WTO vs. TRAINS: A quantitative comparison of Ad-Valorem Equivalents (AVE) for non-tariff trade measures

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Background

Non-tariff measures (NTMs): policies other than tariffs that affect trade

- Often implemented to achieve environmental, health, and safety goals
- Can act as trade barriers
- Increase in applied non-tariff measures over time (Ferrantino, 2006; Orefice, 2017)
- Quantifying the impact of NTMs is complex: NTM heterogeneity, less straightforward effects than tariffs, and data limitations
- NTMs quantified using Ad-Valorem Equivalents (AVE)
- Two primary NTM data sources:
  - WTO Notifications
  - UNCTAD Trade Analysis Information System (TRAINS) database

Research question

- Do WTO Notifications and the UNCTAD database yield different AVE estimates ?
- Where does the difference in AVE stem from?

Objectives:

- Estimate AVE from the two databases and compare estimates
- Test if WTO database can be used instead of UNCTAD database, because if its higher coverage

Motivation and focus

Contribution:

- For TRAINS: mostly static AVE (Beghin, Maertens, and Swinnen, 2015; Cadot and Gourdon, 2016; Cadot, Gourdon, and Van Tongeren, 2018)
- For WTO: static and time-varying AVE (Ghodsi et al., 2017; Ghodsi and Stehrer, 2022; Cadot, Gourdon, and Van Tongeren, 2018)

→ Only De Melo and Nicita (2018); Rau and Vogt (2017) discuss qualitatively the merits and drawbacks of each

Focus:

- Technical Barriers to Trade (TBT) and Sanitary and Phytosanitary Measures (SPS)
- Countries with frequent data collection by UNCTAD from 2012 to 2016 (9 countries with 82 partners, and 5200 HS codes).

Database comparisons

	UNCTAD-TRAINS	**WTO Notifications**
Access	Open source ✓	Open source ✓
Reporting	Snapshot of existing NTMs for a country at collected years ✓	Self-notification to the WTO of implementing NTMs ✗
Availability	Data availability limited to collected years and country ✗	Data availability limited to WTO members ✓
Coverage	Reporting/affected countries, Implemented NTM at the HS6 level, with product details ✓	Reporting/affected countries, Implemented NTM at the HS6 level, with product details ✓
Reported time	Implementation year ✓	Notification year ✗
NTM repeal	Account for withdrawal ✓	Do not account for withdrawal ✗

Table: Comparison of UNCTAD-TRAINS and WTO Notifications

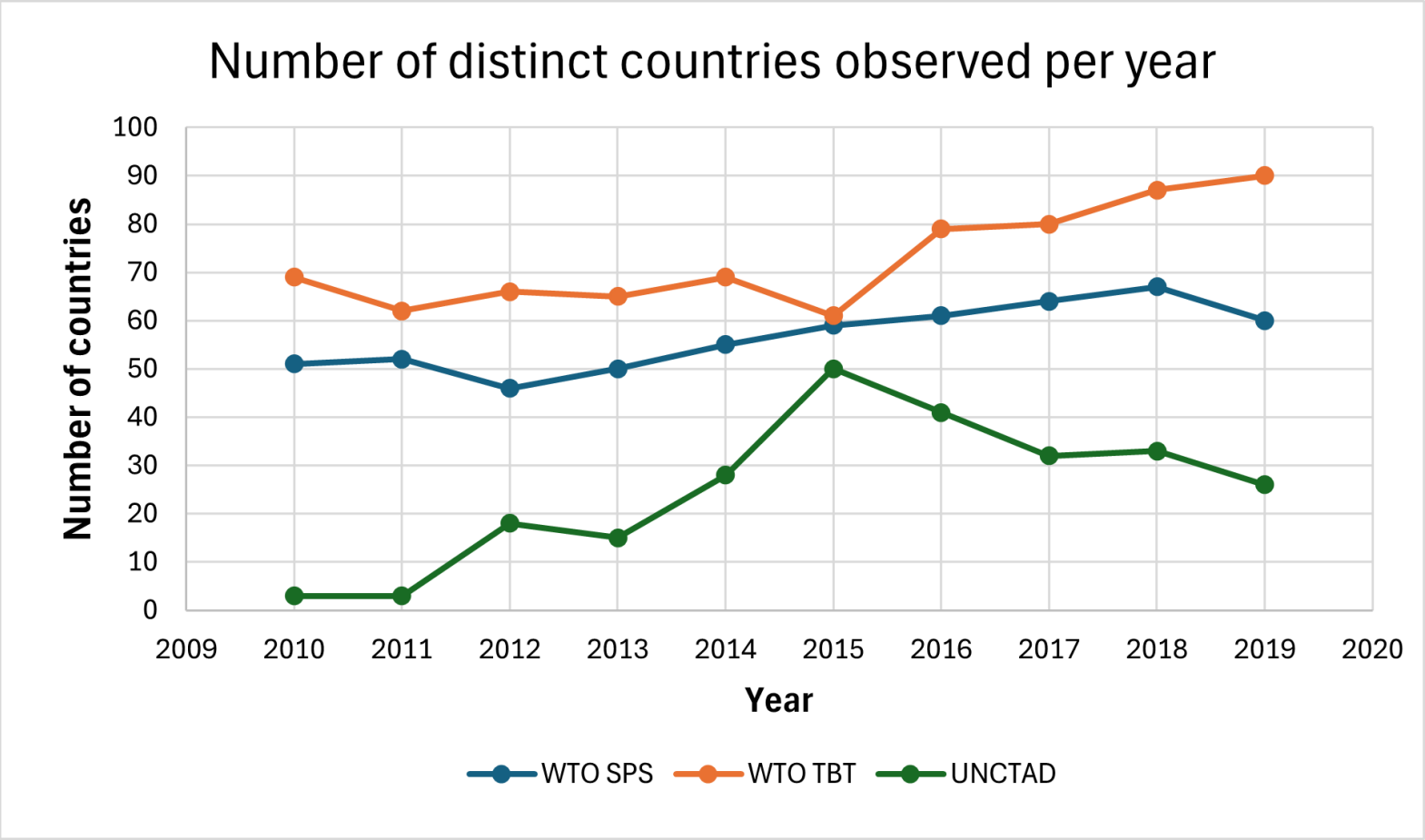
Data usage and Assumptions

WTO Notifications data usage requires making assumptions NTMs.

- No withdrawal: when NTM is notified, indicated as implemented until the last period
- Year of notification is the year of implementation
- Missing HS code retrieved through product descriptions and matched to other trade data (Ghodsi et al. (2017))
- All countries correctly notify WTO when implementing an NTM

$\rightarrow$ Assumptions lead to measurement error and bias AVE estimates when using WTO notification data

Time and country coverage



NTM database:

- UNCTAD: 92 countries maps
- WTO Notifications (I-TIP): 120 countries for TBT and 103 for SPS in WTO

Empirical method: NTMs effects

- NTMs can impact trade in two main ways: compliance cost and market creating effect
- A negative AVE indicates that the market-creating effect exceeds the compliance cost, while a positive AVE suggests the opposite.
- We apply a quantity-based gravity model to estimate AVEs Kee and Nicita (2022) at the importer-exporter-product level

