	-2.70%	-5.50%	-2.80%	13.80%	-2.80%	8.60%	-4.60%	-3.80%	-4.50%	-4.90%	-4.50%
gro (Other grains)	-11.00%	-31.40%	-7.10%	0.10%	-30.30%	-7.30%	40.60%	-11.50%	-1.30%	1.20%	-9.20%	2.50%
v_f (Vegetables & fruit)	-4.00%	2.30%	-5.30%	-5.50%	-2.40%	-3.30%	5.10%	-3.40%	-4.60%	-6.50%	-4.30%	-4.40%
osd (Oil seeds)	-8.90%	-1.20%	-9.60%	0.30%	2.20%	-8.20%	3.90%	-8.70%	-8.60%	1.80%	-8.60%	-9.50%
c_b (Sugar crops)	-2.90%	23.90%	0.30%	1.00%	-4.80%	-0.80%	4.90%	-0.90%	0.40%	-12.90%	-1.10%	4.90%
pfb (Plant-based fibres)	6.10%	-25.30%	6.80%	0.40%	29.90%	3.20%	21.80%	6.30%	9.30%	-15.40%	6.40%	6.80%
ocr (Other crops)	-2.00%	2.80%	-3.20%	-1.40%	-1.50%	-2.10%	2.80%	-1.60%	-2.20%	-2.30%	-1.90%	-2.70%
ctl (Cattle)	2.00%	-2.90%	2.10%	-2.40%	-6.60%	2.50%	4.70%	2.10%	0.50%	13.60%	1.80%	1.90%
oap (Other animals)	-11.50%	3.50%	-11.00%	-7.10%	-12.70%	-10.10%	-14.20%	-11.00%	-8.50%	12.20%	-10.30%	-11.30%
wol (Wool)	0.80%	-1.20%	1.30%	-0.60%	-2.30%	0.30%	-2.60%	0.80%	0.40%	4.50%	0.80%	0.90%
frs (Forestry)	4.30%	2.20%	5.90%	6.90%	7.60%	4.40%	0.40%	3.70%	9.20%	-9.10%	8.20%	5.60%
fsh (Fishing)	-5.20%	9.20%	-4.50%	-7.10%	-0.30%	-5.20%	-1.90%	-9.80%	-6.10%	-16.20%	-6.30%	-6.10%
cmt (Cattle meat)	-2.50%	0.30%	-3.60%	0.90%	-8.10%	-0.90%	-2.10%	-2.60%	-1.90%	0.20%	-2.40%	-2.20%
omt (Other meat)	-2.60%	0.00%	-3.60%	0.70%	-6.70%	-1.20%	-1.70%	-2.70%	-2.00%	0.00%	-2.40%	-2.30%
vol (Vegetable oils)	-2.00%	-4.10%	-1.70%	-1.10%	-2.00%	-1.60%	9.30%	-1.80%	-1.20%	5.60%	-1.90%	0.40%
mil (Dairy milk)	-3.90%	-4.80%	-3.70%	-1.30%	-0.90%	-1.60%	9.00%	-3.80%	-2.00%	-3.70%	-3.50%	-3.50%
pcr (Processed rice)	1.30%	0.90%	0.90%	1.80%	-8.40%	4.80%	6.80%	0.90%	5.20%	-1.40%	2.00%	2.00%
sgr (Sugar)	-1.60%	-2.00%	-2.80%	-4.80%	1.00%	-0.10%	6.40%	-1.30%	-0.80%	0.90%	-1.30%	-1.50%
ofd (Other food)	-2.70%	-1.20%	-2.40%	-0.90%	-0.30%	-1.70%	0.90%	-2.50%	-2.70%	0.60%	-2.00%	-

