The Global Trade Analysis Project (GTAP) Data Base: Version 12

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This paper provides an overview of the Global Trade Analysis Project (GTAP) Data Base, version 12 (hereafter referred to as GTAP 12). This latest version distinguishes 145 countries and 18 aggregate regions for 7 reference years (2004, 2007, 2011, 2014, 2017, 2019, and 2023) and details the annual value of economic flows, within and between economies, across 65 goods and services sectors at pre- and post-tax valuation. Central to this database are the bilateral trade and international transportation margin flows that link all countries/regions in the world. GTAP 12 also marks the first instance in which the land use and land cover (LULC) data, classified into 18 agro-ecological zones (AEZs), are incorporated into the standard database construction process, thereby resulting in consistent land information across all GTAP databases. This, along with the greenhouse gas emissions satellite data, will greatly facilitate the use of the GTAP framework in economy-wide studies of trade and environmental issues at the global and regional levels.

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1. Introduction

In 1992, during a very dynamic time for trade policy, the *Global Trade Analysis Project* (GTAP) was established (van Tongeren et al., 2017). One of the objectives of GTAP since its inception has been to lower the entry barriers for researchers and policy makers seeking to conduct quantitative analyses of international economic issues in an economy-wide framework. While initially focused on trade issues, GTAP has also become a key component of energy and environmental analyses at the global level following the addition of satellite datasets (i.e., data that complement the core database), particularly greenhouse gas emissions (GHGs) and land use/land cover data that supplement the standard GTAP Data Base.

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The GTAP Data Base is the centerpiece of the project and it is widely used by the global economic modeling community. The database provides a benchmark representation of the world economy for seven reference years between 2004 and 2023, and underlies most, if not all, global Computable General Equilibrium (CGE) models (Aguiar et al., 2019). The GTAP Data Base also serves as a benchmark equilibrium for the standard GTAP model (Corong et al., 2017).

The standard GTAP model is freely available and easy to modify and extend.[1] There are a variety of model extensions available on the GTAP website, under the technical paper series, and in the Journal for Global Economic Analysis. For a growing list of economic models calibrated to GTAP data, please refer to this GTAP web page. These models go beyond the analysis of trade issues to examine environmental and other economic issues at both national and global levels.

For each region in the database, GTAP provides information on values of production, intermediate, and final consumption of goods and services measured in millions of current U.S. Dollars (USD). Many domestic tax policies are also captured by GTAP, including value-added taxes, producer subsidies, and consumption taxes (Aguiar, Narayanan, and McDougall, 2016). All these data constitute an 'initial equilibrium' of domestic transactions, global bilateral trade patterns, international transport margins, and protection matrices upon which global CGE models are built.

Compared to the GTAP 11 Data Base, GTAP 12 provides 2 additional reference years (i.e., 2019 and 2023) and increases geographic coverage to 145 individual countries and 18 composite regions (compared to 141 countries and 19 composite regions in the GTAP 11 Data Base) to capture global economic activity—with the 145 individual countries accounting for 99.2% of world Gross Domestic Product (GDP) and 97.04% of world population.[2] Table A.1 reports new and updated countries in GTAP 12.

The sectoral coverage remains the same as in GTAP 11, with each country/region distinguishing 65 goods and services (see Table A.2 for a complete list of sectors in the standard database). In broad terms, GTAP classifies agriculture, food, resource extraction, manufacturing, and service activities to describe all economic sectors within each country as well as each of the 18 aggregate regions.[3]

The GTAP Data Base relies on country-based input output tables (IOTs) which capture inter-sectoral linkages within each country. Relative to GTAP 11 (Aguiar

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[1] For information about GTAP courses, please refer to the GTAP website.

[2] Composite regions aggregate countries by geographical location. During the construction cycle we strive to collect information for more than 200 countries.

[3] While several countries can provide very detailed input output tables (IOTs) that can be aggregated to represent the 65 sectors in GTAP, the majority of tables submitted by our data contributors are less than 65 sectors. Whenever necessary, we disaggregate sectors using a representative table, prior to the other adjustments. Corong (2024) provides information about the composition of the representative table.

et al., 2023), this latest version incorporates 4 new countries and updates 16 IOTs. The 4 new countries that have been disaggregated from previous regional aggregates are Angola, Burundi, Mauritania, and São Tomé & Príncipe. These additions have been made possible due to collaboration with African researchers and support from the United Nations Economic Commission for Africa (UNECA).

Figure 1 shows the country coverage of GTAP 12. Three shades of green are used to reflect existing countries in GTAP that are new or updated relative to the previous version. Dark green indicates a new country in GTAP 12, which was previously part of a regional aggregate. The lightest shade of green represents 16 existing countries with updated IOTs. The medium shade of green is for all other existing countries—i.e., those without an updated IOT. Finally, countries in beige are part of a regional aggregate.

New IOT   Updated IOT   Existing IOT   IOT part of regional aggregates
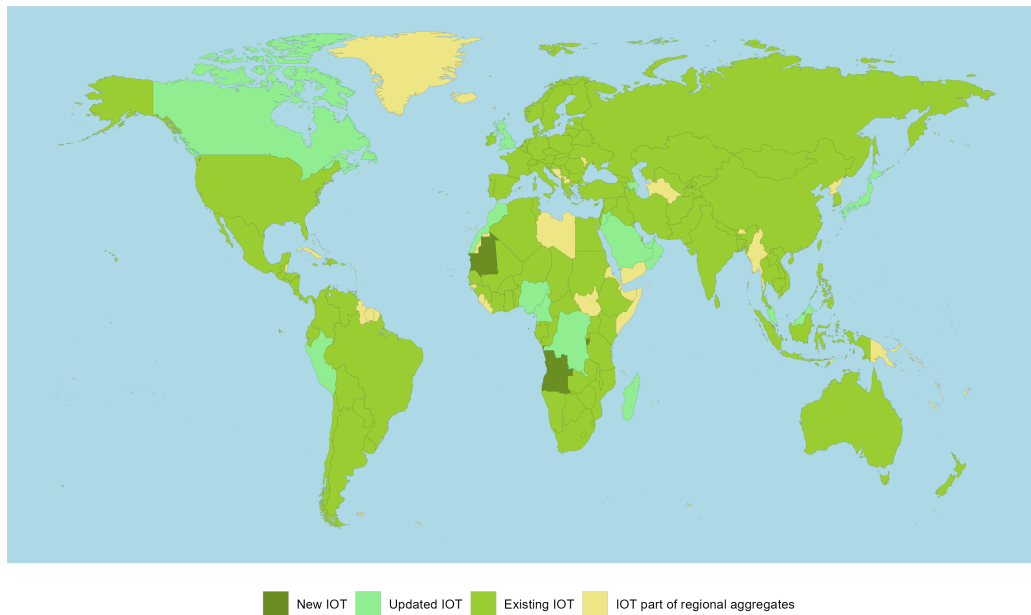
Figure 1. Regional coverage in GTAP 12.

Notes: Countries in green are part of GTAP 12. The darkest green indicates a country newly extracted from a composite region, based on newly available IOTs. The lightest green represents countries that have been updated for version 12. The medium shade of green is for existing countries with no IOT updates. Other countries (in beige) are represented in GTAP's 'Rest of' regions.

Source: GTAP 12 Data Base.

There are several new features of GTAP 12, which we summarize here, with additional details provided in Section 3. First, we include the following balance of payments elements: remittances, investment income, and foreign assistance. For each of these elements, we report unilateral inflows and outflows for each country/region. Capital stocks are now sourced from the International Monetary Fund

(IMF) instead of the Penn World Tables. Finally, the standard database is now aligned with the land use and land cover data (Baldos and Corong, 2025).

In addition, there are several database extensions and satellites that accompany the standard GTAP Data Base. Satellite data are additional files that do not alter the base data flows and are updated after the public release. The satellite datasets include:

- Energy volumes and CO_2 emissions (Chepeliev, 2024a,c),
- Bilateral time-series merchandise trade data (Gehlhar, 2026),
- Complementary greenhouse gas emissions (GHGs) (Chepeliev, 2024b) and air pollution (Chepeliev, 2021) accounts,
- Food balance sheets (Chepeliev, 2022a),
- Trade in services by mode of supply (Aguiar, 2026),
- GDP and population projections from the Shared Socio-economic Pathways (SSPs) (Simonato, 2025).

These files can be aggregated when placed alongside the main data files in each distribution.

The GTAP framework extensions have their own distribution and these models are accompanied by a modified database. Detailed information is available from the Satellite Data and Utilities page of the GTAP website. These model extensions include:

- Energy extension (GTAP-E documented in McDougall and Golub (2009)),
- Land use and cover (GTAP-LULC documented in Baldos and Corong (2025)),
- International migration and remittances (GMIG documented in Aguiar and Walmsley (2025)),
- Foreign income payment and receipts (GDYN documented in Golub (2016)),
- Electricity generation (GTAP-Power documented in Chepeliev (2020b)),
- Multi-region Input Output (MRIO described in Carrico, Corong, and van der Mensbrugghe (2020))
- Circular economy extension (GTAP-CE documented in Chepeliev et al. (2026)).

The release of GTAP 12 data will be announced on the GTAP website. Three formats will be distributed: (1) the standard format to match the nomenclature of the standard GTAP model (Corong et al., 2017); (2) General Algebraic Modeling System (GAMS) Data Exchange (GDX) containers for GAMS users—also using the conventions of the new standard format; and (3) the classic version of GTAP (Hertel, 1997) for backward compatibility.[4]

The standard format of the database is presented in Appendices 1 to 3 of Corong et al. (2017). These Appendices show the relationship between the classic and new

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[4] The latter is aimed at providing flexibility for researchers as they convert to the new standard format.

standard nomenclature in side-by-side tables. Among other things, the standard database includes a MAKE matrix to facilitate modeling of multi-product sectors, as well as accommodating multiple sectors producing the same commodity, e.g., electricity from multiple power generation sectors (Corong et al., 2017).

Those interested in accessing previous versions of the GTAP Data Base are referred to the Archive page where versions 1 to 10 can be downloaded for free.[5] The most recent versions of the Data Base are free to contributors (both data contributors and consortium members). Others are charged a fee, the revenue from which goes to support ongoing development of the GTAP Data Base.

The next section provides a summary of the data reconciliation procedure used in the construction of the GTAP Data Base. Section 3 discusses updates and new features of GTAP 12, while Section 4 presents a numerical illustration of the Data Base using the standard GTAP model Corong et al. (2017). The final section concludes with a brief discussion of future developments.

2. Data reconciliation

The GTAP Data Base uses international data to supplement individual country-level IOTs in order to reflect economy-wide relationships for each country/region in each of the 7 reference years. All IOTs representing each reference years and national currencies are adjusted to each GTAP reference year using market exchange rates and are reported in millions of U.S. dollars using macroeconomic data we collect from the World Development Indicators (WDI) (Benavidez et al., 2026). Thus, the first macroeconomic condition we impose is:

$$GDP = C + I + G + X - M \qquad (1)$$

where GDP is Gross Domestic Product, C is Private consumption, I is Investment or Gross fixed capital formation, G is Government consumption, X is Exports of goods and services, and M is Imports of goods and services. For exports and imports, GTAP relies on reconciled bilateral trade data for merchandise and services. Gehlhar (1997) documents the frequent discrepancies between countries' reported imports and what their partners report as exports, which causes world exports to differ from world imports (The Economist, 2011).

Given GDP and balanced trade, GTAP must adjust the other GDP expenditure-side aggregates (private consumption, government consumption, and investment) to ensure that equation 1 is satisfied in the initial equilibrium provided by the database.

Another macroeconomic condition that GTAP abides by is the condition that the savings-investment balance must equal the trade balance:

$$S - I = X - M \qquad (2)$$

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[5] Once version 12 is published, version 11 is retained, becoming freely available to the public once version 13 is released.

where *S* is Savings and *I* is Investment net of depreciation. Depreciation is assumed to be 4% of capital stock for all countries. Capital stock is estimated based on the perpetual inventory method using a time-series of investment flows from the WDI for 2023 and IMF (2021) for all other GTAP reference years.

Because exports and imports are also targeted in the GTAP Data Base construction, and investment must adjust to maintain GDP, the level of savings is computed as a residual. This is also the case in other GTAP data extensions such as the international labor migration extension (see GMIG, documented in Aguiar and Walmsley (2025)) and one of the dynamic extensions (GDYN, documented in McDougall et al. (2012); Golub (2016)) where other elements of the external accounts are considered such as net remittances and net foreign payments, respectively. In both of these datasets, the level of savings is also computed as a residual.

Since GTAP 12 reports foreign assistance flows (*AID*), remittances (*RM*), and foreign investment flows (*FY*), the user can further refine Savings in the standard version, without having to switch to one of the extensions mentioned above.[6] Header 'VBPF' contains the value of balance of payment flows. Considering the additional elements, the value of Savings can be recomputed from the following equation:

$$S - I = X - M + RM_{in} - RM_{out} + AID_{in} - AID_{out} + FY_{in} - FY_{out} \qquad (3)$$

Another long-standing feature of GTAP is its treatment of border protection data, which supersedes the tax information included in the contributed IOTs (McDougall, 2006). The protection data are composed of bilateral tariff information contributed by the International Trade Centre (ITC, 2021), agricultural domestic support from the OECD's Producer Support Estimates (OECD, 2021), and agricultural export subsidies based on World Trade Organization notifications (WTO, 2021).

