The GTAP 11 satellite Data Base on Ad-Valorem Equivalents of Border Non-Tariff Measures

Overview of the database

This note describes a GTAP database containing ad-valorem equivalents (AVEs) of border non-tariff measures (NTMs). The estimation of AVEs is based on Kee and Nicita (2022) and made consistent with the GTAP version 11 Data Base (Aguiar et al., 2022). This data can be used directly within the GTAP model (Corong et al., 2017). The estimates use UNCTAD TRAINS NTM data: trainsonline.unctad.org. For information about the International NTM classification and the data collection see here: unctad.org/ntm.

AVEs provided in this database capture compliance costs with NTMs imposed at the border and/or customs. These are customs regulations and include traditional quantitative restrictions, price control measures as well as other NTMs such as traceability, licensing, processing and inspections. The definition of such measures follows the international classification of non-tariff measures at UNCTAD. The codes of the measures utilized are listed in *Annex I.* In general terms the ad-valorem equivalent of a non-tariff measure is the uniform tariff that will result in the same trade impacts on the import of a product due to the presence of the NTM. The AVEs in this database represent the additional costs that the presence of NTMs has on imports. Overall, the AVE are to be interpreted as the cost associated with the compliance of NTMs at the border, given the existing level of trade as of 2017. In economic terms, the AVEs represent the NTMs wedge between the domestic price and foreign price of the good. In this regard, when used in GTAP simulations, the AVEs should be implemented as iceberg shocks and should not be used to recalibrate initial tariffs to account for the NTM. One further consideration is that the AVEs do not provide any information on whether importers and exporters bear the costs associated with NTMs.

The dataset consists of 162,760 observations. Data coverage includes 85 importing countries plus the European Union[1] and 5 residual regions, and 99 exporting countries plus the European Union and 11 residual regions. Importer and exporter country coverage, and

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[1] As the data is based on 2017 levels, the European Union includes the United Kingdom.

product groups are provided in *Annex II.* Importantly, AVEs of NTM are not calculated in presence of very small level of trade (less than 10 thousand US$). This should be considered in the simulation and in the interpretation of results.[2]

AVE are originally estimated at the 6 digits of the HS classification revision 5 using the methods of Kee and Nicita (2022) and then aggregated at the GTAP level. Products are matched from HS to GTAP as in the concordance table available at: https://www.gtap.agecon.purdue.edu/resources/res_display.asp?RecordID=5111 The aggregation employs trade weights based on 2017 import flows. AVEs are adjusted to achieve consistency with Armington elasticities (i.e., ESUBD) of the GTAP model. To maximize country coverage AVEs are based on NTM data collected between 2015 and 2021, under the assumption that these measures were in effect in 2017. Data sources, some technical details and additional references for the estimation methods are provided in *Annex III.*

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[2] In practice, AVEs that are listed as zero are to be considered as missing when the amount of trade is minimal. Similarly, if the AVEs of an importer is always zero it has to be considered as missing (e.g. Nigeria)

Summary statistics of the AVE in the database

The trade weighted average of the AVE is about 4.7 percent (trade weighted average) and 8.1 percent (simple average). Figure below provides the distribution of the AVE while the tables provide some self-explanatory summary statistics of the database, for reference purposes.

