The GTAP Data Base: Version 10

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This paper highlights the numerous improvements to the Global Trade, Assistance, and Production (GTAP) Data Base, version 10 (also referred to as GTAP 10). The Data Base describes the world economy for 4 reference years (2004, 2007, 2011, and 2014) and distinguishes 65 sectors, up from 57 in the previous release, in each of the 141 countries/regions. The 121 countries in the Data Base account for 98% of world GDP and 92% of world population. For each country/region, the Data Base reports production, intermediate and final uses, international trade and transport margins, and taxes/subsidies. This Data Base underlies most, if not all, applied global general equilibrium models. We use the time series GTAP 10 Data Base to examine the evolution of carbon dioxide emissions embodied in bilateral merchandise and services trade over the 2004-2014 period.

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1. Introduction

The Global Trade Analysis Project (GTAP) Data Base provides a time series of snapshots of the global economy for each of four reference years: 2004, 2007, 2011, and 2014, with 2014 being the latest year added to GTAP 10. The Data Base describes global bilateral trade patterns, international transport margins and protection matrices that link individual countries/regions. For each country/region, the Data Base presents values of production, and intermediate and final consumption of commodities and services in millions of U.S. dollars. The GTAP Data Base underlies the majority, if not all, of global general equilibrium models[1] that are used to examine environmental and economic issues at the global level.

The GTAP Data Base relies on country-based Input Output Tables (IOTs), and is supplemented by various international datasets as discussed below. In its tenth

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[1] A growing list of these models is available at https://www.gtap.agecon.purdue.edu/about/data_models.asp.

edition, the GTAP Data Base covers 121 countries and 20 aggregate regions of the world for each reference year.[2] Relative to version 9, Tajikistan is the latest country to be extracted from one of the aggregate regions.[3] GTAP 10 includes updated IOTs for 50 countries, reflecting new cost structures and sales dispositions for each sector. Figure 1 shows, in green, the countries for which IOTs have been updated in GTAP 10; countries in gray use IOTs introduced in GTAP 9 or earlier and the countries in white are those for which we do not have an IOT. The missing countries—many of which are located in Africa—in aggregate represent only 2% of world GDP, but 8% of world population. Individual countries not represented in GTAP are part of the 'Rest of' composite regions. For Africa, there are six of these: Rest of North Africa, Western Africa, Central Africa, South Central Africa, Eastern Africa, and Rest of South African Customs Union.[4] We actively work with network member institutions and individuals to encourage the development of IOT statistics and look forward to increasing the number of individually-represented countries in the GTAP Data Base.

In terms of sectoral coverage, GTAP 10 considers 65 products and services (this is the third GTAP sector classification, GSEC3), up from 57 in previous versions (GSEC2), see Table A.2 for the complete listing.[5] In broad terms, GTAP classifies agriculture, food, resource extraction, manufacturing, and service activities to describe all economic activities in each country.

GTAP 10 has more manufacturing and services sectors than previous versions (Table 1). There are three new sectors in manufacturing, namely: Chemicals, Pharmaceuticals, and Rubber products, that were previously aggregated as a single "Chemical, Rubber, and Plastics (crp)" sector. We also now distinguish the Electrical Equipment sector separately from other machinery. In terms of services, the Data Base now represents Accommodations and Food Services, Warehousing, Real Estate Activities, Education and Health Services, which were previously included in aggregated Trade, Other transport, Other business and Other government services sectors, respectively.[6]

The GTAP Data Base tracks reconciled bilateral trade data between countries. These trade data must be reconciled because the initial data are not balanced, i.e.,

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[2] Table A.1 in the Appendix provides a summary of the history of GTAP data releases.

[3] GTAP 9's documentation, Aguiar, Narayanan, and McDougall (2016), provides additional information about the GTAP Data Base that is not covered in this paper.

[4] To learn about the country composition of each of these, please go to: https://www.gtap.agecon.purdue.edu/databases/regions.asp?Version=10.131.

[5] Since GTAP 5, the GSEC2 classification was used. GTAP 4 used the GSEC1 classification of 50 sectors. Versions 1-3 used SALTER's classification of 37 sectors. To access the archive please go to: https://www.gtap.agecon.purdue.edu/databases/archives.asp.