Table 5: Manufacturing AVE Results by FTA Cluster and GTAP Sector

GTAP Sector	0	1	2	3	4	5	6	7	8	9	10
tex (Textiles)	1.00%	1.30%	2.30%	1.10%	4.30%	-1.70%	-0.50%	2.20%	4.00%	5.40%	0.60%
wap (Wearing apparel)	4.20%	3.20%	9.40%	4.30%	5.80%	-0.30%	4.30%	3.90%	4.40%	8.20%	4.90%
lea (Leather)	4.70%	3.10%	2.70%	4.80%	7.40%	-1.50%	1.30%	4.70%	6.40%	8.30%	4.60%
lum (Lumber)	-2.10%	-0.70%	-2.50%	-2.00%	-1.00%	0.60%	0.70%	0.00%	-0.70%	-0.50%	-2.40%
ppp (Paper products)	-1.50%	-0.20%	-1.90%	-1.20%	-0.90%	0.00%	0.30%	-0.70%	-1.10%	-0.70%	-0.80%
p_c (Petroleum & coal)	-1.20%	-12.80%	-0.60%	-1.20%	-2.00%	-0.80%	-1.50%	0.90%	-1.40%	-1.50%	0.20%
chm (Chemicals)	-2.10%	-0.20%	-2.20%	-2.30%	-0.10%	-0.60%	-0.10%	-0.50%	-0.20%	-0.10%	-2.20%
bph (Pharmaceuticals)	-7.40%	1.40%	-10.80%	-8.20%	0.20%	-0.10%	-1.10%	0.80%	-0.60%	-0.10%	-5.10%
rpp (Rubber & plastics)	-1.50%	-0.30%	-1.10%	-1.40%	-0.40%	-0.30%	0.10%	-1.40%	-0.10%	-0.40%	-0.70%
nmm (Non-metallic minerals)	-0.60%	2.70%	0.20%	-0.60%	-0.90%	0.00%	-0.10%	-2.10%	-1.20%	-1.10%	-0.30%
i_s (Iron & steel)	-0.60%	0.70%	-1.20%	-0.40%	-1.30%	-0.80%	-1.00%	-1.80%	-1.70%	-1.50%	1.80%
nfm (Non-ferrous metals)	-3.80%	-1.90%	-5.00%	-4.30%	-2.20%	-7.90%	-3.90%	-2.50%	-3.10%	-2.10%	0.40%
fmp (Fabricated metals)	-2.00%	0.90%	-3.40%	-1.90%	-2.90%	-1.60%	-1.90%	-4.40%	-4.00%	-3.10%	-1.60%
ele (Electronics)	-1.90%	2.00%	-3.80%	-1.90%	1.00%	0.60%	1.80%	0.50%	0.80%	1.20%	-2.00%
eeq (Electrical equipment)	-1.30%	-1.90%	-0.90%	-1.20%	1.30%	0.60%	0.50%	0.30%	0.20%	1.70%	-0.20%
ome (Other machinery)	-0.80%	-0.60%	-0.60%	-0.70%	-1.40%	-1.60%	-1.80%	-2.00%	-1.90%	-1.50%	-0.10%
mvh (Motor vehicles)	5.00%	1.30%	10.00%	5.40%	-2.80%	-0.80%	-1.00%	-4.20%	-3.70%	-3.00%	10.90%
otn (Other transport)	1.10%	4.80%	2.70%	1.60%	1.10%	1.00%	0.50%	0.30%	0.80%	0.80%	3.50%
omf (Other manufacturing)	-1.30%	-2.30%	0.20%	-1.40%	6.70%	-0.70%	-0.50%	5.40%	5.10%	8.70%	-1.20%

Table 6: Services AVE Results by FTA Cluster and GTAP Sector

GTAP Sector	0	1	2	3	4	5	6	7	8
cns (Construction)	1.10%	-13.70%	0.40%	0.60%	1.10%	11.20%	3.10%	-5.50%	-
trd (Trade)	-17.40%	-15.90%	-19.20%	-30.40%	-19.20%	-19.30%	-19.20%	-0.40%	-
afs (Accommodation & food)	-19.80%	-4.50%	-11.50%	-11.50%	-13.90%	-20.40%	-11.10%	-8.00%	-
otp (Other transport)	-4.30%	-4.60%	-3.10%	-2.90%	-1.50%	-6.10%	-0.20%	-2.10%	-2.10%
wtp (Water transport)	-4.30%	-4.60%	-3.10%	-2.90%	-1.50%	-6.10%	-0.20%	-2.10%	-2.10%
atp (Air transport)	-4.30%	-4.60%	-3.10%	-2.90%	-1.50%	-6.10%	-0.20%	-2.10%	-2.10%
whs (Warehousing)	-4.30%	-4.60%	-3.10%	-2.90%	-1.50%	-6.10%	-0.20%	-2.10%	-2.10%
cmn (Communication)	-3.30%	-4.30%	-3.10%	-4.90%	-1.30%	-6.10%	-0.70%	-2.30%	-0.80%
ofi (Financial services)	-1.40%	-1.80%	1.00%	-0.60%	-2.20%	-3.80%	-3.30%	-3.90%	4.80%
ins (Insurance)	0.30%	-1.90%	2.30%	-10.60%	-2.60%	-3.50%	-4.10%	-2.50%	1.00%
rsa (Real estate)	0.00%	1.00%	1.20%	-0.90%	1.70%	1.00%	-0.60%	1.60%	-0.10%
obs (Other business services)	-10.40%	-7.30%	-9.20%	-4.60%	-11.60%	-11.80%	-12.90%	-11.30%	-4.30%
ros (Recreational services)	-10.20%	-99.90%	-9.20%	3.30%	-	-	-	-	-
osg (Other services)	5.40%	6.40%	5.60%	6.90%	5.20%	10.20%	1.00%	0.80%	-
edu (Education)	13.50%	1.00%	-15.10%	-11.60%	-17.40%	-15.30%	-12.90%	-7.30%	-

Table 7: Agri-Food Clusters by Agreement

cluster	agreement
0	European Free Trade Association EFTA
0	Central American Common Market CACM
0	EC 9 Enlargement
0	EU Syria
0	EC 10 Enlargement
0	Latin American Integration Association LAIA
0	EC 12 Enlargement
0	Andean Community CAN
0	Southern Common Market MERCOSUR
0	ASEAN Free Trade Area AFTA
0	EC 15 Enlargement
0	Common Market for Eastern and Southern Africa COMESA
0	Eurasian Economic Community EAEC
0	Commonwealth of Independent States CIS
0	West African Economic and Monetary Union WAEMU
0	East African Community EAC
0	Israel Mexico
0	New Zealand Singapore
0	EU Former Yugoslav Republic of Macedonia
0	Chile Costa Rica Chile Central America
0	EU Jordan
0	Canada Costa Rica
0	Singapore Australia
0	Chile El Salvador Chile Central America
0	EC 25 Enlargement
0	Southern African Development Community SADC
0	Thailand Australia
0	Panama El Salvador Panama Central America
0	Economic Community of West African States ECOWAS
0	Turkey Morocco
0	EU Algeria
0	US Bahrain
0	EC 27 Enlargement
0	PanArab FTA PAFTA
0	EU Albania
0	Panama Singapore
0	Central European FTA CEFTA
0	EU Montenegro
0	Pakistan China
0	Panama Chile
0	South Asian FTA SAFTA
0	Turkey Albania
0	EU Bosnia and Herzegovina
0	Ukraine Former Yugoslav Republic of Macedonia
0	Common Economic Zone CEZ
0	EU CARIFORUM States EPA
0	US Oman

