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Long-run World Input-Output Database: Version 1.1 Sources and Methods

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Contents

0. Change Log

March 2022 – Update to Long-run World Input-Output Database, new version 1.1. The version 1.0 release of LR WIOD relied on the WIOD 2013 SUTs for JPN and USA for the years 1995-2000, instead of the original Make/Use tables for these countries. This caused a break in the timeseries for the USA and JPN, primarily affecting the Trade in Value Added for Services. This issue has been resolved in version 1.1.

1. Introduction

The World Input–Output Database (WIOD) provides annual time-series of world input–output tables. In addition, the WIOD provides data on factor inputs enlarging the scope of potential applications considerably. Since its public inception on April 2012, two further releases have been made (2013 and 2016 releases.[1] The WIOD is an open access database and has proved very useful in analyses of the causes and consequences of international trade for firms, countries and workers. It has been frequently used in various (sub)disciplines such as International Economics, Labour Economics, Economic Growth, International Business, Finance, Marketing and Economic Geography, as well as Economic Sociology and even Environmental Sustainability. The 2016 release of the WIOD contains data from 1995 onwards. In this paper we outline the construction of the WIOD for a longer period, namely from 1965 onwards, hence the name Long-run WIOD (LR-WIOD). This encompasses the period of rapid growth in the world economy – the Golden Age of Growth according to Maddison (1995) – and characterized by increasing integration of production and consumption in the world economy, including the integration of Japan, South Korea and other East-Asian countries in the world economy, and the continuous integration of countries within the European Union.

Related work has been performed by Johnson and Noguera (2012, 2016) and Pahl and Timmer (2020). Pahl and Timmer provide national input output tables for a wide set of 76 countries for 1970-2010, but do not link these together with bilateral trade data. Johnson and Noguera do link up national tables for 34 countries back to 1970 but only at a very aggregate sector level (for 4 sectors"agriculture, mining, manufacturing and services) obscuring many interesting developments within manufacturing and services. Moreover, the long-run WIOD provides not only nominal tables at current prices, but also volume tables at constant prices, as well as compatible information on labour and capital inputs used, thus greatly enhancing the type of research questions that can be handled. Last but not least, the LR-WIOD is an open access database providing full details on construction methods, allowing others to use the data, and also to generate alternative tables by modifying underlying assumptions.

1.1 World Input–Output Tables layout

Central in the WIOD is a time-series of world input–output tables. A world input– output table (WIOT) can be regarded as a set of national input–output tables that are connected with each other by bilateral international trade flows. This is illustrated by the schematic outline for a WIOT involving three countries in Figure 1. WIOT provides a comprehensive summary of all transactions in the global economy between industries and final users across countries. The columns in the WIOT contain information on production processes. When expressed as ratios to gross output, the cells in a column provide information on the shares of inputs in total costs. Such a vector of cost shares is often referred to as a production technology. Products can be used as intermediates by other industries, or as final products by households and governments (consumption) or firms (stocks and gross fixed

[1] see www.wiod.org

capital formation). The distribution of the output of industries over user categories is indicated in the rows of the table. An important accounting identity in the WIOT is that gross output of each industry (given in the last element of each column) is equal to the sum of all uses of the output from that industry (given in the last element of each row). In addition to a national input–output table, imports are broken down according to the country and industry of origin in a WIOT. This allows one, for example, to trace the country of origin of the chemicals used in the food industry of country A. The combination of national and international flows of products provides a powerful tool for analysis of global production networks. While national tables are routinely produced by national statistical institutes, WIOTs are not, as they require integration of national account statistics across countries. It is this gap that the WIOD project aimed to fill.

Figure 1: Schematic Outline of a World Input–Output Table (WIOT)

			Use by country-industries							**Final use by countries**			**Total use**
			Country 1			…	Country M			Country 1	…	Country M	
			Industry 1	…	Industry N	…	Industry 1	…	Industry N		…		
Supply from country industries	Country 1	Industry 1											
		…											
		Industry N											
	……												
	Country M	Industry 1											
		…											
		Industry N											
Value added by labour and capital													
Gross output													

1.2 Basic construction approach for Long-run WIOTs

A world input–output table (WIOT) is basically an extension of a national input– output table in which the origins and destinations of imports and exports are made explicit. As building blocks for the long-run WIOTs, we used published national input-output tables (NIOTs) and link these across countries through detailed bilateral international trade statistics. Use is made of published and publicly available statistics from national statistical institutes around the world, plus various international statistical sources such as OECD and UN National Accounts and IMF trade statistics. In this section we discuss how we dealt with four major challenges in data construction: harmonization of basic NIOT data; derivation of time-series of NIOTs; disaggregation of imports by country of origin and use category, and global closure. This will be brief and nontechnical; more detail can be found in Dietzenbacher et al. (2013). In general, we follow the construction philosophy of the previous release of the WIOD, and flag when it is otherwise.

Harmonization of national IOT data The WIOTs have been constructed on the basis of sets of national input-output tables (NIOTs). NIOTs were collected from national statistical institutes and harmonized in terms of concepts and classifications. The World Input–Output Tables have been constructed in a clear conceptual framework based on the system of national accounts (Intersecretariat Working Group on National Acccounts (ISWGNA), 1993, 2010). We adopt the **SNA 1993.** This is motivated by two considerations. First, timeseries of national accounts data in SNA 1993 generally cover our entire timeframe (1965-2000), SNA 2008 typically does not extend that far back in time. SNA 2008 may also have a distortionary effect on Global Value Chain (GVC) indicators, as it disregards transactions

related to goods sent abroad for processing but with no change of ownership. For the industry selection, we adopt the International Standard Industrial Classification of All Economic Activities (**ISIC) version 3.1**, primarily because of data availability before 1990 and because of the ISIC 3.1's alignment with the SNA 1993. NIOTs have been tailored to dimensions of 23 industries that cover the overall economy and are mostly at the two-digit ISIC rev. 3 level or groups thereof. This level of detail was dictated by the available data, reflecting the lowest common denominator across countries. Construction involved aggregation of more detailed source data and sometimes disaggregation based on additional data from detailed production surveys.[2] The national IOTs have also been harmonized to a **producer price concept**. Producer prices reflect all costs borne by the producer, whereas purchasers' prices reflect the amounts paid by the buyer. The difference between the two is given in so-called valuation matrices with product-specific trade and transportation margins. (Note: the WIOTs are in basic prices, the differences with the producer price concept in the LR-WIOT is net taxes paid by the producer). National IOTs in producer and purchasers' prices are separately estimated and reported. International trade flows were accordingly expressed in "free on board" (fob) prices through estimation of international trade and transport margins. The values in WIOTs have been expressed in millions of **US dollars** and exchange rates were used for currency conversion of the SUTs, which originally contain values in national currencies.

Time-series of national IOTs A second challenge in data construction is the derivation of time-series of IOTs. National tables are only available for particular benchmark years that are unevenly spread over time and asynchronous across countries. Moreover, they are not designed for comparisons over time, which becomes clear when comparing data from the IOTs with the national accounts statistics. While the latter are frequently revised, the former are not. To deal with both these issues simultaneously, a procedure was applied that imputes IOT coefficients subject to hard data constraints from the National Accounts Statistics (NAS). As such, the solution matches exactly the most matches exactly the revised NAS data on final expenditure categories (household and government consumption and investment), total exports and total imports, and gross output and value added by industry. The unknown product shares are imputed using a constrained optimization method akin to the well-known bi-proportional (***RAS***) updating method. In this way the tables will also satisfy another important accounting identity that is related to the measurement of GDP in the System of National Accounts: the sum of value added over all industries (representing incomes for labour and capital) will be equal to the sum of final domestic use expenditures and the net trade balance (exports minus imports). Appendix Table A1 gives for each country the years for which a benchmark national SUT was available and used in the construction of the time-series.

Use categories of imports A third challenge was the breakdown of imports of a product for each use category by country and industry of origin. This type of information is not available in published supply and use tables. Typically, researchers rely on the so-called import proportionality assumption, applying a product's economy-wide import share for all use categories (as e.g. Johnson and Noguera, 2012). To improve upon this, bilateral trade statistics have been used in WIOD to derive import shares for three end-use categories. Bilateral import flows of all countries covered in WIOD from all partners in the world at the six-digit product level of the Harmonized System (HS) were taken from the World Trade Flows (Feenstra et al., 2005). We used the detailed product descriptions to refine the well-known BEC ("broad economic categories") codes, which allocates imported goods to intermediate use, final consumption use, or investment use. Within each **end-use category**, the

[2] Note: the 2013 and 2016 WIOTs are built up from a deeper level, namely supply- and use tables. This approach has certain advantages, but could not be used for the LR-WIOTs as data on supply and use tables is too scarce in the period before 1995.

allocation was based on the proportionality assumption (as dictated by a lack of additional information). For intermediate use by industries, for example, we applied ratios between imported use and total use that were equal across industries, but differed from the corresponding ratio for consumption purposes.

The LR-WIOT contains data for 25 individual countries (see Appendix Table). These countries cover about 85% of world GDP. To have a closed model of the world economy, we also defined a **rest of the world (RoW) region** that proxies for all other countries in the world. Exports to this region for each product and country from the set of WIOD countries are defined residually to achieve consistency of global trade flows. It ensures that exports summed over all countries of destination (including the RoW region) are equal to total exports as given in the national SUTs. It was modeled based on totals for industry output and final use categories from the UN National Accounts for non-covered countries, to capture the unusual large size of its mining and natural resource sectors compared with WIOD countries. This was combined with an input–output structure reflecting the average of the US in 1980. The RoW was treated as an additional trade reporter alongside the other 40 countries. Bilateral trade shares were re-calculated using a RAS procedure and shares that were originally computed from the World Trade Flows data are not necessarily maintained in all cases.

Comparability of LR-WIOD with the WIOD releases 2013 and 2016. The LR-WIOD provides data for the period 1965-2000. The WIOD 2013 release provides data for 1995-2011, and the 2016 release for 2000-2014. The tables cannot be used together at a detailed industry level. This is because of differences in the price concepts (producer prices in LR-WIOT versus basic prices in the others); differences in the SNA version (SNA 2008 in the 2016 release, SNA 1993 in the others); in the industrial classification (ISIC rev.4 in the 2016 release versus rev 3.1 in the others) and in the level of industry detail. This precludes comparability at a detailed level. Yet, for analyses at more aggregate levels trends and levels are likely to be comparable and could be used side-by-side.

2. Sources and methods

The LR-WIOD is constructed top-down, meaning we always start from an estimate of GDP and break this down by expenditure categories, value added by industry, gross output and intermediate inputs. We then distinguish between domestically and internationally produced intermediates and final consumption items and identify the country and industry of origin for all imports. A credible and consistent timeseries of GDP, both across time and space, is essential to estimating the flow of value added across borders and the implications of these transnational linkages on domestic production and consumption.

2.1. GDP by type of expenditure

2.1.1 Nominal GDP and total value added

Nominal GDP at market prices is sourced from the United Nations' Official Country Data (UN OCD) 'Gross domestic product by expenditures at current prices' table (see stage 1a). GDP is listed in local currencies (LCU) and converted to US Dollars (USD) using exchanges rates provided by the International Monetary Fund's International Financial Statistics (IMF IFS). If required, the GDP data is extrapolated based on GDP data from the UN's Estimates of Main Aggregates (UN EMA) 'GDP by Type of Expenditure at current prices – US dollars' tables and current GDP data from the Penn World Table (PWT) 9.1 (Feenstra et al. 2015).

Stage 1a: Total Gross Domestic Product and Value Added				**Variable(s)**	**Period**
Data	**GDP (market prices), LCU** Source: *UN OCD, GDPe* Type: nominal, SNA 1993			GDP_lcu	1965-2000
Data	/	**Exchange rate (XR)** Source: *IMF IFS* Type: LCU / USD		XR	1965-2000
Data	~*	**GDP (market prices), USD** Source: *UN EMA* Type: nominal, SNA 2008		GDP_usd	[1970]-2000
Data	~*	**GDP (market prices), USD** Source: *PWT 9.1* Type: nominal, SNA 2008		GDP_usd	1965-2000
Output	=	**GDP (market prices), USD** Type: nominal, SNA 1993		GDP_usd	1965-2000
Data		*(1-x)	**Total TXSP and Statistical Discrepancy** Source: *UN OCD, ind. VA* Type: share of GDP, SNA 1993	TXSP, SD	1965-2000
Output		=	**Value Added (basic prices), USD** Type: nominal, SNA 1993	VA	1965-2000

Note: ~ denotes variable is used to interpolate/extrapolate series above*

Whenever possible we use GDP estimates compiled under the 1993 System of National Accounts (SNA) framework. The choice of the SNA 1993 over the more recent 2008 framework is motivated by two considerations: availability of data and the treatment of goods sent abroad for processing. Timeseries of expenditure and output in SNA 1993 generally cover our entire timeframe (1965-2000), SNA 2008 typically does not extend that far back in time. SNA 2008 may also have a distortionary effect on Global Value Chain (GVC) indicators, as it disregards transactions related to goods sent abroad for processing but with no change of ownership.

The UN OCD provides separate series based on the SNA 1993 as well as the 1968 and 2008 frameworks. We always prefer the latest available series based on SNA 1993 and extrapolate iterating through the remaining series that are based on SNA 2008 and 1968 (newest first). Note that both the UN EMA and PWT are based on the SNA 2008 framework. The growth rates of GDP estimates based on the different SNA frameworks tend to be very similar. Levels of nominal GDP can differ by as much as 10 percentage points however, most notably for the United Kingdom and Mexico.

GDP at market prices is converted to Value Added (VA) at basic prices using data on Taxes Less Subsidies on Products (TXSP) and the Statistical Discrepancy (SD). Both TXSP and SD are expressed in percentage shares of GDP and taken from the UN OCD 'Value added by industries at current prices (ISIC Rev. 3)' table.

2.1.2 GDP by type of expenditure

GDP at market prices, from stage 1a, is assigned to six expenditure categories: Household Consumption (CONS_h), Government Consumption (CONS_g), Gross Fixed Capital Formation (GFCF), Changes in Inventories (INV), Exports (X) and Imports (M). These six expenditure categories serve as the column totals for final consumption in the National Input Output Tables (NIOTs) and World Input Output Tables (WIOTs), discussed below. We rely on shares of GDP taken from the UN's EMA 'GDP by Type of Expenditure at current prices – US dollars' tables (see stage 1b). If required, the shares are extrapolated based on current expenditures shares derived from PWT 9.1.

In the Long-run WIOD, the intermediate consumption block is presented in producer prices, meaning TXSP is included in the value of intermediate inputs. To ensure that, for each industry, intermediate- and final consumption add up to Gross Output (GO) in basic prices, we deduct total TXSP (and SD) from final consumption. Final consumption thus equals total VA in basic prices. TXSP is allocated to the expenditure categories based on the distribution of TXSP as listed in the National IOTs. SD is distributed based on the share of each expenditure category in GDP.