[6] Please note that the previous labels for 'other mining' (omn) and 'insurance services' (isr) have been re-labeled to 'oxt' and 'ins', respectively, to avoid clashes with the ISO-3 codes for Oman and Israel.
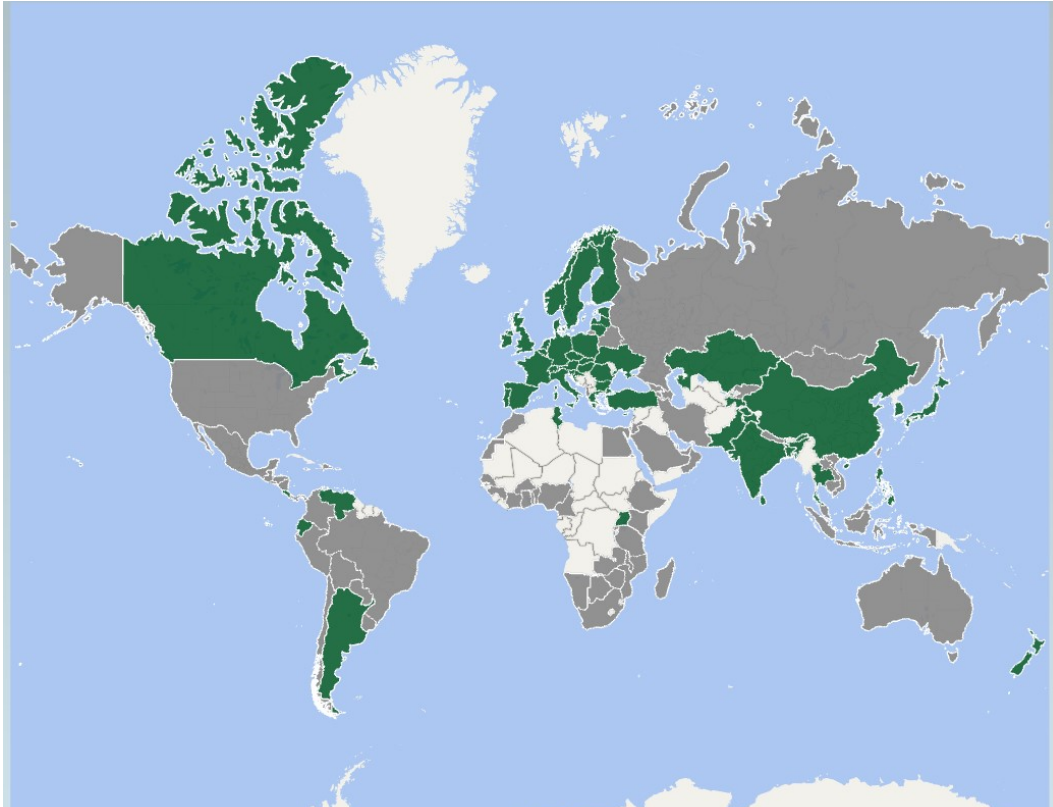
Figure 1. Regional coverage in GTAP 10.

Notes: Countries in green have had their IOTs updated in GTAP 10. For countries in gray, we use the same IOTs as in GTAP 9. Other countries (in white) are represented in GTAP's 'Rest of' regions.

Source: GTAP 10 Data Base.

Table 1. New sectors in GTAP 10.

GSEC2	Description	GSEC3	Description
crp	Chemical, rubber, plastic products	chm	Chemical products
		bph	Basic pharmaceuticals
		rpp	Rubber and plastic products
ome	Machinery and equipment, not elsewhere classified (n.e.c)	eeq	Electrical equipment
		ome	Machinery and equipment (n.e.c)
trd	Trade	afs	Accomodation and food service activities
		trd	Trade
otp	Transport n.e.c.	whs	Warehousing and support activities
		otp	Land transport and transport via pipelines
obs	Business services n.e.c	rsa	Real estate activities
		obs	Other business services
osg	Public Administration, Defense, Education, Health	osg	Public administration and defense
		edu	Education
		hht	Human health and social work

Notes: The 57 GTAP Sector classification is GSEC2; while the 65 GTAP Sector classification is GSEC3.

Source: GTAP 10 Data Base.

world exports differ from world imports, and, as well, there are frequent discrepancies between countries' reported imports and what their partners report as exports. GTAP merchandise trade data is based on the United Nations Commodity Trade (UN-COMTRADE) Statistics and the reconciliation treatment has been updated for all reference years using a new consistent methodology. Section 2 provides more detail on the bilateral trade data.

The Data Base also accounts for how traded merchandise is delivered across countries using estimates of international transport margins. These estimates have been improved in version 10 using information from a wider set of countries than in previous versions, as described in Section 2.

In terms of protection data, we have updated tariff information contributed by the International Trade Centre (ITC). In addition, agricultural domestic support is obtained from the Producer and Consumer Support Estimates database provided by the Organisation for Economic Co-operation and Development (OECD) for the OECD countries and important non-member countries, and the European Commission's Joint Research Center (JRC) for European Union (EU) countries. Agricultural export subsidies are updated based on World Trade Organization (WTO) notifications and EU information.

Other regular updates of GTAP 10 include: macroeconomic data from the World Development Indicators (WDI), income and factor taxes from the International Monetary Fund (IMF), and energy data from the International Energy Agency (IEA). In addition, several data extensions accompany the standard GTAP Data Base. These extensions have been prepared to facilitate their use with the standard GTAP data. They include, energy volumes and CO_2 emissions, which are part of the standard distribution; land cover and use (GTAP-LULC), international migration and remittances (GMIG), foreign income payment and receipts (GDYN), electricity[7] (GTAP-Power), non-CO_2 emissions among others. These extensions will be listed below with references for each dataset; more information is also available from https://www.gtap.agecon.purdue.edu/databases/Utilities/default.asp.