0 Panama Costa Rica Panama Central America
0 China New Zealand
0 Nicaragua Chinese Taipei

0 Panama Chinese Taipei
0 Chile Colombia
0 EU Cameroon
0 ASEAN Japan
0 Panama Honduras Panama Central America

0 MERCOSUR India
0 El Salvador Honduras Chinese Taipei
0 EU Serbia
0 Colombia Mexico
0 EFTA Albania

0 EU Korea Republic of
0 Guatemala Chinese Taipei
0 India Japan
0 Canada Colombia
0 EU Papua New Guinea Fiji

0 Chile Honduras Chile Central America
0 Peru Chile
0 Dominican Republic Central America
0 EU Eastern and Southern Africa States Interim EPA
0 Chile Guatemala Chile Central America

0 Panama Peru
0 East African Community EAC Accession of Burundi and Rwanda
0 Colombia Northern Triangle El Salvador Guatemala Honduras
0 EFTA Montenegro
0 Chile Malaysia

0 Panama Nicaragua Panama Central America
0 EU Colombia and Peru
0 EU Central America
0 Canada Panama
0 Canada Jordan

0 Panama Guatemala Panama Central America
0 EU 28 Enlargement
0 Turkey Mauritius
0 Costa Rica Peru
0 Chile Nicaragua Chile Central America

0 El Salvador Cuba
0 Switzerland China
0 Iceland China
0 Eurasian Economic Union EAEU
0 EFTA Bosnia and Herzegovina

0 Canada Honduras
0 Chile Viet Nam
0 Gulf Cooperation Council GCC Singapore
0 Agadir Agreement
0 China Korea Republic of

0 Korea Republic of Viet Nam
0 Panama Dominican Republic

0	Japan Mongolia
0	Mexico Panama
0	Costa Rica Colombia
0	Pacific Alliance
0	The Gulf Corporation Council
0	European Economic Area EEA
1	North American Free Trade Agreement NAFTA
1	US Chile
1	US Singapore
1	US Australia
1	US Morocco
1	Dominican Republic Central America USFTA CAFTA DR
1	US Peru
1	US Colombia
1	US Panama
1	EU Georgia
2	Kyrgyz Republic Ukraine
2	Kyrgyz Republic Uzbekistan
2	Armenia Ukraine
2	Ukraine Azerbaijan
2	Ukraine Belarus
2	Ukraine Kazakhstan
2	Ukraine Moldova
2	Ukraine Tajikistan
2	Ukraine Turkmenistan
2	Ukraine Uzbekistan
3	US Israel
3	Canada Israel
3	Canada Chile
3	EFTA Mexico
3	Japan Singapore
3	EFTA Singapore
3	Korea Republic of Chile
3	Japan Mexico
3	Korea Republic of Singapore
3	EFTA Korea Republic of
3	TransPacific Strategic Economic Partnership
3	Chile Japan
3	Australia Chile
3	Peru Singapore
3	Canada Peru
3	EFTA Canada
3	Japan Switzerland
3	Hong Kong China New Zealand
3	Peru Korea Republic of
3	Japan Peru
3	Korea Republic of US
3	Costa Rica Singapore
3	New Zealand Chinese Taipei
3	Singapore Chinese Taipei

3	Hong Kong China Chile
3	Korea Republic of Australia
3	Japan Australia
3	Canada Korea Republic of
3	Korea Republic of New Zealand
3	Korea Republic of Colombia
3	TransPacific Partnership
4	EU Chile
4	EFTA Chile
4	EFTA Peru
4	EFTA Colombia
4	EFTA Ukraine
4	EFTA Hong Kong China
4	EU Rep. of Moldova
4	EU Ukraine
4	EFTA Central America Costa Rica and Panama
5	EU Norway
5	EFTA Turkey
5	EFTA Israel
5	Faroe Islands Norway
5	EU Faroe Islands
5	EU Andorra
5	Turkey Israel
5	EFTA Palestinian Authority
5	EFTA Morocco
5	EU Mexico
5	EU Israel
5	EFTA Former Yugoslav Republic of Macedonia
5	Turkey Former Yugoslav Republic of Macedonia
5	EFTA Jordan
5	Turkey Bosnia and Herzegovina
5	EU Egypt
5	EFTA Tunisia
5	Turkey Palestinian Authority
5	Turkey Tunisia
5	EFTA Lebanon
5	Turkey Syria
5	EFTA Eqypt
5	Egypt Turkey
5	Iceland Faroe Islands
5	EFTA SACU
5	EU Cote dIvoire
5	Turkey Georgia
5	Turkey Montenegro
5	Turkey Serbia
5	EFTA Serbia
5	Turkey Chile
5	Ukraine Montenegro
5	Korea Republic of Turkey
6	EU Overseas Countries and Territories OCT