Stage 1b: GDP by expenditure				**Variable(s)**	**Period**
Input [1a]	**GDP (market prices), USD** Type: nominal, SNA 1993			GDP_usd	
Data	*	**GDP by expenditure** Source: *UN EMA* Type: share of GDP, SNA 2008		CONS_h, CONS_g, GFCF, INV, X, M	[1970]-2000
Data	~*	**GDP by expenditure** Source: *PWT 9.1* Type: share of GDP, SNA 2008			1965-2000
Output	=	**Expenditure categories (market prices), USD** Type: nominal, SNA 1993			1965-2000
Data		-	**Total TXSP and Statistical Discr.** Source: *UN OCD, ind. VA* Type: share of GDP, SNA 1993	TXSP, SD	1965-2000
Data		~*	**TXSP by CIG** Source: *National IOTs* Type: share of TXSP	CONS_h, CONS_g, GFCF	Bench mark yrs.
Output		=	**Expenditure categories (basic prices), USD** Type: nominal, SNA 1993 Note: TXSP and SD are only subtracted from final expenditure.	CONS_h, CONS_g, GFCF, INV, X, M	1965-2000

Note: ~ denotes variable is used to interpolate/extrapolate series above*

2.1.3 Direct purchases abroad by residents

Direct purchases abroad by residents (PURR) and purchases on the domestic territory by non-residents (PURNR) are identified separately and are only reported as a total at the bottom of the Long-run WIOD matrix.[3] This means these expenditures are deducted from final expenditure, imports and exports of services respectively, in which they are explicitly included in the UN's EMA (see section 2.1.2). These direct expenditures primarily relate to travel, either for business or pleasure. Note that, in our calculation of PURR and PURNR, we always assume that only services are consumed by tourists and business travelers.

For the years 1995-2000, we estimate the share of PURR and PURNR, in imports and exports respectively, based on data from the 2013 release of WIOD. If PURR and PURNR are not available in WIOD 2013, we base these shares on the value of 'Travel' from the IMF's 'International Trade in Services' (TIS) table instead – expressed as a share of total trade, not just services as in the IMF's table. If, for a country, TIS data is unavailable for any year, we take the values from the share of 'Hotels and Restaurants' in either exports for PURNR or imports for PURR (see section 2.3).

[3] In the Long-run WIOD, the industry and country of origin and/or country of destination for PURR and PURNR are not explicitly identified. Data on the type of expenditure and the origin and destination of tourists or business travelers are still scarce and incomplete for most of the years covered by the Long-run WIOD, making it impracticable to break these items down by industry or country.

For PURNR in years prior to 1995, we extrapolate the shares using the value for 'Travel' from the TIS table. For all years and countries, we then estimate the ratio of PURNR to the export of services (see section 2.3). For each year we calculate the average ratio over all countries for which we have data and use this to extrapolate the missing ratios of PURNR to the export of services. Finally, the share of PURNR is again expressed in relation to total exports instead of the exports of just services.

For PURR, no data is available from the IMF's TIS table, preventing us from extrapolating the pre-1995 levels directly. Instead, for each country we estimate the ratio of PURR to the import of services in 1995 and assign this ratio to every year prior to 1995. We then compare the implicit *level* of PURR to the previously calculated *level* of PURNR.[4] Assuming that all expenditures by tourists occur solely within the countries in our sample (and not in the rest of the world), we can normalize the total level of PURR to the total level of PURNR. For each year, the excess of total PURR to PURNR is subtracted from PURR for each country, distributed based on that countries' share in total PURR. The normalized levels of PURR are then expressed as a share of total imports.

2.2. Value added and gross output by industry

We estimate a complete timeseries of Value Added (VA), Gross Output (GO) and (implicitly) Intermediate Input (II) for the 23 industries listed in Appendix 4.a. GO and II by industry serve as the row and column totals respectively in both the NIOTs and WIOTs. For the industry selection, we adopt the International Standard Industrial Classification of All Economic Activities (ISIC) version 3.1, primarily because of data availability before 1990 and because of the ISIC 3.1's alignment with the SNA 1993. The Long-run WIOD lists total II, VA and GO in millions of current US Dollars, as is true for all the variables in the dataset.

The primary source for VA and GO by industry are the KLEMS-type productivity studies. Of the twenty-five countries in our sample, eighteen are included in the EU KLEMS database, three in World KLEMS and four are taken directly from the countries' National Accounts, the UN OCD and the UNIDO INDSTAT 2 (see stage 2 and Appendix 4.b). For EU KLEMS we rely on the 2008 release, which implements an industry classification (NACE 1.1) that mirrors ISIC3.1 at the two-digit level.

For the countries included in the KLEMS-type datasets, VA is generally available for all industries from 1970-2000. We extrapolate the VA-shares for missing years based on data from the UN OCD's 'Value added by industries at current prices (ISIC Rev. 3)' table, the UN Industrial Development Organization's 'INDSTAT 2' table, and the GGDC's 2014 10-sector Database (Timmer et al. 2015). Data for Brazil, Hong Kong and Mexico are based entirely on the UN OCD and UNIDO INDSTAT2 series, while data for Taiwan is drawn from its official National Accounts. For the extrapolation we always use shares relative to the industry's direct parent. If no data is available, we hold the shares constant, but the reported value of the parent industry for extrapolated years is still taken into account.

GO is always estimated based on reported or imputed ratios of VA to GO (VAtGO) times VA. If both VA and GO are available in the original source, the resulting GO will exactly match that reported in the original source. If GO is unavailable, VAtGO is either extrapolated from values available in other datasets or is based on the ratio reported for its parent. To ensure consistency with the original source, the resulting GO values are normalized to always sum to their parent's value while, at the same time, enforcing an upper bound of 1. The VAtGO ratio is taken from EU KLEMS, World KLEMS, the UNIDO INDSTAT2 dataset and the UN OCD's 'Output, gross value added, and fixed assets by industries at current prices (ISIC Rev. 3)' table.

[4] The level of PURR is calculated as the (extrapolated) ratio of PURR to the imports of services *times* the share of services in total imports *times* the share of imports in GDP *times* the nominal GDP. The level of PURNR is calculated in a similar fashion only for exports.

Stage 2: Value Added (VA) and Gross Output (GO) by industry				**Variable(s)**	**Period**
Input [1a]	**VA (basic prices), USD** Type: nominal, SNA 1993			VA	
Data	*	**VA by industry** Source: *EU/World KLEMS | NA* Type: share of VA, 23 sectors		VA_AtB … VA_LtQ	[1970]-2000
Data	~*	**VA by industry** Source: *UN OCD, ind. VA* Type: share of VA, 10 sectors		VA_AtB … VA_LtQ	1965-2000
Data	~*	**VA by industry** Source: *10-sector database, 2014* Type: share of VA, 10 sectors		VA_AtB … VA_LtQ	1965-2000
Data	~*	**VA by manufacturing ind.** Source: *UNIDO INDSTAT2* Type: share of VA_D, 12 sectors		VA_D15t16 … VA_D34t35	1965-2000
Output	=	**VA by industry, USD** Type: nominal, 23 sectors		VA_AtB … VA_LtQ	1965-2000
Data		*	**VAtGO ratio by industry** Source: *EU KLEMS / World KLEMS* Type: ratio VA/GO, 23 sectors	GO_AtB … GO_LtQ	[1970]-2000
Data		~*	**VAtGO ratio by industry** Source: *UN OCD, ind. GO/VA* Type: ratio VA/GO, 10 sectors	GO_AtB … GO_LtQ	1965-2000
Data		~*	**VAtGO ratio by manufacturing ind.** Source: *UNIDO INDSTAT2* Type: ratio VA/GO, 12 sectors	GO_D15t16 … GO_D34t35	1965-2000
Output		=	**GO by industry, USD** Type: nominal, 23 sectors	GO_AtB … GO_LtQ	1965-2000

Note: ~ denotes variable is used to interpolate/extrapolate series above*

2.3. Exports and imports by product group

A crucial component of the Long-run WIOD are the trade flows between countries, industries and consumers. Estimating these flows is performed in two separate stages. in this stage (4a/b) we break down total exports (X) and imports (M) from stage 1b into a timeseries of trade by product group. Total exports and imports for a range of goods and services is then linked to our industry list. This results in estimates of the trade share of the supplying industry for exports and imports for every country and year in our sample. In stage 7 we estimate the bilateral trade flows, mapping the destination and origin of exports and imports respectively, distinguishing between both the country and industry of destination/origin.

The flows of both exports and imports in the Long-run WIOD are presented in millions of current USD, Free on Board (FOB). The total value of exports, from stage 1b, is already expressed as FOB. The total value of imports is recorded at Cost, Insurance and Freight (CIF), however. To convert the valuation of imports from CIF to FOB we estimate International Trade and Transport Margins (MRG) specific to each product group.

The split of total imports and exports by product group proceeds in three steps. First, we distinguish between the trade in goods and services. Second, we break the value of trade in goods and services down into a selection of product groups that can be directly linked to our list of industries. Third, for imports we estimate the international trade and transport margins.

The primary source for the share of goods is the UN's OCD estimate for exports and imports of goods and of services from the 'GDP by type of Expenditure at current prices' table (see stage 4a).

Whenever necessary, the shares are extrapolated using two primary sources. Firstly, the International Monetary Fund's (IMF) export and import values of goods and services taken from the 'Current Account' table. Secondly, the IMF's export and import values of goods and services taken from the 'External Sector' table. Alternatively, we extrapolate the share of goods in trade based on the aggregate value of exports or imports from the timeseries of World Trade Flows (WTF) by Robert Feenstra *et al.* (2005), which covers only goods, divided by the total value of exports and imports, estimated during stage 1b. Lastly, we extrapolate based on the trend of the average value of the share of goods in exports and imports for the countries for which we have a complete timeseries.

Stage 3a: Exports (X) and Imports (M) of goods				**Variable(s)**	**Period**
Input [1b]	**Total X/M, USD** Type: nominal, SNA 1993			X, M	1965-2000
Data	*	**Split X/M goods** Source: *UN OCD, cur GDP* Type: share of X/M, SNA 1993		X_g, M_g	1965-2000
Data	~*	**Split X/M goods** Source: *IMF Current Account* Type: share of X/M, SNA 1993		X_g, M_g	1965-2000
Data	~*	**Split X/M goods** Source: *IMF External Sector* Type: share of X/M, SNA 1993		X_g, M_g	1965-2000
Data	~*	**Split X/M goods** Source: *World Trade Flows (WTF)* Note: total WTF over total X/M Type: share of X/M		X_g, M_g	1965-2000
Data	~*	**Split X/M goods** Source: *average share all countries* Type: share of X/M, SNA 1993		X_g, M_g	1965-2000
Output	=	**X/M by goods, USD** Type: nominal, SNA 1993		X_g, M_g	1965-2000
Data		*	**Split X_g/M_g by industry** Source: *SUTs/IOTs* Type: share of X_g/X_s	X_AtB...M_Dnec	Benchmark yrs.
Data		~*	**Split X_g/M_g by industry** Source: *World Trade Flows (WTF)* Type: share of X_g/M_g	X_AtB...M_Dnec	1965-2000
Output		=	**X_g/M_g by industry, USD** Type: nominal, SNA 1993	X_AtB...M_Dnec	1965-2000

Note: ~ denotes variable is used to interpolate/extrapolate series above*

The value of goods exports and imports is broken down further into product groups using shares from the national SUTs or IOTs for benchmark years. These shares are extrapolated using the WTF. Note that the WTF is also used to determine country and Broad Economic Category (BEC) of destination/origin in stage 7 below. For the export shares we collapse the trade value over our selection of product groups as well as the destination countries, and divide by the total export of goods also taken from the WTF. For the import shares we collapse the data over our selection of product groups as well as the country of origin.

Total trade in services is estimated as the residual between total trade and the trade in goods (see stage 3a). The share of services is also corrected for the direct purchases abroad by residents (PURR) and purchases on the domestic territory by non-residents (PURNR), see section 2.1.3. The value of services exports and imports is again split by product groups using shares from the national SUTs or

IOTs for benchmark years. For exports we extrapolate the services shares using the IMF's 'International Trade in Services' (TIS) table. No timeseries data is available for the breakdown of imports of services. Here we extrapolate the shares observed for benchmark years using data on domestic consumption (GO-X), thus assuming that imports of services increase at the same rate as the consumption of domestically produced services.

Stage 3b: Exports (X) and Imports (M) of services				**Variable(s)**	**Period**
Input [1b]	**Total X/M, USD** Type: nominal, SNA 1993			X, M	1965-2000
Input [3a]	*	**Share X/M services** Type: 1 - share X/M goods		X_s, M_s	1965-2000
Input [1c]	-	**Share of PURNR/PURR** Type: share of total X/M		PURNR, PURR	1965-2000
Output	=	**X/M by services, USD** Type: nominal, SNA 1993		X_s, M_s	1965-2000
Data		*	**Split X_s/M_s by industry** Source: *SUTs/IOTs* Type: share of X_s/M_s	X_E...M_LtQ	Benchmark yrs.
Data		~*	**Split X_s by industry** Source: *IMF Trade in Services* Type: share of X_s	X_E...X_LtQ	1965-2000
Input [2a/3a]		~*	**Split M_s by industry** Note: Extrapolate using GO – X Type: share of M_s	M_E...M_LtQ	1965-2000
Output		=	**X_s/M_s by industry, USD** Type: nominal, SNA 1993		

Note: ~ denotes variable is used to interpolate/extrapolate series above*

Finally, to convert the valuation of import from CIF to FOB we estimate International Trade and Transport Margins (MRG) specific to each product group (see stage 3c). These margins are based on data from the 2013 WIOD, from which we calculate the ratio of margins to import (MRG/M). This ratio is typically fixed throughout our entire timeframe.

Stage 3c: Exports (X) and Imports (M) of goods			**Variable(s)**	**Period**
Data	**MRG by industry** Source: *WIOD 2013 SUTs* Type: 1 - ratio of MRG to M		MRG_AtB ... MRG_LtQ	[1995]-2000
Input [3a/b]	*	**M by industry, CIF** Type: nominal, SNA 1993	M_AtB ... M_LtQ	1965-2000
Output	=	**M by industry, FOB** Type: nominal, SNA 1993	M_AtB ... M_LtQ	1965-2000

2.4. Changes in inventories by industry

Prior to the estimation of the NIOTs during stage 6 below, we first estimate changes in inventories (INV) by industry. We exclude INV from the GRAS procedure that is used to fill the other cells of the matrix since INV can become negative and lacks a clear trend over time.

INV split by industry is typically only available in the National Supply and Use Tables (SUTs) and IOTs. For the benchmark years we express INV as the ratio relative to the sum of GO and M – as reported in the SUTs/NIOTs (see stage 3). This ensures that the resulting estimates of INV for non-benchmark

years do not exceed the total production and consumption for each industry. Simply extrapolating levels tends to inflate INV for earlier years. Instead, we interpolate the ratio of INV to the sum of GO and M between benchmark years, and extrapolate by holding this ratio constant for years beyond the benchmarks.

For each industry and for all years we estimate the level of INV by multiplying the above ratio times the sum of GO and M constructed in stages 2 and 4 respectively. Note that, since the estimates of GO and M need not be identical to those listed in the SUTs/NIOTs, the resulting level of INV sometimes deviates from the value reported in the official sources for benchmark years.

For each year and country, the sum of INV by industry should match the expenditure item of total changes in inventories from the national accounts. To ensure this is the case, we normalize the levels of INV by industry to correspond to the total value of INV estimated during stage 1b above. Given that INV by industry can include both negative and positive values for any given year, we distribute the residual (the sum of INV by industry minus the total of INV from the NA) using absolute shares of INV by industry. This normalization method prevents positive and negative values from surging away from one another. Nonetheless, given the scarcity of data that underpins the estimates of INV by industry, this variable should be used with caution, particularly for non-benchmark years.