The next section highlights the updates and new features related to data sources and methodologies used in constructing the GTAP 12 Data Base.

3. Updates and new features of GTAP 12

The sub-sections below highlight the new features, data sources, and methodologies used to revise each of the reference years contained in GTAP 12.

3.1 Country and sector coverage

Both the expansion and update of country level information in the GTAP Data Base are made possible through IOTs contributed by members of the GTAP network. In version 12, 4 new and 16 updated national IOTs have been incorporated.

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[6] Note that GTAP reports Savings net of depreciation, not Gross Savings. In general, Savings take a more prominent role in dynamic analyses. The level of the capital stock, depreciation, and savings can be adjusted by users where better data is available. As with other adjustments, we recommend the use of pre-simulations as explained in Malcolm (1998).

Table A.1 lists new and updated country information included in GTAP 12. For detailed treatment of each country database, refer to the Documentation page of the GTAP website. In addition, a complete listing of the countries/regions is available in the Appendix, Table A.3.[7]

For purposes of building a new time series database, beginning with the GTAP 10 release, we allocate IOTs to the closest reference year. This allocation is restricted to countries for which we have received IOTs for multiple years (see Table A.4). Table A.4 lists the countries for which we have two or more IOTs matching the closest reference year. For the remaining countries, however, a single IOT must be matched against all reference years. This deficiency highlights the need for a continuing stream of new IOT contributions and the important role that other international data sources have in updating IOTs for historical and future years. We regularly improve the collection and allocation of IOTs as information becomes available to us via contributions from researchers in the GTAP network, who help us improve the quality of the GTAP time-series data with country-specific knowledge.

Individual countries not represented in GTAP—i.e., countries without IOTs—are included in the 'Rest of' composite regions. In GTAP 12, the *Rest of South and Central Africa* region was removed because IOTs for Angola and São Tomé and Príncipe were contributed and are now separately reported.[8] In GTAP, composite regions are assigned an estimated IOT using neighboring countries' data using similarity in GDP per capita. They are then adjusted using information we collect from these countries as explained in Corong (2024). For Africa, there are four remaining aggregate regions: Rest of North Africa, Western Africa, Eastern Africa, and Rest of South African Customs Union.[9] We encourage the development of IOT statistics and look forward to increasing the number of individually-represented countries in the GTAP Data Base. For a summary of the history of GTAP data releases, please refer to Table A.5 in the Appendix.

The 65 sectors in GTAP are listed in Table A.2. For the Food and Agricultural sectors, Table A.6 shows the concordance between the United Nations (UN) Central Product Classification (CPC) version 2.1 and relevant GTAP sectors. Tables A.7 and A.8 display the concordances between the UN International Standard Industry Classification (ISIC) revision 4 and the GTAP sectors for manufacturing and services, respectively.

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[7] For information on all countries available in GTAP, refer to the Regional coverage page and the Detailed documentation for GTAP 12.

[8] The standard country list used in GTAP covers more than 200 countries.

[9] The Regional coverage page also provides the country composition of these regional aggregates.

3.2 Adjustments to Input-Output tables

After an IOT is contributed, the table is first checked and then cleaned for any remaining minor issues. For instance, the balance condition is checked based on a tolerance threshold. We also undertake cost structure comparisons against an average table and the previous table for the contributor country, if it exists. These balance check and data comparisons help reveal potential mapping issues and/or important structural changes. We also rely on regional experts to help us peer-review the contributed IOTs.

Inventory changes, or changes in stocks, are removed from IOTs as these are incompatible with the GTAP model theory, which is medium-run in nature. Tables with less than 65 GTAP sectors are disaggregated using a representative table. The IOTs are then adjusted with supplementary data, for example, macroeconomic accounts in millions of USD. Furthermore, some taxes (tariffs and export subsidies, for example) and value added are replaced with other internationally sourced data. Labor is split into five labor categories using data from the International Labour Organization (ILO).

Starting with GTAP 11, we use the Food and Agriculture Organization of the United Nations (FAO) data to target agricultural production for countries aiming to improve their representation (Chepeliev, 2020a). The following sub-sections explain other supplementary data.

3.2.1 Agricultural factor shares

The value-added shares for agricultural and resource commodities are adjusted and replaced. This allows us to report land and natural resources, since this information is not generally available from the contributed IOTs. Since GTAP 11, Saeed, Hertel, and Fuglie (2020) compiled a revised set of value-added cost shares obtained from the literature; they developed qualitative and quantitative comparisons, the latter of which was based on regression analysis to identify outliers that are excluded from GTAP.

Further in GTAP 12, we adopt the land use adjustment procedure, which reallocates land payments for crops, forestry, and nonruminant sectors prior to disaggregation of land rents across agroecological zones (Lee et al., 2005; Avetisyan, Baldos, and Hertel, 2011; Baldos and Corong, 2025). For countries with missing land cover and land use information in crop sectors (FAO, 2024), land payments are reallocated to capital while maintaining initial tax rates. In the forestry sector (frs), payments to natural resources are initially moved to land before final adjustments to land payments based on available land rent information (Sohngen et al., 2008). Finally, land payments in nonruminant livestock (oap) are reallocated to other sectors, and some payments to capital and labor in other sectors are transferred back to nonruminant livestock sector.

3.2.2 Labor splits

Initial versions of the GTAP Data Base only distinguished 3 primary factors, namely: land, capital, and labor. Between GTAP 4 and 8 Data Base, labor was disaggregated into skilled and unskilled categories based on econometric estimates by Liu et al. (1998). Since GTAP version 9, the labor flows have been disaggregated into 5 occupational categories (agricultural/unskilled workers, service workers, clerks, technicians/associate professionals, and officials/managers) based on Weingarden and Tsigas (2010) who processed wage and occupation data from the ILO to estimate imputed wages by occupation and industry using constrained optimization. Since GTAP 11, we updated Weingarden and Tsigas (2010) by using recently available and more detailed industry and occupation wage (respectively, by ISIC rev.4 and the International Standard Classification of Occupations—ISCO-08) from the ILO, to estimate imputed wages for reference years 2017 onwards (Corong, Pattawee, and Tsigas, 2022). For GTAP 12, the same methodology is used to update the reference years 2019 and 2023 (Corong and Pattawee, 2025).

3.2.3 Energy data

Energy data treatment continues to play an important role in the construction of the GTAP Data Base (McDougall and Chepeliev, 2021). Several important modifications are introduced to the new treatment of energy data, in part due to changes to the accounting of CO_2 emissions (Chepeliev, 2024c). Several data sources are considered. First, the extended energy balances developed by the International Energy Agency (IEA) are used as a core dataset to represent energy volumes (IEA, 2025b). While the latter reports over 150 countries, since there are 251 individual countries mapped to the GTAP regional classification, we further rely on the energy balances reported by the UN (UN, 2021) for complementary energy volume estimates. UN energy balances are less detailed than the IEA data but have greater country coverage.

Second, for a more consistent representation of the bilateral energy trade flows, we rely on data from the Energy Institute and British Petroleum (EI, 2025; BP, 2022) and the statistical office of the European Union (Eurostat, 2022). In combination with the United Nations Commodity Trade (UN-COMTRADE) flows, these are then used to bilateralize the unilateral trade data from IEA. These updates result in a more consistent representation of trade between key energy exporters and importers, and allow us to address the widely-recognized weakness of UN-COMTRADE in capturing energy trade (Bellora, Cotterlaz, and Thie, 2022).

Third, to convert energy volumes to value flows, price and tax data are needed. These should cover both domestic and international (exports and imports of energy commodities) markets. To estimate prices and taxes of energy commodities, we primarily rely on the IEA domestic energy prices and taxes dataset (IEA, 2025a). The latter reports data across multiple energy commodities and users, covering over 70 countries. We further complement this data with the estimates of export/im-

port prices of fossil fuels from the IEA and natural gas export price estimates from UN-COMTRADE, among other sources (Chepeliev, 2024c).

In addition, fossil-fuel consumption subsidies based on estimates from the IMF (for the pre-2010 period) and IEA (for the post-2010 period) data are integrated in the standard database following an approach developed in Chepeliev, McDougall, and van der Mensbrugghe (2018). IMF data has higher country coverage and is accompanied by both energy volumes and prices, making it more convenient to process. However, the data is not representative of some of the recent subsidy reforms, therefore, the IEA data is given a higher priority, if available (IEA covers the period starting from 2010). Since IEA reports subsidy estimates in constant prices, the US consumer price index is used to convert subsidy values to current prices, aligning with the GTAP valuations.

3.2.4 Emissions

Since GTAP version 5 (Lee, 2002), CO_2 emissions from fossil fuel combustion have been provided as an extension of the standard database. These have been estimated based on the Tier 1 method of the 1996 Intergovernmental Panel on Climate Change (IPCC) Guidelines (IPCC/OECD/IEA, 1996). However, a number of concerns regarding discrepancies between GTAP CO_2 emissions data and other international data sources, such as The Emissions Database for Global Atmospheric Research (EDGAR) and IEA, have been raised over time (Chepeliev, 2022b). To address the discrepancies, an emissions accounting framework based on Tier 1 method of the 2006 IPCC Guidelines has been implemented beginning with GTAP 11. This approach includes estimation of emission factors at a more granular commodity level. Two additional refinements include an updated accounting of emissions from blast furnaces and other recovered gases, as well as a more transparent treatment of CO_2 emissions from flaring. As shown in Chepeliev (2022b), this treatment substantially reduces the discrepancies between GTAP and other international data sources both at the global and country levels.

In addition to the CO_2 emissions from fossil fuel combustion, GTAP also reports complementary GHG and air pollutant emissions. GHG emissions are based on the combination of data from FAO (for the case of agricultural activities) and EDGAR (for all other activities) databases (Chepeliev, 2024b). The reporting covers four types of GHGs - CO_2 (from sources other than fossil fuel combustion), methane (CH_4), nitrous oxide (N_2O) and the group of fluorinated gases (F-gases). Each emission flow is associated with one of the four sets of emission drivers: output by industries, endowment by industries, input use by industries and consumption by households. Selected categories of land use GHG emissions are reported separately without association with emission drivers.

Data for air pollutants is sourced from the EDGAR database and mapped to GTAP economic flows using the same approach as for GHG emissions (Chepeliev, 2021). In addition to the non-land use sources, emissions from land use activities

are estimated by land cover type, based on the volume of burned biomass and emission factors. In the GTAP Data Base distributions, complementary GHG and air pollutant emissions are reported in a single data file. Global warming potentials (GWP) across multiple IPCC assessment reports are included in the database distribution, providing GTAP users an opportunity to perform conversion to CO_2-equivalents using either one of the provided GWP conversion factors or alternative approaches.

3.2.5 Protection data

GTAP accounts for several types of protection instruments. Bilateral import tariffs are included for all merchandise products for all countries represented in GTAP. For agricultural sectors, domestic support and export subsidies are taken into account for a selection of countries as data permits.

Tariff information consists of applied *ad-valorem* tariffs, including *ad-valorem* equivalents of specific tariffs and import quotas. Tariff data for reference years (2007, 2011, 2014, 2017, 2019, and 2023) at the 6 digit Harmonized System (HS6) level are provided by Mondher Mimouni and Xavier Pichot from the UN International Trade Centre (ITC).[10] For 2004 we use previously contributed data from Laborde (2010) based on ITC data. Trade weights, based on 3-year imports average, are used to aggregate HS6 level tariffs to the GTAP sector level (ITC, 2021).

MAcMap tariffs used in GTAP consider statutory tariffs, but exclude trade remedies which are trade policy measures that allow governments to impose remedial action against imports that cause material injury to a domestic industry. Typically, trade remedies can be of 3 types:

- anti-dumping measures, when imports are being sold domestically at an unfairly low price
- countervailing measures, when imports benefit from subsidies to compete abroad
- safeguard measures, when there are unforeseen increased imports

Trade remedies target specific trade partners, products, and even specific companies. As such, other remedial actions exist that are outside of the scope of the aforementioned 3 types of protection measures. While the US is the country that imposes the highest number of trade remedies, there are 77 other countries making use of these measures. For those interested in modeling trade remedies, we suggest the use of a CGE model like the GTAP model, to adjust tariffs so they represent existing trade remedies. The resulting updated data base is used for subsequent policy experiments (Malcolm, 1998).

Agricultural domestic support is based on the Producer Support Estimates (PSE) from the OECD (2021). These data are only available for Organisation for Economic

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[10] This is documented in https://www.macmap.org/en/about/methodology.