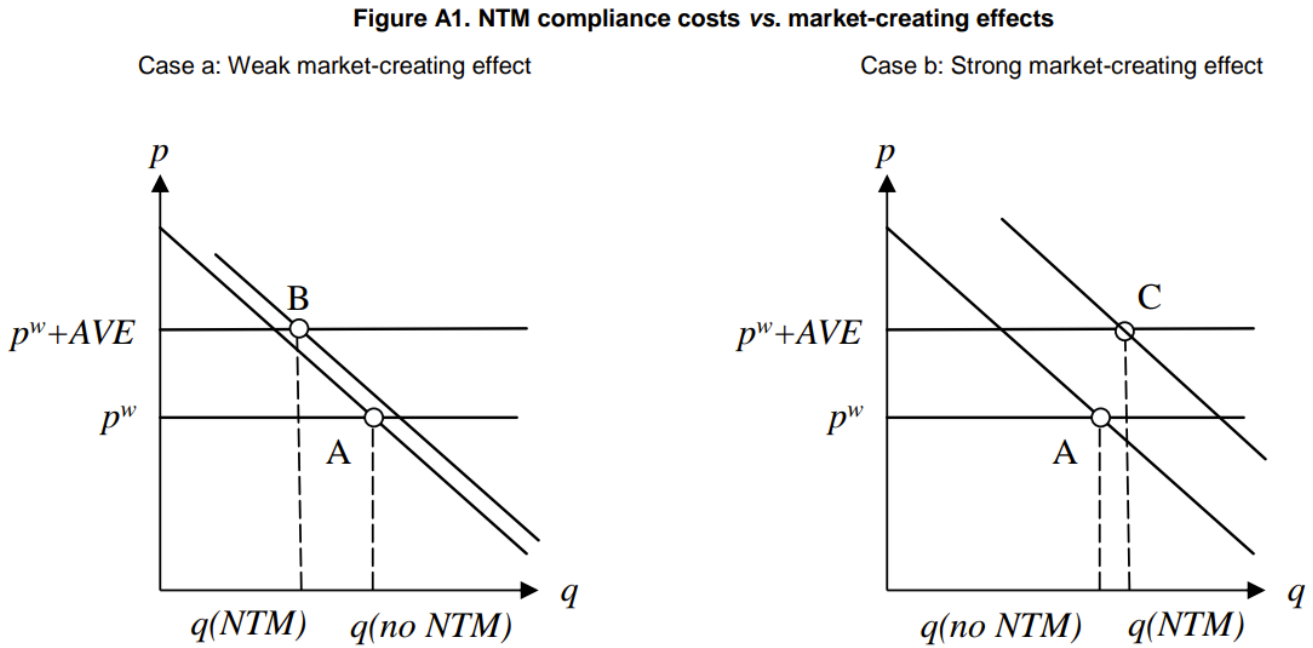


Figure: Market creation effect

Empirical method: gravity model

$$\ln Q_{ijk} = \beta_k + \left(\beta_k^t + \beta_{k1}^t\, share_{ki} + \beta_{k2}^t\, share_{kj}\right) t_{kij} + \left(\beta_k^{NTM} + \beta_{k1}^{NTM}\, share_{ki} + \beta_{k2}^{NTM}\, share_{kj}\right) NTM_{kij} + Z_{ij}\beta + \varepsilon_{ijk} \quad \text{for j} = 1, \ldots, \text{J} \tag{1}$$

Q_{ijk} : import value of importer i from exporter j for product k

Z_{ij} : gravity variables adjusted by GDP as Bratt (2017) to account for multilateral resistance (dist, contiguity, landlocked, language, GDP, RTA)

NTM_{kij} : Predicted count of SPS/TBT measures imposed by importer i on imports from exporter j for product k using the NTMs of three neighboring countries as IVs.

t_{kij} : predicted applied tariff imposed by country i on imports from j on good k using the tariffs of three neighboring countries as IVs.

$share_{ki}/share_{kj}$: importer/exporter's share in the world market for product i

$$\beta_{kij}^t = \beta_k^t + \beta_{k1}^t\, share_{ki} + \beta_{k2}^t\, share_{kj}$$
$$\beta_{kij}^{NTM} = \beta_k^{NTM} + \beta_{k1}^{NTM}\, share_{ki} + \beta_{k2}^{NTM}\, share_{kj}$$

Empirical method: AVE estimation

From the gravity equation (1) , we know that: The proportionate change in quantity due to an additional NTM is:

$$\ln(Q_{ijk}|NTM = n+1) - \ln(Q_{ijk}|NTM = n) = \widehat{\beta}_{kij}^{NTM} \tag{2}$$

$$\frac{Q_{ijk}|NTM = n+1}{Q_{ijk}|NTM = n} = \exp(\widehat{\beta}_{kij}^{NTM}) \tag{3}$$

$$\frac{Q_{ijk}|NTM = n+1 - Q_{ijk}|NTM = n}{Q_{ijk}|NTM = n} = \exp(\widehat{\beta}_{kij}^{NTM}) - 1 \tag{4}$$

Similarly, the proportionate change in quantity imported due to 1 percentage point increase in tariff is

$$\ln(Q_{ijk}|t_{kij} = t+1) - \ln(Q_{ijk}|t_{kij} = t) = \widehat{\beta}_{kij}^{t} \tag{5}$$

$$\frac{Q_{ijk}|t_{kij} = t+1}{Q_{ijk}|t_{kij} = t} = \exp(\widehat{\beta}_{kij}^{t}) \tag{6}$$

$$\frac{Q_{ijk}|t_{kij} = t+1 - Q_{ijk}|t_{kij} = t}{Q_{ijk}|t = t} = \exp(\widehat{\beta}_{kij}^{t}) - 1 \tag{7}$$

THE AVE which is the Ad-Valorem tariff that induces the same proportionate change in quantity imported as the presence of an NTM:

$$\text{AVE}_{ijk}^{NTM} = \frac{\exp(\widehat{\beta}_{kij}^{NTM}) - 1}{\exp(\widehat{\beta}_{kij}^{t}) - 1} \tag{8}$$

Empirical method: AVE estimation continued

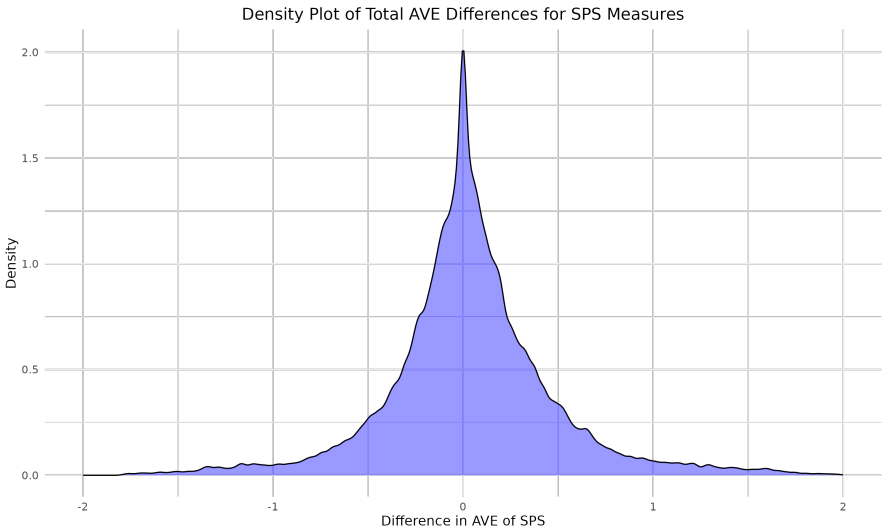
To obtain the total effect of all NTMs, we multiply the first line of equation (2) by the total count of NTMS (Kravchenko et al., 2022).

