
Global Macro Database

TECHNICAL APPENDIX

Version 2026–01

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January 25, 2026

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1 Introduction

The Global Macro Database (GMD), introduced by Müller et al. (2025), is the world's most comprehensive open-source repository of cross-country macroeconomic statistics. Updated on a quarterly basis, the 2025-12 version of the GMD contains 74 variables, spanning 240 countries and territories over the period 1086 to 2024 with projections up to 2030. The data and further information can be found at www.globalmacrodata.com.

This technical documentation is specific to the 2025-12 release and contains several sections. Sections 2-6 outline the terms of use, citation requirement, version history, acknowledgements, and access methods. Sections 7-9 cover the list of variables, data coverage, and data sources. Section 10-12 outline issues related to variable definitions, source priority ordering, and measurement issues. Section 13 provides an overview of planned improvements.

2 Terms of Use

Summary: The Global Macro Database (GMD) is free to use and share for **non-commercial** purposes (e.g., academic research), provided you **attribute and cite** the dataset and share only under identical license terms. **Any commercial use is prohibited** unless you obtain a separate commercial license from us.

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- **Commercial analytics:** using the data to support revenue-generating activities or business decisions (e.g., trading, investment research, risk management, underwriting, pricing, forecasting for business operations, client reporting).
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- **Sponsored / marketing use:** using the data in paid reports, sponsored research, marketing materials, or other promotional activity.

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- **Attribution** – Appropriate credit must be given to the *Global Macro Database (GMD)*, citing the authors as specified in Section 3 below, including a link to the license and an indication of changes made. Attribution must not suggest endorsement.
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- **ShareAlike** – If you remix, transform, or build upon the material, you must distribute your contributions under the same license.

3 Citation

If you use the GMD, it must be cited as follows. Because the GMD is updated quarterly, you may want to refer to the exact version you used:

```
@techreport{GMD2025,  
  title = {The Global Macro Database: A New International Macroeconomic Dataset},  
  author = {M{"u}ller, Karsten and Xu, Chenzi and Lehib, Mohamed and Chen,  
    Ziliang},  
  institution = {National Bureau of Economic Research},  
  type = {Working Paper},  
  series = {Working Paper Series},  
  number = {33714},  
  year = {2025},  
  month = {April},  
  doi = {10.3386/w33714},  
  URL = {http://www.nber.org/papers/w33714}  
}
```

4 Version History

This section summarizes major updates to the Global Macro Database (GMD). For full release notes and version details, please visit www.globalmacrodata.com/data.

Version 2026_01 – *current*

Overview This release introduces significant enhancements to data accuracy and infrastructure. Key updates include a comprehensive revision of the real GDP series and the deployment of a fully automated, cloud-based data processing pipeline to ensure timely future updates.

Real GDP Improvement We have conducted a major review of the real GDP series. The data has been rigorously corrected and is now consistently rebased to the year 2015, ensuring greater comparability and accuracy across the dataset.

Automated Pipeline We have implemented a new automated pipeline. This system autonomously handles downloading, processing, and merging data from all sources in the cloud, ensuring the maintenance process and allowing for more frequent and reliable database updates.

Stata Package & Documentation We have launched a dedicated repository for the official Stata package ¹. Moreover, we have released a comprehensive companion paper², which serves as a detailed guide to using the package effectively.

Version 2025_12

Overview The *2025_12* version includes updated data as of December 2025 and introduces various important patches and improvements. We also rewrote the Stata package from scratch: get the new version by typing `ssc install gmd`. [Lehbib and Müller \(2025\)](#) provides more details.

Improved Government Finance Statistics We further improved the construction of combined government finance statistics. Relative to before, the combined time series are now mostly based on chain-linking ratios, with some exceptions, and we more commonly use a country-specific priority ordering of sources.

Extended Technical Appendix We considerably improved the technical appendix to enhance clarity and readability. Going forward, we will provide a dedicated technical appendix with each release.

Major Update to Stata Package We rewrote the Stata package from scratch to make it faster and added various new functionalities, including the ability to easily access all the (cleaned) data underlying the GMD. A new companion paper ([Lehbib and Müller, 2025](#)) now describes the package in detail.

Bug Fixes Thanks to the support of many GMD users, we were able to identify and fix many bugs. Noteworthy examples include real GDP per capita for Venezuela and the inflation rates of a few countries.

New Variable The GMD now includes the World Bank's income classification.

¹To access the package source-code, please visit: github.com/KMueller-Lab/Global-Macro-Database-Stata.

²To access the paper, please visit: github.com/KMueller-Lab/Global-Macro-Database-Stata/blob/main/Global_Macro_Database_Stata.pdf.

Version 2025_09

Overview This quarterly update introduces improved government finance statistics, streamlined source handling, a new outlier detection process, and numerous fixes and small improvements.

Improved Government Finance Statistics The database now explicitly distinguishes between data referring to the central or general government. The GMD now contains separate series for central and government variables, as well as consolidated aggregates (which maximize data availability).

Improved Download Infrastructure The download infrastructure has been updated to pull data directly from primary institutions like the IMF, Eurostat, OECD, and the UN, rather than relying on dbnomics. Additionally, all IMF data collection now uses its newly released API (3.0) for better reliability.

Pipeline Improvements The underlying GMD processing pipeline has undergone a comprehensive overhaul to optimize performance and data handling. As a result of these structural changes, the total runtime for updating the database has improved by approximately 10x.

New and Improved Sources To streamline data management, various disparate datasets from the IMF and OECD are now treated as single, unified “sources” where appropriate. We have also expanded our historical coverage by adding monetary statistics for France and unemployment series from Eurostat.

Automated Error Checking Our automated quality control system has been expanded to detect multiple distinct error types across the entire dataset. Any values flagged as suspicious by these new automated checks are subsequently reviewed and confirmed manually by our team.

Bug Fixes Thanks to reports from our community of contributors, we have identified and resolved a variety of small bugs in this release. Notably, this update corrects systematic errors in the World Bank’s WDI and the IMF’s FPP data series.

Version 2025_08

Technical Documentation Updates We have improved the technical documentation to provide a better user experience. This includes enhancing the clarity of both data source descriptions and our methodological explanations.

Long-Term Interest Rate Updates We updated the long-term interest rate data using the latest available information. These updates also improved the overall data quality and consistency for interest rate variables.

Version 2025_06

The data was updated as of June 2025. In this release, we patched issues in inflation data caused by breaks in CPI series and revised the priority list accordingly. We added six new sources: [Reinhart and Rogoff \(2010\)](#), [International Institute of Social History \(2024\)](#), [United Nations Statistics Division \(2025\)](#), [Fortin-Gagnon et al. \(2022\)](#), [Cha et al. \(2022\)](#), and [National Bank of Belgium \(2024\)](#). Furthermore, we updated the source priority order for nGDP, cons, inv, finv, imports, and exports.