Figure 1: Distribution of Ad-valorem equivalents of border NTM
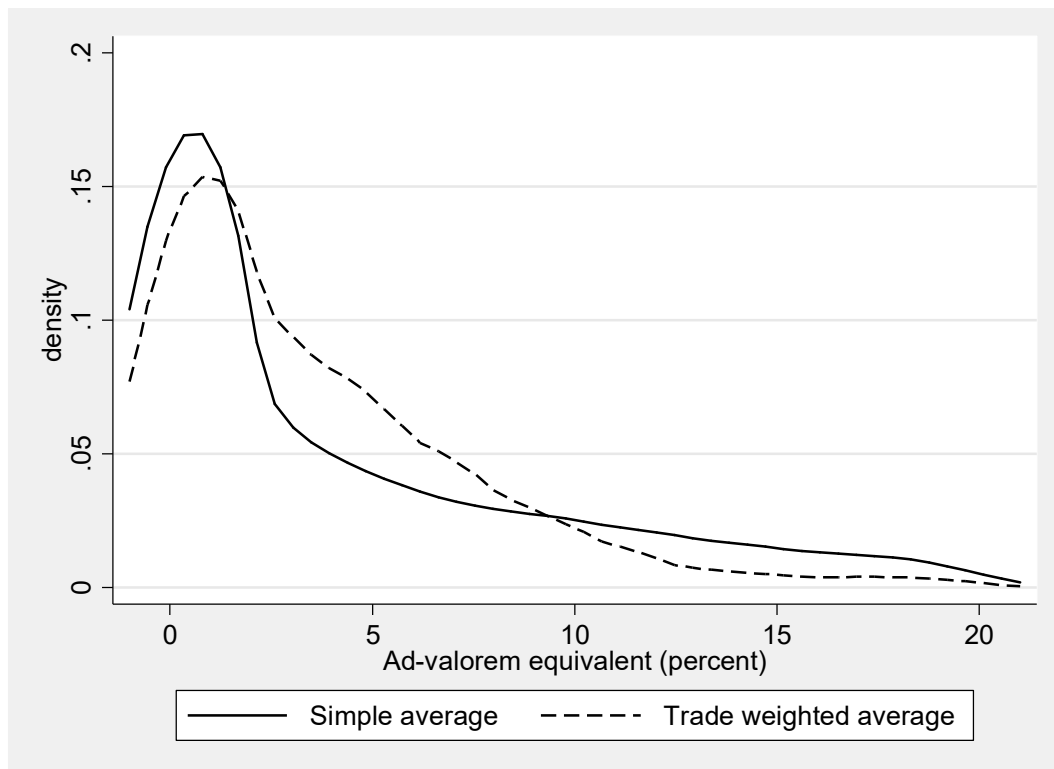
Table 1 Average Ad-valorem equivalents, by importer and exporter region (percent)

GTAP aggregation	Ad-Valorem equivalents (trade weighted avg)		Ad-Valorem equivalents (simple avg)			
	on imports	on exports	on imports	standard deviation	on exports	standard deviation
Brazil	4.3	9.0	9.3	12.5	8.4	12.8
CentralAfrica	5.0	2.5	6.8	12.0	6.9	11.5
CentralAsia	6.1	3.5	9.8	12.0	8.9	13.0
China	8.2	3.9	11.7	14.0	8.6	13.4
EFTA	2.7	4.9	7.6	12.2	7.1	12.4
EUUK	3.8	4.7	10.0	15.2	7.7	11.3
EastAfrica	3.6	6.8	7.2	12.0	9.3	13.5
HincEastAsia	4.7	5.8	10.3	13.9	7.9	13.0
MiddleEast	4.4	3.1	8.7	12.9	7.7	12.0
NorthAfrica	5.1	4.4	8.4	11.3	7.0	11.1
Oceania	3.9	5.5	10.3	13.2	8.8	13.2
RestNAmerica	1.9	4.0	9.6	13.2	7.8	13.0
RestSAmerica	4.1	7.8	6.6	12.0	8.8	13.4
RestSouthAfrica	2.4	7.5	5.2	11.1	8.4	13.0
RestWorld	5.6	3.8	9.7	11.4	7.9	12.5
SouthAsia	2.6	4.2	6.0	11.4	8.0	11.7
SouthEastAsia	3.8	5.1	8.8	13.2	7.5	12.0
USA	5.1	4.2	12.5	15.0	8.4	12.8
WestAfrica	3.0	2.5	6.2	11.5	8.2	12.7

Table 2 Average Ad-valorem equivalents, by GTAP sector (percent)