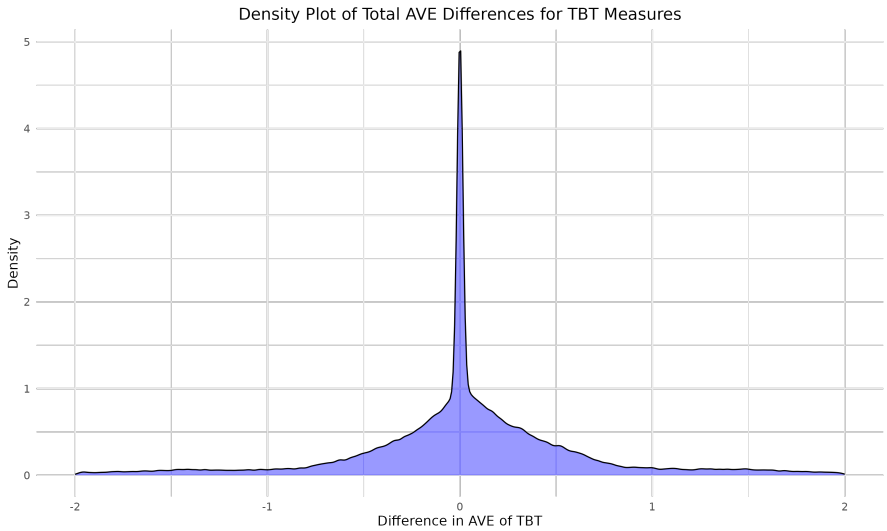
$$\text{AVE}_{ijk}^{NTM} = \frac{\exp(\widehat{\beta}_{kij}^{NTM} * NTM) - 1}{\exp(\widehat{\beta}_{kij}^{t}) - 1} \tag{9}$$

Steps:

- Run the gravity equation (1) at the product level for each year, covering 5,200 distinct HS codes and five years.
- Following Bratt (2017), bootstrap the gravity equation by running it 50 times at the product level to obtain standard errors for each AVE estimate. AVEs are specific to the product, importer, exporter, and year, resulting in a dataset of size 5,200 $\times$ 9 $\times$ 82 $\times$ 5.
- Discard non-significant estimates, as well as values in the lowest and highest percentiles. Additionally, exclude AVE values below -1, in line with Bratt (2017) and Kee and Nicita (2022).

Overall difference in AVE estimates





- Distributions of AVEs: ▸ dist ▸ SPS ▸ TBT
- Measurement error stemming from:
  - Variation in the number of NTMs per HS6-digit code (assuming no withdrawal of NTMs).
  - Incorrect or incomplete NTM Notifications to the WTO. ▸ Coverage ▸ Number

Comparing differences in AVE estimates by ...

We explore the differences in estimates between the two datasets by importing/reporting countries, by HS section, and by year.

- By importing countries: Some countries show slightly less discrepancy in AVE estimates between the two data due to better WTO Notifications. ▸ rep
- By year: assuming no withdrawal, not much variation in the distribution in difference in AVEs by years. ▸ Year
- By HS section: Some products are better notified due to their importance to the importing country (e.g., higher notification effort for sanitary or phytosanitary reasons where risks are severe). Agricultural products generally exhibit less variation (in percentage points) compared to other HS sections. ▸ HS

Discussion

Key findings:

- Overall, the AVE estimates provided by both datasets are different.
- The variation in estimates differ across reporting countries, as some may be less accurate in their notifications.
- There is also a slight variation in the differences in estimates across HS sections. However, Agricultural goods seem to do slightly better than other goods.

Limitations:

- Additional bias can be created from choice in IVs (if NTMs are not measured correctly).
- Requires to test differences in distribution.
- Some estimates may reach extremely high or infinite values, as the AVE is based on a combination of multiple estimates.

Ongoing work: Systematic error

We examine whether differences between the two datasets stem from specific factors, aiming to identify and correct potential biases.
The factors are:

- the importance of the good among its import
- the overall level of SPS/TBT measures imposed by the importer
- whether the NTM faced by the exporter applies to a key export product
- time (WTO data use cumulative count of NTM, which impose an upward trend in number of NTM over time.)

Difficulty in finding a systematic error: The coefficients are very small, and their significance is driven by the large sample size. ▸ SPS ▸ TBT

Next Steps...

Construct a new dataset

- **Motivation:** limited coverage restricts the number of studied countries, complicates panel analysis, and poses challenges for the use of instrumental variables (IV).
  ▸ US CAN ▸ map
  - Update historical NTMs by integrating UNCTAD data with WTO records. Rather than relying on the cumulative count of NTMs notified to the WTO over time, adjustments can be made using available UNCTAD data.
  - Explore alternative data sources, such as trade disputes and concerns, to account for withdrawn NTMs and improve accuracy.
  - Use those estimates to look at the effect of NTMs over time on labor.

Thank you!

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SPS Coverage by country from 2010 to 2019