Methodologically, government finance variables (`govdebt`, `govdef`, `govexp`, `govrev`, `govtax`) are now derived from GDP ratios, after which the estimated levels series are chain-linked with other series. Finally, we improved the data cleaning pipeline to resolve minor source inconsistencies and fixed specific issues with the government deficit and current account balance data.

Version 2025_03

Data was updated as of March 2025, and we introduced official support for Python, R, and Stata packages. Beyond a general update across all indicators, we extended historical coverage using data from [Ferrerres et al. \(2005\)](#), [Stuart \(2018\)](#), and [Taiwan Statistical Office \(2025\)](#). We also refined the treatment of the IMF WEO within our source hierarchy and fixed inconsistencies in several long-run series, such as Australian GDP.

Version 2025_01 - *Initial Release*

First release with date up-to-date as of January 2025. The coverage spans 46 variables, 243 countries, and annual data spanning from the 1800s to 2030 (including forecasts). The GMD integrates data from 32 major contemporary sources and 78 historical datasets, providing a unified structure for macroeconomic indicators across countries and time.

5 Acknowledgments

The development of the Global Macro Database would not have been possible without the generous funding provided by the Singapore Ministry of Education (MOE) through the PYP grants (WBS A-0003319-01-00 and A-0003319-02-00), a Tier 1 grant (A-8001749-00-00), and the NUS Risk Management Institute (A-8002360-00-00). This financial support laid the foundation for the initial completion of this extensive project.

We would also like to thank the many people who have supported this project. For helpful feedback on data issues, we would like to thank Andrea Presbitero, Matteo Iacoviello, Xander Uyttenbroek, Flint O’Neil, Luis Libonatti, Jeroen Bouma, and Tom Hamburger. Shixuan Yuan provided excellent research assistance.

6 Accessing the Data

The Global Macro Database (GMD) is available through multiple access methods:

6.1 Web Download

Visit www.globalmacrodata.com/data to download the dataset in CSV, Excel, or Stata format.

6.2 Stata Package

Install the official SSC package and retrieve data using the `gmd` command:

```
ssc install gmd, replace
gmd
gmd rGDP, country(FRA)
```

To download the package from github:

```
net install gmd, from("https://raw.githubusercontent.com/KMueller-Lab/Global-Macro-Database-Stata/main/stata") replace
```

Please make sure you use the most recently updated version. Type `help gmd` in Stata for full documentation. We provide more details on the extensive functionalities of the package in a dedicated companion paper (Lehbib and Müller, 2025).

One useful feature of the `gmd` function is that it also allows you to easily download and compare the raw data underlying the harmonized GMD estimates, and also includes the option to generate BibTeX citations for the GMD and all of its underlying sources.

6.3 Python Package

Install the package via pip and use `gmd()` to access the data with filtering options:

```
pip install global_macro_data
from global_macro_data import gmd

df = gmd()
df = gmd(version="2025_01", country=["USA", "CHN"], variables=["rGDP", "CPI"])
```

6.4 R Package

Install the R package from GitHub and access the data in the following manner:

```
install.packages("devtools")
devtools::install_github("KMueller-Lab/Global-Macro-Database-R")

library(globalmacrodata)
df <- gmd(version = "2025_01", country = c("USA", "CHN"), variables = c("rGDP", "
  CPI"))
```

For full setup instructions and usage examples, see www.globalmacrodata.com/data.

7 Variables

Table 1 shows the key variables included in the Global Macro Database (GMD). The table provides detailed information on each variable, including the variable name, the abbreviation used in the database, units of measurement, temporal coverage, forecast horizons, and country coverage. The variables are grouped into six categories: national accounts, consumption and investments, external sectors, government finances, money and interest rates, and prices and labor market. For detailed definitions and descriptions of each variable, please refer to Section 10.

Table 1: Variable Overview

Variable	Abbreviation	Derivations	Range	Forecasts	Countries
A. National accounts					

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Variable	Abbreviation	Derivations	Range	Forecasts	Countries
Nominal GDP	nGDP	USD	1086-2029	4	230
Real GDP	rGDP	USD, pc	1270-2029	4	227
Real GDP in USD	rGDP_USD	pc	1791-2025	—	218
GDP deflator	deflator		1270-2029	4	227
Final consumption	cons	USD, GDP	1800-2027	2	220
Gross capital formation	inv	USD, GDP	1830-2029	4	219
Gross fixed capital formation	finv	USD, GDP	1800-2027	2	217
B. External sectors					
Current account , % GDP	CA_GDP	LC, USD	1772-2029	4	207
Exports	exports	USD, GDP	1280-2029	4	226
Imports	imports	USD, GDP	1560-2029	4	226
Real effective exchange rate	REER		1870-2026	1	180
USD exchange rate	USDfx		1791-2029	4	236
C. Consolidated government finances					
Gov. debt , % GDP	govdebt_GDP	LC	1670-2025	—	185
Gov. deficit , % GDP	govdef_GDP	LC	1689-2029	4	198
Gov. expenditure , % GDP	govexp_GDP	LC	1689-2024	—	173
Gov. revenue , % GDP	govrev_GDP	LC	1689-2024	—	170
Gov. tax revenue , % GDP	govtax_GDP	LC	1789-2024	—	147
D. General government finances					
Gov. debt , % GDP	gen_govdebt_GDP	LC	1800-2029	4	195
Gov. deficit , % GDP	gen_govdef_GDP	LC	1800-2029	4	197
Gov. expenditure , % GDP	gen_govexp_GDP	LC	1800-2029	4	198
Gov. revenue , % GDP	gen_govrev_GDP	LC	1800-2029	4	197
Gov. tax revenue , % GDP	gen_govtax_GDP	LC	1850-2027	2	148
E. Central government finances					
Gov. debt , % GDP	cgovdebt_GDP	LC	1670-2025	—	185
Gov. deficit , % GDP	cgovdef_GDP	LC	1689-2024	—	167
Gov. expenditure , % GDP	cgovexp_GDP	LC	1689-2024	—	173
Gov. revenue , % GDP	cgovrev_GDP	LC	1689-2024	—	170

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Variable	Abbreviation	Derivations	Range	Forecasts	Countries
Gov. tax revenue , % GDP	cgovtax_GDP	LC	1789-2024	—	147
F. Money and interests					
M0	M0		1619-2025	—	174
M1	M1		1841-2025	—	165
M2	M2		1841-2025	—	154
M3	M3		1819-2025	—	164
M4	M4		1870-2020	—	4
Central bank policy rate	cbrate		1694-2026	1	167
Short-term interest rate	strate		1695-2026	1	136
Long-term interest rate	ltrate		1727-2026	1	83
G. Prices, labor market, and population					
Consumer price index	CPI		1209-2029	4	216
House price index	HPI		1819-2025	—	58
Inflation	infl		1210-2029	4	218
Unemployment rate	unemp		1760-2029	4	220
Population	pop		1277-2030	5	235
H. Financial crisis dummy					
Banking crisis	BankingCrisis		1800-2020	—	163
Sovereign debt crisis	SovDebtCrisis		1800-2020	—	160
Currency crisis	CurrencyCrisis		1800-2019	—	160