6	EU Switzerland Liechtenstein
6	EU Iceland
6	EU Turkey
6	EU Palestinian Authority
6	EU Tunisia
6	EU Morocco
6	EU South Africa
6	EU Lebanon
6	Turkey Jordan
7	Georgia Azerbaijan
7	Georgia Kazakhstan
7	Armenia Kazakhstan
7	Russian Federation Azerbaijan
7	Russian Federation Tajikistan
7	Russian Federation Belarus Kazakhstan
7	Russian Federation Uzbekistan
7	Russian Federation Turkmenistan
7	Eurasian Economic Union EAEU Accession of Armenia
7	Eurasian Economic Union EAEU Accession of Kyrgyz
8	Australia Papua New Guinea PATCRA
8	Australia New Zealand ANZCERTA
8	ASEAN China
8	Thailand New Zealand
8	Japan Malaysia
8	India Singapore
8	Japan Thailand
8	Pakistan Malaysia
8	Pakistan Sri Lanka
8	Japan Indonesia
8	Brunei Darussalam Japan
8	Japan Philippines
8	China Singapore
8	Japan Viet Nam
8	India Afghanistan
8	ASEAN Australia New Zealand
8	ASEAN India
8	India Malaysia
8	New Zealand Malaysia
8	Malaysia Australia
8	Mauritius Pakistan
8	ASEAN Korea Republic of
8	Korea Republic of India
9	Chile Mexico
9	China Hong Kong China
9	Chile China
9	Peru China
9	Peru Mexico
9	China Costa Rica
9	Mexico Uruguay
9	Mexico Central America

9	Australia China
10	Asia Pacific Trade Agreement APTA
10	South Pacific Regional Trade and Economic Cooperation Agreement
10	Global System of Trade Preferences among Developing Countries GSTP
10	Lao Peoples Democratic Republic Thailand
10	Economic Cooperation Organization ECO
10	Faroe Islands Switzerland
10	South Asian Preferential Trade Agreement SAPTA
10	Melanesian Spearhead Group MSG
10	US Jordan
10	India Sri Lanka
10	China Macao China
10	Asia Pacific Trade Agreement APTA Accession of China
10	Jordan Singapore
10	Southern African Customs Union SACU
10	Pacific Island Countries Trade Agreement PICTA
10	Chile India
10	EU San Marino
10	India Nepal
10	Russian Federation Serbia
10	Southern African Development Community Accession of Seychelles
10	South Asian FTA SAFTA Accession of Afghanistan
11	EC Treaty
11	Caribbean Community and Common Market CARICOM
11	Kyrgyz Republic Moldova
11	Kyrgyz Republic Kazakhstan
11	Economic and Monetary Community of Central Africa CEMAC
11	Kyrgyz Republic Armenia
11	Georgia Armenia
11	Georgia Russian Federation
11	Georgia Turkmenistan
11	Georgia Ukraine
11	Armenia Turkmenistan
11	Armenia Moldova
11	India Bhutan
11	Treaty on a free trade area between members of the CIS

Table 8: Goods Clusters by Agreement

cluster	agreement
0	EC Treaty
0	Central American Common Market CACM
0	EC 9 Enlargement
0	EC 10 Enlargement
0	EC 12 Enlargement
0	EC 15 Enlargement
0	Eurasian Economic Community EAEC
0	East African Community EAC
0	Chile Mexico
0	US Jordan
0	Chile Costa Rica Chile Central America
0	Chile El Salvador Chile Central America
0	EC 25 Enlargement
0	Panama El Salvador Panama Central America
0	Economic Community of West African States ECOWAS
0	Turkey Morocco
0	EC 27 Enlargement
0	EU Albania
0	Panama Chile
0	EU Bosnia and Herzegovina
0	Common Economic Zone CEZ
0	Panama Costa Rica Panama Central America
0	Chile Colombia
0	Panama Honduras Panama Central America
0	EU San Marino
0	El Salvador Honduras Chinese Taipei
0	EU Serbia
0	Chile Honduras Chile Central America
0	Dominican Republic Central America
0	EU Eastern and Southern Africa States Interim EPA
0	Peru Mexico
0	China Costa Rica
0	Chile Guatemala Chile Central America
0	Colombia Northern Triangle El Salvador Guatemala Honduras
0	Chile Malaysia
0	Panama Nicaragua Panama Central America
0	Canada Jordan
0	Panama Guatemala Panama Central America
0	EU 28 Enlargement
0	Costa Rica Peru
0	Chile Nicaragua Chile Central America
0	Mexico Uruguay
0	Iceland China
0	Eurasian Economic Union EAEU
0	Eurasian Economic Union EAEU Accession of Armenia
0	Chile Viet Nam
0	Eurasian Economic Union EAEU Accession of Kyrgyz

0	Australia China
0	Agadir Agreement
0	Korea Republic of Viet Nam
0	Japan Mongolia
1	North American Free Trade Agreement NAFTA
1	US Chile
1	US Singapore
1	US Australia
1	US Morocco
1	Dominican Republic Central America USFTA CAFTA DR
1	US Peru
1	US Colombia
1	US Panama
1	EU Georgia
2	Kyrgyz Republic Ukraine
2	Kyrgyz Republic Uzbekistan
2	Commonwealth of Independent States CIS
2	Armenia Ukraine
2	Ukraine Azerbaijan
2	Ukraine Belarus
2	Ukraine Kazakhstan
2	Ukraine Moldova
2	Ukraine Tajikistan
2	Ukraine Turkmenistan
2	Ukraine Uzbekistan
3	Georgia Azerbaijan
3	Georgia Kazakhstan
3	Armenia Kazakhstan
3	Russian Federation Azerbaijan
3	Russian Federation Tajikistan
3	Russian Federation Belarus Kazakhstan
3	Russian Federation Uzbekistan
3	Russian Federation Turkmenistan
4	EU Overseas Countries and Territories OCT
4	EU Switzerland Liechtenstein
4	EU Iceland
4	Latin American Integration Association LAIA
4	Common Market for Eastern and Southern Africa COMESA
4	EU Turkey
4	EU Palestinian Authority
4	EU Tunisia
4	EU Morocco
4	EU South Africa
4	EU Jordan
4	EU Lebanon
4	Southern African Development Community SADC
4	EU Algeria
4	EU Montenegro
4	Turkey Jordan
5	European Free Trade Association EFTA