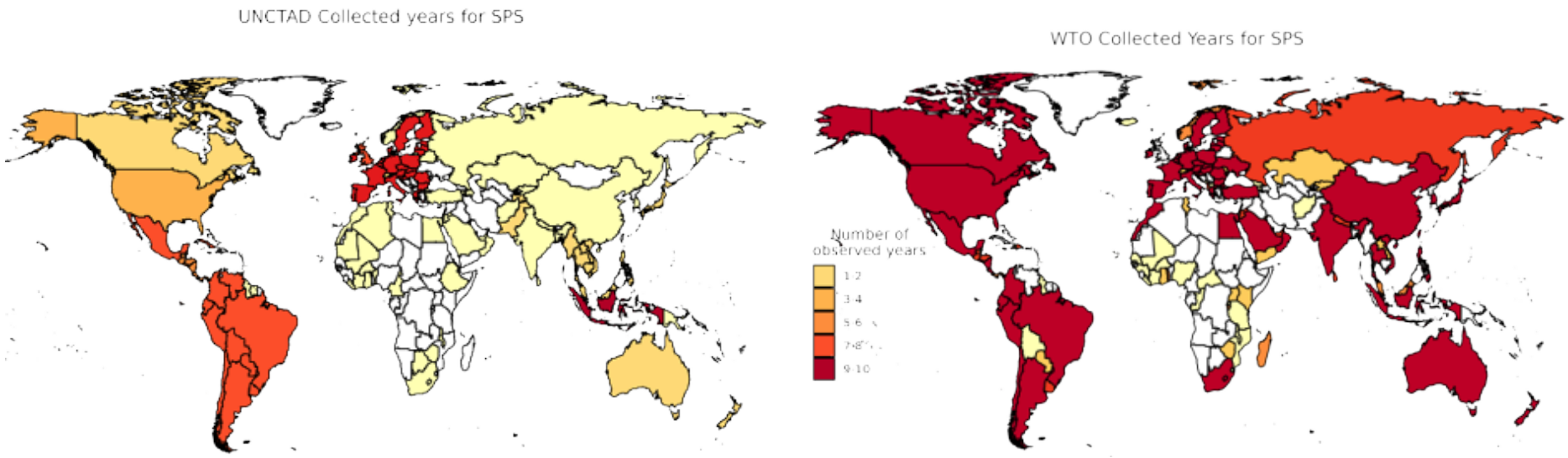

Figure: SPS Coverage from 2010 to 2019

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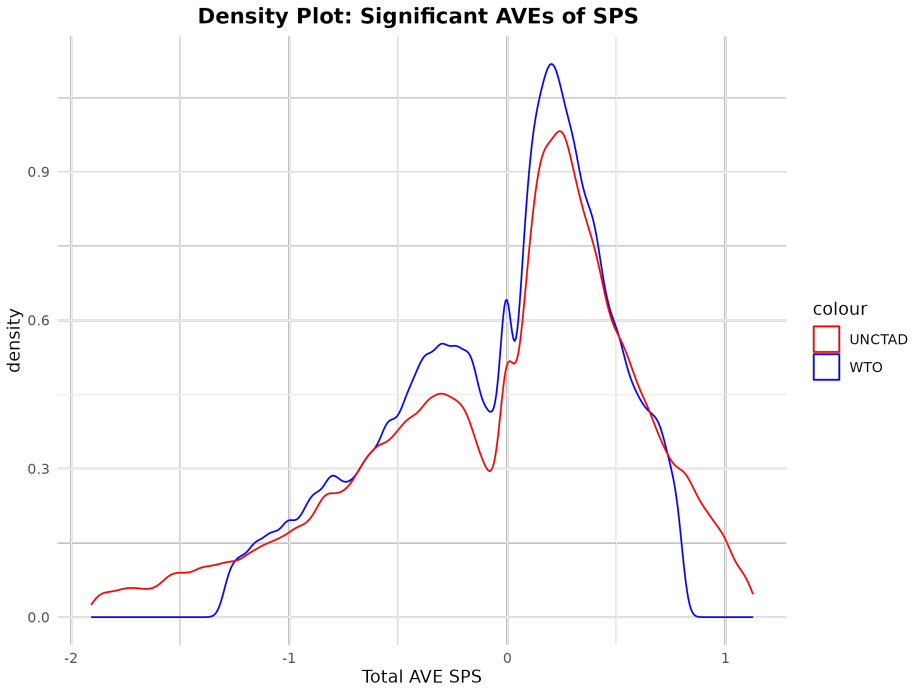
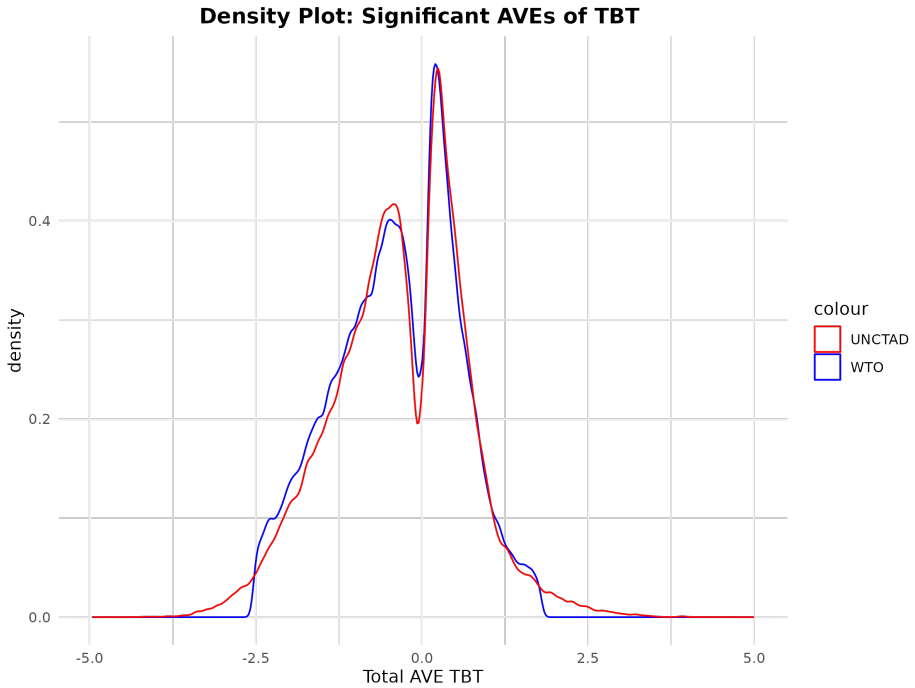
Distribution of the estimated AVEs of SPS/TBT





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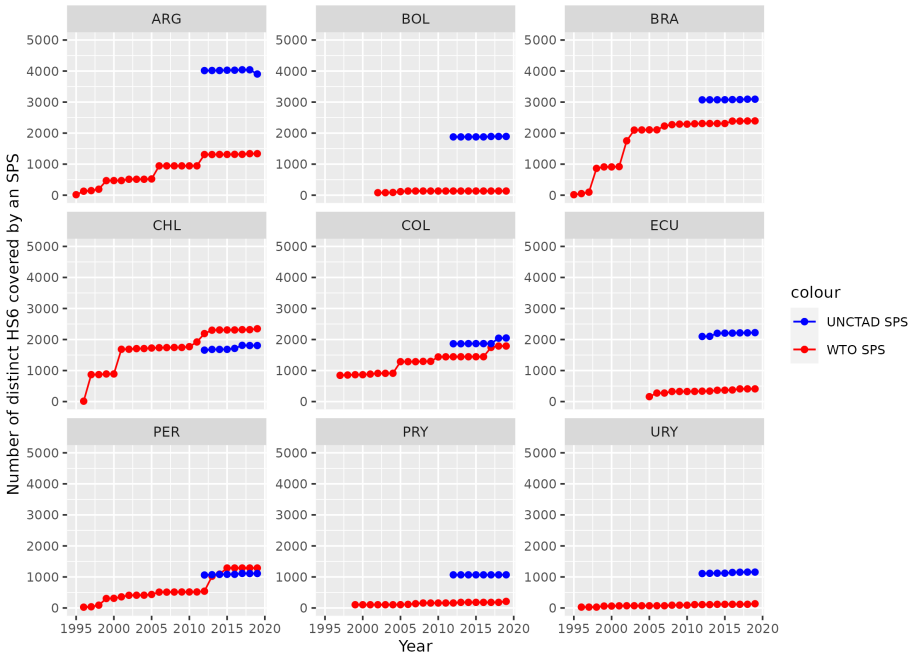
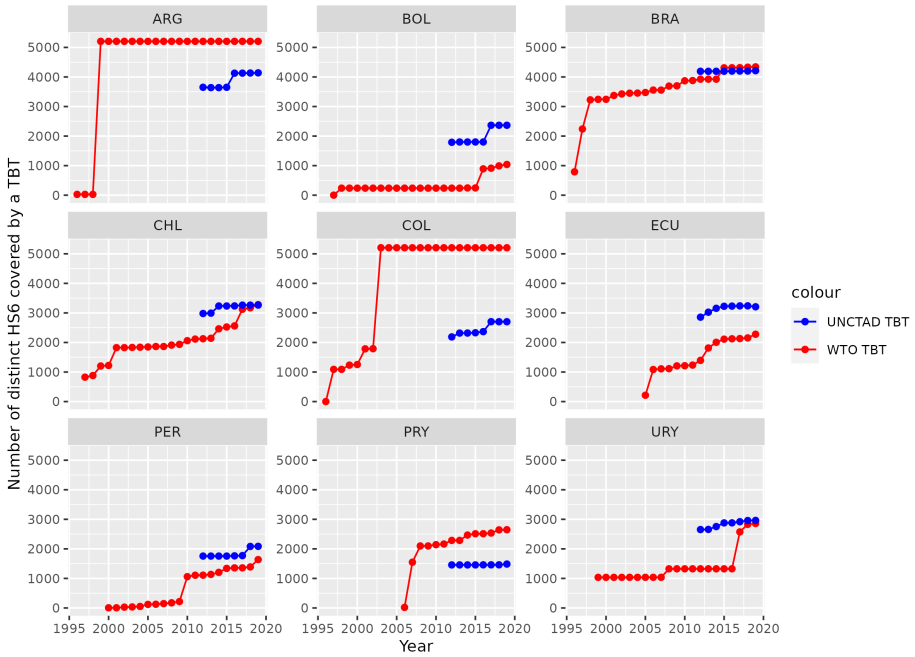
We look at the distribution of the estimated AVEs by data and by type of NTMs.