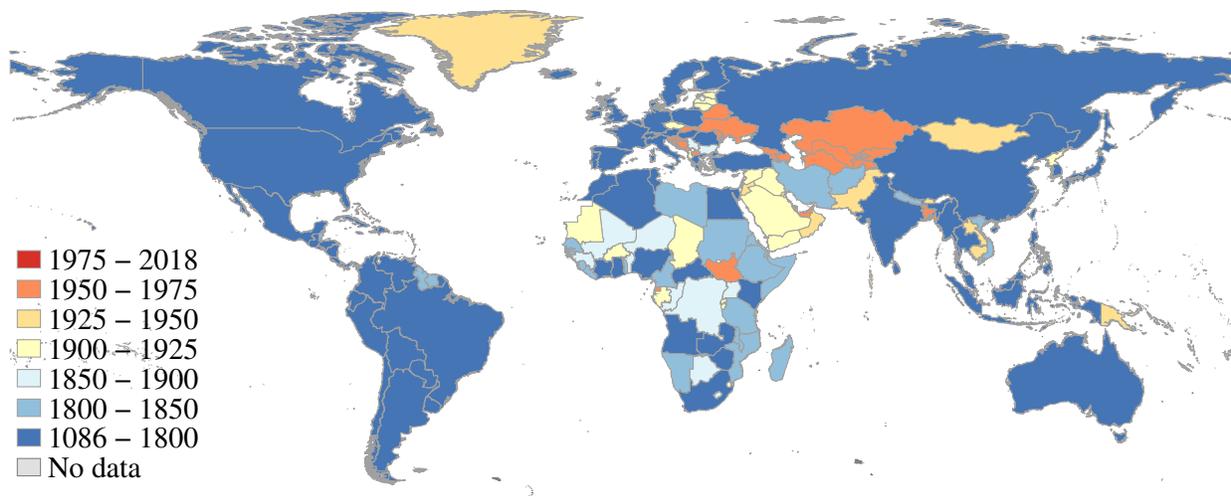
Note: This table presents the variables included in the Global Macro Database (GMD), along with their abbreviations/variable names, available derivations, temporal coverage, forecast horizons, and country coverage. Except for variables explicitly in USD, all variables in levels are recorded in millions of local currency units. Indices (CPI, HPI) are recorded such that 2015 = 100. Interest rates, inflation, and unemployment are recorded in percent (e.g., 5 means 5%). Derivations refer to other versions of the variables available in the data, where “LC” stands for local currency (instead of % of GDP), “USD” for US dollars, and “GDP” for fraction of GDP.

7.1 Data collection

The GMD is based on two broad categories of sources:

1. *Modern sources*: Datasets from major international organizations (e.g., Eurostat, OECD) that are continuously updated. The GMD retrieves these via an automated code pipeline and APIs to ensure continuous updates.
2. *Historical sources*: Academic work or datasets from national authorities (e.g., [Mitchell \(2013\)](#) or [Inklaar et al. \(2018a\)](#)) that are updated infrequently or cannot be accessed through our automated pipeline. Integrating these sources often requires manual digitization and extensive harmonization of data from archival records.

Figure 1: First Year in Dataset, By Country

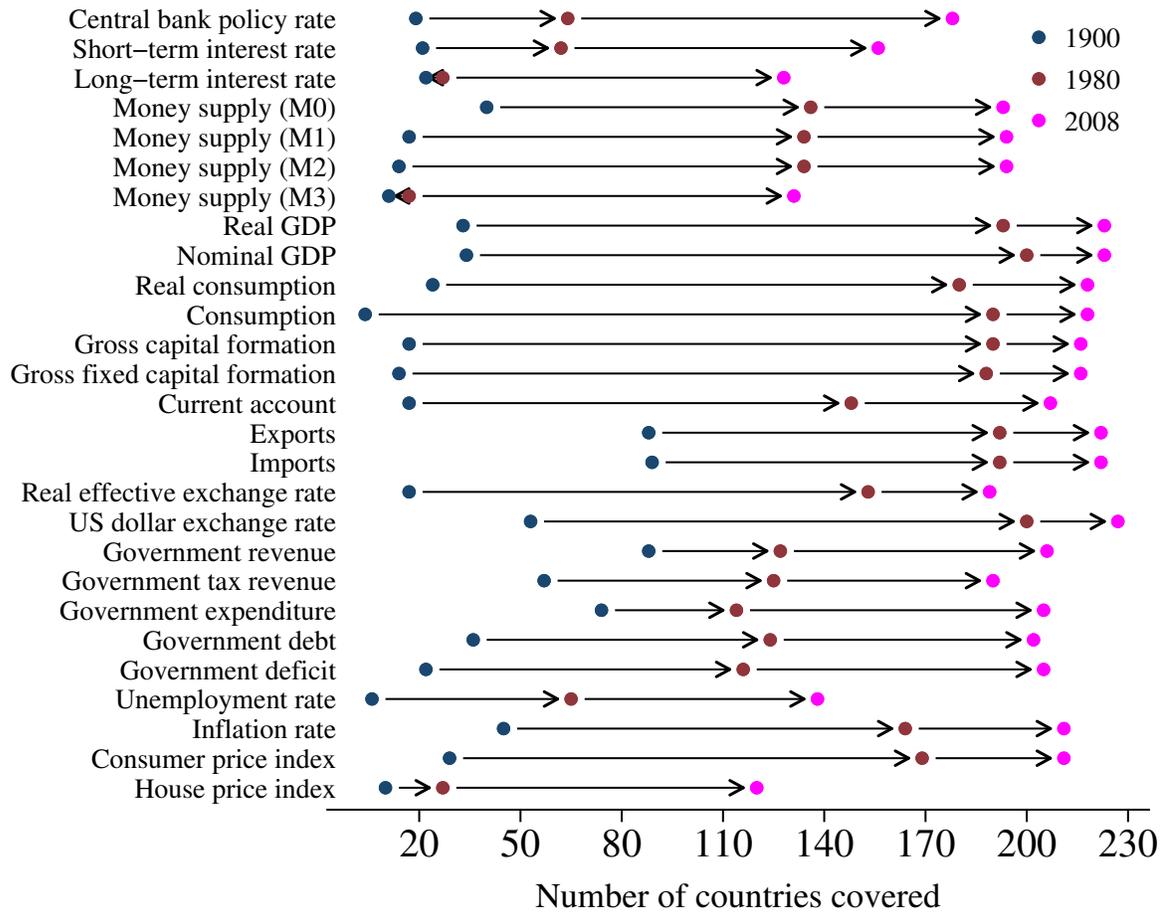


Note: This figure visualizes, for each country, the first year for which we have data on any macroeconomic variable other than population in the Global Macro Database (GMD). The map demonstrates that for the vast majority of countries, we have time series before 1950, with many series extending back to the 1800s for both advanced and developing economies. For some countries, such as the United Kingdom, data coverage begins as early as 1086.