5	EU Norway
5	EFTA Turkey
5	EFTA Israel
5	Faroe Islands Norway
5	EU Faroe Islands
5	EU Andorra
5	Turkey Israel
5	EFTA Palestinian Authority
5	EFTA Morocco
5	EU Mexico
5	EU Israel
5	EFTA Former Yugoslav Republic of Macedonia
5	Turkey Former Yugoslav Republic of Macedonia
5	EU Former Yugoslav Republic of Macedonia
5	EFTA Jordan
5	Turkey Bosnia and Herzegovina
5	EU Egypt
5	EFTA Tunisia
5	Turkey Palestinian Authority
5	Turkey Tunisia
5	EFTA Lebanon
5	Turkey Syria
5	EFTA Eqypt
5	Central European FTA CEFTA
5	Egypt Turkey
5	Turkey Albania
5	Iceland Faroe Islands
5	Ukraine Former Yugoslav Republic of Macedonia
5	EFTA SACU
5	EU Cote dIvoire
5	Turkey Georgia
5	EU Cameroon
5	Turkey Montenegro
5	Turkey Serbia
5	EFTA Serbia
5	EFTA Albania
5	Turkey Chile
5	EU Papua New Guinea Fiji
5	EFTA Montenegro
5	Ukraine Montenegro
5	Korea Republic of Turkey
5	Turkey Mauritius
5	Switzerland China
5	EFTA Bosnia and Herzegovina
6	US Israel
6	Canada Israel
6	Canada Chile
6	Israel Mexico
6	EFTA Mexico
6	Japan Singapore

6	EFTA Singapore
6	EU Chile
6	Korea Republic of Chile
6	EFTA Chile
6	Japan Mexico
6	Korea Republic of Singapore
6	EFTA Korea Republic of
6	US Bahrain
6	Panama Singapore
6	TransPacific Strategic Economic Partnership
6	Chile Japan
6	EU CARIFORUM States EPA
6	US Oman
6	Australia Chile
6	Peru Singapore
6	Canada Peru
6	EFTA Canada
6	Japan Switzerland
6	Colombia Mexico
6	Hong Kong China New Zealand
6	EFTA Peru
6	EU Korea Republic of
6	Peru Korea Republic of
6	EFTA Colombia
6	Canada Colombia
6	Japan Peru
6	Korea Republic of US
6	EFTA Ukraine
6	EFTA Hong Kong China
6	EU Colombia and Peru
6	EU Central America
6	Canada Panama
6	Costa Rica Singapore
6	New Zealand Chinese Taipei
6	Singapore Chinese Taipei
6	EU Rep. of Moldova
6	EU Ukraine
6	Hong Kong China Chile
6	EFTA Central America Costa Rica and Panama
6	Korea Republic of Australia
6	Japan Australia
6	Canada Korea Republic of
6	Canada Honduras
6	Gulf Cooperation Council GCC Singapore
6	Korea Republic of New Zealand
6	Korea Republic of Colombia
6	TransPacific Partnership
6	European Economic Area EEA
7	Australia Papua New Guinea PATCRA
7	Australia New Zealand ANZCERTA

7	New Zealand Singapore
7	Singapore Australia
7	Thailand Australia
7	ASEAN China
7	Thailand New Zealand
7	Japan Malaysia
7	India Singapore
7	Japan Thailand
7	Pakistan China
7	Pakistan Malaysia
7	Pakistan Sri Lanka
7	Japan Indonesia
7	Brunei Darussalam Japan
7	Japan Philippines
7	China Singapore
7	China New Zealand
7	Nicaragua Chinese Taipei
7	Panama Chinese Taipei
7	Japan Viet Nam
7	Peru China
7	India Afghanistan
7	ASEAN Australia New Zealand
7	ASEAN India
7	Guatemala Chinese Taipei
7	India Malaysia
7	India Japan
7	Peru Chile
7	New Zealand Malaysia
7	Panama Peru
7	Malaysia Australia
7	Mexico Central America
7	Mauritius Pakistan
7	ASEAN Korea Republic of
7	Korea Republic of India
8	Asia Pacific Trade Agreement APTA
8	SPARTECA
8	Andean Community CAN
8	Economic Cooperation Organization ECO
8	ASEAN Free Trade Area AFTA
8	South Asian Preferential Trade Agreement SAPTA
8	West African Economic and Monetary Union WAEMU
8	India Sri Lanka
8	Asia Pacific Trade Agreement APTA Accession of China
8	Jordan Singapore
8	Pacific Island Countries Trade Agreement PICTA
8	Chile India
8	ASEAN Japan
8	India Nepal
8	Russian Federation Serbia
8	El Salvador Cuba