Stage 4: Changes in Inventories (INV)					**Variable(s)**	**Period**
Input [1b]	**Total INV, USD** Type: nominal, SNA 1993				INV	Benchmark yrs.
Data	*	**Split INV by industry** Source: *SUTs/IOTs* Type: share of INV			INV_AtB, INV_LtQ	Benchmark yrs.
Output	=	**INV by industry, USD** Type: nominal, SNA 1993			INV_AtB, INV_LtQ	Benchmark yrs.
Input [2]		~*	**GO by industry, USD** Note: Extrapolate INV using ratio of INV to GO + M		GO_AtB, GO_LtQ	1965-2000
Input [3a/b]		~*	**M by industry, USD** Note: Extrapolate INV using ratio of INV to GO + M		M_AtB, M_LtQ	1965-2000
Output		=	**INV by industry, USD (not normalized)** Type: nominal, SNA 1993		INV_AtB, INV_LtQ	1965-2000
Input [1b]			~/	**Total INV, USD** Type: nominal, SNA 1993	INV	1965-2000
Output			=	**INV by industry, USD (normalized)** Type: nominal, SNA 1993	INV_AtB, INV_LtQ	1965-2000

Note: ~ denotes variable is used to interpolate/extrapolate series above*
Note: ~/ denotes variable is used to normalize series above

2.5. Basic National Accounts Rest-of-World

The national accounts variables – GDP by expenditure and VA, II and GO by industry – for the Rest of World (RoW) are estimated using similar sources and methods to those described above. Note that the RoW does not cover the entire world economy, but does capture the remaining 157 countries in

the Penn World Table that are not already included in the Long-run WIOD. Combined these 182 countries covers nearly all of World GDP and global trade.

Total GDP for RoW and GDP by expenditure is taken directly from PWT 9.1. Note that we assume Changes in Inventories (INV) to always be zero for RoW, and the total value for export (X) and import (M) is calculated as a residual in stage 7 below. Total value added (VA) is assumed to equal total GDP, therefore TXSP is also set to zero. Also note that PWT 9.1 reports GDP in SNA 2008, not our preferred framework from 1993. As noted previously, this is unlikely to affect the trend in GDP over time but could lead to a slight overestimation of the level of GDP for the RoW.

VA by industry is estimated based on data from the UN's OCD 'Value added by industries at current prices (ISIC Rev. 3)' and UNIDO's INDSTAT2 tables. For all 157 RoW countries we obtain the industry share in total value added, for any year available. We extrapolate missing shares based on the trends from countries that do report data for the entire timeframe. We then aggregate the shares using VA as weights. Gross Output (GO) levels for each industry are again calculated by multiplying the nominal levels of VA times the ratio of VA to GO taken from the UN OCD's 'Output, gross value added, and fixed assets by industries at current prices (ISIC Rev. 3)' and UNIDO's INDSTAT2 tables. Again, the VAtGO ratios are extrapolated and weighted using VA. The resulting aggregate measure of VAtGO is used to estimate both GO directly and II as a residual.

Stage 5: National Accounts Rest of World (RoW)					**Variable(s)**	**Period**
Data	**GDP RoW, USD** Source: *PWT 9.1* Type: nominal, SNA 2008				GDP	1965-2000
Data	*	**GDP by expenditure RoW** Source: *PWT 9.1* Type: share of GDP, SNA 2008 Note: *INV = 0, X/M based on stage 7*			CONS_h, CONS_g, GFCF	1965-2000
Output	=	**GDP by expenditure RoW, USD** Type: nominal, SNA 2008 Note**: Consumption totals**			CONS_h, CONS_g, GFCF, INV	1965-2000
Data	**VA RoW, USD** Source: *PWT 9.1* Type: nominal, SNA 2008 Note: GDP = VA				VA	1965-2000
Data	*	**VA by industry RoW** Source: *UN OCD, ind. VA* Type: share of VA, 10 sectors			VA_AtB … VA_LtQ	1965-2000
Data	~*	**VA by manufacturing ind. RoW** Source: *UNIDO INDSTAT2* Type: share of VA_D, 12 sectors			VA_D15t16 .. VA_D34t35	1965-2000
Output	=	**VA by industry RoW, USD** Type: nominal, SNA 2008			VA_AtB … VA_LtQ	1965-2000
Data		*	**VAtGO by industry RoW** Source: *UN OCD, ind. VA* Type: ratio of VA to GO, 10 sectors		VAtGO_AtB … VAtGO_LtQ	1965-2000
Data		~*	**VAtGO by manufacturing ind.** Source: *UNIDO INDSTAT2* Type: ratio of VA_D to GO_D, 12 sectors		VAtGO_D15t16 .. VAtGO_D34t35	1965-2000
Output		=	**GO by industry RoW, USD** Type: *nominal, SNA 2008* Note: **Row totals**		GO_AtB … GO_LtQ	1965-2000
Input [5]			-	**VA by industry RoW, USD** Type: nominal, SNA 2008	VA_AtB … VA_LtQ	1965-2000
Output			=	**II by industry RoW, USD** Type: nominal, SNA 2008 Note: **Column totals**	II_AtB … II_LtQ	1965-2000

2.6. National Input-Output Tables

For the construction of the Long-run WIOD we require annual NIOTs. Unfortunately, official SUTs and NIOTs are only available for a handful of benchmark years for most countries (see Appendix 4.c). To interpolate and extrapolate the NIOTs we apply a Generalized RAS (GRAS) procedure (Temurshoev et al. 2013). This commonly applied method is used to reconcile the official IOTs, which serve as templates, with a set of pre-specified row and column totals. GRAS is an iterative scaling method that requires a non-negative matrix that need not be square.

Whenever necessary official SUTs are converted to IOTs and concorded to our list of industries and final consumption categories. We express each cell of the IOTs as a share of total GO and interpolate these shares between benchmark years if required. The building blocks for the row and column totals are estimated in stages 1-5 above. To ensure all cells in the reconciled matrix are non-negative we exclude Changes in Inventories (INV) and trade (X, M, MRG) from the estimation procedure (see stage 6). The row total is thus GO + M + MRG – X – INV, where both M and X are listed as FOB. The column total is simply II by industry and total Household Consumption (CONS_h), Government Consumption (CONS_g) and Gross Fixed Capital Formation (GFCF). Where, as note during stage 1b,

TXSP is deducted from final consumption. Figure 6.1 below provides an illustration of the estimation of annual NIOTs. The figure shows the prefilled cells in green, while the reconciled matrix is presented in blue.

Stage 6: Estimate National Input Output Tables (NIOTs)				**Variable(s)**	**Period**
Input [2]	R	**GO by industry, USD** Type: nominal, basic prices	RoW TOTALS	GO_AtB … GO_LtQ	1965-2000
Input [3c]	+	**M by industry, USD** Type: nominal, FOB		M_AtB … M_LtQ	1965-2000
Input [3c]	+	**MRG by industry, USD** Type: nominal		MRG_AtB … MRG_LtQ	1965-2000
Input [3a/b]	-	**X by industry, USD** Type: nominal, FOB		X_AtB … X_LtQ	1965-2000
Input [4]	-	**INV by industry, USD** Type: nominal		INV_AtB … INV_LtQ	1965-2000
Input [2]	C	**II by industry, USD** Type: nominal, producer prices		II_pro_AtB … II_pro_LtQ	1965-2000
Input [1b]	C	**GDP by expenditure, USD** Type: nominal, excluding TXSP	COL TOTALS	CONS_h, CONS_g, GFCF	1965-2000
Data	*	**NIOTs for benchmark years** Source: *SUTs/IOTs* Type: nominal, producer prices			Benchmark yrs.
Process	f()	**GRAS()** Row: GO + M_fob + MRG – X_fob - INV Column: II_pro, CONS_h, CONS_g, GFCF			1965-2000
Output	=	**National Input Output Table** Type: nominal, producer prices			1965-2000

There are two exceptions to this procedure. For the USA, we have annual Make-Use tables, which we converted into annual IOTs. These IOTs provide all the components which we require for our analysis, so we disregard the national accounts data that we gathered during stage 1-4 for the USA. For the RoW we do not have a single SUT or IOT. Instead, we apply the 1980 IOT from the USA. We opted for this table since it is a high-quality table for a well-rounded economy that exhibits activity in all industries in our list, positioned roughly in the center of our period of interest.

Figure 6.1: Estimation of NIOTs using GRAS

		Industries			CONS_h	CONS_g	GFCF	INV	X_fob	(-) M_fob	(-) MRG	GO_bas
		AtB	...	LtQ								
Industries	AtB							4	3a	3a	3c	2
	...							4	3a/b	3a/b	3c	2
	LtQ							4	3b	3b	3c	2
***Subtotal*: II_pro**		2b	2b	2b	1b	1b	1b	1b	1b	1b		
TXSP					1b	1b	1b					
VA_bas		2	2	2								
GO_bas		2	2	2								

Legend

- Data available annually
- Data estimated using GRAS
- Empty cell

2.7. Bilateral trade flows

To track the origin of intermediate and final consumption we need to distinguish between the flows of goods and services coming from domestic and international producers. Figure 7.1 provides a stylized example of a NIOT for Austria, the output of stage 6. It shows two industries – both as producers along the rows and (intermediate) consumption along the columns – one final consumption category (CONS), gross capital formation (GCF) and export (X) and import (M).

Figure 7.2 illustrates the process where the import vector (M) is split across the four consumption categories. Note that for each respective cell, the domestic flows plus the international flows sum to the value listed in the NIOT. For the WIOD, distinguishing the international flows from the domestic production is not sufficient. The international flows need to distinguish between the country-of-origin, see figure 7.3. Doing this for all countries in our sample, this process will automatically also define the split for the country-of-destination and consumption category for the export vector.

Figure 7.1: stylized example of a NIOT

		AUT Ind 1	AUT Ind 2	AUT CONS	AUT GCF	AUT X	AUT M
NIOT	Ind 1						
NIOT	Ind 2						

Figure 7.2: stylized example of split domestic (DOM) and international (INT) IOT

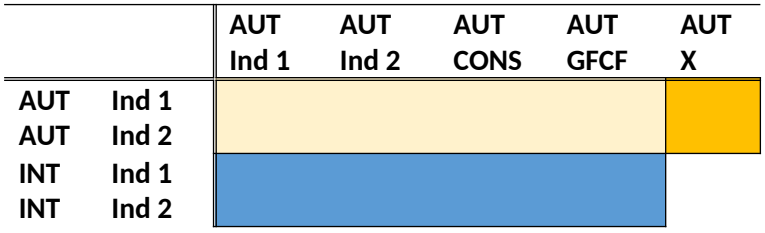
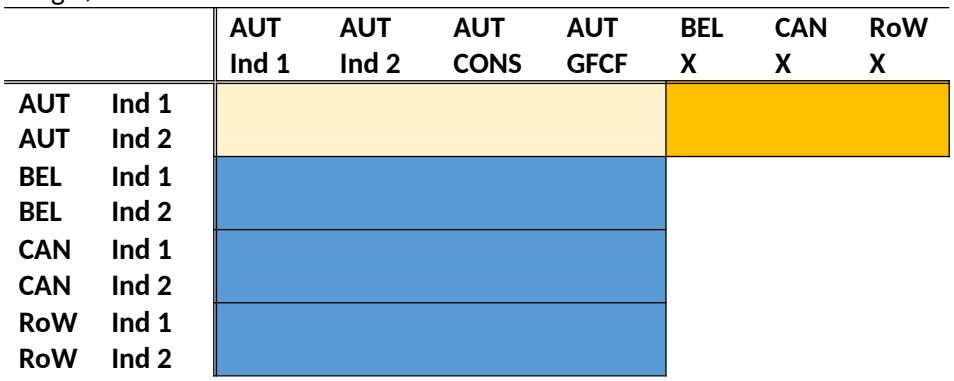


Figure 7.3: stylized example of split exports and imports by country of origin/destination



For the Long-run WIOD we separate this process in three distinct steps. First, we split the total imports from each industry by country-of-origin and, as a mirror image, the total exports by country-of-destination. Second, we split the import and export flows from/to each country in three Broad Economic Categories (BEC); namely intermediate consumption, final consumption and capital formation. Third, we split the BEC categories into the complete list of consumption categories in the WIOD.

For the first step – splitting imports and exports by supplying/using countries – we rely on data from the World Trade Flows (WTF) database. This database contains international flows of goods, at the product level, for all countries and years in our sample. In the WTF products are classified according to Standard International Trade Classification (SITC rev. 2), generally at the 4-digit level. We concord the products in WTF to the 2002 version of the Classification of Products by Activity (CPA), utilizing concordance tables from Eurostat.[5] We then assign each product to the ISIC 3.1 industry directly matching the activity, thus assuming that all traded goods are produced only as principal output and that there is no secondary production. This provides us, for each goods-producing industry, with the *share* of imports by country-of-origin and the *share* of exports by country-of-destination.

For the concordance between SITC2 and ISIC 3.1, a small number of 4-digit products are matched to multiple industries; e.g., 'fresh or preserved milk and cream' originating either from farms or from the food and drink industry. For those cases we weight the trade value by the share of SITC2 product matches to each respective ISIC 3.1 industry. The WTF does not always list the trade flows at the fully disaggregated 4-digit level, sometimes values are allocated to 3-, 2- or one-digit product groups. We assign these flows to the producing industries for the more disaggregate products (children) that are contained within these product groups (parents). For each year, we calculate the share of each child in the total parent's World trade value, which we then use as weights for the ISIC industries matched

[5] http://ec.europa.eu/eurostat/ramon/relations/index.cfm?TargetUrl=LST_REL, SITC2 → HS2 → CPA2.

to each child. For example, the one-digit SITC2 product group 6, 'Manufactured goods classified chiefly by materials', is assigned to, among others, the textile, chemicals and rubber and plastics industries, depending on that year's volume of World trade in the more detailed (4-digit) products that are part of product group 6.

For most services industries we assume that the import share of services by country-of-origin mirrors that of the average share for all goods, and vice versa for exports. Here the imports of services thus follow the same trade patterns as those observed for goods, likely reflecting relative geographical and cultural distances. The exceptions being imports for Financial Intermediation (J) and Real Estate, Renting and Business Activities (K), where we rely on the export share in worldwide exports instead. The assumption being that all countries import financial and business services at (nearly) identical proportions from the primary exporters of these services, regardless of the geographical or cultural distances to these producers.

To obtain the actual levels for each trade flow we multiply the import shares times the total import value from the countries' national accounts. The appeal of this method is that, for most countries, the bilateral trade flows directly mirror the import shares listed in WTF. As discussed in more detail in appendix 4.d., estimating the levels of trade flows based on import shares can sometimes lead to negative flows to and from the Rest-of-World (RoW), which we treat as a residual. In those cases, we alternately attempt to estimate the trade levels using *export* shares times the total export values from the national accounts. If assigning export shares still results in negative flows, we apply a GRAS to obtain an industry/year matrix that adheres to the import and export totals from the national accounts.

For each year, approximately 96 percent of the value of trade is estimated using the import share method, 1 percent using export shares, and 3 percent using GRAS. The application of the export shares or GRAS generally alters the bilateral trade flows only modestly compared to those listed in WTF. A notable exception is trade to and from the RoW. Since RoW serves as a residual category, the trade flows can differ quite substantially from those implied by WTF. Also, the totals for export and import for RoW will differ from those implied by the National Accounts. A major reason for the latter discrepancy is trade between RoW countries themselves, which, since we treat RoW as a single country/region, we explicitly want to exclude. Overall, the export and import values for RoW should be treated with caution since they are not based on primary data.

After trade flows are apportioned to countries-of-origin and -destination, we assign all imports by Broad Economic Categories (BEC). The imports are either used as intermediates by industry (II), final consumption by either households or government (CONS) or as investment (GFCF). The products listed in the WTF dataset is assigned a BEC classification, where final goods typically end up being consumed and raw materials serve as industrial inputs. We aggregate the resulting BEC shares for all bilateral trade flows; meaning we can observe what share of imports from say AUT to DNK is consumed by industry or is used as a capital investment. Note that total imports by BEC may never exceed the sum of domestically and internationally sourced consumption listed in the NIOTs. This would imply negative domestic production, which has no clear economic interpretation. We shift imports between BEC whenever this occurs, forcing a lower bound of zero on domestic production.