8 Data Coverage

The Global Macro Database comprises a collection of 74 macroeconomic variables, spanning 240 countries and territories. The majority of countries have time series data extending to pre-1950 periods, with many reaching back to the early 20th century or even the 19th century, including several developing nations. Figure 1 presents a world map indicating the earliest year for which any macroeconomic statistic is available for each country (excluding population data).

Figure 2: Number of Countries Covered, By Variable

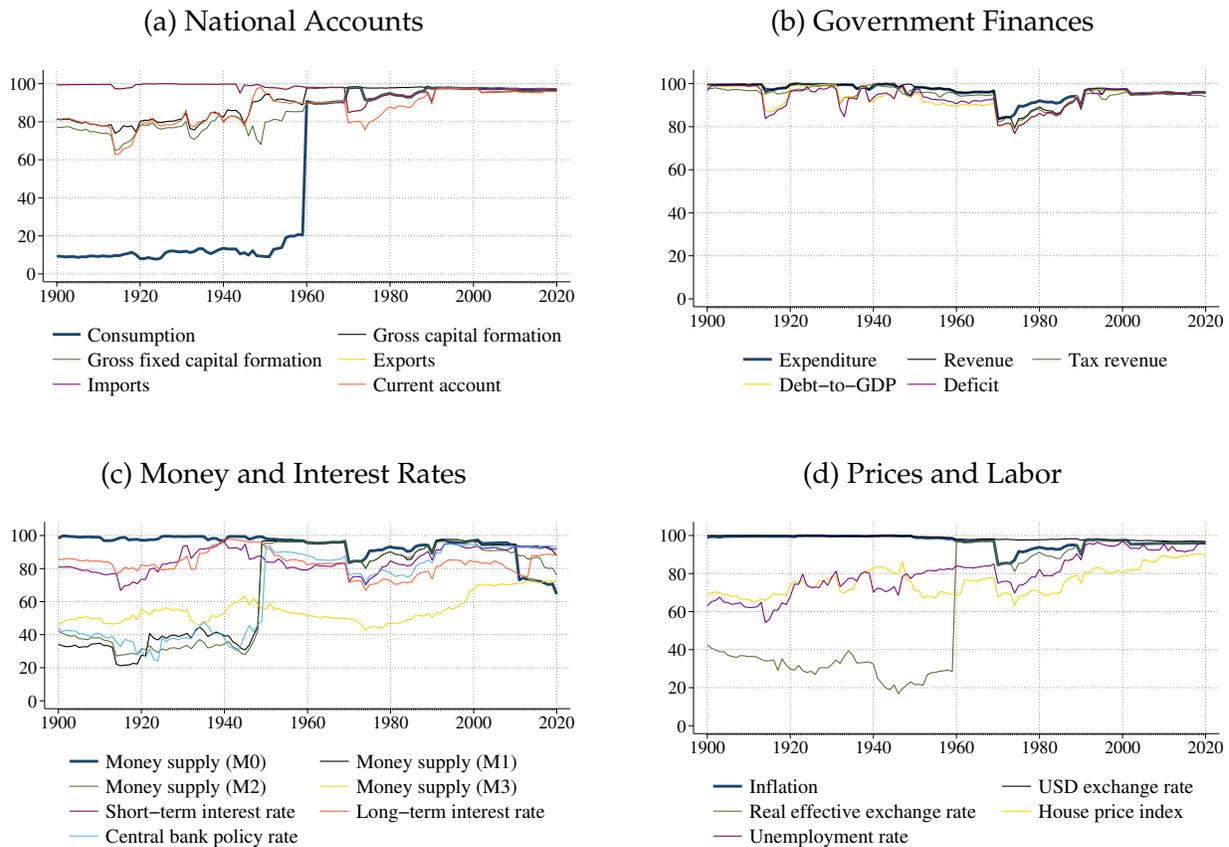


Note: This figure plots the number of countries with available data for all macroeconomic variables contained in the Global Macro Database (GMD) at three points in time: 1900, 1980, and 2008. Each line represents a variable, with dots indicating the coverage at these three dates. The graph reveals substantial variation in coverage across variables and time.

8.1 Dataset overview

Figure 2 illustrates the number of countries covered by the Global Macro Database (GMD) for each variable in the years 1900, 1980, and 2008. A significant proportion of the variables have coverage for over 20 countries since 1900, over 100 countries since 1980, and nearly 200 countries since 2008, reflecting the increasing scope and comprehensiveness of the database over time. Figure 3 depicts the share of GDP for which data is available on key variables in the GMD.

Figure 3: Share of GDP Covered Over Time, By Variable



Note: This figure plots the share of GDP covered by each variable in the Global Macro Database (GMD) between 1900 and 2020.

8.2 Comparison with other sources

By design, the coverage of our dataset surpasses that of all existing publicly available sources we are aware of, as these sources have been integrated into the Global Macro Database (GMD). Table 2 compares the coverage of key variables in the GMD with those offered by other widely-used data providers. Table 3 presents the number of country-year observations included in the GMD and the fraction covered by the major providers in percentage. Figure 4 compares the coverage of the Global Macro Database (GMD) with that of the next best source for each key variable.

In addition to publicly available sources, Table 2 also includes a comparison with the dataset provided by the commercial data provider Global Financial Data (GFD). Beyond surpassing the coverage of many commercial products, the Global Macro Database (GMD) offers more comprehensive and transparent documentation, supported by an open-source