GTAP code	Ad-valorem equivalents		GTAP code	Ad-valorem equivalents	
	simple average	trade weighted average		simple average	trade weighted average
BPH	5.4	3.7	OAP	32.1	34.3
B_T	28.1	20.7	OCR	9.5	2.8
CHM	4.0	5.3	OFD	11.1	9.5
CMT	17.1	14.9	OIL	4.5	1.3
COA	3.8	0.6	OME	3.3	4.3
CTL	28.9	15.0	OMF	3.7	2.6
C_B	21.4	8.4	OMT	7.5	5.5
EEQ	3.5	3.8	OSD	20.3	29.4
ELE	3.8	5.6	OTN	3.7	4.1
ELY	1.6	0.2	OXT	11.3	2.2
FMP	2.4	2.3	PCR	15.4	3.1
FRS	16.6	21.0	PDR	12.6	10.7
FSH	27.4	10.9	PFB	15.2	7.1
GAS	0.8	1.0	PPP	2.1	1.6
GDT	0.1	0.0	P_C	3.0	3.5
GRO	42.5	39.8	RPP	2.8	3.0
I_S	2.8	2.7	SGR	11.7	11.1
LEA	3.4	2.0	TEX	2.8	2.2
LUM	6.7	7.5	VOL	10.6	8.2
MIL	12.0	8.4	V_F	21.6	16.4
MVH	5.0	4.9	WAP	3.3	1.5
NFM	2.6	5.3	WHT	7.4	2.7
NMM	2.6	3.4	WOL	5.2	1.0

Table 3 Average Ad-valorem equivalents, by GTAP region and broad sector (trade weighted, percent)

aggregimporter	Extraction	GrainsCrops	HeavyMnfc	LightMnfc	MeatLstk	ProcFood	TextWapp	Util_Cons
EastAsia	1.7	24.0	7.6	5.6	14.4	12.4	1.4	0.0
LatinAmer	3.6	22.3	2.7	4.2	12.6	10.2	1.5	0.0
MENA	2.2	16.6	3.2	4.4	12.3	9.1	3.0	4.2
NAmerica	2.2	11.7	4.1	3.5	11.0	11.2	3.2	0.0
Oceania	2.4	14.2	2.4	4.8	13.4	11.1	1.2	0.0
RestWorld	2.5	20.8	4.2	5.2	12.6	10.7	5.0	0.0
SEAsia	4.0	14.1	2.9	2.9	14.8	10.4	1.4	0.0
SSA	2.6	9.1	1.3	3.5	10.6	9.5	0.7	0.0
SouthAsia	1.2	10.0	2.9	1.1	10.4	7.6	0.2	0.0
WestEurope	0.8	15.3	4.0	2.3	18.0	13.7	0.3	0.0

Table 4 Average bilateral Ad-valorem equivalents, by GTAP region (trade weighted, percent)

importer	exporter-> EastAsia	LatinAmer	MENA	NAmerica	Oceania	RestWorld	SEAsia	SSA	SouthAsia	WestEurope
EastAsia	6.7	9.4	3.3	10.6	4.6	4.1	6.3	6.7	5.0	7.4
LatinAmer	2.7	6.5	3.0	4.0	4.1	1.8	2.9	3.7	4.7	4.1
MENA	3.7	12.3	4.5	5.4	9.2	5.2	4.6	4.9	3.8	4.0
NAmerica	5.1	8.0	3.5	2.3	13.7	4.1	4.3	6.5	6.2	5.8
Oceania	2.7	6.0	3.1	4.6	7.4	3.7	4.2	4.9	2.3	4.6
RestWorld	5.6	10.5	9.8	4.9	5.3	6.9	5.5	11.4	7.1	4.3
SEAsia	3.1	13.1	3.4	4.5	5.7	3.3	4.0	5.8	6.3	3.1
SSA	1.9	4.0	2.0	3.7	2.7	4.0	5.6	4.8	2.6	3.0
SouthAsia	2.0	5.5	2.7	4.2	1.4	2.5	4.2	2.1	2.3	1.8
WestEurope	4.1	7.5	2.7	4.2	8.3	2.8	5.0	3.7	2.4	2.4

Annex I: International classification of non-tariff measures. Measures covered.