The release of version 10 will be distributed via the GTAP website (i.e., https://www.gtap.agecon.purdue.edu/). Two formats will be made available to match the needs of the new standard version of the GTAP model (Corong et al., 2017) and the classic version (Hertel, 1997). This will also help researchers that use GTAP data with their own models. Providing both formats allows for flexibility as users adjust to the new data format. New developments, however, such as the domestic margins extension, will only be available for the new standard format. The new 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 nomenclature in side-by-side tables. Among other things, the new model allows for multi-product

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[7] A data extension that disaggregates the standard electricity sector of the GTAP Data Base into 11 generating activities with an additional transmission and distribution activity.

sectors, as well as multiple sectors producing the same commodity.

The following section describes the new features included in version 10 of the Data Base. Section 3 presents a numerical illustration of the Data Base. The final section concludes with a brief discussion on future developments.

2. New features of GTAP 10

2.1 Country and Sector Coverage

The expansion and updating of countries are made possible because of the IOTs contributed by members of the GTAP network. In version 10, 51 newly contributed national IOTs are used in the construction of GTAP, 50 belong to countries previously represented in the Data Base and Tajikistan, which is the only new country separately identified. References to each of these new and updated countries are available on the GTAP website[8] and listed in Table 2. A complete listing of the 141 country/regions is available in the Appendix, Table A.3.

Starting with GTAP 10, we allocate IOTs to the closest reference year. Of course, this allocation is restricted to countries for which we have received IOTs for multiple years (see Table 3). For the remaining countries, however, there is only one IOT to match with all reference years. This deficiency highlights the need for regular IOT contributions and the important role that other international data sources have in updating IOTs. We will continue to improve the allocation of IOTs as information becomes available to us via contributions from GTAP researchers to improve the quality of the time-series dimension of the Data Base. In doing so, GTAP contributes to the growing field of time-series multi-regional input-output databases, which include EXIOBASE (Stadler et al., 2018), WIOD (Timmer and de Vries, 2016), EORA (Lenzen et al., 2013), OECD ICIO Tables (details available from oe.cd/icio), ADB-MRIO (Mariasingham, 2011), and AIIOTs (AIIOTs, 2005).[9] Among these efforts, GTAP is unique in the extent of its coverage of individual countries, number of agricultural sectors, and protection data (i.e., tariffs, agricultural domestic sup-

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[8] For new and updated country information included in version 10, please refer to https://www.gtap.agecon.purdue.edu/databases/v10/v10_doco.asp; for information on all countries, please refer to https://www.gtap.agecon.purdue.edu/databases/regions.asp?Version=10.131.

[9] EXIOBASE 3 reports time-series data for the 1995-2011 period. It distinguishes 200 products, 163 industries, 44 countries (28 EU members plus 16 major economies) and 5 aggregate regions. WIOD's second release covers 56 product groups and reports 43 countries (28 EU members plus 15 major countries) and the rest of the world. It provides an annual time-series of the input-output tables from 2000 to 2014. EORA covers 190 countries and 120 sectors for the 1990-2015 period. The ICIO tables are available for 64 economies (OECD members and selected Non-OECD countries) and 36 sectors for the 2005-2015 period. The ADB-MRIO considers 18 Asian countries and 56 product groups for the years 2000, 2005-2008, and 2011. AIIOTs are the Asian Input Output Tables, developed since 1975 by the Institute of Developing Economies, Japan External Trade organization (IDE-JETRO).

Table 2. New and updated national country IOTs in GTAP 10.

Country	IO Year(s)	Country	IO Year(s)
28 EU members (Rueda-Cantuche et al., 2017)	2010	Pakistan (Zeshan, 2018)	2011
Argentina (Cicowiecz, 2018)	2000	Philippines (Corong and Cororaton, 2018)	2006
Bangladesh (Raihan and Khondker, 2018)	2012	South Korea (Ko, 2018)	2014
Canada (Chen, 2018)	2011	Sri Lanka (Weerahewa, Weerasooriya, and Bandaralage, 2018)	2010
China (Yu, 2018)	2012	Switzerland (van Nieuwkoop, 2018)	2011
Costa Rica (Monge-Arino and Vargas, 2018)	2011	Tajikistan (new in GTAP 10) (Khakimov, 2018)	2011
Ecuador (Aguiar, 2018)	2007, 2013	Thailand (Apaitan, 2018)	2010
India (Chadha and Pratap, 2018)	2007	Tunisia (Balma, 2018)	2005
Japan (Suzuki, 2018)	2011	Turkey (Biyik and Özkale, 2018)	2012
Kazakhstan (Horridge, 2018)	2015	Uganda (Teichmann, 2018)	2007
New Zealand (Strutt and Siameja, 2018)	2007	Ukraine (Chepeliev, 2018b)	2007, 2013
Norway (Peters and Andrews, 2018)	2014	Venezuela (Leone, Ferrer, and Hernandez, 2018)	2007

Source: GTAP 10 Data Base.

port and export subsidies).