SPS/TBT Coverage by Country per Year

SPS Coverage per Year: number of distinct HS6 products affected by SPS



TBT Coverage per Year: number of distinct HS6 products affected by TBT



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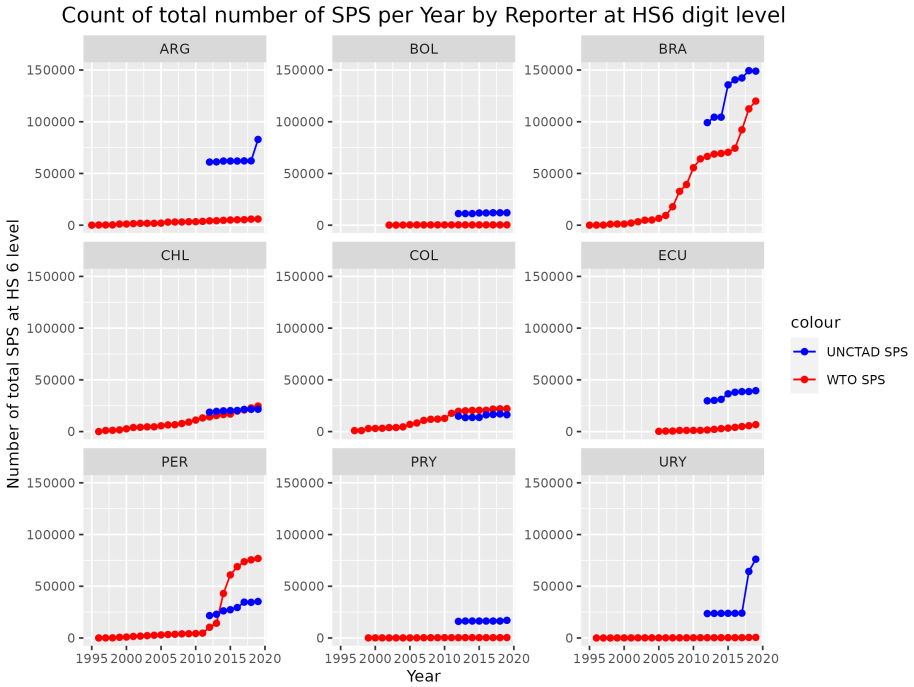
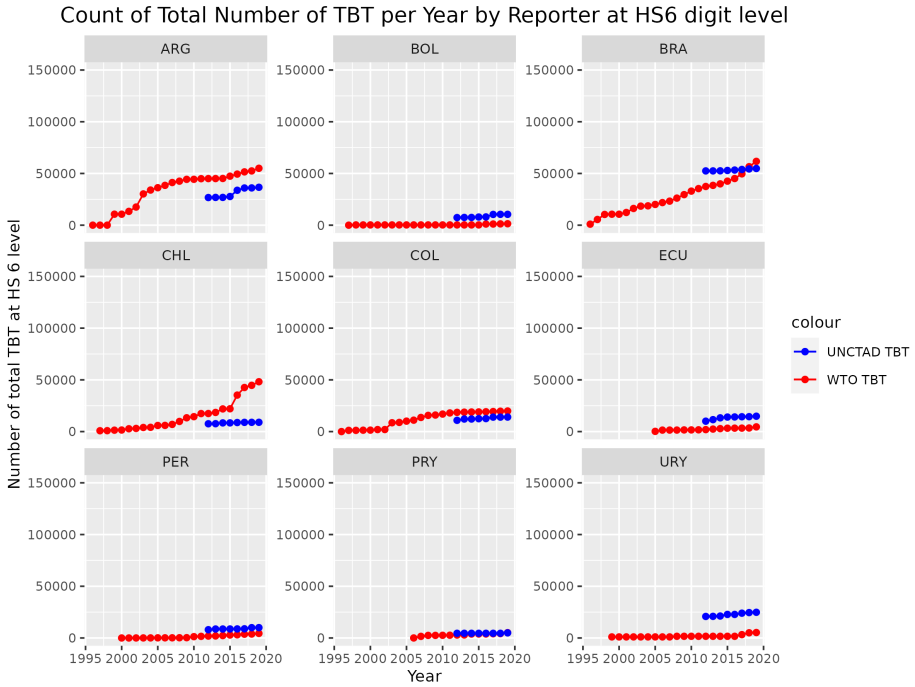
We look at the distinct number of HS codes (at the HS 6-digit level) affected by an SPS or a TBT.

SPS/TBT Coverage by Country per Year





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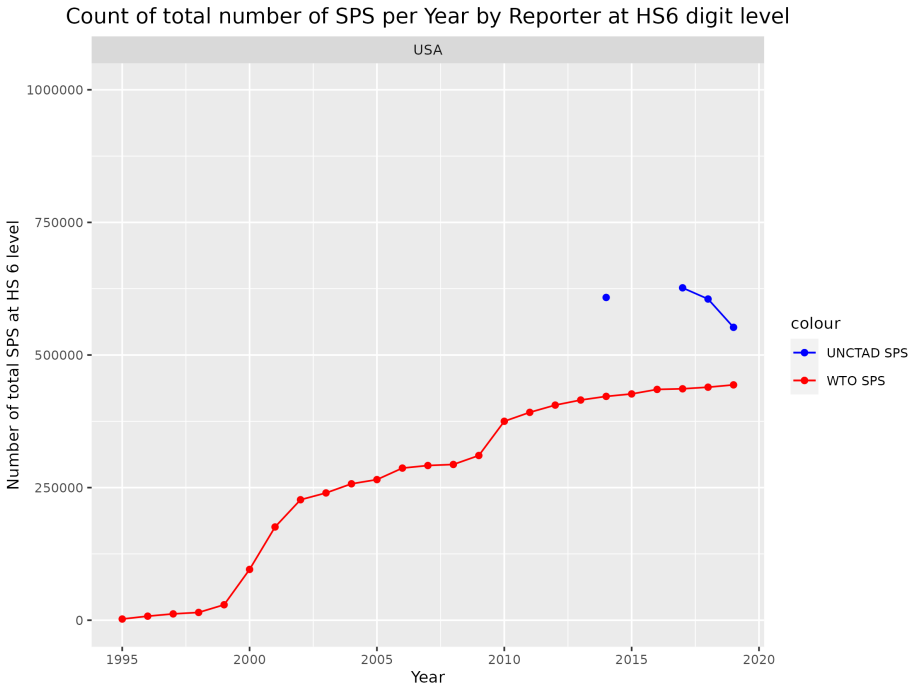
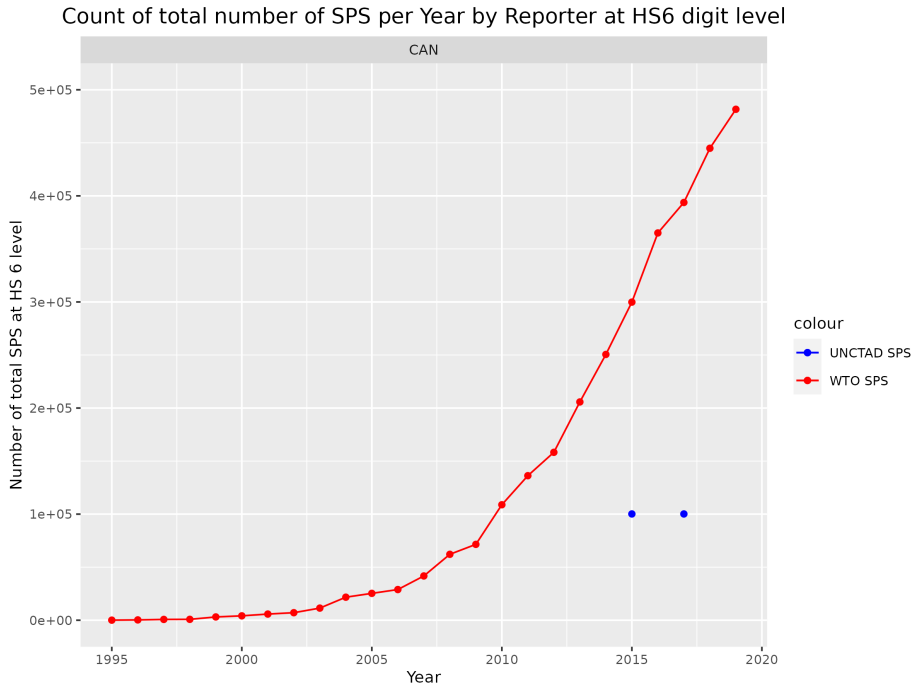
We look at the total number of applied SPS/TBT (at the HS 6-digit level).