8	Southern African Development Community SADC Accession of Seychelles
8	Mexico Panama
9	EU Syria
9	Global System of Trade Preferences among Developing Countries GSTP
9	Southern Common Market MERCOSUR
9	Lao Peoples Democratic Republic Thailand
9	Faroe Islands Switzerland
9	Economic and Monetary Community of Central Africa CEMAC
9	Melanesian Spearhead Group MSG
9	Canada Costa Rica
9	China Macao China
9	China Hong Kong China
9	PanArab FTA PAFTA
9	Chile China
9	Southern African Customs Union SACU
9	South Asian FTA SAFTA
9	MERCOSUR India
9	China Korea Republic of
9	Panama Dominican Republic
9	South Asian FTA SAFTA Accession of Afghanistan
9	Costa Rica Colombia
9	Pacific Alliance
9	The Gulf Corporation Council
10	Caribbean Community and Common Market CARICOM
10	Kyrgyz Republic Moldova
10	Kyrgyz Republic Kazakhstan
10	Kyrgyz Republic Armenia
10	Georgia Armenia
10	Georgia Russian Federation
10	Georgia Turkmenistan
10	Georgia Ukraine
10	Armenia Turkmenistan
10	Armenia Moldova
10	India Bhutan
10	East African Community EAC Accession of Burundi and Rwanda
10	Treaty on a free trade area between members of the CIS

Table 9: Services Clusters by Agreement

cluster	agreement
0	Asia Pacific Trade Agreement APTA
0	Southern Common Market MERCOSUR
0	EU Former Yugoslav Republic of Macedonia
0	EU Jordan
0	Singapore Australia
0	EU Albania
0	Central European FTA CEFTA
0	Panama Chile
0	EU Bosnia and Herzegovina
0	China New Zealand
0	Japan Viet Nam
0	EU Serbia
0	Dominican Republic Central America
0	Korea Republic of Australia
0	Australia China
0	Japan Mongolia
0	Costa Rica Colombia
0	Pacific Alliance
1	North American Free Trade Agreement NAFTA
1	US Chile
1	US Singapore
1	US Australia
1	US Morocco
1	Dominican Republic Central America USFTA CAFTA DR
1	US Peru
1	US Colombia
1	US Panama
1	EU Georgia
2	EU Overseas Countries and Territories OCT
2	EU Switzerland Liechtenstein
2	EU Iceland
2	EU Norway
2	Caribbean Community and Common Market CARICOM
2	Australia Papua New Guinea PATCRA
2	EU Syria
2	SPARTECA
2	Latin American Integration Association LAIA
2	Global System of Trade Preferences among Developing Countries GSTP
2	Andean Community CAN
2	Lao Peoples Democratic Republic Thailand
2	Economic Cooperation Organization ECO
2	Faroe Islands Switzerland
2	EU Faroe Islands
2	South Asian Preferential Trade Agreement SAPTA
2	EU Andorra
2	Eurasian Economic Community EAEC
2	Kyrgyz Republic Moldova

2	Kyrgyz Republic Ukraine
2	Kyrgyz Republic Uzbekistan
2	Kyrgyz Republic Kazakhstan
2	Economic and Monetary Community of Central Africa CEMAC
2	Kyrgyz Republic Armenia
2	Georgia Armenia
2	Georgia Azerbaijan
2	Georgia Kazakhstan
2	Georgia Russian Federation
2	Georgia Turkmenistan
2	Georgia Ukraine
2	India Sri Lanka
2	EU Lebanon
2	China Macao China
2	China Hong Kong China
2	Asia Pacific Trade Agreement APTA Accession of China
2	Armenia Turkmenistan
2	Armenia Moldova
2	Armenia Kazakhstan
2	Armenia Ukraine
2	Southern African Development Community SADC
2	PanArab FTA PAFTA
2	Southern African Customs Union SACU
2	South Asian FTA SAFTA
2	Turkey Albania
2	Pakistan Sri Lanka
2	India Bhutan
2	Ukraine Azerbaijan
2	Ukraine Belarus
2	Ukraine Kazakhstan
2	Ukraine Tajikistan
2	Ukraine Turkmenistan
2	Ukraine Uzbekistan
2	Common Economic Zone CEZ
2	EU Cote dIvoire
2	Chile India
2	ASEAN Japan
2	MERCOSUR India
2	EU San Marino
2	India Afghanistan
2	India Nepal
2	Turkey Chile
2	EU Papua New Guinea Fiji
2	China Costa Rica
2	East African Community EAC Accession of Burundi and Rwanda
2	Russian Federation Azerbaijan
2	Russian Federation Tajikistan
2	Russian Federation Belarus Kazakhstan
2	Russian Federation Serbia
2	Russian Federation Uzbekistan

2 Russian Federation Turkmenistan
2 Chile Malaysia
2 Canada Jordan
2 Korea Republic of Turkey
2 Turkey Mauritius
2 El Salvador Cuba
2 Eurasian Economic Union EAEU Accession of Armenia
2 Chile Viet Nam
2 Eurasian Economic Union EAEU Accession of Kyrgyz
2 Mauritius Pakistan
2 Southern African Development Community SADC Accession of Seychelles
2 Agadir Agreement
2 Panama Dominican Republic
2 South Asian FTA SAFTA Accession of Afghanistan
2 The Gulf Corporation Council
3 EFTA Turkey
3 EFTA Israel
3 EU Turkey
3 Faroe Islands Norway
3 EU Palestinian Authority
3 Turkey Israel
3 EU Tunisia
3 Commonwealth of Independent States CIS
3 EFTA Palestinian Authority
3 Melanesian Spearhead Group MSG
3 West African Economic and Monetary Union WAEMU
3 EFTA Morocco
3 EU Mexico
3 EU Israel
3 EU Morocco
3 EU South Africa
3 EFTA Former Yugoslav Republic of Macedonia
3 Turkey Former Yugoslav Republic of Macedonia
3 New Zealand Singapore
3 US Jordan
3 EFTA Jordan
3 Canada Costa Rica
3 Turkey Bosnia and Herzegovina
3 EU Egypt
3 EFTA Tunisia
3 Turkey Palestinian Authority
3 Turkey Tunisia
3 Turkey Morocco
3 EU Algeria
3 EFTA Lebanon
3 Turkey Syria
3 EFTA Eqypt
3 Egypt Turkey
3 EU Montenegro
3 Pakistan China