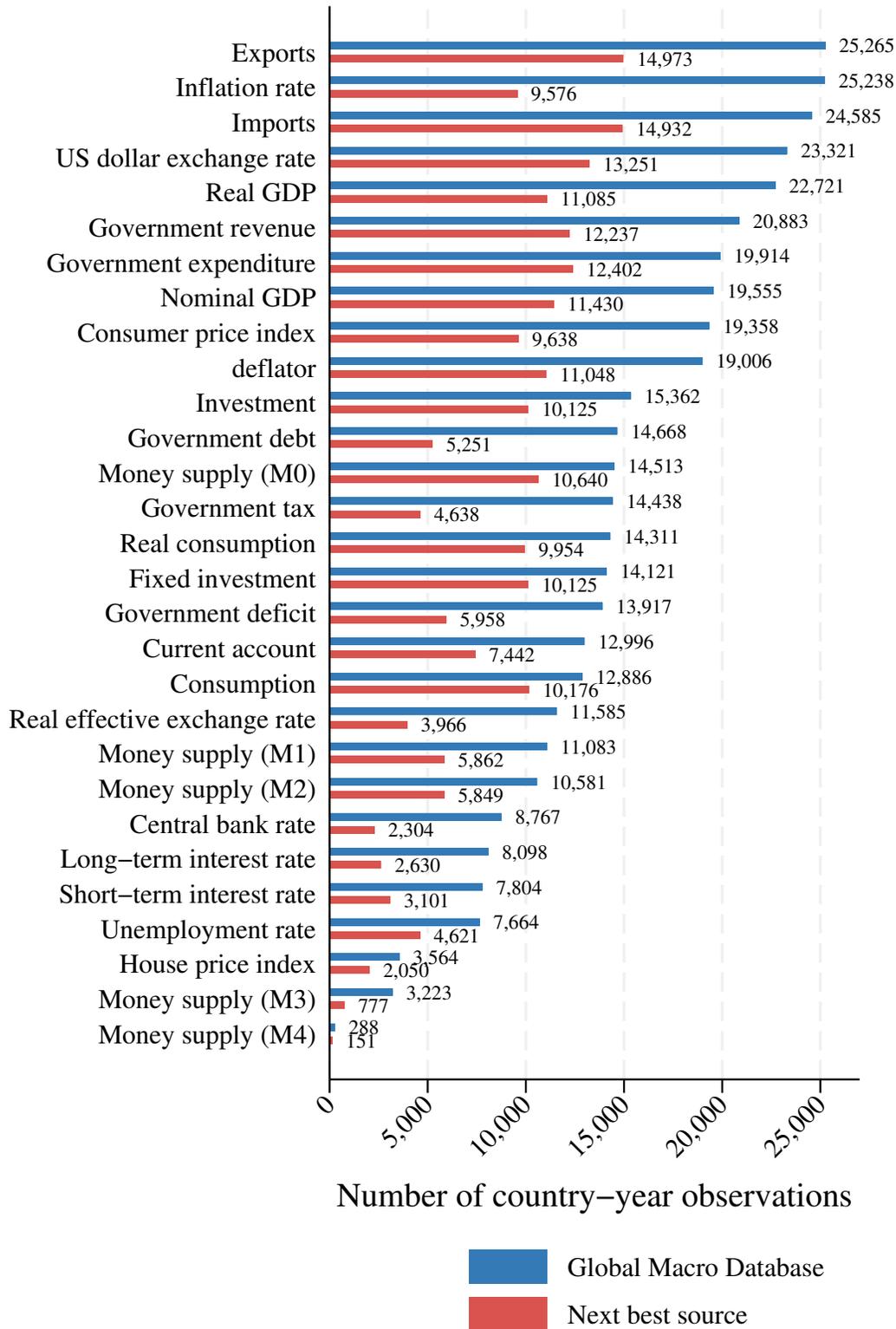
code base. For further details, please refer to our [GitHub repository](#).

Table 2: Comparing the Coverage of Key Macroeconomic Variables

Source	Start Year		Latest		Countries		Variables
	First	Median	Actual	Forecast	Number	Year-Obs.	
GMD	1086	1800	2024	2030	243	57,559	46
GFD	1000	1820	2024	—	236	39,345	37
IFS	1920	1950	2024	—	219	14,234	25
WEO	1960	1970	2024	2029	208	11,149	23
JST	1870	1870	2020	—	18	2,666	29
MAD	1253	1876	2022	—	169	20,590	3
OECD EO	1960	1960	2024	2025	49	2,726	36
PWT	1950	1960	2019	—	183	10,399	3
UN	1900	1970	2020	—	215	11,179	15
WDI	1960	1960	2024	—	222	13,820	37

Note: This table compares the coverage of the key macroeconomic variables included in our dataset across a selected sample of widely-used data providers. See Table 1 for the list of variables, which also includes derived measures such as GDP-scaled variables. The number of variables refers to the subset of macroeconomic indicators we cover that are available in a given source, not the total number of variables available. The acronyms in the source column refer to the following datasets: GFD = Global Financial Data, IFS = IMF International Financial Statistics, WEO = IMF World Economic Outlook, JST = Jordà-Schularick-Taylor Macro History Database, MAD = Maddison Historical Statistics, OECD EO = OECD Economic Outlook, PWT = Penn World Table, UN = United Nations Statistics, WDI = World Bank World Development Indicators. “Year-Obs.” under the “Countries” header refers to the total number of country-year observations with non-missing information on any of the variables. Note that, for the Maddison dataset, we keep only continuous observations which started in 1253.

Figure 4: Comparing Dataset Coverage by Variable



Note: This figure compares, for each variable, the coverage of the Global Macro Database (GMD) with that of the next most comprehensive source. Blue bars show the number of country-year observations in the Global Macro Database, and the red bars shows the number of country-year observations for the next best source.

Table 3: Coverage of GMD Variables in Selected Sources

Variable	GMD	Fraction of observations in the GMD covered in... (in %)							
		IFS*	WEO	OECD	EO	WDI†	UN	JST	Mitchell
Central bank policy rate	8,767	26	—	21	—	—	—	—	73
Short-term interest rate	7,804	40	—	27	—	—	32	—	53
Long-term interest rate	8,098	26	—	22	—	—	32	—	96
Money supply (M0)	14,513	47	—	—	—	—	3	73	93
Money supply (M1)	11,083	61	—	11	—	—	18	53	41
Money supply (M2)	10,581	64	—	—	—	—	14	55	—
Money supply (M3)	3,223	—	—	31	—	—	24	—	—
Money supply (M4)	288	—	—	—	—	—	52	—	—
Real GDP	22,721	23	33	10	49	44	12	29	87
Nominal GDP	19,555	30	38	12	58	52	14	39	83
Consumption	12,886	25	—	18	66	79	—	—	—
Real consumption	14,311	26	—	—	50	70	—	—	—
Gross capital formation	15,362	28	42	15	55	66	16	35	28
Gross fixed capital formation	14,121	32	—	16	56	72	—	31	28
Current account	12,996	35	55	16	57	—	19	—	21
Exports	25,265	19	34	9	35	40	10	59	73
Imports	24,585	19	35	9	36	41	11	61	75
Real effective exchange rate	11,585	34	—	8	34	—	—	—	38
US dollar exchange rate	23,321	57	32	11	52	—	11	—	97
Government revenue	20,883	19	28	6	22	—	12	59	70
Government tax revenue	14,438	28	—	7	32	—	—	31	1
Government expenditure	19,914	19	30	6	22	—	13	62	70
Government debt	14,668	80	36	10	13	—	17	—	13
Government deficit	13,917	27	43	9	—	—	—	40	92
Unemployment rate	7,664	60	51	26	38	—	25	—	66
Inflation rate	25,238	38	29	2	35	—	10	32	96
Consumer price index	19,358	50	39	3	47	—	14	43	96
House price index	3,564	—	—	—	—	—	58	—	31
Population	51,938	29	14	4	27	32	5	—	53

Notes: This table shows the number of country-year observations in the Global Macro Database (GMD) and the fraction covered in major providers of macroeconomic data (in percent). Our dataset begins in the year 1086.

* IFS includes data from the [IMF GFS](#) datasets.

† Unemployment data from the World Bank is added from International Labour Organization (ILO).