AVEs capture the effects of border measures defined as "Customs regulations" in *Ederington and Ruta (2016).* These are customs regulations and include traditional quantitative restrictions, price control measures as well as other NTMs such as traceability, licensing, processing and inspections. The world price of the good represents the international trading price outside of the importer's borders (namely the free on board -f.o.b.- price). In practice, customs regulations are to be intended similarly to transport costs or tariffs as they drive a wedge between world prices and domestic prices. The domestic price represents the tradeable price of the good right inside the country's borders. The border measures are categorized under the following codes of the international classification of non-tariff measures (UNCTAD, 2019).

Border measures include many categories under different chapters of the classification. In detail, they include the codes: A14, A140, A15, A150, A81, A810, A84, A840, A85, A850, A851, A852, A853, A859, A86, A860, A89, A890, B14, B140, B15, B150, B81, B810, B84, B840, B85, B850, B851, B852, B853, B859, B89, B890, C00, C000, C10, C100, C20, C200, C30, C300, C40, C400, C90, C900, E10, E100, E11, E110, E111, E112, E113, E119, E12, E120, E121, E122, E129, F40, F400, F60, F600, F61, F610, F62, F620, F63, F630, F64, F640, F65, F650, F67, F670, F80, and F800.

Annex II: Country and Product Coverage

While covering most countries, data on ad-valorem equivalent does not cover all GTAP countries and regions. This should be considered in the simulations or in any aggregation exercise. Below is the country coverage where * denotes AVE data available only as exporter.

AFG	Afghanistan*	IND	India	RWA	Rwanda
ALB	Albania*	IDN	Indonesia	SAU	Saudi Arabia
DZA	Algeria	IRN	Iran, Islamic Rep.*	SEN	Senegal
ARG	Argentina	IRQ	Iraq*	SGP	Singapore
ARM	Armenia	ISR	Israel	ZAF	South Africa
AUS	Australia	JAM	Jamaica	LKA	Sri Lanka
AZE	Azerbaijan	JPN	Japan	SDN	Sudan*
BHR	Bahrain	JOR	Jordan	CHE	Switzerland
BGD	Bangladesh	KAZ	Kazakhstan	TWN	Taiwan, province of China*
BLR	Belarus*	KEN	Kenya	TJK	Tajikistan
BEN	Benin	KOR	Korea, Rep. of	TZA	Tanzania, United Rep. of
BOL	Bolivia	KWT	Kuwait	THA	Thailand
BWA	Botswana	KGZ	Kyrgyzstan	TGO	Togo*
BRA	Brazil	LAO	Lao PDR	TTO	Trinidad and Tobago
BRN	Brunei Darussalam	LBN	Lebanon	TUN	Tunisia
BFA	Burkina Faso	MDG	Madagascar*	TUR	Turkey
KHM	Cambodia	MWI	Malawi	UGA	Uganda
CMR	Cameroon	MYS	Malaysia	UKR	Ukraine*
CAN	Canada	MLI	Mali	ARE	United Arab Emirates
TCD	Chad	MUS	Mauritius	USA	United States of America
CHL	Chile	MEX	Mexico	URY	Uruguay
CHN	China	MNG	Mongolia*	UZB	Uzbekistan*
COL	Colombia	MAR	Morocco	VNM	Viet Nam
COG	Congo*	MOZ	Mozambique	ZMB	Zambia*
CRI	Costa Rica	NAM	Namibia*	ZWE	Zimbabwe
CIV	Côte d'Ivoire	NPL	Nepal	EUN	European Union
COD	Dem. Rep. of the Congo	NZL	New Zealand		
DOM	Dominican Rep*	NIC	Nicaragua	XCB	Rest of Caribbean
ECU	Ecuador	NER	Niger	XEE	Rest of Eastern Europe*
EGY	Egypt	NGA	Nigeria*	XER	Rest of Europe*
SLV	El Salvador	NOR	Norway	XEF	Rest of European FTA
ETH	Ethiopia	OMN	Oman	XSU	Rest of Former Soviet Union
GAB	Gabon	PAK	Pakistan	XOC	Rest of Oceania
GEO	Georgia	PAN	Panama	XSM	Rest of South America
GHA	Ghana	PRY	Paraguay	XAC	Rest of South + Central Africa*
GTM	Guatemala	PER	Peru	XSE	Rest of Southeast Asia*
GIN	Guinea	PHL	Philippines	XWF	Rest of Western Africa
HND	Honduras	QAT	Qatar	XWS	Rest of Western Asia*
HKG	Hong Kong, SARC	RUS	Russian Federation		