Lastly, we split the BEC categories by industry, or final consumer (either household or government), based on the shares in the NIOTs constructed during stage 6. Here we assume that imports of intermediates are used in the same proportion by industries as domestic output.

2.8. World Input-Output Tables

During the final stage of the construction of the Long-run WIOD we separate the bilateral trade flows from the NIOTs. For each country, the vector in the NIOT that represents total exports by industry is replaced row-wise by a matrix of exports by industry, broken down by country and industry of destination. The vector of total imports by industry is also dropped and replaced column-wise by a matrix of imports by industry, broken down by country and industry of origin. Note that the inner matrix of the NIOTs captures both domestically and internationally produced intermediates and final consumption items. We aggregate the import matrix over country of origin and subtract this from the NIOT, leaving solely domestic production along the diagonal of the final WIOTs.

2.9. Previous year's prices

To facilitate long-run analyses, we also incorporate price information into the IOTs. Trends in volumes might differ substantially from trends in nominal values (Timmer et al., 2021). We follow the same deflation approach as was used for the 2016 release of WIOD and publish the LR WIOD not only in current but also in previous-year's prices (pyp).[6] Below a short summary of the general method and the specific implementation challenges faced during the construction of the Long-run WIOD in pyp.[7]

To construct the pyp tables we once again rely on the RAS-algorithm, used above to update IO-tables in situations in which limited survey data is available for the projection year. The approach originally advocated by Dietzenbacher and Hoen (1998) supposes that data on gross output by industry in pyp, value added by industry in pyp and total final demand by supplying industry are given. This implies that the row totals and column totals for the block of intermediate inputs transactions in pyp are known. Hence, the iterative RAS-procedure can be used to derive each value of intermediate inputs transactions in pyp. The RAS-procedure is completed if the sums over cells in each row are very close to the exogenously given row totals and the same applies to cells in columns. This implies that both rows and columns have been scaled up or down by row- and column-specific factors in an iterative procedure. Since cells are in both a row and a column, each cell value originally expressed in current prices has been scaled up or down by a cell-specific factor. As we deflate cell values in current prices, these cell-specific factors can be considered as cell-specific deflators.

For the Long-run WIOD, the data availability differs slightly from the case example above. Deflating the intermediate inputs block of the WIOTs is not sufficient to arrive at fully deflated WIOTs, since estimates of cell-specific values of final demand by supplying industry, use category and country of destination are also part of a WIOT. These values in pyp are not known and should also be estimated using RAS.

In the Long-run WIOD the row constraints are based on industry-level gross output, converted to pyp using price deflators taken from KLEMS, the WIOD Socio Economic Accounts, the Taiwanese National Accounts and the 10-Sector Database.[8] The column constraints for the intermediate inputs block are estimated as the residual of gross output in pyp minus value added and trade and transport margins

[6] For a detailed discussion see the 'Note on the Construction of WIOTs in Previous Year's Prices' available on https://www.rug.nl/ggdc/valuechain/wiod/wiod-2016-release

[7] Alternatively, one may construct so-called constant price tables, that is, with values in prices of a particular benchmark year (say 1970 or 1995). These tables can be derived from the pyp tables in combination with the nominal table for the chosen benchmark year using a simple year-to-year linking method.

[8] See section 3.1.1 for a description of, and links to, these sources. It is important to note that the deflation procedure requires dollar-denominated deflators, while WIOD's industry-level gross output and value added deflators have been obtained from sources reporting these in national currencies. Hence, all deflators as used in the deflation procedure were adjusted for changes in exchange rates.

in pyp. The source of the price deflators for value added are identical to those for gross output, and the deflator for trade and transport margins is assumed to be identical to the implicit deflator for intermediate input. For the final expenditure categories' column constraints, we rely on price deflators from the UNOCD, UNEMA and PWT 9.1. We aim for consistency between GDP at pyp and value added by industry at pyp.[9] To achieve this consistency, we make a number of adjustments to the forementioned deflators.

We force the deflator for total value added (across all industries in a country) to be identical to the deflator for GDP.[10] We use the GDP values as the target point, as this is available for nearly all countries and periods in our sample. When the deflator for total value added is adjusted, the industry-level value added deflators also need to be updated. We adjust them using a top-down approach, ensuring that the sum of value added in pyp over all industries sums to the total value added deflated using the GDP deflator. Similarly, if the value-added deflator is adjusted, the gross-output deflator also needs to be corrected to ensure the residual deflator for intermediate input takes on credible values. We adjust the gross output deflator by the same adjustment factor as was applied to the value added deflator.

We have a longer timeseries of industry-level price data for value added than for gross output. When the deflator for gross output is unavailable, we attempt to extrapolate using the trend in the price index for value added. Alternatively, if no price information is available for gross output by industry, we take the value added deflator as a proxy. If, value added deflators are also not available we use the trend in the price index for GDP. For RoW, we always apply the deflators for the USA.

The column changes in inventories (INV) are treated separately. Since both the nominal and price index for this variable can take on negative values, we estimate this column before we apply the RAS procedure and set the row constraint for the WIOTs equal to gross output minus INV. We use the deflator for Gross Capital Formation (GCF) to deflate INV.

References

Dietzenbacher, E. and A.R. Hoen (1998), "Deflation of Input-Output Tables from the User's Point of View: A Heuristic Approach", *Review of Income and Wealth*, 44, 111-122.

Dietzenbacher, E., B. Los, R. Stehrer, M.P. Timmer and G. de Vries (2013), "The Construction of World Input-Output Tables in the WIOD Project", *Economic Systems Research*, 25, 71-98.

Feenstra, R.C., R. Inklaar and M.P. Timmer (2015), "The Next Generation of the Penn World Table" *American Economic Review*, 105(10), 3150-3182.

Johnson, R.C. and G. Noguera (2012), "Accounting for intermediates: Production sharing and trade in value added", *Journal of International Economics*, 86, 224-236.

Johnson, R.C. and G. Noguera (2017), "A Portrait of Trade in Value-Added over Four Decades", *Review of Economics and Statistics*, 99(5), 896-911.

[9] The alternative would be to aim for consistency between GDP and expenditure at pyp. Most of the applications of the WIOT however prioritize consistency of interindustry flows rather than final demand flows. This means that we do not use export and import price indices from a country's National Accounts. As a result, the sum of intermediate input and final expenditure in pyp does not always add to gross output in pyp. The residual, which tends to be small, is allocated to changes in inventories (INV).

[10] Generally, these deflators are nearly identical. Otherwise, for those cases where there are sizable disparities, the RAS procedure would exacerbate the differences leading to imbalances between intermediate input and final expenditure categories' deflators

Maddison, A. (1995), *Monitoring the World Economy*, OECD Development Centre, Paris.

Pahl, S. and M.P. Timmer (2020), "Do Global Value Chains Enhance Economic Upgrading? A Long View", *Journal of Development Studies*, 56(9), 1683-1705.

Temurshoev, U., R. Miller and M. Bouwmeester (2013), "A Note on the GRAS Method", *Economic Systems Research*, 25, 361-367.

Timmer, M. P., Los, B., Stehrer, R., & de Vries, G. J. (2021). Supply Chain Fragmentation and the Global Trade Elasticity: A New Accounting Framework. *IMF Economic Review*.

3. Country sources

3.1 Introduction

This section contains a summary of the sources for the variables discussed in section 2.1 through 2.4, for each individual country in our sample. On the Long-run WIOD website we also offer a complete source description that lists the sources for all combinations of variables, countries and industries in more detail. Below we condense the source information into a single row for each source per variable. Each row contains a reference to the *method* used, as well as the *period* and (optionally) the *sector(s)* or *variables* covered by this *source*, as illustrated in the example below:

$$\underbrace{levels}_{method}\ \underbrace{[unido]}_{source}\ \underbrace{1970-2000}_{period}\ \underbrace{manufacturing}_{\substack{sector/variable \\ (optional)}}$$

The *method* can take on three values: 'levels', 'extrapolated', or 'linear extrapolation'. (1) 'levels', the nominal values, shares or ratios from the original source are used directly. (2) 'extrapolated', the source is used to extrapolate estimates from a later year. For extrapolated values, the growth rates match the source, but the reported levels generally differ. (3) 'linear extrapolation', when no source data is available, the last reported or estimated value, share or ratio is held constant.

The codes for each *source* are listed below, where we provide a brief description of each source and references. Section 2 provides an in-depth discussion of which variables are used from each source and how they are utilized.

The *period* variables list the years covered by the source. A dash (-) indicates a range of years, whereas a semicolon (;) separates distinct years or periods.

If a *sector/variable* is explicitly listed, the source was only used to estimate that sector or variable. If no sector or variable is listed, then this source covers all sectors or variables. An exception to this rule is if there are multiple sources listed for an overlapping period. In this case, all the sectors/variables not explicitly listed in subsequent rows (covering the same period) are estimated using this source. For example, the United Nations' Official Country Data [unocd] contains estimates for value added at the one-digit industry level and therefore does not contain detailed estimates for the two-digit manufacturing industries. We typically supplement this source with data from the United Nation's Industrial Development Organization [unido] to estimate the *manufacturing* detail. Note that the code 'goods/services' for exports and imports denotes that the split of trade by goods and services is based on this source; product detail for trade in goods and services is typically taken from a different source. When two or more variables are explicitly listed for a particular source (e.g. 'GFCF and INV'), this usually means a higher-level aggregate (i.e. Gross Capital Formation) is broken down using shares from the listed source.

3.1.1 Alphabetical list of sources

- **[go_shr] – Gross Output Share**
  - Share of Gross Output by industry. The export of services by industry is extrapolated using the GO share, thus assuming the volume of exports grows proportionately to the total output of that (service) industry.
- **[H_shr] – Share of sector H**
  - Share of 'Hotels and Restaurants' in either exports for PURNR or imports for PURR (see section 2.3).
- **[imf_curacc] – International Monetary Fund Current Account**
  - IMF International Financial Statistics (IFS), External Sector, http://data.imf.org/ifs
  - IMF International Financial Statistics (IFS), Trade of Goods, http://data.imf.org/ifs
- **[imf_tis] – International Monetary Fund Trade in Services**
  - IMF International Trade in Services and the Comparative Advantage of Nationals, Bulk Download, https://data.imf.org/its
- **[imf_xr] - International Monetary Fund Exchange Rates**
  - IMF International Financial Statistics (IFS), Exchange Rates incl. Effective Ex. Rates, http://data.imf.org/ifs
- **[iot] – Input-Output Table**
  - National Input-Output and Supply and Use Tables. See appendix 4.c for country-specific sources.
- **[klems] – Capital Labour Energy Materials and Service Growth Accounts**
  - *AUS*, *AUT*, *BEL*, *DEU*, *DNK*, *ESP*, *FIN*, *FRA*, *GBR*, *GRC*, *IRL*, *ITA*, *JPN*, *KOR*, *NLD*, *PRT*, *SWE*, *USA* – EU KLEMS Growth and Productivity Accounts: March 2008 Release, http://www.euklems.net/euk08I.shtml
  - *CAN* – World KLEMS Canada, Released July 2012, Basic file, http://www.worldklems.net/data.htm
  - *CHN* – Research Institute of Economy, Trade and Industry (RIETI), China Industrial Productivity (CIP) Database 3.0, a) Gross value of output and b) intermediate input by industry in ml. current yuan, Released July 9 2015, https://www.rieti.go.jp/en/database/CIP2015/index.html
  - *IND* – World KLEMS India, Released December 2016, Data file, http://www.worldklems.net/data.htm
- **[na] – National Accounts**
  - *TWN* – National Statistics Republic of China (Taiwan), National Accounts, Statistical Tables, Gross Domestic Product by Kind of Activity, 1982-2012, https://eng.stat.gov.tw/np.asp?ctNode=1555
- **[pwt91] – Penn World Table 9.1**
  - Groningen Growth and Development Centre (GGDC), Penn World Table 9.1, Jan. 2019, https://www.rug.nl/ggdc/productivity/pwt/
- **[rat_mean] – Average ratio**
  - Average ratio of PURR to import of services or PURNR to export of services. For each year we calculate the average ratio over all countries for which we have data and use this to extrapolate the missing ratios of PURNR to the export of services (see section 2.3).
- **[sd10_2014] – 10-Sector Database 2014**
  - Groningen Growth and Development Centre (GGDC), 10-Sector Database, Jan. 2014, https://www.rug.nl/ggdc/productivity/10-sector/

- **[unema] – United Nations Estimates of Main Aggregates**
  - National Accounts Estimates of Main Aggregates, GDP by Type of Expenditure at current prices – US Dollars, http://data.un.org/Explorer.aspx
  - National Accounts Estimates of Main Aggregates, Gross Value Added by Kind of Economic Activity at current prices – National currency, http://data.un.org/Explorer.aspx
- **[unido] – United Nations Industrial Development Organization**
  - Industrial Statistics Database, Revision 3 two-digit, https://www.unido.org/researchers/statistical-databases
- **[unocd] – United Nations Official Country Data**
  - National Accounts Official Country Data, Table 1.1 Gross domestic product by expenditures at current prices, http://data.un.org/Explorer.aspx
  - National Accounts Official Country Data, Table 2.1 Value added by industries at current prices (ISIC Rev. 3), http://data.un.org/Explorer.aspx
  - National Accounts Official Country Data, Table 2.3 Output, gross value added and fixed assets by industries at current prices (ISIC Rev. 3), http://data.un.org/Explorer.aspx
- **[wiod_sea] – WIOD Socio Economic Accounts, July 2014**
  - https://www.rug.nl/ggdc/valuechain/wiod/wiod-2013-release
- **[wtf] – World Trade Flows**
  - Feenstra et al. (2005) "World Trade Flows: 1962-2000", NBER Working Paper 11040 - World Import and Export Data, https://cid.econ.ucdavis.edu/nberus.html

3.2. Australia (AUS)

- **Gross Domestic Product:**
  - levels [unocd]: 1965-2000
- **VA, TXSP, SD:**
  - levels [unocd]: 1965-2000
- **Direct purchases abroad by residents:**
  - levels [H_shr]: 1991-2000 | PURR
  - levels [imf_tis]: 1970-1987; 1989-2000 | PURNR
  - extrapolated [rat_mean]: 1965-1990 | PURR
  - extrapolated [rat_mean]: 1965-1969; 1988 | PURNR
- **GDP by expenditure:**
  - levels [unema]: 1970-2000
  - extrapolated [pwt91]: 1965-1969
  - extrapolated [iot]: 1968-1969 | GFCF, INV
  - linear extrapolation: 1965-1967 | GFCF, INV
- **VA by industry:**
  - levels [klems]: 1970-2000
  - extrapolated [unocd]: 1965-1969
  - extrapolated [iot]: 1968 | manufacturing, services
  - extrapolated [unido]: 1965-1967; 1969 | manufacturing
  - linear extrapolation: 1965-1967; 1969 | services
- **GO by industry:**
  - levels [klems]: 1970-2000