Co-operation and Development (OECD) countries and select non-OECD countries. The PSE is composed of Market Price Support (MPS) and budgetary transfers. MPS is an estimate of indirect transfers to producers that includes the accumulated impact of various policies, domestic price support, and border measures such as tariffs. As in previous versions of GTAP, since one of key elements of the Data Base is the tariff dataset, the MPS component of the PSE is excluded, leaving us to only consider the transfers to agricultural producers as explained in Huang (2013). We use the OECD's PSE data to update all reference years in GTAP 12. For European Union (EU) member countries, we rely on the contribution from the European Commission's Joint Research Centre (Boulanger, Philippidis, and Jensen, 2018) to disaggregate domestic support for each EU member country because the OECD only provides the EU as an aggregate. For the additional reference years of GTAP 12 (i.e., 2019 and 2023), we are still using 2017 rates because the OECD could no longer provide us with EU member information related to PSEs.

Agricultural export subsidies also rely on previous efforts by various GTAP researchers: for 2004 we use Elbehri and Narayanan (2010), for 2007 we use Laborde (2012), for 2011, 2014, 2017, and 2019 we benefit from the contributions of Kayode Ajewole and Jayson Beckman from U.S. Department of Agriculture (USDA), who collected notifications to the World Trade Organization (WTO) (Ajewole, Beckman, and Aguiar, 2023). For 2023, however, there were just 3 countries reporting: Brazil, Canada, and Korea, for which only the latter reports subsidies. For Türkiye and Morocco we use the subsidy rates reported for 2022. The WTO information on agricultural export subsidies supersede the information contained in the contributed IOT. When not available, GTAP reports the IOT tax/subsidy structure.

3.2.6 Merchandise trade data

Merchandise trade data are based on the UN-COMTRADE Statistics (UNSD, 2021) and the reconciliation of import and export reporters has been updated for all reference years using a new methodology at the HS6 level (Gehlhar, 2026). One of the objectives of the trade data reconciliation process is to ensure that re-exports are reassigned to the country of origin. Therefor, only domestically-produced exports are recorded.

Gehlhar (2017) explains that since version 10, a unified and comprehensive approach has been applied consistently across time in order to obtain this key element of the GTAP Data Base for all reference years. This new approach is applied to the UN-COMTRADE dataset for 231 countries, where the main objective is to produce balanced trade, i.e., world exports line up with world imports for each commodity. In addition to the discrepancies in countries' reporting of bilateal trade data, the increasing presence of re-exports presents a significant challenge. Trade data for more than 50 countries with re-exports are estimated by deriving domestic exports and by converting total imports into retained imports.

The UN-COMTRADE dataset is available at the 6-digit level of the Harmonized

System Classification. We use a concordance between the HS6 and GTAP sectors to aggregate the HS6 flows.[11]

3.2.7 Services trade data

Prior to GTAP 11, trade in services data was based on unilateral services trade statistics from the IMF, which we had to bilateralize in-house (McDougall, 2002; McDougall and Hagemejer, 2006; Lejour, van Leeuwen, and McDougall, 2010). This data was bilateralized using the RAS method in versions 3, 4 and 5, then improved by using additional sources of services trade data such as OECD and Eurostat, in versions 6 to 10. Since GTAP 11, we take advantage of a dataset provided by the OECD and WTO called the Balanced Trade in Services (BaTiS) (Liberatore and Wettstein, 2021), which provides an initial bilateralization that does not need to be reconciled. The starting point for BaTiS is the trade in services dataset developed jointly by the WTO and the United Nations Conference on Trade and Development (WTO-UNCTAD). BaTiS provides time series data from 2005 to 2023 covering 200 economies and the services sector is classified into 12 service categories based on the 2010 extended balance of payments services (EBOPS) classification (Liberatore and Wettstein, 2021), see Table 1.[12]

Table 1. BaTiS services and its correspondence to GTAP's services sectors.

BaTiS services description	GTAP services codes
Manufacturing services on physical inputs owned by others	n/a
Maintenance and repair services n.i.e.	trd
Transport	atp, wtp, otp, whs, cmn
Travel	trvl, hht, edu, afs
Construction	cns
Insurance and pension services	ins
Financial services	ofi
Charges for the use of intellectual property n.i.e.	n/a
Telecommunications, computer, and information services	cmn
Other business services	obs, trd, rsa
Personal, cultural, and recreational services	cmn, hht, edu, ros
Government goods and services n.i.e.	osg

Notes: n.i.e. Not included elsewhere; n/a is not available; trvl is not a sector in GTAP, but is a code assigned for the special treatment of traveler's expenditures.

Source: The Balanced Trade in Services (BaTiS) is documented in Liberatore and Wettstein (2021).

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[11] The concordances used in GTAP are available in https://www.gtap.agecon.purdue.edu/resources/res_display.asp?RecordID=5111.

[12] Since BaTiS is not available for 2004, the earliest reference year for GTAP, we select 2005 which is the closest year for all but two countries. We then apply GDP weights to obtain an estimate for 2004. For Serbia and Montenegro, the earliest available year in BaTiS is 2006.

Using the BaTiS bilateral balanced data is convenient, however the sectoral coverage does not map exactly to GTAP's 20 services sector. There are 4 GTAP services that are not covered by BaTiS, these are: electricity, gas distribution, water supply, and ownership of dwellings. As in previous versions, for these and the other energy sectors including electricity and gas distribution, energy trade data is constructed using data from IEA as documented in Chepeliev (2024c). The two remaining sectors of water supply (wtr) and dwellings (dwe) are not targeted.

In addition, there are two sectors provided in BaTiS that we do not consider: manufacturing services on physical inputs owned by others and the charges for the use of intellectual property not included elsewhere (n.i.e). In the first case, the information is not utilized because the breakdown by type of manufacturing services (i.e., whether it is assembly or packaging) is unknown, as well as the economic sectors from which it originates (i.e., motor vehicles or machinery). For the latter, we follow previous treatments that consider royalties to be an income flow rather than a trade flow. As such, this information is also discarded because we consider it as a factor payment (McDougall and Hagemejer, 2006).

Table 1 lists the mapping between BaTiS and GTAP. For the following BaTiS sectors there is a one-to-one correspondence with a GTAP service. For example, Construction (cns), Insurance (ins), Financial services (ofi), and Government services (osg).

The remaining sectors in BaTiS are sometimes too aggregated for GTAP. In order to disaggregate the sectors in BaTiS, we use another recently developed dataset that focuses on services trade. This is called the Trade in Service data by Mode of Supply (TiSMoS), which provides more detailed information, but is not bilateral (Wettstein et al., 2021). TiSMoS is a dataset produced by the WTO and funded by the Directorate-General for Trade of the European Commission (Wettstein et al., 2021).[13]

TiSMoS also uses the WTO-UNCTAD data set as a starting point for the measurement of resident to non-resident transactions. It is developed with the objective of providing another analytical dimension to the information available to the public—namely, the mode of supply dimension. The dataset covers 200 countries or regions for the period 2005-2022, which is classified by the four modes of supply per General Agreement on Trade in Services (GATS) definition: cross-border supply (mode 1), consumption abroad (mode 2), commercial presence (mode 3), and presence of natural persons (mode 4).

The sectoral coverage of TiSMoS is very detailed; it covers 55 sectors (similar to the EBOPS classification) and 4 different modes. We use TiSMoS to disaggregate BaTiS sectors considering the sum of all modes, except Mode 3. Table A.9 lists the BaTiS sectors that are disaggregated using TiSMoS. Table A.9 also includes the

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[13] Another possible data source is the International Trade in Services Statistics by the OECD, which is bilateral but with emphasis on OECD member countries.

concordance between the disaggregated sector and GTAP. Traveler's expenditures (trvl) is not a sector in GTAP but is accounted for by allocating these expenditures as direct trade among countries using private consumption information (McDougall and Hagemejer, 2006). This is a simplifying assumption due to the lack of better data, and the reason why the GTAP Data Base may sometimes report trade in water supply between distant countries, even though there is no target for trade in water supply from BaTiS.

4. Numerical illustration

In this section, we provide an illustrative application of the GTAP 12 Data Base using the standard GTAP model (Corong et al., 2017) to quantify the economic impacts of global tariff policy changes. For this application, we aggregate the GTAP 12 Data Base into 48 sectors and 14 regions (see Appendix tables A.10 and A.11, respectively), which, among others, include the US, China, East Asia, EU, Canada, and Mexico.

We evaluate four policy scenarios. The first three tariff policy scenarios analyze the economic impacts of unilateral actions, bilateral escalation, full global escalation against the US, and the fourth scenario complements the analysis by considering a return to multilateralism. The four scenarios are:

I.   The US imposes tariffs on all countries without retaliation
II. Scenario I plus tariff retaliation by China against the USA
III. Scenario II plus tariff retaliation by all other countries against the USA
IV. Tariff elimination in all countries including the USA

The tariff shocks in Scenario I are based on the tariff tracker by Pattawee (2025). and Pattawee, Corong, and Aguiar (2025) who processed the United States International Trade Commission's (US ITC) Harmonized Tariff Schedule (HTS) and customs data at the 8-digit level, before aggregating them to GTAP sectors. Using legal texts and customs trade data, Pattawee, Corong, and Aguiar (2025) employ a Natural Language Processing procedure to extract sectoral and country-specific tariff rates—including ad-valorem, unit rates, specific and mixed duties, trade agreements, preferential and special programs—from unstructured HTS legal texts into a bilateral tariff matrix of all US trading partners. In turn, the sectoral and country-specific tariff rates from HTS are combined with US customs data to calculate the changes in ad-valorem tariff rates that were announced and imposed by the US as of November 2025 relative to their 2023 levels. The latter year was chosen for consistency with sectoral and bilateral tariff rates in the GTAP 12 Data Base. For scenarios II and III, China and all countries bilaterally retaliate against the US by implementing the same commodity-specific bilateral tariff increases imposed on them by the US. Scenario IV simulates a global tariff elimination scenario by removing all tariff rates in the GTAP 12 Data Base.

To better understand the economic impacts of the tariff scenarios described

above, we first analyze the structure of the global economy in the GTAP 12 Data Base prior to the tariff policy changes by the US in 2025. Table 2 summarizes the trade and GDP shares at the global level, while also highlighting three integrated regional economies: an Asian bloc composed China, Japan, Korea and all Southeast Asian countries (ESEA); a North American bloc composed of the United States, Canada and Mexico (USA, CAMX); and a European bloc (EUR) composed of 27 EU member countries, United Kingdom, and the European Free Trade Area countries such as Switzerland, Norway, Iceland, and Liechtenstein.

In Table 2, the row headings identify exporters while the column headings identify importers. Entries along the row show the share in global exports from a country of origin (identified in the row headings) going to a destination country or region (identified in the column headings). Similarly, entries down the column show the share in global imports purchased by a country or region identified in the column headings, from a country or region identified in the row headings. The column heading 'Share in World Exports' represents the share in total global exports originating from a country or region, while the row heading 'Share in World Imports' represents the share in total global imports purchased by a country or region.

In general, tariff rates are relatively low, with a global weighted average of 1.9%. Compared to this global average, the European and North American blocs imposed relatively lower average tariff rates of 1% and 1.4% in 2023 (the latter is calculated as weighted average of 0.7% and 1.8% for USA and CANMX), while the Asian Bloc and the rest of the world imposed slightly higher average tariff rates of 3.3% and 2.3% respectively in 2023. Across blocs, ESEA imposes the highest average tariff rates of 3.1% and 2.7% on imports from North America and Europe respectively. In contrast, the European bloc imposes a lower average tariff of 2.4% and 0.3% on imports from Asia and North America, respectively. As expected, the within-bloc average tariffs are remarkably low with tariffs close to zero for Europe, 0.3% in North America and 1.1% within the Asian bloc.

Table 2. Bilateral trade and GDP shares, in %.

Region	ESEA	USA	CAMX	EUR	ROW	Share in World Exports	Share in Global GDP	Exports to GDP Ratio
ESEA	9.8	4.3	0.9	4	7	26	26.6	0.24
USA	2.1	0	2.3	2.7	2.3	9.3	26	0.09
CAMX	0.4	3.6	0.2	0.4	0.4	5	3.7	0.33
EUR	3.2	3.7	0.6	24.3	5.4	37.1	21.9	0.41
XTW	7.2	2.5	0.4	5.2	7.3	22.6	21.9	0.25
Share in World Imports	22.7	14.1	4.3	36.6	22.3	100	100	0.24

Notes:
(a) ESEA-East and South East Asia (includes China, Japan, Korea and all South East Asian countries); USA-United States of America; CAMX-Canada and Mexico; EUR-West Europe (includes the European Union, United Kingdom. Switzerland, Norway and European Free Trade Association countries; ROW-Rest of the World;
(b) The row headings represent exporters while column headings represent importers. Entries along the row show the share in global exports from a country of origin (identified in the row headings) going to a destination country or region (identified in the column headings). Similarly, entries down the column show the share in global imports purchased by a country or region identified in the column headings, from a country or region identified in the row headings;
(c) The column heading "Share in World Exports" represents the share in total global exports originating from a country or region, while the row heading "Share in World Imports" represents the share in total global imports purchased by a country or region;
(d) GDP shares indicate a country or region's share in World GDP;
(e) Export to GDP Ratio is calculated as Total Exports divided by GDP for each country or region.