Data on ad-valorem equivalent cover all GTAP version 11 sectors. Below is the GTAP sectoral code and description.

GTAP sector	Description	GTAP sector	Description
BPH	Basic pharmaceutical products	OCR	Crops nec
B_T	Beverages and tobacco products	OFD	Food products nec
CHM	Chemical products	OIL	Oil
CMT	Bovine meat products	OME	Machinery and equipment nec
COA	Coal	OMF	Manufactures nec
CTL	Bovine cattle, sheep and goats, horses	OMT	Meat products nec
C_B	Sugar cane, sugar beet	OSD	Oil seeds
EEQ	Electrical equipment	OTN	Transport equipment nec
ELE	Computer, electronic and optical products	OXT	Other Extraction (formerly ONM)
FMP	Metal products	PCR	Processed rice
FRS	Forestry	PDR	Paddy rice
FSH	Fishing	PFB	Plant-based fibers
GAS	Gas	PPP	Paper products, publishing
GDT	Gas manufacture, distribution	P_C	Petroleum, coal products
GRO	Cereal grains nec	RPP	Rubber and plastic products
I_S	Ferrous metals	SGR	Sugar
LEA	Leather products	TEX	Textiles
LUM	Wood products	VOL	Vegetable oils and fats
MIL	Dairy products	V_F	Vegetables, fruit, nuts
MVH	Motor vehicles and parts	WAP	Wearing apparel
NFM	Metals nec	WHT	Wheat
NMM	Mineral products nec	WOL	Wool, silk-worm cocoons
OAP	Animal products nec		

Annex III– Technical note

This annex summarizes the methods for the estimation of the AVEs at the HS 6-digits level. The estimation follows the methods of Kee and Nicita (2022) and includes additional NTMs data that has become recently available in the UNCTAD TRAINS database.

Data sources

The trade data used in the estimation originates from the UN COMTRADE database. The estimation makes use of product level data at the 6-digits level of the HS classification revision 5. The computation of AVE relies both on quantity and value trade data. Trade data is for the year 2017 to be consistent with the GTAP database. In cases for which trade data is missing, mirror data is used. The estimation does not consider observations where the value is less than 10 thousand US\$. Issues related to measurement errors are addressed by eliminating outliers identified by unreasonable unit values (values/quantity). In particular, the estimation does not consider observations where unit values are outside one standard deviation away from the median, or 50 times bigger/smaller than the median. Observations where reported quantity unit is not provided, or quantity unit is different form the general unit for that product are also dropped.

NTM data is from the UNCTAD NTM database and follows the international classification of NTMs: https://unctad.org/en/PublicationsLibrary/ditctab2019d5_en.pdf. For this analysis, NTM data is aggregated into a variable identifying the presence of border measures, as identified by the codes of Annex I. Non-tariff measure data also follows the 6-digit level of the HS classification revision 5.