U.S. and CAN SPS/TBT Coverage by Year





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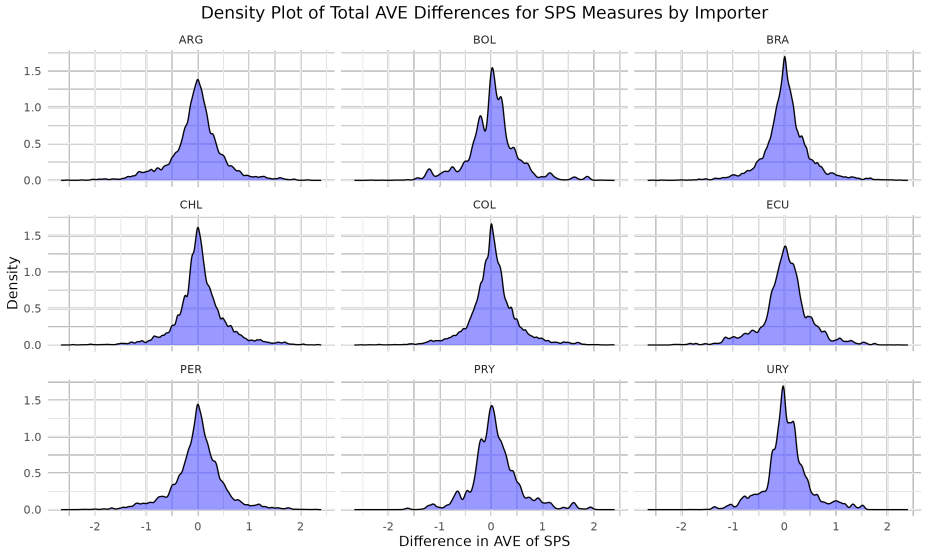
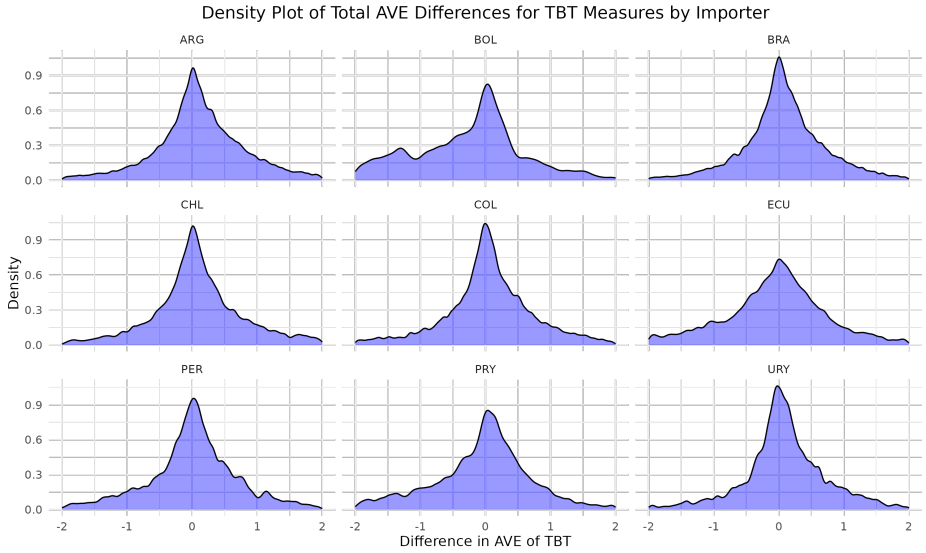
Density of differences in AVE by Importer





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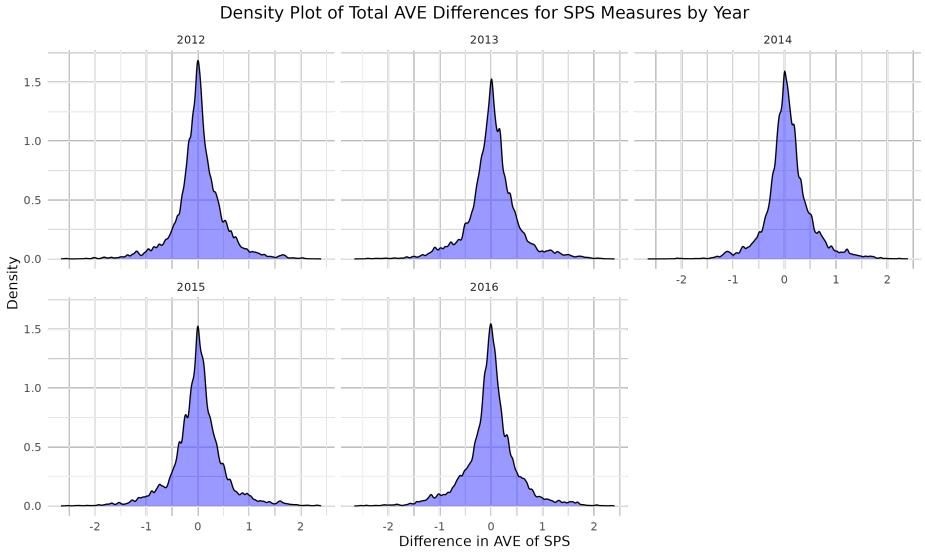
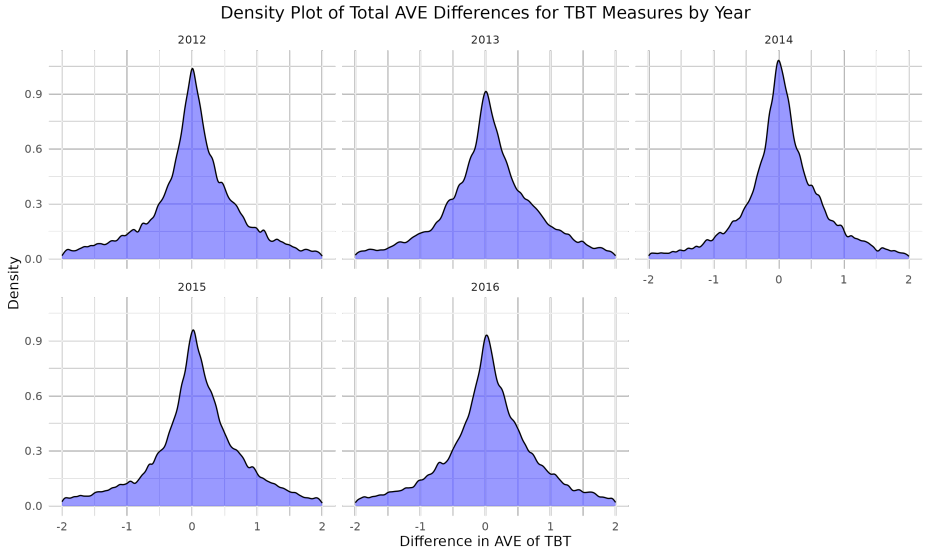
Density of differences in AVE by Year