‡ The GFD coverage is based on the subset of data currently available to us and may not represent the entirety of the GFD dataset.

9 Sources and Data Access

9.1 Types of data sources

Our dataset combines information from 111 distinct sources that can be categorized along two primary dimensions. The first dimension is update frequency. Current sources (27) are continuously updated with regular release calendars, primarily from major international organizations and statistical agencies. Historical sources (84) are either never or infrequently updated without a regular schedule.

The second dimension is coverage. The 67 aggregators we include provide data for multiple countries (e.g., IMF, World Bank). The 44 country-specific sources focus on individual countries, and are national statistical offices or academic research.

Table 5 provides a comprehensive overview of all sources currently incorporated in the Global Macro Database (GMD), along with detailed information about each source. This includes the source reference, the abbreviation used in the GMD, the latest update date, an indication of whether the source is newly digitized, temporal coverage, variable coverage, country coverage, and whether it is classified as a historical source (i.e., a dataset that is not updated or is only infrequently updated).

Table 4: Types of Sources in the Global Macro Database

	Current	Historical	Total
Aggregators	18	49	67
<i>Examples</i>	<i>WEO</i>	<i>JST</i>	
Country-specific	9	35	44
<i>Examples</i>	<i>FRED</i>	<i>Thomas et al. (2010)</i>	
Total	27	84	111

Note: This table plots information on the number of sources used in the Global Macro Database. We differentiate sources along two dimensions: (1) whether they are continuously updated (*current*) or contain only historical data (*historical*), and (2) whether they report information on several countries (*aggregators*) or only a single country (*country-specific*). Note that we count as historical sources that have been updated on an ad-hoc basis but do not have a clear release calendar, such as the Jordá et al. (2017) Macro History Database.

Table 5: Dataset Overview

Source	Abbreviation	Updated	Digitized	From	To	Forecasts	Variables	Countries	Historical
Panel A: Aggregator Sources									
Asian Development Bank (2024)	ADB		No	2000	2023	—	30	49	Yes
African Development Bank (2018)	AFDB	2025-12-31	No	1980	2020	—	14	53	No
African Union (2024)	AFRISTAT		No	1990	2023	—	11	22	Yes
IEC, Hitotsubashi University (2020)	AHSTAT		No	1868	2013	—	28	5	Yes
European Commission (2024)	AMECO	2025-12-31	No	1960	2027	3	26	27	No
Arab Monetary Fund (2024)	AMF		No	1971	2021	—	22	22	Yes
Barro and Ursúa (2008)	BARRO		No	1790	2009	—	2	42	Yes
BCEAO (2024)	BCEAO	2025-12-31	No	1960	2024	—	29	8	No
Broadberry and Gardner (2022)	BG		No	1885	2008	—	2	8	Yes
BIS (2025c)	BIS CPI	2025-12-31	No	1661	2024	—	2	62	No
BIS (2025e)	BIS HPI		No	1947	2025	1	1	57	No
BIS (2025d)	BIS REER	2025-12-31	No	1994	2025	1	1	63	No
BIS (2025a)	BIS USDfx		No	1791	2024	—	1	189	No
BIS (2025b)	BIS cbrate		No	1945	2025	1	1	48	No
Banca d'Italia (2024)	BIT		No	1955	2024	—	1	9	Yes
Bordo et al. (2001)	BORDO		No	1880	1997	—	10	56	Yes
Darvas (2021)	BRUEGEL		No	1960	2023	—	1	178	Yes
Baron et al. (2020)	BVX		No	1870	2016	—	7	48	Yes

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Source	Abbreviation	Updated	Digitized	From	To	Forecasts	Variables	Countries	Historical
International Institute of Social History (2024)	CLIO		No	1500	2011	—	2	175	Yes
Mack and Martínez-García (2011)	DallasFED		No	1975	2023	—	2	26	Yes
University of California – Davis (2024b)	Davis		No	1818	2012	—	1	55	Yes
United Nations (2024a)	ECLAC		No	1950	2023	—	26	34	Yes
Eurostat (2025)	EUS	2025-12-31	No	1949	2024	—	39	43	No
FAO (2024)	FAO		No	1970	2023	—	5	214	Yes
University of California – Davis (2024a)	FLORA		No	1790	1975	—	6	12	Yes
Banque de France (2024b)	FRANC ZONE		No	1991	2019	—	7	15	Yes
Flandreau and Zumer (2004)	FZ		No	1880	1913	—	14	16	Yes
Smits et al. (2009)	GNA		No	1800	2005	—	3	17	Yes
Gapminder (2024)	Gapminder		No	1800	2030	6	1	197	Yes
Grimm (2024)	Grimm		No	1945	2023	—	1	166	Yes
Schuler (2015)	HFS		No	1800	2008	—	30	64	Yes
Homer and Sylla (1996)	Homer Sylla		No	1798	1989	—	3	26	Yes
Ellison et al. (2024)	IHD		No	1925	1936	—	7	39	Yes
International Labour Organization (2024)	ILO		No	2000	2023	—	1	215	Yes
Mauro et al. (2015)	IMF FPP		No	1800	2023	—	5	151	Yes
Mbaye et al. (2018)	IMF GDD		No	1950	2018	—	5	185	Yes
International Monetary Fund (2024)	IMF GFS	2025-12-31	No	1972	2024	—	16	140	No
International Monetary Fund (2010)	IMF HDD		No	1800	2015	—	1	188	Yes

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Source	Abbreviation	Updated	Digitized	From	To	Forecasts	Variables	Countries	Historical
International Monetary Fund (2025a)	IFS	2025-12-31	No	1914	2025	1	27	223	No
International Monetary Fund (2025b)	WEO	2025-12-31	No	1960	2029	5	52	208	No
Albers et al. (2023)	JERVEN		No	1890	2015	—	4	50	Yes
Jones and Obstfeld. (1997)	JO		No	1850	1945	—	7	13	Yes
Jordá et al. (2017)	JST		No	1870	2020	—	30	18	Yes
Ljungberg (2019)	LUND		No	1870	2016	—	1	27	Yes
Laeven and Valencia (2013)	LV		No	1970	2017	—	4	155	Yes
Cox and Dincecco (2021)	MD		No	1703	1913	—	6	2	Yes
Officer and Williamson (2024)	MW		No	1209	2024	—	10	41	Yes
Inklaar et al. (2018b)	Maddison		No	1253	2022	—	3	169	Yes
Mitchell (2013)	Mitchell		Yes	1750	2010	—	26	142	Yes
Bértola and Rey (2018)	Moxlad		No	1870	2010	—	7	20	Yes
National Bank of Serbia (2024)	NBS		No	1833	1950	—	27	8	Yes
OECD (2024a)	OECD EO	2025-12-31	No	1960	2026	2	42	49	No
OECD (2024b)	OECD HPI	2025-12-31	No	1960	2024	—	1	47	No
OECD (2024c)	OECD KEI	2025-12-31	No	1914	2024	—	6	47	No
OECD (2024d)	OECD MEI	2025-12-31	No	1951	2024	—	2	37	No
OECD (1986)	OECD MEI ARC		Yes	1955	1984	—	3	18	Yes
Feenstra et al. (2015)	PWT		No	1950	2023	—	3	185	Yes
Reinhart and Rogoff (2009)	RR		No	1719	2016	—	7	72	Yes