Table 3. IOT allocations in GTAP 10.

| Country | GTAP reference years | | | |
	2004	2007	2011	2014
Australia	2005	2010	2010	2010
Canada	2003	2011	2011	2011
China	2002	2007	2010	2012
Colombia	2003	2007	2007	2007
Ecuador	2001	2007	2013	2013
India	2003	2007	2007	2007
Japan	2005	2005	2011	2011
Kazakhstan	2004	2004	2015	2015
Norway	2004	2007	2011	2014
Pakistan	2002	2011	2011	2011
Philippines	2000	2006	2006	2006
South Korea	2003	2007	2010	2014
Sri Lanka	2000	2000	2011	2011
Switzerland	2005	2008	2011	2011
Thailand	2005	2005	2010	2010
Turkey	2002	2002	2012	2012
Uganda	2002	2007	2007	2007
Ukraine	2004	2007	2013	2013
Vietnam	2003	2005	2005	2005

Source: GTAP 10 Data Base.

To support those working with the new GSEC3 classification, we provide new concordances to match sector classifications for different sources of information to our own sector classification. For Food and Agricultural sectors, Table A.4 shows the new concordance between the United Nations (UN) Central Product Classification (CPC) and GTAP sectors. Tables A.5 and A.6 display the new concordances between the UN International Standard Industry Classification (ISIC) and GTAP sectors for, respectively, manufacturing and services.

2.2 International Transportation Margins

In previous versions of GTAP, international transport margins by commodity and mode of transport were solely based on U.S. data. In GTAP 10 we use estimates based on reported values from a large set of countries with a sizable set of trading partners. This results in more variability of international transport margins by mode of transport (i.e., land, air and water) than in previous versions. The new estimates are based on data from U.S. imports of merchandise and North American

Trans-border Freight Data, EUROSTAT trade data for European countries, and the Latin American Integration Association (ALADI) imports data (Nuño and Villoria, 2019).

2.3 International Trade Protection

Version 10 of the GTAP Data Base continues to represent several types of protection instruments. For agricultural products, domestic support and export subsidies are taken into account. Additionally, import tariffs are included for all merchandise products (agricultural and non-agricultural).

Agricultural domestic support is based on Producer Support Estimates (PSE) from the OECD (2017). These data are only available for OECD countries and selected Non-OECD countries. The OECD 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, including 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 a tariff dataset, the MPS component of the PSE is excluded, leaving us only to consider the transfers to agricultural producers as explained in Huang (2013). We use OECD data to update all reference years. For European Union member countries, we rely on the contribution from the European Commission's Joint Research Centre (JRC) (Boulanger, Philippidis, and Jensen, 2018). For version 10, reference year 2014 was added, while year 2011 was updated. For 2004 and 2007, we rely on previously contributed data.

Agricultural export subsidies also rely on previous treatment and efforts by researchers: for 2004 we use Elbehri and Narayanan (2010), for 2007 we use Laborde (2012), for 2011 and 2014 we benefit from the contribution of Jayson Beckman who collected notifications to the World Trade Organization (WTO) (Beckman and Aguiar, 2018) and for EU members, we draw on information from the European Agricultural Guarantee Fund (EAGF) provided by Alessandro Antimiani.

For tariff information, we consider applied ad valorem tariffs, including ad valorem equivalents of specific tariffs and import quotas. Mondher Mimouni and Xavier Pichot from the International Trace Centre (ITC) provide us with consistent data for the three most recent reference years (2007, 2011, and 2014) at the 6 digit Harmonized System (HS6) level.[10] For 2004 we use previously contributed data from Laborde (2010) based on ITC data.

2.4 Trade data

Discrepancies in reported bilateral trade flows need to be reconciled to obtain the initial equilibrium required for general equilibrium modeling. Gehlhar (2017) explains that for version 10, a unified and comprehensive approach has been applied consistently across time in order to obtain this key element of the GTAP

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[10] This is documented in http://www.macmap.org/SupportMaterials/Methodology.aspx.

Data Base for all four reference years. This new approach is applied to the UN-COMTRADE dataset of 231 countries, where the main objective is to produce balanced trade, that is world exports line up with world imports. Besides the discrepancies in countries' reporting, one of the challenges is the increasing presence of re-exports. Trade data for more than 50 countries that re-export are re-estimated by deriving domestic exports and by converting total imports into retained imports.

2.5 Other methodological improvements

The GTAP Data Base makes use of IOTs to reproduce cost structures for each economic agent, and is supplemented by international data to reflect economic activities for each country/region in each of the four reference years. Prior to version 10, many of the commodity tax rates from the IOTs intermediate use had been zeroed out because the tax representation of older tables were not representative of a more recent reference year. In version 10, we change our treatment in order to better reflect the information we obtain from the IOTs.