    - extrapolated [iot]: 1968
    - extrapolated [unido]: 1965-1967; 1969 | manufacturing
    - linear extrapolation: 1965-1967; 1969
- **INV by industry:**
    - levels [iot]: 1995-2000
    - linear extrapolation: 1965-1994
- **X by industry:**
    - levels [unocd]: 1965-2000 | goods/services
    - levels [iot]: 1968; 1974; 1986; 1989; 1995-2000
    - extrapolated [wtf]: 1965-1967; 1969-1973; 1975-1985; 1987-1988; 1990-1994 | goods
    - extrapolated [imf_tis]: 1970-1973; 1975-1985; 1987; 1990-1994 | services
    - extrapolated [go_shr]: 1965-1967; 1969-1973; 1975-1985; 1987-1988; 1990 | services
- **M by industry:**
    - levels [unocd]: 1965-2000 | goods/services
    - levels [iot]: 1968; 1974; 1986; 1989; 1995-2000
    - extrapolated [wtf]: 1965-1967; 1969-1973; 1975-1985; 1987-1988; 1990-1994 | goods
    - linear extrapolation: 1965-1967; 1969-1973; 1975-1985; 1987-1988; 1990-1994 | services

3.3. Austria (AUT)

- **Gross Domestic Product:**
    - levels [unocd]: 1965-2000
- **VA, TXSP, SD:**
    - levels [unocd]: 1965-2000
- **Direct purchases abroad by residents:**
    - levels [iot]: 1995-2000
    - extrapolated [rat_mean]: 1965-1994 | PURR
    - extrapolated [imf_tis]: 1970-1994 | PURNR
    - extrapolated [rat_mean]: 1965-1969 | PURNR
- **GDP by expenditure:**
    - levels [unema]: 1970-2000
    - extrapolated [pwt91]: 1965-1969
    - linear extrapolation: 1965-1969 | GFCF, INV
- **VA by industry:**
    - levels [klems]: 1970-2000
    - extrapolated [unocd]: 1965-1969
    - extrapolated [unido]: 1965-1969 | manufacturing
    - linear extrapolation: 1965-1969 | services
- **GO by industry:**
    - levels [klems]: 1970-2000
    - extrapolated [unido]: 1965-1969 | manufacturing

    - linear extrapolation: 1965-1969
- **INV by industry:**
    - levels [iot]: 1995-2000
    - linear extrapolation: 1965-1994
- **X by industry:**
    - levels [unocd]: 1965-2000 | goods/services
    - levels [iot]: 1988-2000
    - extrapolated [wtf]: 1965-1987 | goods
    - extrapolated [imf_tis]: 1970-1987 | services
    - extrapolated [go_shr]: 1965-1969; 1974-1981 | services
- **M by industry:**
    - levels [unocd]: 1965-2000 | goods/services
    - levels [iot]: 1988-2000
    - extrapolated [wtf]: 1965-1987 | goods
    - linear extrapolation: 1965-1987 | services

3.4. Belgium (BEL)

- **Gross Domestic Product:**
    - levels [unocd]: 1965-2000
- **VA, TXSP, SD:**
    - levels [unocd]: 1965-2000
- **Direct purchases abroad by residents:**
    - levels [iot]: 1995-2000
    - extrapolated [rat_mean]: 1965-1994
- **GDP by expenditure:**
    - levels [unema]: 1970-2000
    - extrapolated [pwt91]: 1965-1969
    - linear extrapolation: 1965-1969 | GFCF, INV
- **VA by industry:**
    - levels [klems]: 1970-2000
    - extrapolated [unocd]: 1965-1969
    - extrapolated [unido]: 1965-1969 | manufacturing
    - linear extrapolation: 1965-1969 | services
- **GO by industry:**
    - levels [klems]: 1970-2000
    - extrapolated [unido]: 1965-1969 | manufacturing
    - linear extrapolation: 1965-1969
- **INV by industry:**
    - levels [iot]: 1995-2000
    - linear extrapolation: 1965-1994
- **X by industry:**
    - levels [unocd]: 1965-2000 | goods/services
    - levels [iot]: 1980; 1985; 1990; 1995-2000
    - extrapolated [wtf]: 1965-1979; 1981-1984; 1986-1989; 1991-1994 | goods

    - extrapolated [go_shr]: 1965-1979; 1981-1984; 1986-1989; 1991-1994 | services
- **M by industry:**
    - levels [unocd]: 1965-2000 | goods/services
    - levels [iot]: 1980; 1985; 1990; 1995-2000
    - extrapolated [wtf]: 1965-1979; 1981-1984; 1986-1989; 1991-1994 | goods
    - linear extrapolation: 1965-1979; 1981-1984; 1986-1989; 1991-1994 | services

3.5. Brazil (BRA)

- **Gross Domestic Product:**
    - levels [unocd]: 1990-2000
    - extrapolated [unema]: 1970-1989
    - extrapolated [pwt91]: 1965-1969
- **VA, TXSP, SD:**
    - levels [unocd]: 1980-2000
    - extrapolated [unema]: 1970-1979 | VA
    - extrapolated [gdpe]: 1965-1969 | VA
    - linear extrapolation: 1965-1979 | SD, TXSP
- **Direct purchases abroad by residents:**
    - levels [H_shr]: 1965-2000 | PURR
    - levels [imf_tis]: 1975-2000 | PURNR
    - extrapolated [rat_mean]: 1965-1974 | PURNR
- **GDP by expenditure:**
    - levels [unema]: 1970-1979; 1983-2000 | X
    - levels [unema]: 1970-2000 | CONS, GCF, M
    - extrapolated [pwt91]: 1965-1969; 1980-1982 | M, X
    - extrapolated [pwt91]: 1965-1969 | CONS, GCF
    - linear extrapolation: 1965-1969; 1980-1982; 1986-1989 | GFCF, INV
- **VA by industry:**
    - levels [unocd]: 1980-2000
    - levels [iot]: 1995-2000 | manufacturing
    - extrapolated [unema]: 1970-1979
    - extrapolated [unema]: 1970-1981 | goods
    - extrapolated [iot]: 1995-1999 | services
    - extrapolated [unido]: 1990; 1992-1994 | manufacturing
    - linear extrapolation: 1965-1969
    - linear extrapolation: 1965-1981 | goods
    - linear extrapolation: 1965-1994 | manufacturing, services
- **GO by industry:**
    - levels [unocd]: 1992-2000
    - levels [iot]: 1995-2000 | manufacturing
    - extrapolated [unido]: 1990; 1992-1994 | manufacturing
    - linear extrapolation: 1965-1991
    - linear extrapolation: 1965-1989; 1991 | manufacturing
- **INV by industry:**

    - levels [iot]: 1995-2000
    - linear extrapolation: 1965-1994
- **X by industry:**
    - levels [unocd]: 1995-2000 | goods/services
    - levels [iot]: 1995-2000
    - extrapolated [imf_curacc]: 1975-1994 | goods/services
    - extrapolated [mean]: 1965-1974 | goods/services
    - extrapolated [wtf]: 1965-1994 | goods
    - extrapolated [imf_tis]: 1975-1994 | services
    - extrapolated [go_shr]: 1965-1992; 1994 | services
- **M by industry:**
    - levels [unocd]: 1995-2000 | goods/services
    - levels [iot]: 1995-2000
    - extrapolated [imf_curacc]: 1975-1994 | goods/services
    - extrapolated [mean]: 1965-1974 | goods/services
    - extrapolated [wtf]: 1965-1994 | goods
    - linear extrapolation: 1965-1994 | services

3.6. Canada (CAN)

- **Gross Domestic Product:**
    - levels [unocd]: 1965-2000
- **VA, TXSP, SD:**
    - levels [unocd]: 1965-2000
- **Direct purchases abroad by residents:**
    - levels [H_shr]: 1987-2000 | PURR
    - levels [imf_tis]: 1970-2000 | PURNR
    - extrapolated [rat_mean]: 1965-1986 | PURR
    - extrapolated [rat_mean]: 1965-1969 | PURNR
- **GDP by expenditure:**
    - levels [unema]: 1970-2000
    - extrapolated [pwt91]: 1965-1969
    - linear extrapolation: 1965-1969 | GFCF, INV
- **VA by industry:**
    - levels [klems]: 1965-2000
- **GO by industry:**
    - levels [klems]: 1965-2000
- **INV by industry:**
    - levels [iot]: 1995-2000
    - linear extrapolation: 1965-1994
- **X by industry:**
    - levels [unocd]: 1965-2000 | goods/services
    - levels [iot]: 1971; 1976; 1981; 1986; 1990; 1995-2000
    - extrapolated [wtf]: 1965-1970; 1972-1975; 1977-1980; 1982-1985; 1987-1989; 1991-1994 | goods

    - extrapolated [imf_tis]: 1970; 1972-1975; 1977-1980; 1982-1985; 1987-1989; 1991-1994 | services
    - extrapolated [go_shr]: 1965-1970; 1972-1975; 1977-1980; 1982-1985; 1987-1989 | services
- **M by industry:**
    - levels [unocd]: 1965-2000 | goods/services
    - levels [iot]: 1971; 1976; 1981; 1986; 1990; 1995-2000
    - extrapolated [wtf]: 1965-1970; 1972-1975; 1977-1980; 1982-1985; 1987-1989; 1991-1994 | goods
    - linear extrapolation: 1965-1970; 1972-1975; 1977-1980; 1982-1985; 1987-1989; 1991-1994 | services

3.7. China (CHN)

- **Gross Domestic Product:**
    - levels [unocd]: 1965-2000
- **VA, TXSP, SD:**
    - levels [unocd]: 1965-2000
- **Direct purchases abroad by residents:**
    - levels [H_shr]: 1993-2000 | PURR
    - levels [imf_tis]: 1982-2000 | PURNR
    - extrapolated [rat_mean]: 1965-1992 | PURR
    - extrapolated [rat_mean]: 1965-1981 | PURNR
- **GDP by expenditure:**
    - levels [unema]: 1970-2000
    - extrapolated [pwt91]: 1965-1969
    - linear extrapolation: 1965-1969 | GFCF, INV
- **VA by industry:**
    - levels [klems]: 1981-2000
    - extrapolated [unocd]: 1965-1980
    - extrapolated [sd10_2014]: 1965-1980
    - extrapolated [unido]: 1980 | manufacturing
    - linear extrapolation: 1965-1980 | services
    - linear extrapolation: 1965-1979 | manufacturing
- **GO by industry:**
    - levels [klems]: 1981-2000
    - extrapolated [unido]: 1980 | manufacturing
    - linear extrapolation: 1965-1980
    - linear extrapolation: 1965-1979 | manufacturing
- **INV by industry:**
    - levels [iot]: 1981-2000
    - linear extrapolation: 1965-1980
- **X by industry:**
    - levels [unocd]: 1992-2000 | goods/services
    - levels [iot]: 1981-2000

    - extrapolated [iot]: 1981-1991 | goods/services
    - extrapolated [imf_extsec]: 1980 | goods/services
    - extrapolated [mean]: 1965-1979 | goods/services
    - extrapolated [wtf]: 1965-1980 | goods
    - extrapolated [go_shr]: 1965-1980 | services
- **M by industry:**
    - levels [unocd]: 1992-2000 | goods/services
    - levels [iot]: 1981-2000
    - extrapolated [iot]: 1981-1991 | goods/services
    - extrapolated [imf_extsec]: 1980 | goods/services
    - extrapolated [mean]: 1965-1979 | goods/services
    - extrapolated [wtf]: 1965-1980 | goods
    - linear extrapolation: 1965-1980 | services

3.8. Germany (DEU)

- **Gross Domestic Product:**
    - levels [unocd]: 1970-2000
    - extrapolated [pwt91]: 1965-1969
- **VA, TXSP, SD:**
    - levels [unocd]: 1970-2000
    - extrapolated [gdpe]: 1965-1969 | VA
    - linear extrapolation: 1965-1969 | SD, TXSP
- **Direct purchases abroad by residents:**
    - levels [iot]: 1995-2000
    - extrapolated [rat_mean]: 1965-1994 | PURR
    - extrapolated [imf_tis]: 1971-1994 | PURNR
    - extrapolated [rat_mean]: 1965-1970 | PURNR
- **GDP by expenditure:**
    - levels [unema]: 1970-2000
    - extrapolated [pwt91]: 1965-1969
    - linear extrapolation: 1965-1969 | GFCF, INV
- **VA by industry:**
    - levels [klems]: 1970-2000
    - linear extrapolation: 1965-1969
- **GO by industry:**
    - levels [klems]: 1970-2000
    - linear extrapolation: 1965-1969
- **INV by industry:**
    - levels [iot]: 1995-2000
    - linear extrapolation: 1965-1994
- **X by industry:**
    - levels [unocd]: 1970-2000 | goods/services
    - levels [iot]: 1978; 1986; 1988; 1990; 1995-2000
    - extrapolated [wtf_agg]: 1965-1969 | goods/services

    - extrapolated [wtf]: 1965-1977; 1979-1985; 1987; 1989; 1991-1994 | goods
    - extrapolated [imf_tis]: 1971-1977; 1979-1985; 1987; 1989; 1991-1994 | services
    - extrapolated [go_shr]: 1965-1977; 1979-1985; 1993 | services
- **M by industry:**
    - levels [unocd]: 1970-2000 | goods/services
    - levels [iot]: 1978; 1986; 1988; 1990; 1995-2000
    - extrapolated [wtf_agg]: 1965-1969 | goods/services
    - extrapolated [wtf]: 1965-1977; 1979-1985; 1987; 1989; 1991-1994 | goods
    - linear extrapolation: 1965-1977; 1979-1985; 1987; 1989; 1991-1994 | services

3.9. Denmark (DNK)

- **Gross Domestic Product:**
    - levels [unocd]: 1966-2000
    - extrapolated [pwt91]: 1965
- **VA, TXSP, SD:**
    - levels [unocd]: 1966-2000
    - extrapolated [gdpe]: 1965 | VA
    - linear extrapolation: 1965 | SD, TXSP
- **Direct purchases abroad by residents:**
    - levels [iot]: 1995-2000
    - extrapolated [rat_mean]: 1965-1994 | PURR
    - extrapolated [imf_tis]: 1975-1994 | PURNR
    - extrapolated [rat_mean]: 1965-1974 | PURNR
- **GDP by expenditure:**
    - levels [unema]: 1970-2000
    - extrapolated [pwt91]: 1965-1969
    - linear extrapolation: 1965-1969 | GFCF, INV
- **VA by industry:**
    - levels [klems]: 1970-2000
    - extrapolated [unocd]: 1966-1969
    - extrapolated [unido]: 1965-1969 | manufacturing
    - linear extrapolation: 1965
    - linear extrapolation: 1965-1969 | services
- **GO by industry:**
    - levels [klems]: 1970-2000
    - extrapolated [unocd]: 1966-1969
    - extrapolated [unido]: 1965-1969 | manufacturing
    - linear extrapolation: 1965
- **INV by industry:**
    - levels [iot]: 1995-2000
    - linear extrapolation: 1965-1994
- **X by industry:**
    - levels [unocd]: 1966-2000 | goods/services
    - levels [iot]: 1972; 1977; 1980; 1985; 1990; 1995-2000

- extrapolated [wtf_agg]: 1965 | goods/services
- extrapolated [wtf]: 1965-1971; 1973-1976; 1978-1979; 1981-1984; 1986-1989; 1991-1994 | goods
- extrapolated [imf_tis]: 1975-1976; 1978-1979; 1981-1984; 1986-1989; 1991-1994 | services
- extrapolated [go_shr]: 1965-1971; 1973-1976; 1978; 1981-1984; 1986-1989; 1991-1994 | services

- **M by industry:**
  - levels [unocd]: 1966-2000 | goods/services
  - levels [iot]: 1972; 1977; 1980; 1985; 1990; 1995-2000
  - extrapolated [wtf_agg]: 1965 | goods/services
  - extrapolated [wtf]: 1965-1971; 1973-1976; 1978-1979; 1981-1984; 1986-1989; 1991-1994 | goods
  - linear extrapolation: 1965-1971; 1973-1976; 1978-1979; 1981-1984; 1986-1989; 1991-1994 | services