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Source	Abbreviation	Updated	Digitized	From	To	Forecasts	Variables	Countries	Historical
Albers (2018)	TH ID		No	1925	1936	—	2	27	Yes
Federico and Tena-Junguito (2019)	Tena		No	1800	1938	—	6	150	Yes
United Nations (2024b)	UN		No	1900	2023	—	15	215	No
United Nations Statistics Division (2025)	UN Trade		Yes	1900	1960	—	2	22	Yes
Ha et al. (2023)	WB infl		No	1970	2023	—	3	205	Yes
World Bank (2024)	WDI	2025-12-31	No	1960	2024	—	38	222	No
World Bank (1999)	WDI ARC		No	1960	1997	—	39	208	Yes
Panel B: Country Specific Sources									
Nakamura and Zarazaga (2001)	ARG 1		Yes	1901	1935	—	1	1	Yes
Ministerio de Economia (2024)	ARG 2		No	1940	2023	—	6	1	Yes
Ferreres et al. (2005)	ARG 3		No	1810	2018	—	12	1	Yes
Hutchinson and Ploeckl (2024)	AUS 1		No	1789	2020	—	6	1	Yes
Vamplew (1987)	AUS 2		Yes	1788	1917	—	13	1	Yes
Schulze (2000)	AUT 1		No	1870	1913	—	2	1	Yes
IPEA (2024)	BRA 1		No	1872	2023	—	3	1	Yes
Statistics Canada (2024)	CAN 1		No	1867	1977	—	24	1	Yes
Fortin-Gagnon et al. (2022)	CAN 2		No	1914	2025	1	15	1	Yes
Swiss National Bank (2009)	CHE 1		No	1907	2005	—	5	1	Yes
Historical Statistics of Switzerland (2012)	CHE 2		No	1851	1992	—	7	1	Yes

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Source	Abbreviation	Updated	Digitized	From	To	Forecasts	Variables	Countries	Historical
National Bureau of Statistics of China (2024)	CHN 1		No	1949	2023	—	22	1	Yes
Abildgren (2017)	DNK 1		No	1487	2023	—	17	1	Yes
Bank of Algeria (2023)	DZA 1		No	1974	2023	—	3	1	Yes
Instituto Nacional de Estadística (2024)	ESP 1	2025-12-31	No	1995	2023	—	11	1	No
Banco de España (2024)	ESP 2		No	1277	2014	—	16	1	Yes
Banque de France (2024a)	FRA 1	2025-12-31	No	1970	2025	1	3	1	No
Levy-Garboua and Monnet (2016)	FRA 2		No	1800	2015	—	3	1	Yes
Ngakegni (1991)	FRA 3		Yes	1876	1990	—	7	1	Yes
Thomas et al. (2010)	GBR 1		No	1086	2016	—	17	1	Yes
Bank Indonesia (2023)	IDN 1	2025-12-31	No	2008	2018	—	16	1	No
Stuart (2018)	IRL 1		No	1933	2014	—	6	1	Yes
Jónsson et al. (1997)	ISL 1		Yes	1870	2016	—	3	1	Yes
Statistics Iceland (1997)	ISL 2		No	1625	1990	—	30	1	Yes
Baffigi (2013)	ITA 1		No	1861	2011	—	9	1	Yes
Piselli and Vercelli (2023)	ITA 2		No	1861	2016	—	14	1	Yes
Istituto Nazionale di Statistica (2024)	ITA 3	2025-12-31	No	1995	2023	—	13	1	No
Bank of Japan (2024)	JPN 1		No	1882	2017	—	7	1	Yes
IER, Hitotsubashi University (2019)	KOR 1		No	1911	2016	—	4	1	Yes
Cha et al. (2022)	KOR 2		No	1877	2015	—	21	1	Yes
Gardner (2022)	LBR 1		No	1845	1979	—	9	1	Yes

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Source	Abbreviation	Updated	Digitized	From	To	Forecasts	Variables	Countries	Historical
Bank Al-Maghrib (2024)	MAR 1		No	1985	2024	—	4	1	Yes
Grytten (2022)	NOR 1		No	1816	2019	—	3	1	Yes
Eitrheim et al. (2023)	NOR 2		No	1516	2022	—	17	1	Yes
Statistics Poland (2024)	POL 1	2025-12-31	No	1989	2020	—	18	1	No
Instituto Nacional de Estadística (2001)	PRT 1		Yes	1549	1998	—	15	1	Yes
Saudi Central Bank (2024)	SAU 1	2025-12-31	No	1973	2020	—	9	1	No
Schön and Krantz (2017)	SWE 1		No	1290	2020	—	22	1	Yes
Central Bank of Türkiye (2024)	TUR 1	2025-12-31	No	1994	2024	—	1	1	No
National Statistics, Taiwan (2024)	TWN 1		No	1951	2021	—	4	1	Yes
Taiwan Statistical Office (2025)	TWN 2		No	1951	2025	1	14	1	Yes
Federal Reserve Bank of St. Louis (2024)	FRED	2025-12-31	No	1929	2025	1	26	1	No
Carter et al. (2006)	USA 2		No	1774	2003	—	19	1	Yes
South African Reserve Bank (2024)	ZAF 1	2025-12-31	No	1959	2020	—	22	1	No

Note: This table lists all datasets currently incorporated in the Global Macro Database (GMD). “Updated” refers to the last time a particular set was updated, it’s blank when if the dataset is downloaded-once. “Digitized” tags whether a dataset was newly digitized (i.e., copied from scans or PDF into digital format). “From” and “To” refers to the years covered. “Forecasts” is the number of forecasts into the future. “Variables” refers to the number of variables. “Countries” is the number of countries covered by a dataset. “Historical” means a dataset is not or only infrequently updated.

9.2 How we update the data

Automated downloads For current sources, we use an automated data collection process through APIs and structured web queries. Our data downloading and processing pipeline has the following key functions:

- Automatic downloading and processing of new data as it becomes available
- Data validation and harmonization
- Integration of new information into the existing dataset

Manual collection Historical sources require careful manual processing. This involves the one-time collection of historical datasets, digitization of printed materials where necessary, standardization of formats and units, and integration with the automated updating system for current data. This process ensures that the historical data maintains the same quality standards as our automated collections.

9.3 Data storage and version control

Raw data storage A critical feature for combining many dozens of historical sources with up-to-date recent data is the maintenance of a comprehensive archive of previous versions. For every source file, we always maintain the original data files in their native formats (csv, Excel, Stata, etc.) at the time they were downloaded. We also maintain any additional source documentation or meta data, as available. If the data is newly digitized or comes from an unusual source, we store the PDF files and archive the relevant web pages. In all cases, we always record the time stamp when a dataset was downloaded and the source URLs.