Source: GTAP 12 Data Base.

Table 3 also shows the average tariff rates imposed by the US in 2025, as of November, in parentheses. These tariffs raised the US average tariff rate to 13.5% and boosted the global average tariff rate to 3.5%. The Asian bloc faces the highest increase, with average tariff rates on their exports to the US rising from 2.2% to 30.6%, followed by Europe (1.1 to 15.6%), Canada and Mexico (0.1 to 6.3%), and the rest of the World (1.1 to 11.7%).

Table 3. Bilateral tariffs in %.

Region	ESEA	USA	CAMX	EUR	ROW	Average Tariff Faced
ESEA	1.1	2.2 (30.6)	5.9	2.4	7.3	3.3 (5.6)
USA	2.8	0	0.7	0.9	3.1	1.8
CAMX	3.7	0.1 (6.3)	0.2	0.1	3.8	0.7 (5.5)
EUR	2.7	1.1 (15.6)	0.6	0.0	4	1.0 (2.0)
ROW	2.6	1.1 (11.7)	4.2	0.8	3.4	2.3 (3.5)
Average Tariff Imposed	2.0	1.2 (13.5)	2	0.5	4.7	1.9 (3.5)

Notes:
(a) ESEA-East and South East Asia (includes China, Japan, Korea and all South East Asian countries); USA-United States of America; CAMX-Canada and Mexico; EUR-West Europe (includes the European Union, United Kingdom. Switzerland, Norway and European Free Trade Association countries including Iceland and Liechtenstein; ROW-Rest of the World;
(b) The row headings identify exporters while column headings identify importers. Entries down the column show tariffs imposed by a country or region (identified in the column headings) on imports from a country or region of origin (identified in the row headings);
(c) The column heading 'Average Tariffs Faced' shows the weighted average tariff rate imposed on a country or region identified in the row headings, while the row heading 'Average Tariffs Imposed' shows the weighted average tariff rate imposed by a country or region identified in the column headings;
(d) Numbers in parentheses reflect tariff rates imposed by the US as of November 2025.

Source: GTAP 12 Data Base.

Figure 2 shows the global economic effects of the four scenarios, constructed as perturbations from the 2023 GTAP 12 framework. In this figure, we first look at the changes in real GDP and GDP price index at the global level as an overall measure of global economic activity and production cost, then turn to variations in global exports volume and exports price index to evaluate the impacts on global trade.

Global GDP contracts in the three protectionist scenarios, falling by 0.2% in Scenario 1 when the US unilaterally imposes higher tariffs. The contraction in global economic activity increases further in Scenarios II (0.21%) and III (0.3%) when China and the rest of the world retaliate against tariffs imposed by the US. While the global GDP contraction in the three protectionist scenarios may seem modest in percentage terms, they are relatively large in real terms with real GDP reductions equivalent to $217 billion in Scenario I, $228 billion in Scenario II, and $330 trillion in Scenario III. Much of the reduction in GDP is driven by falling exports as higher tariff protection not only dampens trade but also leads to higher production costs as indicated by rising GDP price indices (Figure 2). Indeed, the magnitude of the export volume reduction is striking, falling by 3.6% ($976 billion), 3.8% ($1 trillion), and 4.7% ($1.3 trillion) in the three protectionist scenarios, respectively. In contrast, the tariff-free scenario IV leads to lower production costs and falling export prices (0.6 and 0.4% respectively), which in turn raises both global GDP (0.13%, $139 bil-

lion) and exports (3.6%, $967 billion).
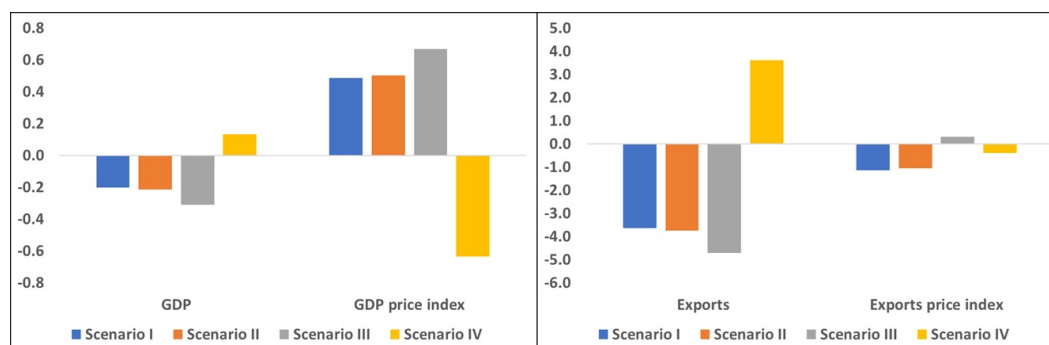
Figure 2. Global results (% change from base).

Notes:
(a) GDP-weighted percent change in real GDP at the global level;
(b) GDP price index-weighted percentage change in GDP price indices at the global level;
(c) Exports-weighted percent change in exports volume at the global level;
(d) Exports price index-weighted percentage change of commodity export prices at the global level;
(e) Scenario I-The US imposes tariffs on all countries without retaliation, Scenario II-Scenario I plus tariff retaliation by China against the USA; Scenario III-Scenario II plus tariff retaliation by all other countries against the USA; Scenario IV-Tariff elimination in all countries including the USA.

Source: Authors' calculation

The global results discussed above suggest that the contraction in global economic activity is mainly driven by international trade disruptions as countries impose higher tariffs. However, the modest percentage change reductions at the global level masks the substantial distributional impacts across regional blocs as shown in Figure 3. In this figure, we present the regional bloc-level changes in real GDP as a measure of economic activity, terms of trade which reflects the price of exports relative to imports, global exports and imports volume, as do exports price and import price indices to evaluate the impact on trade.

Figure 3 shows that much of the decline in imports and exports under all protectionist scenarios emanate from the US where tariff-inclusive import prices go up significantly. In turn, higher imported intermediate input prices drive up production costs, thereby resulting in higher exports prices and lower demand for US exports in the international market. Because of these changes, US exports and imports volume fall by between 20% and 37%.

Despite an improvement in the terms of trade, the US experiences the sharpest output loss in all of the protectionist scenarios, with GDP falling between 0.7% and 0.9% in Scenarios I to III. While China, EASEA (East Asia and South East Asia) and Europe also experience a contraction in economic activity, they are relatively smaller, with GDP deviations ranging between 0.02% and 0.33%.

In all protectionist scenarios, trade volumes generally decline in the major trading blocs except for Canada and Mexico owing to trade diversion effects—i.e., trade

links reorganize around these two countries. Canada and Mexico benefit from their proximity and integration with the US market as their combined exports and imports go up. Thus, their GDP rises by roughly 0.3% in the protectionist scenarios.

Results from the tariff elimination case (Scenario IV) are in stark contrast to the protection scenarios discussed above: the major trading blocs and the rest of the world register an expansion in GDP and trade volumes, owing to declining import prices and production costs that in turn translate to lower exports prices. Once again, Canada and Mexico stand out with a greater GDP, export and import gains relative to all regions.
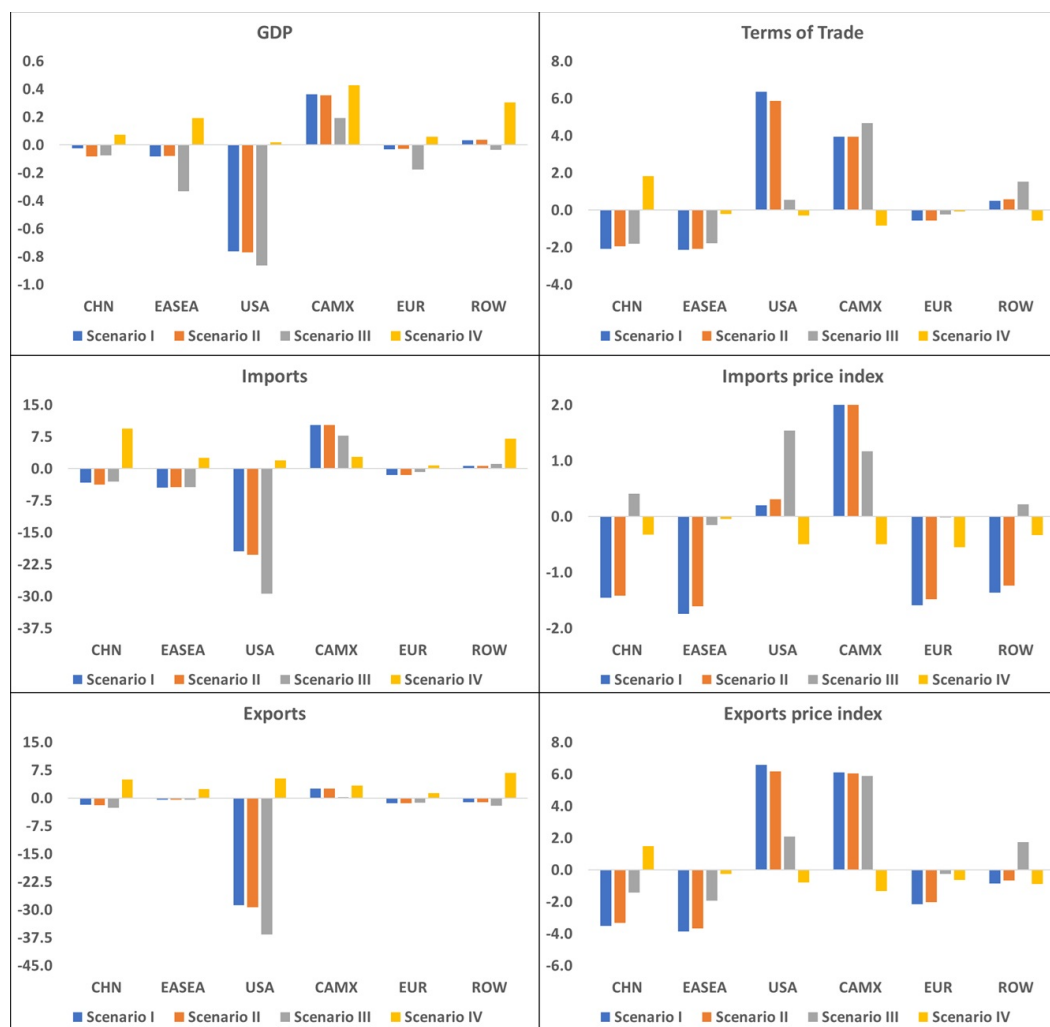
Figure 3. Macro results by aggregate region (% change from base).

Notes:
(a) CHN-China; EASEA-East and South East Asia (includes Japan, Korea and all South East Asian countries); CAMX-Canada and Mexico; EUR-West Europe (includes the European Union, United Kingdom. Switzerland, Norway and European Free Trade Association countries including Iceland and Liechtenstein; ROW-Rest of the World;
(b) GDP-weighted percent change in real GDP;
(c) Terms-of-Trade-percent change in export price index less percent change in imports price index;
(d) Exports-weighted percent change in exports volume;
(e) Exports price index-weighted percentage change of commodity export prices;
(f) Imports-weighted percent change in imports volume;
(g) Exports price index-weighted percentage change of commodity import prices;
(h) Scenario I-The US imposes tariffs on all countries without retaliation, Scenario II-Scenario I plus tariff retaliation by China against the USA; Scenario III-Scenario II plus tariff retaliation by all other countries against the USA; Scenario IV-Tariff elimination in all countries including the USA.

Source: Authors' calculation.

Finally, Table 4 shows that global exports volume increases by 900 billion dollars in the tariff elimination case (Scenario IV), with each bloc registering more than 100 billion dollar additional export earnings. While intra-regional trade marginally declines within each bloc, these reductions are more than offset by higher export earnings from increased market access in other blocs. In summary, the results in Scenario IV confirm the potential gains from trade and economic expansion that could be realized from a return to multilateralism.

Table 4. Change in bilateral trade volumes under tariff elimination (Scenario IV: in billions, US Dollars) .

Region	ESEA	USMCA	EUR	ROW	Total Exports
ESEA	-48.3	28.8	62.5	204.7	247.7
USMCA	83.1	-12.5	54.6	46.8	172
EUR	139	21.4	-126.7	72.6	106.3
ROW	152.5	58.9	82.1	97.6	391.1
Total Imports	326.4	96.6	72.5	421.7	917.2

Notes:
(a) ESEA-East and South East Asia (includes China, Japan, Korea and all South East Asian countries); USMCA-USA, Canada and Mexico; EUR-West Europe (includes the European Union, United Kingdom. Switzerland, Norway and European Free Trade Association countries including Iceland and Liechtenstein; ROW-Rest of the World;
(b) The table shows the bilateral trade volumes, in US dollar equivalent terms;
(c) The row headings represent exporters while column headings represent importers. Entries along the row show the exports volume from a region of origin (identified in the row headings) going to a destination region (identified in the column headings), in US dollar equivalent. Similarly, entries down the column show the imports purchased by a region identified in the column headings, from a region identified in the row headings, in US dollar equivalent;
(d) The column heading 'Total Exports' shows the total global exports volume, while the row heading 'Total Imports' shows the total global imports volume.