We have also improved the energy data module to address simplifying assumptions that affected non-oil producing countries in Africa. The source energy data, from the International Energy Agency, provides us with information for an aggregate Rest of Africa which we apportion among the component countries. GDP shares had been used to allocate energy data in previous versions of the Data Base. Rest of Africa, however, is composed of a heterogeneous group of countries, some of which have significant energy production (e.g., Malawi or Uganda) and others with none that might nonetheless have a relatively large GDP.

3. Numerical illustration

There are many aspects of the Data Base that can be highlighted. In this section, we focus on CO_2 emissions embodied in bilateral trade (EEBT). Calculating trade embodied emissions requires data on bilateral trade and intermediate input use by country, so it is a good way to showcase the usefulness of the GTAP Data Base. To estimate such flows, we follow (Peters, 2008), which we briefly describe below.[11]

Country-specific CO_2 emissions per unit of output by industries are used to estimate emissions associated with bilateral trade flows. This method assumes that the production technology is based on fixed proportions (i.e. in a given sector and country, the same production technology is used to produce domestic and exported commodities) (Peters, 2008). This allows us to decompose emissions from domestic output into its sales disposition, i.e., exports or domestic sales. For every commodity, the total CO_2 emissions associated with fossil-fuels combustion and embodied in trade flows from region r to region s (f_{rs}) are estimated as

$$f_{rs} = F_r(I - A_r)^{-1}e_{rs} \qquad (1)$$

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[11] Similar analysis for 2004 data is also applied in Davis and Caldeira (2010).

where F_r is a vector of country-specific CO_2 emissions per unit of output by industries, I is the identity matrix, A_r is the technological matrix, which represents the industry requirements of domestically produced products in region r and e_{rs} corresponds to the bilateral trade flow from region r to region s.

According to our estimation, out of 7.2 Gigatons (Gt) of CO_2 emissions embodied in global exports in 2014, over 24% are associated with China. Figure 2 shows selected countries with the largest EEBT, measured in Megatons (Mt). Compared to the 2004 data, Chinese carbon-intensive export flows are redirected from the U.S. and Japan towards the EU, Russia and India. The EU as a region and the U.S. as a country are the world's largest net CO_2 importers.

Between 2004 and 2014 global CO_2 EEBT flows increased by 21%. And some countries have undergone significant structural EEBT shifts. In particular, Russia's CO_2 embodied in its net exports declined by almost 37% since 2004, while the U.S.' CO_2 embodied in its net imports declined by 36%.
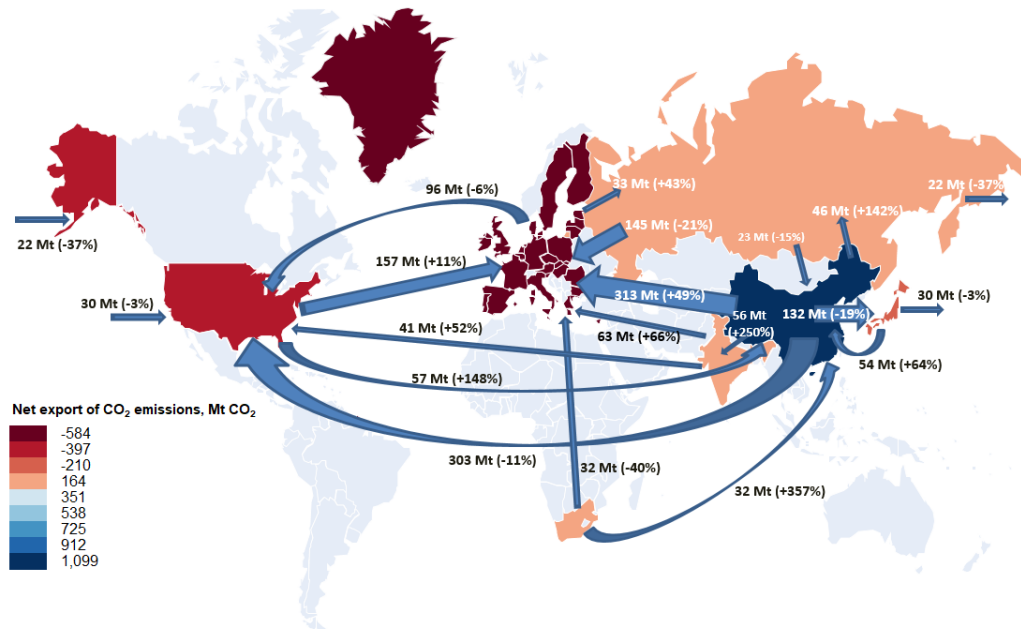
**Figure 2.** CO_2 EEBT flows for selected countries/regions in 2014, Mt CO_2 year^{-1}

Notes: Reported net CO_2 importers include EU-28, U.S. and Japan. Depicted net CO_2 exporters include China, Russia, India and South Africa. Numbers in brackets indicate percentage changes in corresponding flows relative to 2004 levels. Non-reported regions are shaded light grey. This figure was generated on May 9, 2019 using a pre-release version of GTAP 10.