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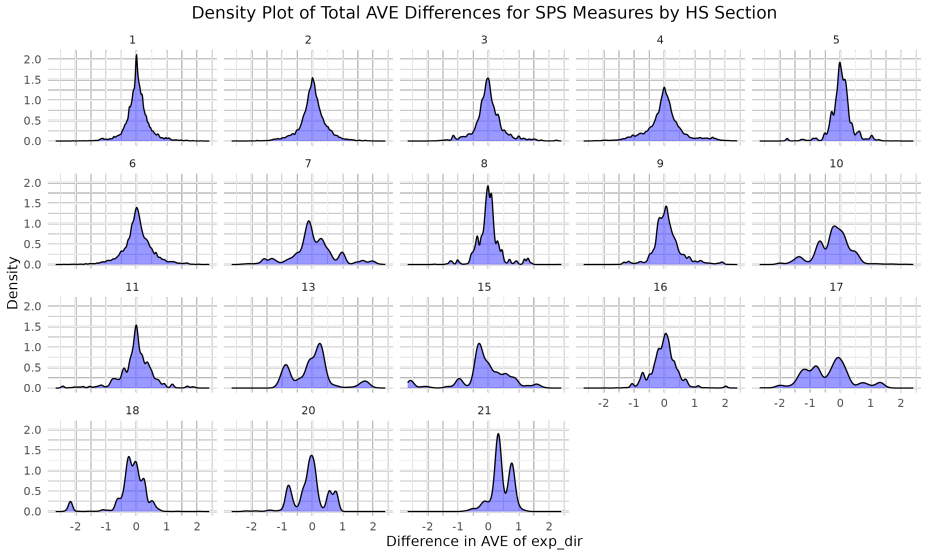
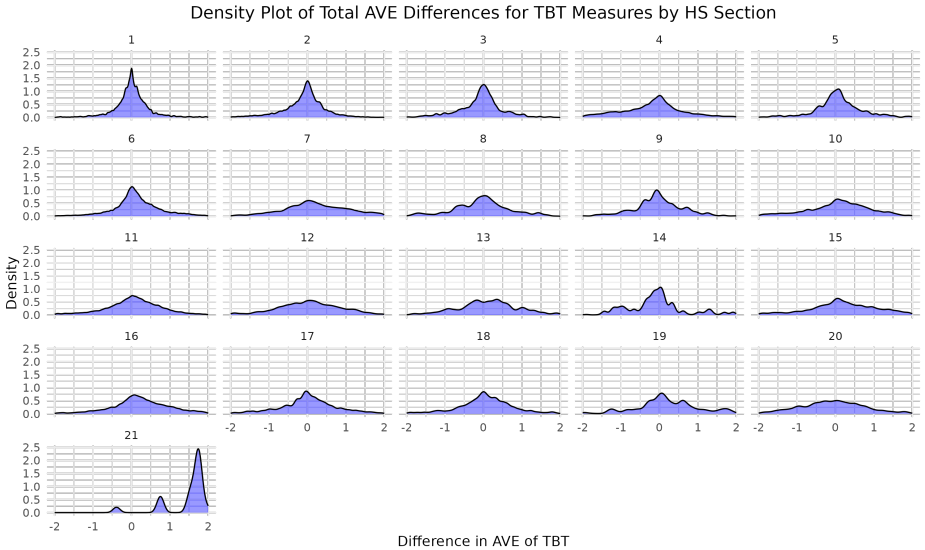
Density of differences in AVE by HS section





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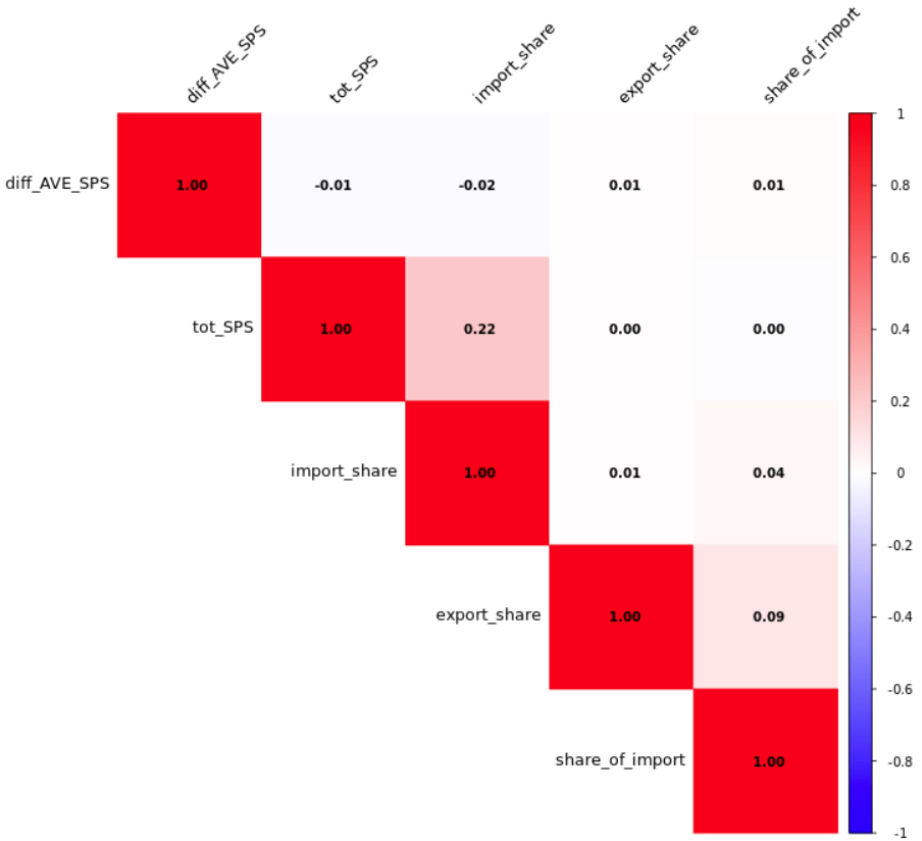
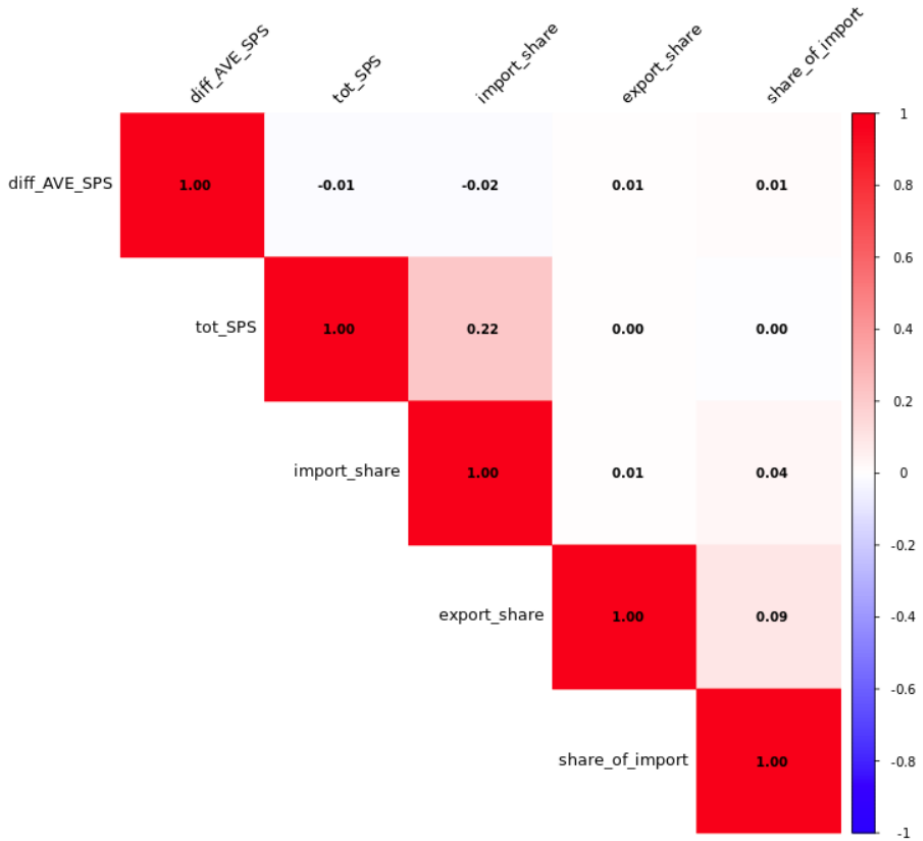
Correlation matrix