Source: Authors' simulations using the GTAP 12 Data Base and the standard GTAP model.

5. Summary and future developments

The geographic coverage of the GTAP 12 Data Base has increased to 163 regions, comprising 145 individual countries and 18 composite regions. With the addition of 4 new countries in Africa, we have been able to eliminate one composite region relative to GTAP 11.

GTAP relies on contributed datasets from a large network of individuals, GTAP Board member agencies, and institutions from around the world. The increasing representation of countries and sectors in GTAP depends on data availability. For instance, 16 IOTs have been updated for GTAP 12, but for a few international data sets we are relying on earlier data, including EU agricultural domestic support based on 2017 rates and agricultural export subsidy rates based on 2022 reports.

To improve the time-series dimension of the GTAP 12 Data Base, continuous development and contribution of IOTs is critical in order to capture structural changes

over time. For historical reference years (i.e., 2004, 2007, 2011, 2014, 2017, and 2019), we rebuild the GTAP 12 with the latest methodologies and updated inputs. For example, the 2017 reference year available in GTAP Data Bases versions 11 and 12 will show differences owing to new sources for services trade data, different treatments of the energy data, or perhaps the IOT was updated for GTAP 12. However, the methodology for GTAP 12 are consistent across all reference years, allowing this to be used for time series analysis.

Further improvements to the GTAP Data Base are also influenced by the quality and availability of international data sources. Our objective is to reconcile available information, with the primary aim of improving initial country data to meet the requirements of global economic modeling. The snapshot of the world economy that we have constructed should be extended to better meet the needs of research and policy objectives. Greater emphasis in the future could be placed on country-specific analyses wherein additional data and insights can be brought to bear.

Since GTAP 11, the services trade data now rely on new sources (Liberatore and Wettstein, 2021; Wettstein et al., 2021). If these data sources are maintained and expanded, we can consider expanding the GTAP services sectoral resolution. These and other examples highlight the particular importance of consistent maintenance and regular updates of the key data sources developed by statistical agencies and other agencies around the world.

To complement GTAP 12, several data extensions will be updated for subsequent release after the public release of GTAP 12. Important extensions of the GTAP Data Base include: a version of GTAP with explicit domestic transport, wholesale and retail margins (Corong, 2018), the energy and environmental extension (GTAP-E documented in McDougall and Golub (2009)), that tracks CO_2 emissions, the international migration and remittances extension (GMig2 documented in Aguiar and Walmsley (2025)), the land use and cover extensions (GTAP-AEZ documented in Baldos and Corong (2025)), the foreign income payment and receipt data extension (GDYN documented in Golub (2016)), the disaggregation of the electricity sector (GTAP-POWER documented in Chepeliev (2020b)) and the Multi-Regional Input-Output (MRIO) extension described in Carrico, Corong, and van der Mensbrugghe (2020). In addition, we expect to release the bilateral time series trade data (Gehlhar, 2026), food balance sheets (Chepeliev, 2022a) and the circular economy extension (GTAP-CE) (Chepeliev et al., 2026) in the coming months.

Improving and enhancing the GTAP Data Base is a continuous process that has been underway since its first release more than 30 years ago. Over this period, the number of represented countries and sectors has been greatly expanded, multiple reference years have been incorporated and additional socio-economic and environmental dimensions have been addressed. This has led to an exponential growth in the number of GTAP users and the topics addressed by this community. Ongoing and emerging policy challenges continue to push the data and methodological frontiers, requiring further developments to allow for the comprehensive

support needed for policy analyses and improved decision-making. In an attempt to provide a more refined approach to the reconciliation and merging of multiple datasets within the GTAP framework, we are constantly exploring new datasets that can be used to complement current procedures. One such example is the potential for using the statistics provided by the UN Industrial Development Organization (UNIDO) to target the production of manufactured goods in GTAP, similar to the approach currently used for agriculture. This would provide a better representation of output across these sectors of the economy.

There is an inherent tension between GTAP's mandate to support global analysis and the potential for additional sectoral resolution. Nonetheless, GTAP continues to push boundaries in this area, in response to emerging policy needs. In light of the rapid evolution of the energy transition landscape, changing domestic policies and emerging critical minerals supply chains is one recent example where added sectoral detail is required (Ku et al., 2024; Reich and Simon, 2025). To facilitate deeper analysis in this area, a version of the GTAP Data Base with a detailed representation of the critical mineral supply chains, including both upstream and downstream activities, is currently under development (Chepeliev et al., 2025).

The livestock sector is another essential part of the economy that supports many livelihoods, but is also associated with substantial environmental impacts, including significant land, water, and GHG emissions footprints (Herrero et al., 2015; Halpern et al., 2022). To permit a better quantification of the heterogeneous livestock production practices and their role in future agri-food transition policies, further disaggregation of these sectors in the data base is being undertaken (Chepeliev et al., 2024). Moreover, additional efforts are underway to further extend the GTAP Data Base by incorporating details of the biofuel production and consumption processes. Finally, a more refined representation of service sectors is being undertaken. This is important since services now represent the majority of employment and economic activity in most economies and this sector is also an increasingly important element of international trade (UNCTAD, 2025).

With the rise of new technologies and an ever-evolving policy landscape, the requirements for comprehensive decision-support systems, like the GTAP framework, need to continually adapt and expand. Efforts to provide additional sectoral detail, the continuous expansion of our geographical coverage, and more frequent database releases, are all part of GTAP's efforts aimed at supporting the evolving needs of the global economic policy analysis community.

Acknowledgements

References

Aguiar, A., M. Chepeliev, E. Corong, and D. van der Mensbrugghe. 2023. "The Global Trade Analysis Project (GTAP) Data Base: Version 11." *Journal of Global Economic Analysis*, 7(2). doi:10.21642/JGEA.070201AF. https://jgea.org/ojs/index.php/jgea/article/view/181.

Aguiar, A., M. Chepeliev, E.L. Corong, R. McDougall, and D. van der Mensbrugghe. 2019. "The GTAP Data Base: Version 10." *Journal of Global Economic Analysis*, 4(1): 1–27. doi:10.21642/JGEA.040101AF. https://jgea.org/ojs/index.php/jgea/article/view/77.

Aguiar, A.H. 2026. "Services Trade Data." In *Global Trade, Assistance, and Production: The GTAP 12 Data Base*, edited by A. H. Aguiar. Department of Agricultural Economics, Purdue University, West Lafayette, IN, Documentation chapter 10B.

Aguiar, A.H., B. Narayanan, and R. McDougall. 2016. "An Overview of the GTAP 9 Data Base." *Journal of Global Economic Analysis*, 1(1): 181–208. doi:10.21642/JGEA.010103AF. https://jgea.org/resources/jgea/ojs/index.php/jgea/article/view/23.

Aguiar, A.H., and T. Walmsley. 2025. "GTAP-Migration (GMig2) for GTAP 11." Global Trade Analysis Project (GTAP), Department of Agricultural Economics, Purdue University, West Lafayette, IN, GTAP Research Memorandum No. 38. https://doi.org/10.21642/GTAP.RM38.

Ajewole, K., J. Beckman, and A.H. Aguiar. 2023. "Agricultural Export Subsidies." In *Global Trade, Assistance, and Production: The GTAP 11 Data Base*, edited by A. H. Aguiar. Center for Global Trade Analysis, Department of Agricultural Economics, Purdue University, West Lafayette, IN: Global Trade Analysis Project (GTAP). https://www.gtap.agecon.purdue.edu/resources/res_display.asp?RecordID=7115.

Avetisyan, M., U.L. Baldos, and T. Hertel. 2011. "Development of the GTAP 7 Land Use Data Base." Global Trade Analysis Project (GTAP), Department of Agricultural Economics, Purdue University, West Lafayette, IN, GTAP Research Memorandum No. 19. https://doi.org/10.21642/GTAP.RM19.

Baldos, U.L., and E. Corong. 2025. "Development of GTAP version 11 Land Use and Land Cover database for years 2004, 2007, 2011, 2014 and 2017." Global Trade Analysis Project (GTAP), Department of Agricultural Economics, Purdue University, West Lafayette, IN, GTAP Research Memorandum No. 39. https://doi.org/10.21642/GTAP.RM39.

Bellora, C., P. Cotterlaz, and M. Thie. 2022. "Trade datasets are not the right starting point to discuss trade in natural gas." CEPII. http://www.cepii.fr/BLOG/en/post.asp?IDcommunique=929.

Benavidez, L., M.S. e Pereira, Y. Inoue, and A.H. Aguiar. 2026. "Macroeconomic Data." In *Global Trade, Assistance, and Production: The GTAP 12 Data Base*, edited by A. H. Aguiar. Department of Agricultural Economics, Purdue University, West Lafayette, IN: Global Trade Analysis Project (GTAP).

Boulanger, P.H., G. Philippidis, and H.G. Jensen. 2018. "Domestic Support in the European Union." In *Global Trade, Assistance, and Production: The GTAP 10 Data Base*, edited by Center for Global Trade Analysis. Department of Agricultural Economics, Purdue University, West Lafayette, IN: Global Trade Analysis Project (GTAP). https://www.gtap.agecon.purdue.edu/resources/res_display.asp?RecordID=5948.

British Petroleum (BP). 2022. "Statistical Review of World Energy." British Petroleum, june 2022 ed. https://www.bp.com/en/global/corporate/energy-economics/statistical-review-of-world-energy.html.

Carrico, C., E. Corong, and D. van der Mensbrugghe. 2020. "The GTAP 10A Multi-Region Input Output (MRIO) Data Base." Global Trade Analysis Project (GTAP), Department of Agricultural Economics, Purdue University, West Lafayette, IN, GTAP Research Memorandum No. 34. https://www.gtap.agecon.purdue.edu/resources/res_display.asp?RecordID=6164.

Chepeliev, M. 2024a. "CO2 Emissions from Fossil Fuels Combustion." In *Global Trade, Assistance, and Production: The GTAP 11 Data Base*, edited by A. H. Aguiar. Center for Global Trade Analysis, Department of Agricultural Economics, Purdue University, West Lafayette, IN: Global Trade Analysis Project (GTAP). https://www.gtap.agecon.purdue.edu/resources/res_display.asp?RecordID=7130.

Chepeliev, M. 2024b. "Complementary Greenhouse Gas Emissions Database." In *Global Trade, Assistance, and Production: The GTAP 11 Data Base*, edited by A. H. Aguiar. Center for Global Trade Analysis, Department of Agricultural Economics, Purdue University, West Lafayette, IN: Global Trade Analysis Project (GTAP). https://www.gtap.agecon.purdue.edu/resources/res_display.asp?RecordID=7131.

Chepeliev, M. 2021. "Developing an Air Pollutant Emissions Database for Global Economic Analysis." *Journal of Global Economic Analysis*, 6(2): 31–85. doi:10.21642/JGEA.060202AF. https://jgea.org/ojs/index.php/jgea/article/view/128.

Chepeliev, M. 2024c. "An Energy Data Base for GTAP." In *Global Trade, Assistance, and Production: The GTAP 11 Data Base*, edited by A. H. Aguiar. Center for Global Trade Analysis, Department of Agricultural Economics, Purdue University, West Lafayette, IN: Global Trade Analysis Project (GTAP). https://www.gtap.agecon.purdue.edu/resources/res_display.asp?RecordID=7124.

Chepeliev, M. 2020a. "The GTAP 10A Data Base with Agricultural Production Targeting Based on the Food and Agricultural Organization (FAO) Data." Global Trade Analysis Project (GTAP), Department of Agricultural Economics, Purdue University, West Lafayette, IN, GTAP Research Memorandum No. 35. https://www.gtap.agecon.purdue.edu/resources/res_display.asp?RecordID=6180.

Chepeliev, M. 2020b. "GTAP-Power Data Base: Version 10." *Journal of Global Economic Analysis*, 5(2): 110–137. doi:10.21642/JGEA.050203AF. https://jgea.org/ojs/index.php/jgea/article/view/108.

Chepeliev, M. 2022a. "Incorporating Nutritional Accounts to the GTAP Data Base." *Journal of Global Economic Analysis*, 7(1): 1–43. doi:10.21642/JGEA.070101AF. https://jgea.org/ojs/index.php/jgea/article/view/150.

Chepeliev, M. 2022b. "A Revised CO2 Emissions Database for GTAP." Global Trade Analysis Project (GTAP), Department of Agricultural Economics, Purdue University, West Lafayette, IN, GTAP Research Memorandum No. 37. https://www.gtap.agecon.purdue.edu/resources/res_display.asp?RecordID=6695.

Chepeliev, M., A. Aguiar, T. Farole, A. Liverani, and D. van der Mensbrugghe. 2026. "Circular economy transition in Europe requires ambitious policies beyond climate mitigation." *Resources, Conservation and Recycling*, 225: 108591. doi:10.1016/j.resconrec.2025.108591. https://www.sciencedirect.com/science/article/pii/S0921344925004689.