Source: GTAP 10 Data Base.

In terms of sectoral distribution, most CO_2 EEBT flows are associated with heavy manufacturing (Figure 3).[12] The global share of corresponding emissions has in-

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[12] Heavy manufacturing includes sectors 33-38 and 40-42 in GTAP. CO_2 EBBT flows are

creased by 1 percentage point since 2004 and accounts for 40.8% in 2014. Light manufacturing and transportation, which are respectively the second and third largest contributors to EEBT flows, in aggregate demonstrate a gradual decrease over time.[13] With a peak of global CO_2 EEBT in 2014 (Figure 3), their EEBT share in the global CO_2 fossil-fuel combustion emissions has increased since 2004 by 0.3 percentage points and is around 24.8% in 2014.[14]
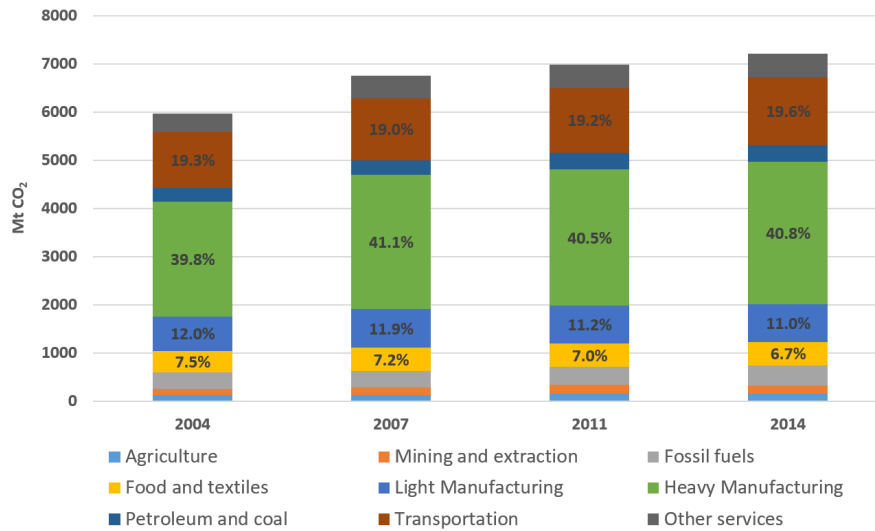
Figure 3. Sectoral decomposition of global CO_2 EEBT flows, Mt CO_2 year^{-1}

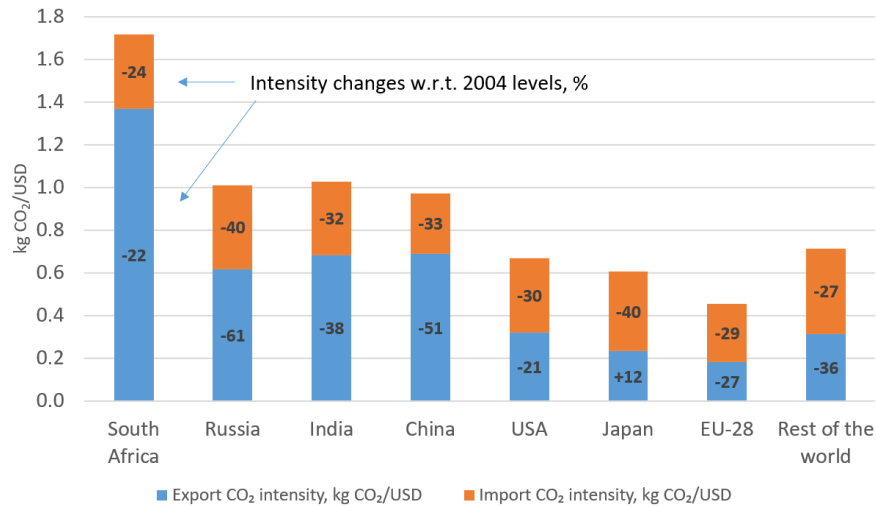*Notes:* This figure was generated on May 9, 2019 using a pre-release version of GTAP 10.

Source: GTAP 10 Data Base.

In most countries, a significant reduction in CO_2 trade flow intensity has been observed since 2004—over 50% in the case of exports from China and Russia (Figure 4). Net CO_2 exporters (South Africa, Russia, India and China) have higher CO_2 intensity of exports relative to their import intensity, while the opposite holds for the net CO_2 importers (U.S., EU and Japan). South Africa has by far the highest CO_2 export intensity among the reported countries, due to the high heavy manufacturing and metal ores export shares. Russia's export and import CO_2 intensities, which were higher than South Africa's in 2004, have decreased by over 50% due to structural shifts in trade. Japan is the only reported country with increased aggregate CO_2 export intensity (Figure 4). The main reason behind the increase is that the CO_2 intensity of Japan's heavy manufacturing output has not changed over time (contrary to most other countries), while trade values (in constant USD) have slightly increased.