3.10. Spain (ESP)

- **Gross Domestic Product:**
  - levels [unocd]: 1970-2000
  - extrapolated [pwt91]: 1965-1969
- **VA, TXSP, SD:**
  - levels [unocd]: 1970-2000
  - extrapolated [gdpe]: 1965-1969 | VA
  - linear extrapolation: 1965-1969 | SD, TXSP
- **Direct purchases abroad by residents:**
  - levels [iot]: 1999-2000 | PURR
  - levels [iot]: 1995-2000 | PURNR
  - extrapolated [rat_mean]: 1965-1998 | PURR
  - extrapolated [imf_tis]: 1975-1994 | PURNR
  - extrapolated [rat_mean]: 1965-1974 | PURNR
- **GDP by expenditure:**
  - levels [unema]: 1970-2000
  - extrapolated [pwt91]: 1965-1969
  - linear extrapolation: 1965-1969 | GFCF, INV
- **VA by industry:**
  - levels [klems]: 1970-2000
  - extrapolated [unido]: 1965-1969 | manufacturing
  - linear extrapolation: 1965-1969
- **GO by industry:**
  - levels [klems]: 1970-2000
  - extrapolated [unido]: 1965-1969 | manufacturing
  - linear extrapolation: 1965-1969
- **INV by industry:**
  - levels [iot]: 1995-2000

    - linear extrapolation: 1965-1994
- **X by industry:**
    - levels [unocd]: 1980-2000 | goods/services
    - levels [iot]: 1995-2000
    - extrapolated [imf_curacc]: 1975-1979 | goods/services
    - extrapolated [wtf_agg]: 1965-1974 | goods/services
    - extrapolated [wtf]: 1965-1994 | goods
    - extrapolated [imf_tis]: 1975-1994 | services
    - extrapolated [go_shr]: 1965-1994 | services
- **M by industry:**
    - levels [unocd]: 1980-2000 | goods/services
    - levels [iot]: 1995-2000
    - extrapolated [imf_curacc]: 1975-1979 | goods/services
    - extrapolated [wtf_agg]: 1965-1974 | goods/services
    - extrapolated [wtf]: 1965-1994 | goods
    - linear extrapolation: 1965-1994 | services

3.11. Finland (FIN)

- **Gross Domestic Product:**
    - levels [unocd]: 1965-2000
- **VA, TXSP, SD:**
    - levels [unocd]: 1965-2000
- **Direct purchases abroad by residents:**
    - levels [iot]: 1995-2000
    - extrapolated [rat_mean]: 1965-1994 | PURR
    - extrapolated [imf_tis]: 1975-1994 | PURNR
    - extrapolated [rat_mean]: 1965-1974 | PURNR
- **GDP by expenditure:**
    - levels [unema]: 1970-2000
    - extrapolated [pwt91]: 1965-1969
    - linear extrapolation: 1965-1969 | GFCF, INV
- **VA by industry:**
    - levels [klems]: 1970-2000
    - extrapolated [unocd]: 1965-1969
    - extrapolated [unido]: 1965-1969 | manufacturing
    - linear extrapolation: 1965-1969 | services
- **GO by industry:**
    - levels [klems]: 1970-2000
    - extrapolated [unido]: 1965-1969 | manufacturing
    - linear extrapolation: 1965-1969
- **INV by industry:**
    - levels [iot]: 1995-2000
    - linear extrapolation: 1965-1994
- **X by industry:**

- levels [unocd]: 1965-2000 | goods/services
- levels [iot]: 1995-2000
- extrapolated [wtf]: 1965-1994 | goods
- extrapolated [imf_tis]: 1975-1994 | services
- extrapolated [go_shr]: 1965-1994 | services

- **M by industry:**
  - levels [unocd]: 1965-2000 | goods/services
  - levels [iot]: 1995-2000
  - extrapolated [wtf]: 1965-1994 | goods
  - linear extrapolation: 1965-1994 | services

3.12. France (FRA)

- **Gross Domestic Product:**
  - levels [unocd]: 1965-2000
- **VA, TXSP, SD:**
  - levels [unocd]: 1965-2000
- **Direct purchases abroad by residents:**
  - levels [iot]: 1995-2000
  - extrapolated [rat_mean]: 1965-1994 | PURR
  - extrapolated [imf_tis]: 1975-1994 | PURNR
  - extrapolated [rat_mean]: 1965-1974 | PURNR
- **GDP by expenditure:**
  - levels [unema]: 1970-2000
  - extrapolated [pwt91]: 1965-1969
  - linear extrapolation: 1965-1969 | GFCF, INV
- **VA by industry:**
  - levels [klems]: 1970-2000
  - extrapolated [unocd]: 1965-1969 | VA
  - extrapolated [unido]: 1965-1969 | manufacturing
  - linear extrapolation: 1965-1969
- **GO by industry:**
  - levels [klems]: 1970-2000
  - extrapolated [unocd]: 1965-1969
  - extrapolated [unido]: 1965-1969 | manufacturing
- **INV by industry:**
  - levels [iot]: 1995-2000
  - linear extrapolation: 1965-1994
- **X by industry:**
  - levels [unocd]: 1965-2000 | goods/services
  - levels [iot]: 1972; 1977; 1980; 1985; 1990; 1995-2000
  - extrapolated [wtf]: 1965-1971; 1973-1976; 1978-1979; 1981-1984; 1986-1989; 1991-1994 | goods
  - extrapolated [imf_tis]: 1975-1976; 1978-1979; 1981-1984; 1986-1989; 1991-1994 | services

    - extrapolated [go_shr]: 1965-1971; 1973-1976; 1978-1979; 1981-1984; 1986-1987 | services
- **M by industry:**
    - levels [unocd]: 1965-2000 | goods/services
    - levels [iot]: 1972; 1977; 1980; 1985; 1990; 1995-2000
    - extrapolated [wtf]: 1965-1971; 1973-1976; 1978-1979; 1981-1984; 1986-1989; 1991-1994 | goods
    - linear extrapolation: 1965-1971; 1973-1976; 1978-1979; 1981-1984; 1986-1989; 1991-1994 | services

3.13. United Kingdom (GBR)

- **Gross Domestic Product:**
    - levels [unocd]: 1970-2000
    - extrapolated [pwt91]: 1965-1969
- **VA, TXSP, SD:**
    - levels [unocd]: 1970-2000
    - extrapolated [gdpe]: 1965-1969 | VA
    - linear extrapolation: 1965-1969 | SD, TXSP
- **Direct purchases abroad by residents:**
    - levels [iot]: 1995-2000
    - extrapolated [rat_mean]: 1965-1994 | PURR
    - extrapolated [imf_tis]: 1970-1994 | PURNR
    - extrapolated [rat_mean]: 1965-1969 | PURNR
- **GDP by expenditure:**
    - levels [unema]: 1970-2000
    - extrapolated [pwt91]: 1965-1969
    - extrapolated [iot]: 1968-1969 | GFCF, INV
    - linear extrapolation: 1965-1967 | GFCF, INV
- **VA by industry:**
    - levels [klems]: 1970-2000
    - extrapolated [iot]: 1968
    - extrapolated [sd10_2014]: 1965-1967; 1969
    - extrapolated [unido]: 1969 | manufacturing
    - linear extrapolation: 1965-1967; 1969 | services
    - linear extrapolation: 1965-1967 | manufacturing
- **GO by industry:**
    - levels [klems]: 1970-2000
    - extrapolated [iot]: 1968
    - extrapolated [unido]: 1969 | manufacturing
    - linear extrapolation: 1965-1967; 1969
    - linear extrapolation: 1965-1967 | manufacturing
- **INV by industry:**
    - levels [iot]: 1995-2000
    - linear extrapolation: 1965-1994

- **X by industry:**
  - levels [unocd]: 1965-2000 | goods/services
  - levels [iot]: 1968; 1979; 1984; 1990; 1995-2000
  - extrapolated [wtf]: 1965-1967; 1969-1978; 1980-1983; 1985-1989; 1991-1994 | goods
  - extrapolated [imf_tis]: 1970-1978; 1980-1983; 1985-1989; 1991-1994 | services
  - extrapolated [go_shr]: 1965-1967; 1969-1978; 1980-1983; 1985-1989; 1991-1994 | services
- **M by industry:**
  - levels [unocd]: 1965-2000 | goods/services
  - levels [iot]: 1968; 1979; 1984; 1990; 1995-2000
  - extrapolated [wtf]: 1965-1967; 1969-1978; 1980-1983; 1985-1989; 1991-1994 | goods
  - linear extrapolation: 1965-1967; 1969-1978; 1980-1983; 1985-1989; 1991-1994 | services

3.14. Greece (GRC)

- **Gross Domestic Product:**
  - levels [unocd]: 1965-2000
- **VA, TXSP, SD:**
  - levels [unocd]: 1965-2000
- **Direct purchases abroad by residents:**
  - levels [rat_mean]: 1965-2000 | PURR
  - levels [iot]: 1997-2000 | PURNR
  - extrapolated [imf_tis]: 1991-1992 | PURNR
  - extrapolated [rat_mean]: 1965-1990; 1993-1996 | PURNR
- **GDP by expenditure:**
  - levels [unema]: 1970-2000
  - extrapolated [pwt91]: 1965-1969
  - linear extrapolation: 1965-1969 | GFCF, INV
- **VA by industry:**
  - levels [klems]: 1970-2000
  - extrapolated [unocd]: 1965-1969
  - extrapolated [unido]: 1965-1969 | manufacturing
  - linear extrapolation: 1965-1969 | services
- **GO by industry:**
  - levels [klems]: 1995-2000
  - extrapolated [unido]: 1965-1994 | manufacturing
  - linear extrapolation: 1965-1994
- **INV by industry:**
  - levels [iot]: 1995-2000
  - linear extrapolation: 1965-1994
- **X by industry:**
  - levels [unocd]: 1965-2000 | goods/services

    - levels [iot]: 1995-2000
    - extrapolated [wtf]: 1965-1994 | goods
    - extrapolated [imf_tis]: 1976-1994 | services
    - extrapolated [go_shr]: 1965-1994 | services
- **M by industry:**
    - levels [unocd]: 1965-2000 | goods/services
    - levels [iot]: 1995-2000
    - extrapolated [wtf]: 1965-1994 | goods
    - linear extrapolation: 1965-1994 | services

3.15. Hong Kong (HKG)

- **Gross Domestic Product:**
    - levels [unocd]: 1980-2000
    - extrapolated [unema]: 1970-1979
    - extrapolated [pwt91]: 1965-1969
- **VA, TXSP, SD:**
    - levels [unocd]: 1980-2000
    - extrapolated [unema]: 1970-1979 | VA
    - extrapolated [gdpe]: 1965-1969 | VA
    - linear extrapolation: 1965-1979 | SD, TXSP
- **Direct purchases abroad by residents:**
    - levels [rat_mean]: 1965-2000 | PURR
    - levels [imf_tis]: 1998-2000 | PURNR
    - extrapolated [rat_mean]: 1965-1997 | PURNR
- **GDP by expenditure:**
    - levels [unema]: 1970-2000
    - extrapolated [pwt91]: 1965-1969
    - linear extrapolation: 1965-1969 | GFCF, INV
- **VA by industry:**
    - levels [unocd]: 1980-2000
    - levels [iot]: 2000 | manufacturing
    - extrapolated [unema]: 1970-1979
    - extrapolated [sd10_2014]: 1970-1979
    - extrapolated [unido]: 1973-1999 | manufacturing
    - linear extrapolation: 1965-1969
    - linear extrapolation: 1965-1979 | services
    - linear extrapolation: 1965-1999 | manufacturing
- **GO by industry:**
    - levels [unocd]: 1980-2000
    - levels [iot]: 2000 | manufacturing
    - extrapolated [unido]: 1973-1999 | manufacturing
    - linear extrapolation: 1965-1979
    - linear extrapolation: 1965-1972 | manufacturing
- **INV by industry:**

    - levels [iot]: 2000
    - linear extrapolation: 1965-1999
- **M by industry:**
    - levels [iot]: 2000
    - extrapolated [imf_curacc]: 1998-1999 | goods/services
    - extrapolated [imf_extsec]: 1965-1997 | goods/services
    - extrapolated [wtf]: 1965-1999 | goods
    - linear extrapolation: 1965-1999 | services

3.16. India (IND)

- **Gross Domestic Product:**
    - levels [unocd]: 1970-2000
    - extrapolated [pwt91]: 1965-1969
- **VA, TXSP, SD:**
    - levels [unocd]: 1965-2000
- **Direct purchases abroad by residents:**
    - levels [H_shr]: 1965-2000 | PURR
    - levels [imf_tis]: 1975-2000 | PURNR
    - extrapolated [rat_mean]: 1965-1974 | PURNR
- **GDP by expenditure:**
    - levels [unema]: 1970-2000
    - extrapolated [pwt91]: 1965-1969
    - linear extrapolation: 1965-1969 | GFCF, INV
- **VA by industry:**
    - levels [klems]: 1980-2000
    - extrapolated [unocd]: 1965-1979
    - extrapolated [unido]: 1965-1979 | manufacturing
    - linear extrapolation: 1965-1979 | services
- **GO by industry:**
    - levels [klems]: 1980-2000
    - extrapolated [unocd]: 1970-1979
    - extrapolated [unido]: 1965-1979 | manufacturing
    - linear extrapolation: 1965-1979
- **INV by industry:**
    - levels [iot]: 1995-2000
    - linear extrapolation: 1965-1994
- **X by industry:**
    - levels [unocd]: 1970-2000 | goods/services
    - levels [iot]: 1995-2000
    - extrapolated [mean]: 1965-1969 | goods/services
    - extrapolated [wtf]: 1965-1994 | goods
    - extrapolated [imf_tis]: 1975-1994 | services
    - extrapolated [go_shr]: 1965-1994 | services
- **M by industry:**

- levels [unocd]: 1970-2000 | goods/services
- levels [iot]: 1995-2000
- extrapolated [wtf_agg]: 1965-1969 | goods/services
- extrapolated [wtf]: 1965-1994 | goods
- linear extrapolation: 1965-1994 | services

3.17. Ireland (IRL)

- **Gross Domestic Product:**
  - levels [unocd]: 1970-2000
  - extrapolated [pwt91]: 1965-1969
- **VA, TXSP, SD:**
  - levels [unocd]: 1970-2000
  - extrapolated [gdpe]: 1965-1969 | VA
  - linear extrapolation: 1965-1969 | SD, TXSP
- **Direct purchases abroad by residents:**
  - levels [iot]: 1995-2000
  - extrapolated [rat_mean]: 1965-1994 | PURR
  - extrapolated [imf_tis]: 1974-1994 | PURNR
  - extrapolated [rat_mean]: 1965-1973 | PURNR
- **GDP by expenditure:**
  - levels [unema]: 1970-2000
  - extrapolated [pwt91]: 1965-1969
  - linear extrapolation: 1965-1969 | GFCF, INV
- **VA by industry:**
  - levels [klems]: 1970-2000
  - extrapolated [unido]: 1965-1969 | manufacturing
  - linear extrapolation: 1965-1969
- **GO by industry:**
  - levels [klems]: 1991-2000
  - extrapolated [unido]: 1965-1990 | manufacturing
  - linear extrapolation: 1965-1990
- **INV by industry:**
  - levels [iot]: 1995-2000
  - linear extrapolation: 1965-1994
- **X by industry:**
  - levels [unocd]: 1970-2000 | goods/services
  - levels [iot]: 1995-2000
  - extrapolated [wtf_agg]: 1965-1969 | goods/services
  - extrapolated [wtf]: 1965-1994 | goods
  - extrapolated [imf_tis]: 1974-1994 | services
  - extrapolated [go_shr]: 1965-1994 | services
- **M by industry:**
  - levels [unocd]: 1970-2000 | goods/services
  - levels [iot]: 1995-2000