Chepeliev, M., A. Golub, T. Simonato, D. van der Mensbrugghe, P. Cao, C.G. Fischer, M. Herrero, and D. Mason-D'Croz. 2024. "Disaggregating Livestock Sector in the GTAP Data Base." Global Trade Analysis Project (GTAP), Department of Agricultural Economics, Purdue University, West Lafayette, IN, Presented during the 27th annual conference on global economic analysis (fort collins, colorado, usa). https://www.gtap.agecon.purdue.edu/resources/res_display.asp?RecordID=7213.

Chepeliev, M., R. McDougall, and D. van der Mensbrugghe. 2018. "Including Fossil-fuel Consumption Subsidies in the GTAP Data Base." *Journal of Global Economic Analysis*, 3(1): 84–121. doi:10.21642/JGEA.030102AF. https://www.jgea.org/ojs/index.php/jgea/article/view/60.

Chepeliev, M., K. Wojtowicz, A.N. Yilmaz, T. Simonato, E. Bekkers, and D. van der Mensbrugghe. 2025. "Advancing the representation of critical minerals supply chains in the global economic models." Global Trade Analysis Project (GTAP), Department of Agricultural Economics, Purdue University, West Lafayette, IN, Presented during the 28th annual conference on global economic analysis (kigali, rwanda). https://www.gtap.agecon.purdue.edu/resources/res_display.asp?RecordID=7561.

Corong, E. 2018. "GTAP Data Base version 10 with domestic margins." Global Trade Analysis Project (GTAP), Department of Agricultural Economics, Purdue University, West Lafayette, IN, Presented at the 21st annual conference on global economic analysis, cartagena, colombia. https://www.gtap.agecon.purdue.edu/resources/res_display.asp?RecordID=5609.

Corong, E. 2024. "Representative Table and Composite Regions." In *Global Trade, Assistance, and Production: The GTAP 11 Data Base*, edited by A. H. Aguiar. Center for Global Trade Analysis, Department of Agricultural Economics, Purdue University, West Lafayette, IN: Global Trade Analysis Project (GTAP). https://www.gtap.agecon.purdue.edu/resources/res_display.asp?RecordID=7121.

Corong, E., T. Hertel, R. McDougall, M. Tsigas, and D. van der Mensbrugghe. 2017. "The Standard GTAP Model, Version 7." *Journal of Global Economic Analy-*

sis, 2(1): 1–119. doi:10.21642/JGEA.020101AF. https://jgea.org/ojs/index.php/jgea/article/view/47.

Corong, E., and P. Pattawee. 2025. "Chapter 12.B Disaggregating labor payments." In *Global Trade, Assistance, and Production: The GTAP 12 Data Base*, edited by A. H. Aguiar. Center for Global Trade Analysis, Department of Agricultural Economics, Purdue University, West Lafayette, IN: Global Trade Analysis Project (GTAP).

Corong, E., P. Pattawee, and M. Tsigas. 2022. "Chapter 12.B Disaggregating labor payments." In *Global Trade, Assistance, and Production: The GTAP 11 Data Base*, edited by A. H. Aguiar. Center for Global Trade Analysis, Department of Agricultural Economics, Purdue University, West Lafayette, IN: Global Trade Analysis Project (GTAP).

Elbehri, A., and B. Narayanan. 2010. "Agricultural Export Subsidies." In *Global Trade, Assistance, and Production: The GTAP 7 Data Base*, edited by B. N. G. and T. L. Walmsley. Center for Global Trade Analysis, Department of Agricultural Economics, Purdue University, West Lafayette, IN: Global Trade Analysis Project (GTAP). https://www.gtap.agecon.purdue.edu/resources/res_display.asp?RecordID=3398.

Energy Institute (EI). 2025. "Statistical Review of World Energy 2025." Energy Institute, London. https://www.energyinst.org/statistical-review/home.

Eurostat. 2022. "Energy statistics - quantities, annual data." Eurostat. https://ec.europa.eu/eurostat/databrowser/explore/all/envir?lang=en&subtheme=nrg.nrg_quant.nrg_quanta&display=list&sort=category&extractionId=NRG_TI_GAS_custom_2160572.

Food and Agriculture Organization of the United Nations (FAO). 2024. "FAOSTAT Database." https://www.fao.org/faostat/en/.

Gehlhar, M. 1997. "GTAP 3 Data Base Documentation - Chapter 11." In *Global Trade, Assistance, and Production: The GTAP 3 Data Base*, edited by R. A. McDougall, A. Elbehri, and T. P. Truong. Center for Global Trade Analysis, Department of Agricultural Economics, Purdue University, West Lafayette, IN: Global Trade Analysis Project (GTAP). https://www.gtap.agecon.purdue.edu/resources/res_display.asp?RecordID=835.

Gehlhar, M. 2017. "Methodological Options for Preparing Merchandise Trade in the GTAP Data Base: Lessons from Past Experiences and Current Approach." Global Trade Analysis Project (GTAP), Department of Agricultural Economics, Purdue University, West Lafayette, IN, Presented at the 20th Annual Conference on Global Economic Analysis, West Lafayette, IN, USA. https://www.gtap.agecon.purdue.edu/resources/res_display.asp?RecordID=5371.

Gehlhar, M. 2026. "Reconciling Merchandise Trade Data." In *Global Trade, Assistance, and Production: The GTAP 12 Data Base*, edited by A. H. Aguiar. Center for Global Trade Analysis, Department of Agricultural Economics, Purdue University, West Lafayette, IN: Global Trade Analysis Project (GTAP).

Golub, A. 2016. "Construction of GDyn v9." Global Trade Analysis Project (GTAP), Department of Agricultural Economics, Purdue University, West Lafayette, IN, Report. https://www.gtap.agecon.purdue.edu/resources/res_display.asp?RecordID=4870.

Halpern, B.S., M. Frazier, J. Verstaen, P.E. Rayner, G. Clawson, J.L. Blanchard, R.S. Cottrell, H.E. Froehlich, J.A. Gephart, N.S. Jacobsen, et al. 2022. "The environmental footprint of global food production." *Nature Sustainability*, 5(12): 1027–1039. https://doi.org/10.1038/s41893-022-00965-x.

Herrero, M., S. Wirsenius, B. Henderson, C. Rigolot, P. Thornton, P. Havlík, I. De Boer, and P.J. Gerber. 2015. "Livestock and the environment: what have we learned in the past decade?" *Annual Review of Environment and Resources*, 40(1): 177–202. https://doi.org/10.1146/annurev-environ-031113-093503.

Hertel, T., ed. 1997. *Global Trade Analysis: Modeling and Applications*. United Nations, New York: Cambridge University Press.

Huang, H. 2013. "Agricultural Domestic Support." In *Global Trade, Assistance, and Production: The GTAP 8 Data Base*, edited by B. Narayanan, A. H. Aguiar, and R. McDougall. Center for Global Trade Analysis, Department of Agricultural Economics, Purdue University, West Lafayette, IN: Global Trade Analysis Project (GTAP). https://www.gtap.agecon.purdue.edu/resources/res_display.asp?RecordID=4296.

Intergovernmental Panel on Climate Change (IPCC)/Organisation for Economic Co-operation and Development (OECD)/ International Energy Agency (IEA). 1996. *Revised 1996 IPCC Guidelines for National Greenhouse Gas Inventories: Greenhouse Gas Inventory Workbook*. OECD.

International Energy Agency (IEA). 2025a. "Energy Prices and Taxes." https://www.iea.org/data-and-statistics/data-product/energy-prices, 2025 edition, latest update September 2025.

International Energy Agency (IEA). 2025b. "World Energy Balances." https://www.iea.org/data-and-statistics/data-product/world-energy-balances, July 2025 edition, updated August 2025.

International Monetary Fund (IMF). 2021. "Investment and Capital Stock Dataset, 1960-2019." https://tinyurl.com/4x58m8ku.

International Trade Centre (ITC). 2021. "Market Access Map: Improving Transparency in International Trade and Market Access. Methodology." Available online at: https://www.macmap.org/en/about/methodology.

Ku, A.Y., E. Alonso, R. Eggert, T. Graedel, K. Habib, A. Hool, T. Muta, D. Schrijvers, L. Tercero, T. Vakhitova, and C. Veeh. 2024. "Grand challenges in anticipating and responding to critical materials supply risks." *Joule*, 8(5): 1208–1223. https://doi.org/10.1016/j.joule.2024.03.001.

Laborde, D. 2012. "Agricultural Export Subsidies." Unpublished.

Laborde, D. 2010. "Tariff Data." In *Global Trade, Assistance, and Production: The GTAP 7 Data Base*, edited by B. Narayanan and T. L. Walmsley. Center for

Global Trade Analysis, Department of Agricultural Economics, Purdue University, West Lafayette, IN: Global Trade Analysis Project (GTAP). https://www.gtap.agecon.purdue.edu/resources/res_display.asp?RecordID=3201.

Lee, H.L. 2002. "An Emissions Data Base for Integrated Assessment of Climate Change Policy Using GTAP." Global Trade Analysis Project (GTAP), Department of Agricultural Economics, Purdue University, West Lafayette, IN, Gtap working paper. https://www.gtap.agecon.purdue.edu/resources/download/1218.pdf.

Lee, H.L., T. Hertel, B. Sohngen, and N. Ramankutty. 2005. "Towards An Integrated Land Use Database for Assessing the Potential for Greenhouse Gas Mitigation." Global Trade Analysis Project (GTAP), Department of Agricultural Economics, Purdue University, West Lafayette, IN, GTAP Technical Paper No. 25. https://doi.org/10.21642/GTAP.TP25.

Lejour, A., N. van Leeuwen, and R. McDougall. 2010. "Services Trade Data." In *Global Trade, Assistance, and Production: The GTAP 7 Data Base*, edited by B. Narayanan and T. L. Walmsley. Center for Global Trade Analysis, Department of Agricultural Economics, Purdue University, West Lafayette, IN: Global Trade Analysis Project (GTAP). https://www.gtap.agecon.purdue.edu/resources/res_display.asp?RecordID=3397.

Liberatore, A., and S. Wettstein. 2021. "The OECD-WTO Balanced Trade in Services database (BPM6 edition)." OECD-WTO, Report. https://www.wto.org/english/res_e/statis_e/daily_update_e/OECD-WTO_Batis_methodology_BPM6.pdf.

Liu, J., N. van Leeuwen, T.T. Vo, R. Tyers, and T. Hertel. 1998. "Disaggregating Labor Payments by Skill Level in GTAP." Global Trade Analysis Project (GTAP), Department of Agricultural Economics, Purdue University, West Lafayette, IN, GTAP Technical Paper No. 11. https://www.gtap.agecon.purdue.edu/resources/res_display.asp?RecordID=314.

Malcolm, G. 1998. "Adjusting Tax Rates in the GTAP Data Base." Global Trade Analysis Project (GTAP), Department of Agricultural Economics, Purdue University, West Lafayette, IN, GTAP Technical Paper No. 12. https://www.gtap.agecon.purdue.edu/resources/res_display.asp?RecordID=315.

McDougall, R. 2002. "Services Trade Data." In *Global Trade, Assistance, and Production: The GTAP 5 Data Base*, edited by B. V. Dimaranan and R. A. McDougall. Center for Global Trade Analysis, Department of Agricultural Economics, Purdue University, West Lafayette, IN: Global Trade Analysis Project (GTAP). https://www.gtap.agecon.purdue.edu/resources/res_display.asp?RecordID=770.

McDougall, R. 2006. "Updating and Adjusting the Regional Input-Output Tables." In *Global Trade, Assistance, and Production: The GTAP 6 Data Base*, edited by B. V. Dimaranan. Center for Global Trade Analysis, Department of Agricultural Economics, Purdue University, West Lafayette, IN: Global Trade Analysis Project (GTAP). https://www.gtap.agecon.purdue.edu/resources/res_display.asp?RecordID=2184.

McDougall, R., and M. Chepeliev. 2021. "An Energy Data Base for GTAP." In *Global Trade, Assistance, and Production: The GTAP 10 Data Base*, edited by A. H. Aguiar. Center for Global Trade Analysis, Department of Agricultural Economics, Purdue University, West Lafayette, IN: Global Trade Analysis Project (GTAP). https://www.gtap.agecon.purdue.edu/resources/res_display.asp?RecordID=6437.

McDougall, R., and A. Golub. 2009. "GTAP-E: A Revised Energy-Environmental Version of the GTAP Model." Global Trade Analysis Project (GTAP), Department of Agricultural Economics, Purdue University, West Lafayette, IN, GTAP Research Memorandum No. 15. https://www.gtap.agecon.purdue.edu/resources/res_display.asp?RecordID=2959.

McDougall, R., and J. Hagemejer. 2006. "Services Trade Data." In *Global Trade, Assistance, and Production: The GTAP 6 Data Base*, edited by B. V. Dimaranan. Center for Global Trade Analysis, Department of Agricultural Economics, Purdue University, West Lafayette, IN: Global Trade Analysis Project (GTAP). https://www.gtap.agecon.purdue.edu/resources/res_display.asp?RecordID=1945.