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estimated separately for each GTAP sector and then aggregated for presentation purposes.
[13] Light manufacturing includes sectors 29-31, 39 and 43-45 in GTAP.
[14] Percentages are based on GTAP 10 Data Base.

Figure 4. Average CO_2 intensity of exports and imports in 2014, kg CO_2 per USD

Notes: For CO_2 trade flows intensity comparison between years trade data is converted into constant $2014 using U.S. GDP deflators. This figure was generated on May 9, 2019 using a pre-release version of GTAP 10.

Source: GTAP 10 Data Base.

To summarize, there are three takeaway messages from this illustration. First, between 2014 and 2004, there has been an increase in global CO_2 EEBT flows by almost 21%. This has been mainly driven by increase in emissions embodied into exports from China and India, which together account for around half of the CO_2 EBBT growth since 2004. At the global level, CO_2 EEBT growth rate has been gradually reducing over time—from over 4% per year between 2007 and 2004 to around 1% between 2014 and 2011. Second, there has been a moderate structural shift in CO_2 EEBT at the sectoral level. With the largest share of CO_2 emissions, heavy manufacturing has been slowly growing over time, which contrasts with the decline, also slow, of food and textiles, and light manufacturing. Finally, two competing drivers have been defining the CO_2 EEBT trend over this period. On the one hand, there has been a significant reduction in the global average CO_2 export intensity—from 0.47 kg CO_2 per USD in 2004 to 0.34 kg CO_2 per USD in 2014 (39.3% improvement). On the other hand, total exports have been growing at an even higher pace—68.4% increase over 2004-2014 period (constant 2014 USD). With increases in exports of heavy manufacturing by 57.7%, transportation by 60.6% and food and textiles by 60.2% over corresponding period. As a result, improvements in the carbon intensity of exports have been out-weighted by an increase in total exports and resulted in the CO_2 EEBT increase over time.

4. Summary and future developments

The GTAP 10 Data Base now covers 65 products and services in 141 regions. Its construction relies on the contributed datasets from a large network of individuals, GTAP Board member agencies, and institutions from around the world. Increasing the representation of countries and sectors depends on data availability. Also, in order to improve the time series dimension of the Data Base, development and contribution of IOTs are the basis to capturing structural changes over time.

After the release of GTAP 10, several data extensions that complement the GTAP Data Base will be updated for subsequent release. These include: the energy environmental extension (GTAP-E documented in McDougall and Golub (2009)), that tracks CO_2 emissions, the international migration and remittances data extension (GMig documented in Walmsley, Winters, and Ahmed (2007)), the land use and cover extensions (GTAP-AEZ documented in Baldos (2017)), the foreign income payment and receipt data extension (GDYN documented in Golub (2016)), the disaggregation of the electricity sector (GTAP-POWER documented in Peters (2016)) and the non-CO_2 emissions dataset documented in Irfanoglu and van der Mensbrugghe (2016).

Also a new air pollution database will be made available. The air pollution database will include an additional 10 emissions linked to economic activities.[15] Similar to the non-CO_2 greenhouse gas emissions, these emissions are linked to specific sources of economic activity, including: intermediate and final demand, endowment use (land and capital), and output (Chepeliev, 2018a).

In addition, we plan to have two special releases of GTAP 10, one which incorporates energy subsidies based on estimates from the International Monetary Fund (IMF) information (Chepeliev, McDougall, and van der Mensbrugghe, 2018). The second release expands the GTAP framework (both model and Data Base) to accommodate domestic margins (Corong, 2018).

There is also ongoing work to release a new GTAP Multi Region Input Output data (GTAP-MRIO), which allows for agent-level sourcing of imports by region of origin with differentiated preferences and tariffs.[16] Finally, we are expanding the country coverage of the Agricultural Production Targeting module. This module calibrates the level of agricultural production in the GTAP Data Base according to internationally recognized data sources. We have begun to use data from the Food and Agricultural Organization of the United Nations (FAO), which has greater country coverage than our current OECD source (Chepeliev and Aguiar, 2018).

Those interested in accessing the GTAP Data Base are referred to the web site: https://www.gtap.agecon.purdue.edu/databases/default.asp where versions 1 to

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[15] Black carbon, carbon monoxide, ammonia, nitrogen oxides, organic carbon, sulfur dioxide, particulate matter 2.5 and 10, and short- and long-cycle volatile organic compounds.
[16] See Carrico (2017) for a Version 9-based MRIO database.

8 can be downloaded for free. 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 Data Base.

Acknowledgements

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Appendix.

Table A.1. A summary of GTAP data releases.

Version	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

Table A.2. The 65 sectors in GTAP 10.