Estimation of Ad-Valorem equivalents

The ad-valorem equivalents of NTMs provided in this database are based on the estimation method detailed in Kee and Nicita (2022), which in turn, builds on the seminal work of Kee, Nicita and Olarreaga (2009). As with most of the econometric literature estimating AVEs, the effects of NTMs on international trade are isolated using incidence measures of NTMs as explanatory variables. Following Kee and Nicita (2022), the AVEs are computed as the

equivalent tariff that would be necessary to impose in order to obtain the same proportionate change in quantity imported due to the presence of NTMs. In short, the estimation method seeks to identify the instantaneous semi-elasticity of trade with respect to differences in the observed tariffs and apply this elasticity to the estimated effects of NTMs on the quantity of trade. Bilateral variations in the AVEs estimates are calculated on the assumption that the trade costs associated with NTMs are a function of importers' and exporters' market power. The econometric model controls for issues related to the estimation of gravity type equations at the disaggregated level. The estimation is performed according to various econometric models (negative binomial, Poisson, zero inflated Poisson, zero inflated negative binomial and OLS) and estimates are based on the best model as identified by statistical tests (Pearson chi-squared, Vuong test and Akaike criterion). In particular, zero-inflated maximum likelihood estimation considers the large presence of zero in the bilateral trade statistics, while two-stage instrumental variable techniques address the endogeneity of tariffs and NTMs. In summary, the second stage quantity estimation equation takes the form:

$$\ln E\big(Q_{nij}|X\big) = \beta_n + \beta_{nij}^t t_{nij} + \beta_{nij}^{NTM} NTM_{nij} + \gamma Z_{ij} + e_{nji}$$

where $$\beta_{nij}^{NTM} = \beta_n^{NTM} + \beta_1^{NTM} share_{nj} + \beta_2^{NTM} share_{nij}$$

where Q denotes quantities, t tariffs, and NTM the presence of an NTM; and where n denotes products, i importing country and j exporting country. Bilateral variation of AVEs is provided by interaction terms (shares) and consists of two terms: market power of the exporter ($export_{jK}/wld\_trade_K$) and market power of the importing country ($import_{iK}/wld\_trade_K$). Z_{ij} are the standard gravity variables: the log of the gross domestic product (GDP) of the importer and the exporter, bilateral distance between the importer and the exporter, landlocked indicators for the importer and the exporter, and common border indicator. The calculation of the AVEs considers only beta coefficients with a significance of 5 percent or better. More details are provided in Kee and Nicita (2022).

In the original setup of Kee and Nicita (2022) the elasticity of trade with respect to tariff is:

$$\beta_{nij}^t = \frac{\partial \ln\big(E\big(Q_{nij}|X\big)}{\partial t_{nij}},$$

and the AVE measuring the ad-valorem tariffs that induce the same proportionate change in quantity as the presence of an NTM is:

$$AVE_{nij}^{NTM} = \frac{\exp(\beta_{nij}^{NTM}) - 1}{\exp(\beta_{nij}^{t}) - 1} \cong \frac{\beta_{nij}^{NTM}}{\beta_{nij}^{t}} \quad \text{for small } \beta_{nij}^{t} \text{ and } \beta_{nij}^{NTM} .$$

For this GTAP database the elasticities of trade are the ones used in the GTAP model. Therefore, the AVE at the GTAP product level (GTAP) is constructed as the trade weighted average β_{nij}^{NTM} divided by the import demand elasticities used by the GTAP model ($Elast_{GTAP}$)

$$AVE_{GTAPij}^{NTM} = \frac{\sum_{n=GT} \beta_{nij}^{NTM} trade_{nij}}{\sum_{n=GT} trade_{nij}} \Big/ Elast_{GTAP}$$

In summary, the AVEs is constructed as the proportionate change in quantity imported due to the presence of NTMs, divided the aggregated price elasticity of demand. To achieve consistency within the import demand elasticities of the GTAP model while retaining the heterogeneity of the AVEs at the product level the estimate impacts on quantities are aggregated at the GTAP-importer-exporter level using import weights. Aggregation from the HS level estimates and the GTAP aggregates are performed utilizing concordance tables available on the GTAP website.

References:

Ederington and Ruta (2016), Non-tariff Measures and the World Trading System; World Bank working paper 7661. https://doi.org/10.1596/1813-9450-7661.

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