McDougall, R.A., T. Walmsley, A. Golub, E. Ianchovichina, and K. Itakura. 2012. "An Overview of the Dynamic GTAP Data Base: The Data Base Construction and Aggregation Programs." In *Dynamic Modeling and Applications for Global Economic Analysis*, edited by E. Ianchovichina and T. Walmsley. Center for Global Trade Analysis, Department of Agricultural Economics, Purdue University, West Lafayette, IN: Global Trade Analysis Project (GTAP). https://www.gtap.agecon.purdue.edu/resources/res_display.asp?RecordID=3169.

Organisation for Economic Co-operation and Development (OECD). 2021. *Agricultural Policy Monitoring and Evaluation 2021.* doi:https://doi.org/https://doi.org/10.1787/2d810e01-en.

Pattawee, P., E. Corong, and A. Aguiar. 2025. "Quantifying Disaggregated Tariffs for Global Trade Analysis: A Dynamic CGE-Based Assessment of U.S. Tariff Policy." Paper presented at the 20th East Asian Economic Association International Conference, Manila, Philippines.

Reich, M., and A.C. Simon. 2025. "Critical minerals." *Annual Review Earth and Planetary Sciences*, 53(1): 141–168. https://doi.org/10.1146/annurev-earth-040523-023316.

Saeed, W., T. Hertel, and K. Fuglie. 2020. "Estimating Cost Shares in Agricultural Value-Added for GTAP." Unpublished, Center for Global Trade Analysis.

Simonato, T. 2025. "GTAPSSP: SSPs for GTAP Framework." https://github.com/tsimonato/gtapssp, original-date: 2024-04-10T13:23:56Z.

Sohngen, B., C. Tennity, M. Hnytka, and K. Meeusen. 2008. "Global Forestry Data for the Economic Modeling of Land Use." Global Trade Analysis Project (GTAP), Department of Agricultural Economics, Purdue University, West Lafayette, IN, GTAP Working Paper No. 41. https://doi.org/10.21642/GTAP.WP41.

The Economist. 2011. "Exports to Mars; Economics focus." *The Economist (London)*, 401. https://www.economist.com/finance-and-economics/2011/11/12/

exports-to-mars.

United Nations Conference on Trade and Development (UNCTAD). 2025. "Global trade grew $300 billion in the first half of 2025, led by US imports and EU exports." https://unctad.org/news/global-trade-grew-300-billion-first-half-2025-led-us-imports-and-eu-exports, 2025 July edition.

United Nations Statistics Division (UNSD). 2021. "UN COMTRADE. International Merchandise Trade Statistics." Available online at: http://comtrade.un.org/.

United Nations (UN). 2021. *2018 Energy Balances*, 2018th ed. United Nations. https://www.un-ilibrary.org/content/books/9789210055246.

van Tongeren, F., R. Koopman, S. Karingi, J.M. Reilly, and J. Francois. 2017. "Back to the Future: A 25-year Retrospective on GTAP and the Shaping of a New Agenda." *Journal of Global Economic Analysis*, 2(2): 1–42. doi:10.21642/JGEA.020201AF.

Weingarden, A., and M. Tsigas. 2010. "Labor Statistics for the GTAP Database." Global Trade Analysis Project (GTAP), Center for Global Trade Analaysis, Purdue University, West Lafayette, Indiana, 13th annual conference on global economic analysis, penang, malaysia.

Wettstein, S., A. Liberatore, J. Magdeleine, and A. Maurer. 2021. "A Global Trade in Services data set by sector and by Mode of Supply." WTO, Report. https://www.wto.org/english/res_e/statis_e/daily_update_e/Tismos_methodology.pdf.

World Trade Organization (WTO). 2021. "Agricultural Export Subsidies Notifications." Available online at: https://docs.wto.org/dol2fe/Pages/FE_Browse/FE_B_S006.aspx.

Appendix.

Table A.1. New and updated national country Input-Output (IO) Tables in GTAP 12.

Country	IO Year(s)	Country	IO Year(s)
Angola*	2015	Mauritania*	2017
Azerbaijan	2021	Mauritius	2018
Burundi*	2016	Morocco	2019
Cameroon	2019	Nigeria	2018
Canada	2017, 2019	Oman	2018
DR Congo	2019	Peru	2022
Jordan	2018	São Tomé and Príncipe*	2019
Korea	2020	Saudi Arabia	2021
Malaysia	2019	United Arab Emirates	2014
Madagascar	2019	United Kingdom	2018, 2019

Notes: An asterisk (*) is used to signal that the country is now separately identified. Thus, it is no longer part of a composite region.

Table A.2. GTAP sector classification (GSEC3).

No.	Code	Description	No.	Code	Description
1	pdr	Paddy rice	34	bph	Basic pharmaceutical products
2	wht	Wheat	35	rpp	Rubber and plastic products
3	gro	Cereal grains, not elsewhere classified (n.e.c.)	36	nmm	Mineral products n.e.c.
4	v_f	Vegetables, fruit, nuts	37	i_s	Ferrous metals
5	osd	Oil seeds	38	nfm	Metals n.e.c.
6	c_b	Sugar cane, sugar beet	39	fmp	Metal products
7	pfb	Plant-based fibers	40	ele	Computer, electronic and optical products
8	ocr	Crops n.e.c.	41	eeq	Electrical equipment
9	ctl	Cattle, sheep, goats, horses	42	ome	Machinery and equipment n.e.c.
10	oap	Animal products n.e.c.	43	mvh	Motor vehicles and parts
11	rmk	Raw milk	44	otn	Transport equipment n.e.c.
12	wol	Wool, silk-worm cocoons	45	omf	Manufactures n.e.c.
13	frs	Forestry	46	ely	Electricity
14	fsh	Fishing	47	gdt	Gas manufacture, distribution
15	coa	Coal	48	wtr	Water
16	oil	Oil	49	cns	Construction
17	gas	Gas	50	trd	Trade
18	oxt	Other extraction	51	afs	Accommodation, Food and service activities
19	cmt	Meat: cattle, sheep, goats, horse	52	otp	Transport n.e.c.
20	omt	Meat products n.e.c.	53	wtp	Sea transport
21	vol	Vegetable oils and fats	54	atp	Air transport
22	mil	Dairy products	55	whs	Warehousing and support activities
23	pcr	Processed rice	56	cmn	Communication
24	sgr	Sugar	57	ofi	Financial services n.e.c.
25	ofd	Food products n.e.c.	58	ins	Insurance
26	b_t	Beverages and tobacco products	59	rsa	Real estate activities
27	tex	Textiles	60	obs	Business services n.e.c.
28	wap	Wearing apparel	61	ros	Recreation and other services
29	lea	Leather products	62	osg	Public administration and defense
30	lum	Wood products	63	edu	Education
31	ppp	Paper products, publishing	64	hht	Human health and social work activities
32	p_c	Petroleum, coal products	65	dwe	Dwellings
33	chm	Chemical products			

Source: GTAP 12 Data Base.

Table A.3. The 163 countries/composite regions in GTAP 12.

No.	Code	Name	No.	Code	Name
1	aus	Australia	44	gtm	Guatemala
2	nzl	New Zealand	45	hnd	Honduras
3	xoc	Rest of Oceania	46	nic	Nicaragua
4	chn	China	47	pan	Panama
5	hkg	Hong Kong	48	slv	El Salvador
6	jpn	Japan	49	xca	Rest of Central America
7	kor	Korea	50	dom	Dominican Republic
8	mng	Mongolia	51	hti	Haiti
9	twn	Chinese Taipei	52	jam	Jamaica
10	xea	Rest of East Asia	53	pri	Puerto Rico
11	brn	Brunei Darussalam	54	tto	Trinidad and Tobago
12	khm	Cambodia	55	xcb	Caribbean
13	idn	Indonesia	56	aut	Austria
14	lao	Lao People's Democratic Republic	57	bel	Belgium
15	mys	Malaysia	58	bgr	Bulgaria
16	phl	Philippines	59	hrv	Croatia
17	sgp	Singapore	60	cyp	Cyprus
18	tha	Thailand	61	cze	Czech Republic
19	vnm	Viet Nam	62	dnk	Denmark
20	xse	Rest of Southeast Asia	63	est	Estonia
21	afg	Afghanistan	64	fin	Finland
22	bgd	Bangladesh	65	fra	France
23	ind	India	66	deu	Germany
24	npl	Nepal	67	grc	Greece
25	pak	Pakistan	68	hun	Hungary
26	lka	Sri Lanka	69	irl	Ireland
27	xsa	Rest of South Asia	70	ita	Italy
28	can	Canada	71	lva	Latvia
29	usa	United States of America	72	ltu	Lithuania
30	mex	Mexico	73	lux	Luxembourg
31	xna	Rest of North America	74	mlt	Malta
32	arg	Argentina	75	nld	Netherlands
33	bol	Bolivia	76	pol	Poland
34	bra	Brazil	77	prt	Portugal
35	chl	Chile	78	rou	Romania
36	col	Colombia	79	svk	Slovakia
37	ecu	Ecuador	80	svn	Slovenia
38	pry	Paraguay	81	esp	Spain
39	per	Peru	82	swe	Sweden
40	ury	Uruguay	83	gbr	United Kingdom
41	ven	Venezuela	84	che	Switzerland
42	xsm	Rest of South America	85	nor	Norway
43	cri	Costa Rica	86	xef	Rest of EFTA

(Continued . . .)

Table A.3. The 163 countries/composite regions in GTAP 12. (...Continued)

No.	Code	Name	No.	Code	Name
87	alb	Albania	126	gha	Ghana
88	srb	Serbia	127	gin	Guinea
89	blr	Belarus	128	mli	Mali
90	rus	Russian Federation	129	mrt	Mauritania
91	ukr	Ukraine	130	ner	Niger
92	xee	Rest of Eastern Europe	131	nga	Nigeria
93	xer	Rest of Europe	132	sen	Senegal
94	kaz	Kazakhstan	133	tgo	Togo
95	kgz	Kyrgyztan	134	xwf	Rest of Western Africa
96	tjk	Tajikistan	135	ago	Angola
97	uzb	Uzbekistan	136	caf	Central African Republic
98	xsu	Rest of Former Soviet Union	137	tcd	Chad
99	arm	Armenia	138	cog	Congo
100	aze	Azerbaijan	139	cod	Democratic Republic of the Congo
101	geo	Georgia	140	gnq	Equatorial Guinea
102	bhr	Bahrain	141	gab	Gabon
103	irn	Iran, Islamic Republic	142	stp	São Tomé and Príncipe
104	irq	Iraq	143	bdi	Burundi
105	isr	Israel	144	com	Comoros
106	jor	Jordan	145	eth	Ethiopia
107	kwt	Kuwait	146	ken	Kenya
108	lbn	Lebanon	147	mdg	Madagascar
109	omn	Oman	148	mwi	Malawi
110	pse	State of Palestine	149	mus	Mauritius
111	qat	Qatar	150	moz	Mozambique
112	sau	Saudi Arabia	151	rwa	Rwanda
113	syr	Syria	152	sdn	Sudan
114	tur	Türkiye	153	tza	Tanzania
115	are	United Arab Emirates	154	uga	Uganda
116	xws	Rest of Western Asia	155	zmb	Zambia
117	dza	Algeria	156	zwe	Zimbabwe
118	egy	Egypt	157	xec	Rest of Eastern Africa
119	mar	Morocco	158	bwa	Botswana
120	tun	Tunisia	159	swz	Eswatini
121	xnf	Rest of North Africa	160	nam	Namibia
122	ben	Benin	161	zaf	South Africa
123	bfa	Burkina Faso	162	xsc	Rest of South African Customs Union
124	cmr	Cameroon	163	xtw	Rest of the World
125	civ	Cote d'Ivoire			

Source: GTAP 12 Data Base.