- extrapolated [wtf_agg]: 1965-1969 | goods/services
- extrapolated [wtf]: 1965-1994 | goods
- linear extrapolation: 1965-1994 | services

3.18. Italy (ITA)

- **Gross Domestic Product:**
  - levels [unocd]: 1970-2000
  - extrapolated [pwt91]: 1965-1969
- **VA, TXSP, SD:**
  - levels [unocd]: 1965-2000
- **Direct purchases abroad by residents:**
  - levels [iot]: 1995-2000
  - extrapolated [rat_mean]: 1965-1994 | PURR
  - extrapolated [imf_tis]: 1970-1994 | PURNR
  - extrapolated [rat_mean]: 1965-1969 | PURNR
- **GDP by expenditure:**
  - levels [unema]: 1970-2000
  - extrapolated [pwt91]: 1965-1969
  - linear extrapolation: 1965-1969 | GFCF, INV
- **VA by industry:**
  - levels [klems]: 1970-2000
  - extrapolated [unocd]: 1965-1969
  - extrapolated [unido]: 1967-1969 | manufacturing
  - linear extrapolation: 1965-1969
  - linear extrapolation: 1965-1966 | manufacturing
- **GO by industry:**
  - levels [klems]: 1970-2000
  - extrapolated [unido]: 1967-1969 | manufacturing
  - linear extrapolation: 1965-1969
  - linear extrapolation: 1965-1966 | manufacturing
- **INV by industry:**
  - levels [iot]: 1995-2000
  - linear extrapolation: 1965-1994
- **X by industry:**
  - levels [unocd]: 1970-2000 | goods/services
  - levels [iot]: 1985; 1995-2000
  - extrapolated [wtf_agg]: 1965-1969 | goods/services
  - extrapolated [wtf]: 1965-1984; 1986-1994 | goods
  - extrapolated [imf_tis]: 1970-1984; 1986-1994 | services
  - extrapolated [go_shr]: 1965-1984; 1986-1994 | services
- **M by industry:**
  - levels [unocd]: 1970-2000 | goods/services
  - levels [iot]: 1985; 1995-2000
  - extrapolated [wtf_agg]: 1965-1969 | goods/services

- extrapolated [wtf]: 1965-1984; 1986-1994 | goods
- linear extrapolation: 1965-1984; 1986-1994 | services

3.19. Japan (JPN)

- **Gross Domestic Product:**
  - levels [unocd]: 1965-2000
- **VA, TXSP, SD:**
  - levels [unocd]: 1965-2000
- **Direct purchases abroad by residents:**
  - levels [rat_mean]: 1965-2000 | PURR
  - levels [iot]: 1995-2000 | PURNR
  - extrapolated [imf_tis]: 1977-1994 | PURNR
  - extrapolated [rat_mean]: 1965-1976 | PURNR
- **GDP by expenditure:**
  - levels [unema]: 1970-2000
  - extrapolated [pwt91]: 1965-1969
  - linear extrapolation: 1965-1969 | GFCF, INV
- **VA by industry:**
  - levels [klems]: 1973-2000
  - extrapolated [unocd]: 1965-1972
  - extrapolated [iot]: 1970 | manufacturing, services
  - extrapolated [unido]: 1965-1969; 1971-1972 | manufacturing
  - linear extrapolation: 1965-1969; 1971-1972 | services
- **GO by industry:**
  - levels [klems]: 1973-2000
  - extrapolated [unocd]: 1970-1972
  - extrapolated [iot]: 1970 | manufacturing
  - extrapolated [unido]: 1965-1969; 1971-1972 | manufacturing
  - linear extrapolation: 1965-1969
- **INV by industry:**
  - levels [iot]: 1970; 1973-2000
  - linear extrapolation: 1965-1969; 1971-1972
- **X by industry:**
  - levels [unocd]: 1965-2000 | goods/services
  - levels [iot]: 1970; 1973-2000
  - extrapolated [wtf]: 1965-1969; 1971-1972 | goods
  - extrapolated [go_shr]: 1965-1969; 1971-1972 | services
- **M by industry:**
  - levels [unocd]: 1965-2000 | goods/services
  - levels [iot]: 1970; 1973-2000
  - extrapolated [wtf]: 1965-1969; 1971-1972 | goods
  - linear extrapolation: 1965-1969; 1971-1972 | services

3.20. Korea, Republic of (KOR)

- **Gross Domestic Product:**
  - levels [unocd]: 1970-2000
  - extrapolated [pwt91]: 1965-1969
- **VA, TXSP, SD:**
  - levels [unocd]: 1965-2000
- **Direct purchases abroad by residents:**
  - levels [iot]: 1995-2000
  - extrapolated [rat_mean]: 1965-1994 | PURR
  - extrapolated [imf_tis]: 1976-1994 | PURNR
  - extrapolated [rat_mean]: 1965-1975 | PURNR
- **GDP by expenditure:**
  - levels [unema]: 1970-2000
  - extrapolated [pwt91]: 1965-1969
  - linear extrapolation: 1965-1969 | GFCF, INV
- **VA by industry:**
  - levels [klems]: 1970-2000
  - extrapolated [unocd]: 1965-1969
  - extrapolated [unido]: 1965-1969 | manufacturing
  - linear extrapolation: 1965-1969 | services
- **GO by industry:**
  - levels [klems]: 1970-2000
  - extrapolated [unido]: 1965-1969 | manufacturing
  - linear extrapolation: 1965-1969
- **INV by industry:**
  - levels [iot]: 1995-2000
  - linear extrapolation: 1965-1994
- **X by industry:**
  - levels [unocd]: 1970-2000 | goods/services
  - levels [iot]: 1985; 1990; 1995-2000
  - extrapolated [mean]: 1965-1969 | goods/services
  - extrapolated [wtf]: 1965-1984; 1986-1989; 1991-1994 | goods
  - extrapolated [imf_tis]: 1976-1984; 1986-1989; 1991-1994 | services
  - extrapolated [go_shr]: 1965-1983 | services
- **M by industry:**
  - levels [unocd]: 1970-2000 | goods/services
  - levels [iot]: 1985; 1990; 1995-2000
  - extrapolated [mean]: 1965-1969 | goods/services
  - extrapolated [wtf]: 1965-1984; 1986-1989; 1991-1994 | goods
  - linear extrapolation: 1965-1984; 1986-1994 | services

3.21. Mexico (MEX)

- **Gross Domestic Product:**
  - levels [unocd]: 1970-2000

    - extrapolated [pwt91]: 1965-1969
- **VA, TXSP, SD:**
    - levels [unocd]: 1970-2000
    - extrapolated [gdpe]: 1965-1969 | VA
    - linear extrapolation: 1965-1969 | SD, TXSP
- **Direct purchases abroad by residents:**
    - levels [iot]: 1999-2000 | PURR
    - levels [iot]: 1995-2000 | PURNR
    - extrapolated [rat_mean]: 1965-1998 | PURR
    - extrapolated [imf_tis]: 1979-1994 | PURNR
    - extrapolated [rat_mean]: 1965-1978 | PURNR
- **GDP by expenditure:**
    - levels [unema]: 1970-2000
    - extrapolated [pwt91]: 1965-1969
    - linear extrapolation: 1965-1992 | GFCF, INV
- **VA by industry:**
    - levels [unocd]: 1970-2000
    - levels [iot]: 1970; 1975; 1980; 1995-2000 | manufacturing, services
    - extrapolated [sd10_2014]: 1965-1969
    - extrapolated [iot]: 1970; 1975; 1980 | services
    - extrapolated [unido]: 1984-1994 | manufacturing
    - linear extrapolation: 1965-1969; 1971-1974; 1976-1979; 1981-1994 | services
    - linear extrapolation: 1965-1969; 1971-1974; 1976-1979; 1981-1983 | manufacturing
- **GO by industry:**
    - levels [unocd]: 1980-2000
    - levels [iot]: 1970; 1975; 1980; 1995-2000 | manufacturing
    - extrapolated [iot]: 1970; 1975
    - extrapolated [unido]: 1984-1994 | manufacturing
    - linear extrapolation: 1965-1969; 1971-1974; 1976-1979
    - linear extrapolation: 1965-1969; 1971-1974; 1976-1979; 1981-1983 | manufacturing
- **INV by industry:**
    - levels [iot]: 1995-2000
    - linear extrapolation: 1965-1994
- **X by industry:**
    - levels [unocd]: 1980-2000 | goods/services
    - levels [iot]: 1970; 1975; 1980; 1995-2000
    - extrapolated [imf_curacc]: 1979 | goods/services
    - extrapolated [imf_extsec]: 1970-1978 | goods/services
    - extrapolated [wtf_agg]: 1965-1969 | goods/services
    - extrapolated [wtf]: 1965-1979; 1981-1994 | goods
    - extrapolated [imf_tis]: 1979; 1981-1994 | services
    - extrapolated [go_shr]: 1965-1994 | services
- **M by industry:**

- levels [unocd]: 1970-2000 | goods/services
- levels [iot]: 1970; 1975; 1980; 1995-2000
- extrapolated [mean]: 1965-1969 | goods/services
- extrapolated [wtf]: 1965-1969; 1971-1974; 1976-1979; 1981-1994 | goods
- linear extrapolation: 1965-1969; 1971-1974; 1976-1979; 1981-1994 | services

3.22. Netherlands (NLD)

- **Gross Domestic Product:**
  - levels [unocd]: 1969-2000
  - extrapolated [pwt91]: 1965-1968
- **VA, TXSP, SD:**
  - levels [unocd]: 1969-2000
  - extrapolated [gdpe]: 1965-1968 | VA
  - linear extrapolation: 1965-1968 | SD, TXSP
- **Direct purchases abroad by residents:**
  - levels [iot]: 1995-2000
  - extrapolated [rat_mean]: 1965-1994 | PURR
  - extrapolated [imf_tis]: 1970-1994 | PURNR
  - extrapolated [rat_mean]: 1965-1969 | PURNR
- **GDP by expenditure:**
  - levels [unema]: 1970-2000
  - extrapolated [pwt91]: 1965-1969
  - extrapolated [iot]: 1969 | GFCF, INV
  - linear extrapolation: 1965-1968 | GFCF, INV
- **VA by industry:**
  - levels [klems]: 1970-2000
  - extrapolated [unocd]: 1969
  - extrapolated [iot]: 1969 | manufacturing, services
  - extrapolated [unido]: 1965-1968 | manufacturing
  - linear extrapolation: 1965-1968
- **GO by industry:**
  - levels [klems]: 1970-2000
  - extrapolated [unocd]: 1969
  - extrapolated [iot]: 1969 | manufacturing
  - extrapolated [unido]: 1965-1968 | manufacturing
  - linear extrapolation: 1965-1968
- **INV by industry:**
  - levels [iot]: 1969-2000
  - linear extrapolation: 1965-1968
- **X by industry:**
  - levels [unocd]: 1969-2000 | goods/services
  - levels [iot]: 1969-2000
  - extrapolated [imf_curacc]: 1967-1968 | goods/services
  - extrapolated [wtf_agg]: 1965-1966 | goods/services

    - extrapolated [wtf]: 1965-1968 | goods
    - extrapolated [go_shr]: 1965-1968 | services
- **M by industry:**
    - levels [unocd]: 1969-2000 | goods/services
    - levels [iot]: 1969-2000
    - extrapolated [imf_curacc]: 1967-1968 | goods/services
    - extrapolated [wtf_agg]: 1965-1966 | goods/services
    - extrapolated [wtf]: 1965-1968 | goods
    - linear extrapolation: 1965-1968 | services

3.23. Portugal (PRT)

- **Gross Domestic Product:**
    - levels [unocd]: 1970-2000
    - extrapolated [pwt91]: 1965-1969
- **VA, TXSP, SD:**
    - levels [unocd]: 1970-2000
    - extrapolated [gdpe]: 1965-1969 | VA
    - linear extrapolation: 1965-1969 | SD, TXSP
- **Direct purchases abroad by residents:**
    - levels [iot]: 1995-2000
    - extrapolated [rat_mean]: 1965-1994 | PURR
    - extrapolated [imf_tis]: 1975-1994 | PURNR
    - extrapolated [rat_mean]: 1965-1974 | PURNR
- **GDP by expenditure:**
    - levels [unema]: 1970-2000
    - extrapolated [pwt91]: 1965-1969
    - linear extrapolation: 1965-1969 | GFCF, INV
- **VA by industry:**
    - levels [klems]: 1970-2000
    - extrapolated [unido]: 1965-1969; 1990-1992 | manufacturing
    - linear extrapolation: 1965-1969
- **GO by industry:**
    - levels [klems]: 1970-2000
    - extrapolated [unido]: 1965-1969; 1990-1992 | manufacturing
    - linear extrapolation: 1965-1969
- **INV by industry:**
    - levels [iot]: 1995-2000
    - linear extrapolation: 1965-1994
- **X by industry:**
    - levels [unocd]: 1970-2000 | goods/services
    - levels [iot]: 1995-2000
    - extrapolated [wtf_agg]: 1965-1969 | goods/services
    - extrapolated [wtf]: 1965-1994 | goods
    - extrapolated [imf_tis]: 1975-1994 | services

    - extrapolated [go_shr]: 1965-1992 | services
- **M by industry:**
    - levels [unocd]: 1970-2000 | goods/services
    - levels [iot]: 1995-2000
    - extrapolated [wtf_agg]: 1965-1969 | goods/services
    - extrapolated [wtf]: 1965-1994 | goods
    - linear extrapolation: 1965-1994 | services

3.24. Sweden (SWE)

- **Gross Domestic Product:**
    - levels [unocd]: 1965-2000
- **VA, TXSP, SD:**
    - levels [unocd]: 1970-2000
    - extrapolated [gdpe]: 1965-1969 | VA
    - linear extrapolation: 1965-1969 | SD, TXSP
- **Direct purchases abroad by residents:**
    - levels [iot]: 1995-2000
    - extrapolated [rat_mean]: 1965-1994 | PURR
    - extrapolated [imf_tis]: 1970-1994 | PURNR
    - extrapolated [rat_mean]: 1965-1969 | PURNR
- **GDP by expenditure:**
    - levels [unema]: 1970-2000
    - extrapolated [pwt91]: 1965-1969
    - linear extrapolation: 1965-1969 | GFCF, INV
- **VA by industry:**
    - levels [klems]: 1970-2000
    - extrapolated [unido]: 1965-1969 | manufacturing
    - linear extrapolation: 1965-1969
- **GO by industry:**
    - levels [klems]: 1970-2000
    - extrapolated [unido]: 1965-1969 | manufacturing
    - linear extrapolation: 1965-1969
- **INV by industry:**
    - levels [iot]: 1995-2000
    - linear extrapolation: 1965-1994
- **X by industry:**
    - levels [unocd]: 1970-2000 | goods/services
    - levels [iot]: 1995-2000
    - extrapolated [wtf_agg]: 1965-1969 | goods/services
    - extrapolated [wtf]: 1965-1994 | goods
    - extrapolated [imf_tis]: 1970-1994 | services
    - extrapolated [go_shr]: 1965-1994 | services
- **M by industry:**
    - levels [unocd]: 1970-2000 | goods/services