3	Iceland Faroe Islands
3	Ukraine Former Yugoslav Republic of Macedonia
3	Ukraine Moldova
3	Pacific Island Countries Trade Agreement PICTA
3	EFTA SACU
3	Turkey Georgia
3	EU Cameroon
3	Turkey Montenegro
3	Turkey Serbia
3	EFTA Serbia
3	EFTA Albania
3	Turkey Jordan
3	EU Eastern and Southern Africa States Interim EPA
3	EFTA Montenegro
3	Treaty on a free trade area between members of the CIS
3	Eurasian Economic Union EAEU
3	EFTA Bosnia and Herzegovina
4	Central American Common Market CACM
4	Australia New Zealand ANZCERTA
4	Thailand Australia
4	ASEAN China
4	Thailand New Zealand
4	Jordan Singapore
4	Japan Malaysia
4	India Singapore
4	Chile China
4	Chile Japan
4	Japan Thailand
4	Pakistan Malaysia
4	Japan Indonesia
4	Brunei Darussalam Japan
4	Japan Philippines
4	China Singapore
4	Peru China
4	ASEAN Australia New Zealand
4	ASEAN India
4	India Malaysia
4	India Japan
4	New Zealand Malaysia
4	Ukraine Montenegro
4	Malaysia Australia
4	Switzerland China
4	Iceland China
4	China Korea Republic of
4	Korea Republic of Viet Nam
4	ASEAN Korea Republic of
4	Korea Republic of India
5	Chile Mexico
5	Panama El Salvador Panama Central America
5	Panama Costa Rica Panama Central America

5 Nicaragua Chinese Taipei
5 Panama Chinese Taipei
5 Chile Colombia
5 Panama Honduras Panama Central America
5 El Salvador Honduras Chinese Taipei
5 Colombia Mexico
5 Guatemala Chinese Taipei
5 Peru Chile
5 Peru Mexico
5 Panama Peru
5 Colombia Northern Triangle El Salvador Guatemala Honduras
5 Panama Nicaragua Panama Central America
5 Panama Guatemala Panama Central America
5 Costa Rica Peru
5 Mexico Uruguay
5 Mexico Central America
5 Mexico Panama
6 US Israel
6 Canada Chile
6 Israel Mexico
6 Chile Costa Rica Chile Central America
6 Japan Singapore
6 Chile El Salvador Chile Central America
6 Korea Republic of Chile
6 Korea Republic of Singapore
6 US Bahrain
6 Panama Singapore
6 TransPacific Strategic Economic Partnership
6 US Oman
6 Australia Chile
6 Peru Singapore
6 Canada Peru
6 Hong Kong China New Zealand
6 Peru Korea Republic of
6 Canada Colombia
6 Chile Honduras Chile Central America
6 Japan Peru
6 Korea Republic of US
6 Chile Guatemala Chile Central America
6 Canada Panama
6 Chile Nicaragua Chile Central America
6 Costa Rica Singapore
6 New Zealand Chinese Taipei
6 Singapore Chinese Taipei
6 Hong Kong China Chile
6 Japan Australia
6 Canada Honduras
6 Korea Republic of New Zealand
6 Korea Republic of Colombia
6 TransPacific Partnership

7	Canada Israel
7	EFTA Mexico
7	EFTA Singapore
7	EU Chile
7	EFTA Chile
7	Japan Mexico
7	EFTA Korea Republic of
7	EU CARIFORUM States EPA
7	EFTA Canada
7	Japan Switzerland
7	EFTA Peru
7	EU Korea Republic of
7	EFTA Colombia
7	EFTA Ukraine
7	EFTA Hong Kong China
7	EU Colombia and Peru
7	EU Central America
7	EU Rep. of Moldova
7	EU Ukraine
7	EFTA Central America Costa Rica and Panama
7	Canada Korea Republic of
7	Gulf Cooperation Council GCC Singapore
7	European Economic Area EEA
8	EC Treaty
8	European Free Trade Association EFTA
8	EC 9 Enlargement
8	EC 10 Enlargement
8	EC 12 Enlargement
8	ASEAN Free Trade Area AFTA
8	EC 15 Enlargement
8	Common Market for Eastern and Southern Africa COMESA
8	East African Community EAC
8	EC 25 Enlargement
8	Economic Community of West African States ECOWAS
8	EC 27 Enlargement
8	EU 28 Enlargement

References

Aichele, R., Felbermayr, G.J. and Heiland, I., 2016. TTIP and intra-European trade: boon or bane?. Jahrbücher für Nationalökonomie und Statistik, 236(6), pp.639-664.

Baier, S.L., Yotov, Y.V. and Zylkin, T., 2019. On the widely differing effects of free trade agreements: Lessons from twenty years of trade integration. Journal of International Economics, 116, pp.206-226.