Where import/export share is the importer/exporter's share in the world market, and share of import is the importance of the imported good among all the imported products.

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Regression Results SPS

We regress the difference in AVE between the two datasets in percentage on: year, the total number of SPS measures imposed by the importing country (from UNCTAD data), the exporter's and importer's share in the global market in percentage, and the importance of the imported good relative to all imported goods, measured as the share of import value in percentage.

Table: Regression Results

Variable	**Estimate**	**Std. Error**	**t value**	**Pr($>|t|$)**
(Intercept)	$3.300e+01$	$1.297e-01$	254.35	$< 2e-16$ ***
Year2013	$2.078e+00$	$1.034e-01$	20.11	$< 2e-16$ ***
Year2014	$-1.230e+00$	$1.107e-01$	-11.13	$< 2e-16$ ***
Year2015	$2.599e+00$	$1.080e-01$	22.91	$< 2e-16$ ***
Year2016	$2.528e+00$	$1.079e-01$	23.43	$< 2e-16$ ***
tot_SPS	$-2.222e-07$	$1.908e-08$	-11.65	$< 2e-16$ ***
import_share	$-2.302e-01$	$1.532e-02$	-1.50	$< 2e-16$
export_share	$4.150e-02$	$7.070e-03$	5.87	$4.35e-09$ ***
import_importance	$6.645e+01$	$5.723e+00$	11.61	$< 2e-16$ ***

Model Fit:
Multiple $R^2 = 0.0242$, Adjusted $R^2 = 0.0241$
F-statistic = 357.4 on 8 and 1,177,072 DF, p-value < 2.2e-16

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Regression Results TBT

We regress the difference in AVE between the two datasets in percentage on: year, the total number of TBT measures imposed by the importing country (from UNCTAD data), the exporter's and importer's share in the global market in percentage, and the importance of the imported good relative to all imported goods, measured as the share of import value in percentage.

Table: Regression Results

Variable	**Estimate**	**Std. Error**	**t value**	**Pr($>|t|$)**
(Intercept)	$6.469e+01$	$1.019e-01$	634.95	$<2e-16$ ***
Year2013	$3.872e+00$	$1.139e-01$	33.99	$<2e-16$ ***
Year2014	$-7.644e+00$	$1.153e-01$	-66.276	$<2e-16$ ***
Year2015	$1.695e+00$	$1.130e-01$	9.69	$<2e-16$ ***
Year2016	$3.785e+00$	$1.115e-01$	33.95	$<2e-16$ ***
tot_TBT	$-7.267e-07$	$8.459e-08$	-8.59	$<2e-16$ ***
import_share	$-1.097e+00$	$2.080e-02$	-51.826	$<2e-16$ ***
export_share	$8.577e-02$	$2.784e-03$	30.818	$<2e-16$ ***
import_importance	$1.583e+01$	$2.758e+00$	5.739	$5.9e-09$ ***

Model Fit:
Multiple $R^2 = 0.008359$, Adjusted $R^2 = 0.008366$
F-statistic = 3414 on 8 and 3,235,921 DF, p-value < 2.2e-16

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Signs of AVEs in both data

SPS	UNCTAD < 0, WTO > 0	UNCTAD > 0, WTO < 0	UNCTAD/WTO > 0	UNCTAD/WTO < 0
TBT	10%	10%	27%	45%
SPS	8%	8%	38%	26%

Table: Distribution of Observations Based on signs of UNCTAD and WTO AVE Estimates

HS section description

1	Live Animals; Animal Products
2	Vegetable Products
3	Animal or Vegetable Fats and Oils and Their Cleavage Products; Prepared Edible Fats; Animal or Vegetable Waxes
4	Prepared Foodstuffs; Beverages, Spirits and Vinegar; Tobacco and Manufactured Tobacco Substitutes
5	Mineral Products
6	Products of the Chemical or Allied Industries
7	Plastics and Articles Thereof; Rubber and Articles Thereof
8	Raw Hides and Skins, Leather, Furskins and Articles Thereof; Saddlery and Harness; Travel Goods, Handbag
9	Wood and Articles of Wood; Wood Charcoal; Cork and Articles of Cork; Manufactures of Straw, of Esparto or of Other Plaiting Materials; Basketware and Wickerwork
10	Pulp of Wood or of Other Fibrous Cellulosic Material; Recovered (Waste and Scrap) Paper or Paperboard; Paper and Paperboard and Articles Thereof
11	Textiles and Textile Articles
12	Footwear, Headgear, Umbrellas, Sun Umbrellas, Walking-Sticks, Seat-Sticks, Whips, Riding-Crops and Parts
13	Articles of Stone, Plaster, Cement, Asbestos, Mica or Similar Materials; Ceramic Products; Glass and Glassw
14	Natural or Cultured Pearls, Precious or Semi-Precious Stones, Precious Metals, Metals Clad with Precious Metal, and Articles Thereof; Imitation Jewellery; Coin
15	Base Metals and Articles of Base Metal
16	Machinery and Mechanical Appliances; Electrical Equipment; Parts Thereof; Sound Recorders and Reproduc Television Image and Sound Recorders and Reproducers, and Parts and Accessories of Such Articles
17	Vehicles, Aircraft, Vessels and Associated Transport Equipment
18	Optical, Photographic, Cinematographic, Measuring, Checking, Precision, Medical or Surgical Instruments a
19	Arms and Ammunition; Parts and Accessories Thereof
20	Miscellaneous Manufactured Articles
21	Works of Art, Collectors' Pieces and Antiques

Comparing UNCTAD AVE estimates with literature

	Own estimates using UNCTAD data		kee et al. (2022) estimates
Importers	SPS AVE	TBT AVE	AVE technical measures
ARG	11.48	9.22	8.90
BOL	22.53	13.90	3.89
BRA	4.05	-0.22	8.28
CHL	10.03	10.08	5.43
COL	9.57	9.16	4.81
ECU	26.41	10.65	2.10
PER	19.06	15.42	3.88
PRY	26.26	18.69	4.87
URY	27.83	17.55	5.65