- levels [iot]: 1995-2000
- extrapolated [wtf_agg]: 1965-1969 | goods/services
- extrapolated [wtf]: 1965-1994 | goods
- linear extrapolation: 1965-1994 | services

3.25. Taiwan (TWN)

- **Gross Domestic Product:**
  - levels [pwt91]: 1965-2000
- **VA, TXSP, SD:**
  - extrapolated [gdpe]: 1965-2000 | VA
  - linear extrapolation: 1965-2000 | SD, TXSP
- **Direct purchases abroad by residents:**
  - levels [H_shr]: 1965-2000
- **GDP by expenditure:**
  - levels [pwt91]: 1965-2000
  - levels [iot]: 1984; 1989; 1995-2000 | GFCF, INV
  - extrapolated [iot]: 1985-1988; 1990-1994 | GFCF, INV
  - linear extrapolation: 1965-1983 | GFCF, INV
- **VA by industry:**
  - levels [na]: 1981-2000
  - extrapolated [sd10_2014]: 1965-1980
  - extrapolated [unido]: 1973-1980 | manufacturing
  - linear extrapolation: 1965-1980 | services
  - linear extrapolation: 1965-1972 | manufacturing
- **GO by industry:**
  - levels [na]: 1981-2000
  - extrapolated [unido]: 1976-1980 | manufacturing
  - linear extrapolation: 1965-1980
  - linear extrapolation: 1965-1975 | manufacturing
- **INV by industry:**
  - levels [iot]: 1995-2000
  - linear extrapolation: 1965-1994
- **X by industry:**
  - levels [iot]: 1984; 1989; 1995-2000
  - extrapolated [mean]: 1965-1983; 1985-1988; 1990-1994 | goods/services
  - extrapolated [wtf]: 1965-1983; 1985-1988; 1990-1994 | goods
  - extrapolated [go_shr]: 1965-1983; 1985-1988; 1990-1994 | services
- **M by industry:**
  - levels [iot]: 1984; 1989; 1995-2000
  - extrapolated [mean]: 1965-1983; 1985-1988; 1990-1994 | goods/services
  - extrapolated [wtf]: 1965-1983; 1985-1988; 1990-1994 | goods
  - linear extrapolation: 1965-1983; 1985-1988; 1990-1994 | services

3.26. United States of America (USA)

- **Gross Domestic Product:**
  - levels [iot]: 1965-2000
- **VA, TXSP, SD:**
  - levels [iot]: 1965-2000
- **Direct purchases abroad by residents:**
  - levels [iot]: 1995-2000
  - extrapolated [rat_mean]: 1965-1994 | PURR
  - extrapolated [imf_tis]: 1970-1994 | PURNR
  - extrapolated [rat_mean]: 1965-1969 | PURNR
- **GDP by expenditure:**
  - levels [iot]: 1965-2000
- **VA by industry:**
  - levels [iot]: 1965-2000
- **GO by industry:**
  - levels [iot]: 1965-2000
- **INV by industry:**
  - levels [iot]: 1965-2000
- **X by industry:**
  - levels [iot]: 1965-2000
- **M by industry:**
  - levels [iot]: 1965-2000

4. Appendices

4.a. Industry list

Industry List (ISIC Rev. 3.1)		
1	AtB	Agriculture, Hunting, Forestry and Fishing
2	C	Mining and Quarrying
3	D15t16	Food, Beverages and Tobacco
4	D17t19	Textiles, Textile, Leather and Footwear
5	D21t22	Pulp, Paper, Paper, Printing and Publishing
6	D23	Coke, Refined Petroleum and Nuclear Fuel
7	D24	Chemicals and Chemical Products
8	D25	Rubber and Plastics
9	D26	Other Non-Metallic Mineral
10	D27t28	Basic Metals and Fabricated Metal
11	D29	Machinery, nec.
12	D30t33	Electrical and Optical Equipment
13	D34t35	Transport Equipment
14	Dnec	Manufacturing, nec.; Recycling
15	E	Electricity, Gas and Water Supply
16	F	Construction
17	G	Wholesale and Retail Trade
18	H	Hotels and Restaurants
19	I60t63	Transport and Storage
20	I64	Post and Telecommunications
21	J	Financial Intermediation
22	K	Real Estate, Renting and Business Activities
23	LtQ	Community Social and Personal Services

4.b. Country list

Countrycode	Description
AUS	Australia
AUT	Austria
BEL	Belgium
BRA	Brazil
CAN	Canada
CHN	China
DEU	Germany
DNK	Denmark
ESP	Spain
FIN	Finland
FRA	France
GBR	United Kingdom
GRC	Greece
HKG	Hong Kong
IND	India
IRL	Ireland
ITA	Italy
JPN	Japan
KOR	Korea, Republic of
MEX	Mexico
NLD	Netherlands
PRT	Portugal
SWE	Sweden
TWN	Taiwan
USA	United States of America

4.c. Sources SUTs/IOTs

- ***Secondary sources:***
  - WIOD 2013 – WIOD 2013 Release, https://www.rug.nl/ggdc/valuechain/wiod/
  - OECD 1995 – The OECD Input-Output Database, 1995 Release, http://www.oecd.org/industry/ind/input-outputtablesedition1995accesstodata.htm
- **AUS: Australia**
  - 1995-2000 – WIOD 2013
  - 1968; 1974; 1986; 1989 – OECD 1995
- **AUT: Austria**
  - 1995-2000 – WIOD 2013
  - 1988-1994 – SUT data prepared by Statistics Austria for EU KLEMS 2008, *unpublished*.
- **BEL: Belgium**
  - 1995-2000 – WIOD 2013
  - 1980; 1985; 1990 – Federal Planning Bureau, Input-Output Tables, https://www.plan.be/databases/data-22-en-input_output_tables_1980_1985_1990_esa_79
- **BRA: Brazil**
  - 1995-2000 – WIOD 2013
- **CAN: Canada**
  - 1995-2000 – WIOD 2013
  - 1971; 1976; 1981; 1986; 1990 – OECD 1995
- **CHN: China**
  - 1995-2000 – WIOD 2013
  - 1981-1994 – Research Institute of Economy, Trade and Industry (RIETI), China Industrial Productivity (CIP) Database 3.0, Released July 9 2015, https://www.rieti.go.jp/en/database/CIP2015/index.html
- **DEU: Germany**
  - 1995-2000 – WIOD 2013
  - 1978; 1986; 1988; 1990 – OECD 1995, note that these tables only cover the Federal Republic of Germany (FRG).
- **DNK: Denmark**
  - 1995-2000 – WIOD 2013
  - 1972; 1977; 1980; 1985; 1990 – OECD 1995
- **ESP: Spain**
  - 1995-2000 – WIOD 2013
- **FIN: Finland**
  - 1995-2000 – WIOD 2013
- **FRA: France**
  - 1995-2000 – WIOD 2013
  - 1972; 1977; 1980; 1985; 1990 – OECD 1995
- **GBR: United Kingdom**
  - 1995-2000 – WIOD 2013
  - 1968; 1979; 1984; 1990 – OECD 1995
- **GRC: Greece**
  - 1995-2000 – WIOD 2013
- **HKG: Hong Kong**

    - 2010 – Asian Development Bank, Hong Kong, China: Input-Output Economic Indicators 2010-2017, https://data.adb.org/dataset/hong-kong-china-input-output-economic-indicators
- **IND: India**
    - 1995-2000 – WIOD 2013
- **IRL: Ireland**
    - 1995-2000 – WIOD 2013
- **ITA: Italy**
    - 1995-2000 – WIOD 2013
    - 1985 – OECD 1995
- **JPN: Japan**
    - 1970; 1973-2000 – Research Institute of Economy, Trade and Industry (RIETI), Japan Industrial Productivity (JIP) Database 2013, Input-output table (current prices, million yen), https://www.rieti.go.jp/en/database/JIP2013/index.html
- **KOR: Korea, Republic of**
    - 1995-2000 – WIOD 2013
    - 1985; 1990 – Input-Output Tables prepared by the Bank of Korea for EU KLEMS 2008
- **MEX: Mexico**
    - 1995-2000 – WIOD 2013
    - 1970; 1975; 1978; 1980 – Instituto Nacional de Estadística y Geografía (INEGI), Matriz de Insumo Producto, Base 2003, https://www.inegi.org.mx/programas/mip/2003/
- **NLD: Netherlands**
    - 1995-2000 – WIOD 2013
    - 1969-1994 – Centraal Bureau voor de Statistiek (CBS), Input-Output Table Producer Prices, 1969-2009, https://www.cbs.nl/en-gb/background/2010/30/-/media/02cd8f9886484e858fc69bc20f5dcfe7.ashx
- **PRT: Portugal**
    - 1995-2000 – WIOD 2013
- **SWE: Sweden**
    - 1995-2000 – WIOD 2013
- **TWN: Taiwan**
    - 1995-2000 – WIOD 2013
    - 1984; 1989 – National Statistics Republic of China (Taiwan), I/O Tables, Statistical Tables, Extended tables (before 2006), https://eng.stat.gov.tw/ct.asp?xItem=37397&ctNode=1650&mp=5
- **USA: United States of America**
    - 1965-1996 – Bureau of Economic Analysis (BEA), Historical Make-Use Tables, Make-Use Tables Before Redefinitions Producer Value, 65 Industries, 1963-1996, https://www.bea.gov/industry/io_annual.htm
    - 1997-2000 - Bureau of Economic Analysis (BEA), Make-Use Tables, Make-Use Tables Before Redefinitions Producer Value, 71 Industries 1997-2016, https://www.bea.gov/industry/io_annual.htm

4.d. Trade by country-of-origin

As discussed in section 2.7, to estimate the imports from each industry by country-of-origin and, as a mirror image, the exports by country-of-destination, we multiply the import shares, listed in WTF, times the total import value from the countries' national accounts. Figure D.1 illustrates this procedure in a stylized example. Here we look solely at 1 industry, and the world economy contains 4 regions: Austria (AUT), Belgium (BEL), Canada (CAN) and the Rest of the World (RoW). Step 1 provides the import shares, which sum to 1 over each column. In step 2, we multiply these shares by the import totals (M NA) obtained from the national accounts. The sum across the rows (X sum) is then compared to the export totals (X NA) listed in the national accounts. For all rows, the sum does not match the value from the national accounts. In Step 3, we drop the values in the RoW column and replace them with a residual; i.e. X NA minus the sum of X excluding RoW. In this example, for all countries this solves the mismatch *and* results in positive values for trade with the RoW. Since RoW serves as a residual category, the trade flows can differ quite substantially from those implied by WTF. Also, the totals for export and import for RoW will differ from those implied by the National Accounts. Overall, the export and import values for RoW should be treated with caution since they are not based on primary data.

Figure D.1: stylized example estimation of import/export levels

Step 1: list import shares

Ind 1, import shares	**AUT**	**BEL**	**CAN**	**RoW**	**X NA (level)**
AUT		0.6	0.4	0.2	130
BEL	0.5		0.1	0.2	90
CAN	0.3	0.1		0.6	120
RoW	0.2	0.3	0.5		165
M NA (lvl)	100	75	200	125	**500**

Step 2: multiply shares by total import (M) from national accounts (NA)

Ind 1, levels	**AUT**	**BEL**	**CAN**	**RoW**	**X NA**	**X sum**	**X sum (ex RoW)**
AUT		45	80	25	130	150	125
BEL	50		20	25	90	95	70
CAN	30	7.5		75	120	112.5	37.5
RoW	20	22.5	100		160	142.5	142.5
M NA	100	75	200	125	**500**	500	375

Step 3: set RoW column equal to X NA minus the sum of X (excluding RoW)

Ind 1, levels	**AUT**	**BEL**	**CAN**	**RoW**	**X NA**	**X sum**
AUT		45	80	5	130	130
BEL	50		20	20	90	90
CAN	30	7.5		82.5	120	120
RoW	20	22.5	100		160	142.5
M NA	100	75	200	107.5	**500**	482.5

Note that the sum of trade flows across the rows, which should give us total export by industry- and country-of-origin, does not always give us a positive residual for trade with the RoW. Figure D.2 illustrates this mismatch between the levels of imports and exports in another stylized example. Step 1 again provides the import shares, which are identical to those listed in figure D.1. Note, however, that we have altered the total export level for AUT and import level for BEL from the national accounts. In Step 3, when we drop the values in the RoW column and replace them with a residual (i.e. X NA minus the sum of X excluding RoW), we obtain a negative export value for AUT in the RoW column, which has no economic interpretation.

Figure D.2: stylized example estimation of import/export levels

Step 1: list import shares

Ind 1, import shares	**AUT**	**BEL**	**CAN**	**RoW**	**X NA (level)**
AUT		0.6	0.4	0.2	100
BEL	0.5		0.1	0.2	90
CAN	0.3	0.1		0.6	120
RoW	0.2	0.3	0.5		165
M NA (lvl)	100	50	200	125	**475**

Step 2: multiply shares by total import (M) from national accounts (NA)

Ind 1, levels	**AUT**	**BEL**	**CAN**	**RoW**	**X NA**	**X sum**	**X sum (ex RoW)**
AUT		30	80	25	100	135	110
BEL	50		20	25	90	95	70
CAN	30	5		75	120	110	35
RoW	20	15	100		165	135	135
M NA	100	50	200	125	**475**	**475**	**350**

Step 3: set RoW column equal to X NA minus the sum of X (excluding RoW)

Ind 1, levels	**AUT**	**BEL**	**CAN**	**RoW**	**X NA**	**X sum**
AUT		30	80	-10	100	100
BEL	50		20	20	90	90
CAN	30	5		85	120	120
RoW	20	15	100		165	135
M NA	100	50	200	95	**475**	445

To remedy this, in step 4 we rely on export shares instead, as shown in figure D.3. Note that we only do this for rows with offending cells; i.e. Import for RoW smaller than zero. In step 5 we again multiply the shares with the export totals (X NA) from the national accounts. When we compare the sum across the columns (M sum) to the import totals (M NA) listed in the national accounts, we again observe a mismatch for all countries except AUT. Mirroring step 3, in step 6 we drop the values in the RoW row and replace them with a residual; i.e. M NA minus the sum of M excluding RoW. This time all values in the RoW row are positive, satisfying our conditions for the international IOT. If, following

step 6, the matrix still contains negatives, we apply GRAS to obtain a matrix with no negatives that adheres to the import and export totals from the national accounts.

Figure D.3: stylized example estimation of import/export levels [continued]

Step 4: list export shares (for rows where RoW_M < 0)

Ind 1, export shares	**AUT**	**BEL**	**CAN**	**RoW**	**X NA (level)**
AUT		0.4	0.5	0.1	100
BEL	0.5		0.2	0.3	90
CAN	0.3	0.1		0.6	120
RoW	0.2	0.1	0.7		135
M NA (lvl)	100	50	200	125	**475**

Step 5: multiply shares by total export (X) from NA (for rows where RoW_M < 0)

Ind 1, levels	**AUT**	**BEL**	**CAN**	**RoW**	**X NA**	**X sum**
AUT		40	50	10	100	100
BEL	50		20	20	90	90
CAN	30	5		85	120	120
RoW	20	15	100		165	135
M NA	100	50	200	125	**475**	**445**
M sum	100	60	170	115		**445**
M sum (ex RoW)	80	45	70	115		**310**

Step 6: set RoW row equal to M NA minus the sum of M (excluding RoW)

Ind 1, levels	**AUT**	**BEL**	**CAN**	**RoW**	**X NA**	**X sum**
AUT		40	50	10	100	100
BEL	50		20	20	90	90
CAN	30	5		85	120	120
RoW	20	5	130		165	155
M NA	100	50	200	125	**475**	**465**
M sum	100	50	200	115		**465**