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 (formerly omn Minerals n.e.c.)	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 (formerly isr)
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			

Table A.3. The 141 regions in GTAP 10.

No.	Code	Name	No.	Code	Name
1	aus	Australia	48	xca	Rest of Central America
2	nzl	New Zealand	49	dom	Dominican Republic
3	xoc	Rest of Oceania	50	jam	Jamaica
4	chn	China	51	pri	Puerto Rico
5	hkg	Hong Kong	52	tto	Trinidad and Tobago
6	jpn	Japan	53	xcb	Rest of Caribbean
7	kor	Korea	54	aut	Austria
8	mng	Mongolia	55	bel	Belgium
9	twn	Taiwan	56	cyp	Cyprus
10	xea	Rest of East Asia	57	cze	Czech Republic
11	brn	Brunei Darussalam	58	dnk	Denmark
12	khm	Cambodia	59	est	Estonia
13	idn	Indonesia	60	fin	Finland
14	lao	Laos	61	fra	France
15	mys	Malaysia	62	deu	Germany
16	phl	Philippines	63	grc	Greece
17	sgp	Singapore	64	hun	Hungary
18	tha	Thailand	65	irl	Ireland
19	vnm	Viet Nam	66	ita	Italy
20	xse	Rest of Southeast Asia	67	lva	Latvia
21	bgd	Bangladesh	68	ltu	Lithuania
22	ind	India	69	lux	Luxembourg
23	npl	Nepal	70	mlt	Malta
24	pak	Pakistan	71	nld	Netherlands
25	lka	Sri Lanka	72	pol	Poland
26	xsa	Rest of South Asia	73	prt	Portugal
27	can	Canada	74	svk	Slovakia
28	usa	United States of America	75	svn	Slovenia
29	mex	Mexico	76	esp	Spain
30	xna	Rest of North America	77	swe	Sweden
31	arg	Argentina	78	gbr	United Kingdom
32	bol	Bolivia	79	che	Switzerland
33	bra	Brazil	80	nor	Norway
34	chl	Chile	81	xef	Rest of European FTA
35	col	Colombia	82	alb	Albania
36	ecu	Ecuador	83	bgr	Bulgaria
37	pry	Paraguay	84	blr	Belarus
38	per	Peru	85	hrv	Croatia
39	ury	Uruguay	86	rou	Romania
40	ven	Venezuela	87	rus	Russian Federation
41	xsm	Rest of South America	88	ukr	Ukraine
42	cri	Costa Rica	89	xee	Rest of Eastern Europe
43	gtm	Guatemala	90	xer	Rest of Europe
44	hnd	Honduras	91	kaz	Kazakhstan
45	nic	Nicaragua	92	kgz	Kyrgyzstan
46	pan	Panama	93	tjk	Tajikistan
47	slv	El Salvador	94	xsu	Rest of Former Soviet Union

...Continued

No.	Code	Name	No.	Code	Name
95	arm	Armenia	124	eth	Ethiopia
96	aze	Azerbaijan	125	ken	Kenya
97	geo	Georgia	126	mdg	Madagascar
98	bhr	Bahrain	127	mwi	Malawi
99	irn	Iran, Islamic Republic of	128	mus	Mauritius
100	isr	Israel	129	moz	Mozambique
101	jor	Jordan	130	rwa	Rwanda
102	kwt	Kuwait	131	tza	Tanzania
103	omn	Oman	132	uga	Uganda
104	qat	Qatar	133	zmb	Zambia
105	sau	Saudi Arabia	134	zwe	Zimbabwe
106	tur	Turkey	135	sdn	Sudan
107	are	United Arab Emirates	135	tun	Tunisia
108	xws	Rest of Western Asia	136	xec	Rest of Eastern Africa
109	egy	Egypt	137	bwa	Botswana
110	mar	Morocco	138	nam	Namibia
111	xnf	Rest of North Africa	139	zaf	South Africa
112	ben	Benin	140	xsc	Rest of South African Customs
113	bfa	Burkina Faso	141	xtw	Rest of the World
114	cmr	Cameroon			
115	civ	Côte d'Ivoire			
116	gha	Ghana			
117	gin	Guinea			
118	nga	Nigeria			
119	sen	Senegal			
120	tgo	Togo			
121	xwf	Rest of Western Africa			
122	xcf	Rest of Central Africa			
123	xac	South Central Africa			

Table A.4. Food and Agricultural Sectors Concordances in GTAP 10.

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 nec	016, 0191, 0193-0197, 0199
ctl	Bovine animals, horses and other equines	0211-0213, 0299
oap	Other animals and animal products nec	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 nec	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 nec	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 10 Data Base.

Table A.5. Manufacturing Sectors Concordances in GTAP 10.

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 (formerly omn Minerals n.e.c.)	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 10 Data Base.

Table A.6. Services Sectors Concordances in GTAP 10.

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 nec	64, 661, 663
ins	Insurance (formerly isr)	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 10 Data Base.