Baier, S.L., Yotov, Y.V. and Zylkin, T., 2019. On the widely differing effects of free trade agreements: Lessons from twenty years of trade integration. Journal of International Economics, 116, pp.206-226.

Borchert, I., Larch, M., Shikher, S. and Yotov, Y.V., 2022. The international trade and production database for estimation-release 2. USITC Work. Pap.

Borchert, Ingo, & Di Ubaldo, Mattia. 2021 (Apr). Deep services trade agreements and their effect on trade and value added.

Breinlich, H., Corradi, V., Rocha, N., Ruta, M., Santos Silva, J.M.C. and Zylkin, T., 2022. Machine learning in international trade research-evaluating the impact of trade agreements.

BV, E.N., Berden, K.G., Francois, J., Thelle, M.M., Wymenga, M.P. and Tamminen, M.S., 2009. Non-tariff measures in EU-US trade and investment–An economic analysis. Report Number OJ 2007/S 180, 219493.

Cadot, O. and Gourdon, J., 2014. Assessing the price-raising effect of non-tariff measures in Africa. Journal of African Economies, 23(4), pp.425-463.

Cadot, O., Gourdon, J. and Van Tongeren, F., 2018. Estimating ad valorem equivalents of non-tariff measures: Combining price-based and quantity-based approaches.

Campello, Ricardo J. G. B., Moulavi, Davoud, & Sander, Joerg. 2013 (Jan). Density-based clustering based on hierarchical density estimates.

Ciuriak, D., Dadkhah, A. and Xiao, J., 2016. Taking the Measure of the TPP as Negotiated. Available at SSRN 2743009.

Dhingra, S., Freeman, R. and Huang, H., 2023. The impact of non-tariff barriers on trade and welfare. Economica, 90(357), pp.140-177.

Economic Impact of Trade Agreements Implemented under Trade Authorities Procedures, 2021 Report

Ederington, J. and Ruta, M., 2016. Nontariff measures and the world trading system. Handbook of commercial policy, 1, pp.211-277.

Egger, P., J. Francois, M. Manchin and D. Nelson (2015), "Non-tariff barriers", Economic Policy, Vol. 2.

Felbermayr, G. and Teti, F., 2023. Revisiting the Trade-Creating Effects of Non-Tariff Barriers (No. 459). Discussion Paper.

Fontagne, L., J. Gourdon, and S. Jean (2013). "Transatlantic Trade: Whither Partnership, which Economic Consequences?" CEPII Policy Brief No. 1, September, Centre d'Etudes Prospectives et d'Informations Internationales (CEPII).

Fontagne, Lionel, Rocha, Nadia, Ruta, Michele, & Santoni, Gianluca. 2021 (Apr). A general equilibrium assessment of the economic impact of Deep Trade Agreements.

Fontagné, L.G., Guillin, A. and Mitaritonna, C., 2011. Estimations of tariff equivalents for the services sectors.

Francois, J., M. Manchin, H. Norberg, O. Pindyuk, and P. Tomberger (2013). "Reducing Transatlantic Barriers to Trade and Investment: An Economic Assessment," Final Project Report, prepared under implementing Framework, CEPR, London

Larch, M., Shikher, S. and Yotov, Y.V., 2025. Estimating gravity equations: Theory implications, econometric developments, and practical recommendations. Review of International Economics.

Looi Kee, H., Nicita, A. and Olarreaga, M., 2009. Estimating trade restrictiveness indices. The Economic Journal, 119(534), pp.172-199.

Mattoo, A., Rocha, N. and Ruta, M., 2020. The evolution of deep trade agreements. Washington, DC: World Bank.

Mattoo, A., Rocha, N. and Ruta, M., 2020. Handbook of deep trade agreements. World Bank Publications.

Nagengast, A.J. and Yotov, Y.V., 2025. Staggered difference-in-differences in gravity settings: Revisiting the effects of trade agreements. American Economic Journal: Applied Economics, 17(1), pp.271-296.

Nagengast, A.J. and Yotov, Y.V., 2025. Staggered difference-in-differences in gravity settings: Revisiting the effects of trade agreements. American Economic Journal: Applied Economics, 17(1), pp.271-296.

Nagengast, A.J. and Yotov, Y.V., 2025. Staggered difference-in-differences in gravity settings: Revisiting the effects of trade agreements. American Economic Journal: Applied Economics, 17(1), pp.271-296.

OECD, 2022. Services trade in the global economy.

Petri, P.A. and Plummer, M.G., 2012. The trans-pacific partnership and asia-pacific integration: Policy implications. Peterson Institute for International Economics Policy Brief

Pierce, Justin, & Schott, Peter. 2012. A concordance between ten-digit U.S. Harmonized System codes and SIC/NAICS product classes and industries. Finance and Economics Discussion Series 2012-15. Board of Governors of the Federal Reserve System (U.S.).

Red Meat Route to Market Project Report | AHDB

Teti, Feodora A. (2020), "30 Years of Trade Policy: Evidence from 5.7 Billion Tariffs." ifo Working Papers 334

Wooldridge, Jeffrey M. 2023. "Simple Approaches to Nonlinear Difference-in Differences with Panel Data." The Econometrics Journal.

Wooldridge, Jeffrey M. 2021. "Two-way Fixed Effects, the Two-Way Mundlak Regression, and Difference-in-Differences Estimators." Available at SSRN 3906345.