Table A.4. IO Table base year allocation across GTAP reference years for purposes of building the time-series database

Countries — Reference Years	2004	2007	2011	2014	2017	2019	2023
Australia	2005	2010	2010	2015	2018	2018	2018
Azerbaijan	2001	2001	2016	2016	2016	2021	2021
Bolivia	2004	2004	2014	2014	2014	2014	2014
Botswana	1994	2016	2016	2016	2016	2016	2016
Brazil	2005	2005	2010	2015	2015	2015	2015
Cameroon	2003	2003	2017	2017	2017	2019	2019
Canada	2003	2011	2011	2014	2017	2019	2019
Chile	2003	2003	2016	2016	2016	2016	2016
China	2002	2007	2010	2012	2017	2017	2017
Colombia	2003	2007	2007	2014	2014	2014	2014
Costa Rica	2002	2011	2011	2017	2017	2017	2017
DR Congo	2013	2013	2013	2013	2019	2019	2019
Ecuador	2001	2007	2013	2013	2019	2019	2019
India	2003	2007	2007	2015	2015	2015	2015
Indonesia	2004	2004	2017	2017	2017	2017	2017
Iran	2001	2012	2012	2012	2012	2012	2012
Japan	2005	2005	2011	2011	2011	2011	2011
Jordan	2006	2006	2006	2018	2018	2018	2018
Kazakhstan	2004	2004	2015	2015	2017	2017	2017
Korea	2003	2007	2010	2014	2015	2020	2020
Laos	2002	2002	2017	2017	2017	2017	2017
Malaysia	2005	2005	2005	2019	2019	2019	2019
Madagascar	1999	1999	2019	2019	2019	2019	2019
Mauritius	1997	1997	2018	2018	2018	2018	2018
Mexico	2003	2003	2013	2013	2013	2013	2013
Mongolia	2005	2005	2016	2016	2016	2016	2016
Morocco	2004	2004	2004	2019	2019	2019	2019
Mozambique	2007	2007	2015	2015	2015	2015	2015
New Zealand	2007	2007	2013	2013	2013	2013	2013
Nigeria	2006	2006	2006	2018	2018	2018	2018
Norway	2004	2007	2011	2014	2017	2017	2017
Oman	2005	2005	2005	2018	2018	2018	2018
Pakistan	2002	2011	2011	2011	2017	2017	2017
Panama	1996	2016	2016	2016	2016	2016	2016
Paraguay	2009	2009	2014	2014	2014	2014	2014
Peru	2004	2004	2004	2022	2022	2022	2022
Philippines	2000	2006	2006	2018	2018	2018	2018
Russian Federation	2003	2003	2016	2016	2016	2016	2016
Saudi Arabia	2005	2005	2005	2021	2021	2021	2021
South Africa	2005	2005	2017	2017	2017	2017	2017
Sri Lanka	2000	2000	2011	2011	2011	2011	2011
Switzerland	2005	2008	2011	2014	2014	2014	2014
Thailand	2005	2005	2010	2015	2015	2015	2015
Turkey	2002	2002	2012	2012	2012	2012	2012
Uganda	2002	2007	2007	2007	2007	2007	2007
Ukraine	2004	2007	2013	2013	2017	2017	2017
United States	2002	2012	2012	2012	2012	2012	2012

(Continued . . .)

Table A.4. IO Table base year allocation across GTAP reference years for purposes of building the time-series database. (…Continued)

Countries — Reference Years	2004	2007	2011	2014	2017	2019	2023
United Arab Emirates	2005	2005	2014	2014	2014	2014	2014
United Kingdom	2010	2010	2010	2013	2018	2019	2019
Uruguay	1997	2016	2016	2016	2016	2016	2016
Vietnam	2003	2005	2016	2016	2016	2016	2016
Zimbabwe	1991	2017	2017	2017	2017	2017	2017

Table A.5. Summary of GTAP data releases, including all reference years.

Version	Release Year	Regions	Sectors	Reference year(s)
1	1993	15	37	1990
2	1994	24	37	1992
3	1996	30	37	1992
4	1998	45	50	1995
5	2001	66	57	1997
6	2005	87	57	2001
7	2008	113	57	2004
8	2012	129	57	2004, 2007
9	2015	140	57	2004, 2007, 2011
10	2019	141	65	2004, 2007, 2011, 2014
11	2022	160	65	2004, 2007, 2011, 2014, 2017
12	2025	163	65	2004, 2007, 2011, 2014, 2017, 2019, 2023

Table A.6. Food and agricultural sectors concordances against the UN Central Product Classification (CPC) version 2.1.

Code	Description	CPC version 2.1
pdr	Paddy rice	0113
wht	Wheat	0111
gro	Cereal grains not elsewhere classified (n.e.c.)	0112, 0114-0119
v_f	Vegetables, fruit, nuts	012, 013, 015, 017
osd	Oilseeds and oleaginous fruits	014
c_b	Sugar crops (cane, beet)	018
pfb	Plant-based fibers	0192
ocr	Crops n.e.c.	016, 0191, 0193-0197, 0199
ctl	Bovine animals, horses and other equines	0211-0213, 0299
oap	Other animals and animal products n.e.c.	0214, 0215, 0219, 023, 024, 0291-0293, 0295, 0296
rmk	Raw milk	022
wol	Wool, silk-worm cocoons	0294
frs	Forestry and logging products	03
cmt	Bovine meat products	21111, 21112, 21115-21119, 2113, 2115
omt	Meat products n.e.c.	21113, 21114, 2112, 2114, 2116-2119
vol	Vegetable oils and fats	215-219
mil	Dairy products and egg products	22
pcr	Processed rice	2316
sgr	Sugar and molasses	235
ofd	Food products n.e.c.	212-214, 2311-2314, 2317, 2318, 232-234, 236-239
b_t	Beverages and tobacco products	24, 25

Notes: For convenience, we use '-' to indicate all elements in between; for example, Cereal grains n.e.c. (gro) is composed of CPC products: 0112, 0114, 0115, 0116, 0117, 0118, and 0119.

Source: GTAP 12 Data Base.

Table A.7. GTAP manufacturing sector concordances against the UN International Standard Industry Classification (ISIC) revision 4.

Code	Description	ISIC revision 4
fsh	Fishing	03, 017
coa	Coal	05
oil	Oil	061, 091 (part)
gas	Gas	062, 091 (part)
oxt	Other extraction	07, 08, 099
tex	Textiles	13
wap	Wearing apparel	14
lea	Leather products	15
lum	Wood products	16
ppp	Paper products, printing	17, 18
p_c	Petroleum, coal products	19
chm	Chemical products	20
bph	Basic pharmaceutical products	21
rpp	Rubber and plastic products	22
nmm	Mineral products n.e.c.	23
i_s	Ferrous metals	241, 2431
nfm	Metals n.e.c.	242, 2432
fmp	Metal products	25
ele	Computer, electronic and optical products	26
eeq	Electrical equipment	27
ome	Machinery and equipment n.e.c.	28
mvh	Motor vehicles and parts	29
otn	Transport equipment n.e.c.	30
omf	Manufactures n.e.c.	31, 32, 33

Notes: The oil and gas sectors are assigned part of ISIC code 091, "Support activities for petroleum and natural gas extraction", because more detailed ISIC codes are not available.

Source: GTAP 12 Data Base.

Table A.8. GTAP services sector concordances against UN International Standard Industry Classification (ISIC) revision 4.

Code	Description	ISIC revision 4
ely	Electricity; steam and air conditioning supply	351, 353
gdt	Gas manufacture, distribution	352
wtr	Water supply; sewerage, waste management and remediation activities	36-39
cns	Construction	41-43
trd	Wholesale and retail trade; repair of motor vehicles and motorcycles	45-47
afs	Accommodation and food service activities	55, 56
otp	Land transport and transport via pipelines	49
wtp	Water transport	50
atp	Air transport	51
whs	Warehousing and support activities	52
cmn	Information and communication	53, 58-63
ofi	Financial services n.e.c.	64, 661, 663
ins	Insurance	65, 662
rsa	Real estate activities	68
obs	Other business services	69-82 (M and N)
ros	Recreational and other services	90-98 (R, S, and T)
osg	Public administration and defense; compulsory social security; and activities of extraterritorial organizations and bodies	84, 99
edu	Education	85
hht	Human health and social work activities	86-88 (Q)
dwe	Dwellings	not available

Notes: For convenience, we use '-' to indicate all elements in between; for example, Water supply (wtr) is composed of ISIC codes: 36, 37, 38, and 39.

Source: GTAP 12 Data Base.

Table A.9. BaTiS sectors subject to disaggregation using TisMoS

Code	BaTiS	Code	TiSMoS	GTAP
SB	Transport	SC11, SC12	Sea transport (passenger and freight)	wtp
SC	Transport	SC11, SC12	Sea transport (passenger and freight)	wtp
		SC21, SC22	Air transport (passenger and freight)	atp
		SC31, SC32	Other transport (passenger and freight)	otp
		SC13, SC23, SC33	Transport, Other	whs
		SC4	Postal and courier services	cmn
SD	Travel	SDA	Business travel	trvl*
		SDB1	Health-related travel	hht
		SDB2	Education-related travel	edu
		SDB3	Other personal travel	afs
SJ	Other	SJ1	Research and development services	obs
	business	SJ2	Professional and management consulting	obs
	services	SJ31	Architectural and engineering services	obs
		SJ32	Waste treatment and de-pollution, agricultural and mining services	obs
		SJ33	Operating leasing services	rsa
		SJ34	Trade-related services	trd
		SJ35	Other business services n.i.e.	obs
SK	Personal,	SK1	Audio-visual and related services	cmn
	cultural, and	SK21	Health services (personal)	hht
	recreational	SK22	Education services (personal)	edu
	services	SK23	Heritage and recreational services	ros
		SK24	Other personal services	ros

Notes: * trvl is not a sector in GTAP, but is a code assigned for the special treatment of travelers' expenditures.

Source: The Balanced Trade in Services (BaTiS) database is documented in Liberatore and Wettstein (2021). The Trade in Service data by Mode of Supply (TiSMoS) is documented in Wettstein et al. (2021).

Table A.10. Sector aggregation used in this document.

Code	Description	Composition
pdr	Paddy rice	pdr
wht	Wheat	wht
gro	Cereal grains not elsewhere classified (n.e.c.)	gro
v_f	Vegetables, fruit, nuts	v_f
osd	Oilseeds and oleaginous fruits	osd
c_b	Sugar crops (cane, beet)	c_b
pfb	Plant-based fibers	pfb
ctl	Bovine animals, horses	ctl
oap	Other animals and animal products nec	oap
rmk	Raw milk	rmk
wol	Wool, silk-worm cocoons	wol
frs	Forestry and logging products	frs
cmt	Bovine meat products	cmt
omt	Meat products nec	omt
vol	Vegetable oils and fats	vol
mil	Dairy products and egg products	mil
pcr	Processed rice	pcr
sgr	Sugar and molasses	sgr
ofd	Food products nec	ofd
b_t	Beverages and tobacco products	b_t
fsh	Fishing	fsh
coa	Coal	coa
oil	Oil	oil
gas	Gas	gas
oxt	Other extraction	oxt
tex	Textiles	tex
wap	Wearing apparel	wap
lea	Leather products	lea
lum	Wood products	lum
ppp	Paper products, printing	ppp
p_c	Petroleum, coal products	p_c
chm	Chemical products	chm
bph	Basic pharmaceutical products	bph
rpp	Rubber and plastic products	rpp
nmm	Mineral products n.e.c.	nmm
i_s	Ferrous metals	i_s
nfm	Metals n.e.c.	nfm
fmp	Metal products	fmp
ele	Computer, electronic and optical products	ele
eeq	Electrical equipment	eeq
ome	Machinery and equipment n.e.c.	ome
mvh	Motor vehicles and parts	mvh
otn	Transport equipment n.e.c.	otn
omf	Manufactures n.e.c.	omf
utc	Utilities and construction	ely, gdt, wtr, cns
trc	Transportation, margins, and communications	trd, afs, otp, wtp, atp, whs, cmn
osr	Other services	ofi, ins, rsa, obs, ros, osg, edu, hht, dwe

Table A.11. Regional aggregations used in this document.

Code	Description	Composition
ANZ	Australia, New Zealand	aus, nzl
CAN	Canada	can
CHN	China	chn, hgk
JPN	Japan	jpn
KOR	Korea	kor
LAM	Latin America	arg, bol, bra, chl, col, ecu, pry, per, ury, ven, xsm, cri, gtm, hnd, nic, pan, slv, xca, dom, hti, jam, pri, tto, xcb
MEN	Middle East and Northern Africa	bhr, irn, irq, isr, jor, kwt, lbn, omn, pse, qat, sau, syr, tur, are, xws, dza, egy, mar, tun, xnf
MEX	Mexico	mex
SAS	South Asia	afg, bgd, ind, npl, pak, lka, xsa
SEA	South East Asia	khm, idn, lao, mys, phl, sgp, tha, vnm, xse
SSA	Sub-Saharan Africa	ben, bfa, cmr, civ, gha, gin, mli, mrt, ner, nga, sen, tgo, xwf, ago, caf, tcd, cog, cod, gnq, gab, stp, bdi, com, eth, ken, mdg, mwi, mus, moz, rwa, sdn, tza, uga, zmb, zwe, xec, bwa, swz, nam, zaf, xsc
USA	United States	usa
WEU	Western Europe	aut, bel, bgr, hrv, cyp, cze, dnk, est, fin, fra, deu, grc, hun, , ita, lva, ltu, lux, mlt, nld, pol, prt, rou, svk, svn, esp, swe, gbr, che, nor, xef
ROW	Rest of the World	xoc, mng, twn, xea, brn, xna, alb, srb, blr, rus, ukr, xee, xer, kaz, kgz, tjk, uzb, xsu, arm, aze, geo, xtw
	Results Aggregation	
ESEA	East and South East Asia	CHN, JPN, KOR, SEA
USA	United States of America	USA
CAMX	Canada and Mexico	CAN, MEX
EUR	Western Europe	WEU
ROW	Rest of the World	ANZ, LAM, MEN, SAS, SSA, ROW