Version control Our version control system tracks data vintages from each source. We store newly-downloaded incremental updates and always record whether data values are genuinely new information or represent revisions (i.e., updates of data points that were already previously available). As such, we maintain complete historical records of all data points, and document all modifications and harmonization steps. This systematic approach ensures full traceability of every transformation made to the original data.

9.4 Data update process

Update monitoring and integration Our update process begins with a continuous monitoring of current sources for new releases, supported by an automated notification system

for new data availability and regular checks of historical sources for potential updates. The integration phase involves automated comparison with existing data, identification of revised values, integration of new data points, and maintenance of vintage data.

Quality control Each update undergoes a rigorous quality control process consistent with the initial release of the Global Macro Database. Among others, we always run (a) a set of automated data validity checks, (b) unit and format verification checks, (c) consistency checks relative to previous versions, and (d) manually review all significant changes. This process is designed to make the resulting dataset as error-free as possible.

In addition to these initial checks, we always manually check the time series plot for each country and variable for potential issues.

10 Variable Definitions

10.1 Statistical framework

Wherever possible, our variable definitions follow the System of National Accounts 2008 (SNA 2008), the international statistical standard for national accounts adopted by the United Nations Statistical Commission. The SNA 2008 provides a comprehensive, consistent, and flexible framework for collecting and reporting macroeconomic statistics.

The SNA framework is a reasonable starting point for our dataset because it provides internationally agreed-upon concepts, definitions, and classifications, ensures consistency and comparability across countries and time periods as much as possible, and offers standardized methodologies for data compilation.

For variables that are not reported as part of national accounts statistics, we try to adopt a consensus approach by surveying the meta data and best practices in existing work.

10.2 Nominal gross domestic product

Nominal Gross Domestic Product (GDP) measures the total market value of all final goods and services produced within a country's borders in a specific time period, typically a year. It reflects the economic output valued at the prices of that same year, often referred to as "current prices."

The international standard, the System of National Accounts (SNA), outlines three distinct approaches for calculating GDP. In theory, all three methods should result in the same values, but there are various reasons why they may differ in practice.

- **Production Approach:** Calculates GDP as the sum of gross value added by all resident producer units, plus any taxes and less any subsidies on products (United Nations, 2009, Chapter 16, Section C).
- **Income Approach:** Sums the incomes generated by production. This includes compensation of employees (wages and salaries), gross operating surplus of enterprises (profits), and taxes on production and imports less subsidies.
- **Expenditure Approach:** Computes GDP by summing all final expenditures. It is calculated as the sum of final consumption (C), gross capital formation (investment, I), government spending (G), and net exports (exports (X) minus imports (M)). The formula is:

$$nGDP = C + I + G + (X - M)$$

Our nGDP series is constructed from sources that may use any of these methods. It is possible to reconstruct nominal GDP based on the expenditure approach because the GMD provides series for its main components, namely household and government final consumption, gross capital formation, and net exports. That said, as discussed in Section 12.6, the GMD currently does not impose accounting identities to hold, which would lead to other complications. nGDP is measured in millions of local currency units at current market prices.

10.3 Real gross domestic product

Real GDP in Local Currency (rGDP) Real GDP measures a country's total economic output adjusted for the effects of price changes (i.e., inflation or deflation). It is valued using the prices of a fixed base year, thus providing a constant price" series that reflects changes in volume. In our dataset, rGDP is measured in millions of constant 2015 local currency units (LCU).

Real GDP in U.S. Dollars (rGDP_USD) There are various ways of calculating real GDP in U.S. dollars, all of which can make sense depending on what one is trying to measure. The GMD follows the methodology used by the World Bank, which ensures that the real growth rates of the local economy are preserved accurately.³

The calculation proceeds as follows:

³The methodology is detailed by the World Bank here: <https://datahelpdesk.worldbank.org/knowledgebase/articles/114943-how-do-you-derive-constant-price-series-in-usd>.

1. First, the nominal GDP for the base year (2015) is converted to U.S. dollars using the 2015 average market exchange rate ($E_{c,2015}$). This single value serves as the anchor for the entire series. The anchor value is calculated as:

$$\text{rGDP}_{\text{USD},c,2015} = \frac{\text{nGDP}_{c,2015}}{E_{c,2015}} \quad (1)$$

For the base year 2015, the values in current and constant prices are the same.

2. Second, the annual real growth rates ($g_{c,t}$) are calculated from the constant local currency series (rGDP):

$$g_{c,t} = \frac{\text{rGDP}_{c,t}}{\text{rGDP}_{c,t-1}} - 1 \quad (2)$$

3. Finally, these growth rates are applied forwards and backwards from the 2015 constant U.S. dollar value to generate the complete time series. The series is constructed recursively as follows:

$$\text{rGDP}_{\text{USD},c,t} = \begin{cases} \text{rGDP}_{\text{USD},c,t-1} \times (1 + g_{c,t}) & \text{if } t > 2015 \\ \frac{\text{rGDP}_{\text{USD},c,t+1}}{1 + g_{c,t+1}} & \text{if } t < 2015 \end{cases} \quad (3)$$

This method ensures that the resulting series reflects the true volume growth of the local economy, free from the distorting effects of both domestic inflation and exchange rate volatility.

GDP deflator (deflator) The GDP deflator is defined as a price index derived by dividing nominal GDP by real GDP (United Nations, 2009, Chapter 15, Section C). `deflator` measures the overall price level of all domestically produced final goods and services. The deflator is set to 100 in the base year (2015) and expressed as an index.

10.4 Consumption and investment

Final consumption (cons) Final consumption is the total expenditure on the consumption of goods and services (United Nations, 2009, Chapter 9, Section D). `cons` is measured in millions of local currency units. `cons_GDP` is in percent of nominal GDP, so that 100 means 100%.

Gross capital formation (inv) Gross capital formation is measured by the total value of the gross fixed capital formation, changes in inventories and acquisitions less disposals of

valuables. (United Nations, 2009, Chapter 10, Section B). *inv* is measured in millions of local currency units. *inv_GDP* is in percent of nominal GDP.

Gross fixed capital formation (*finv*) Gross fixed capital formation is measured by the total value of a producer's acquisitions, less disposals, of fixed assets during the accounting period plus certain specified expenditure on services that adds to the value of non-produced assets. (United Nations, 2009, Chapter 10, Section B). *finv* is measured in millions of local currency units. *finv_GDP* is in percent of nominal GDP.

10.5 External sector

Exports (*exports*) Exports are goods and services produced in one economy and sold to another economy, valued free on board (f.o.b.) at the border of the exporting country (United Nations, 2009, Chapter 15, Section B). *exports* is measured in millions of local currency units. *exports_GDP* is in percent of nominal GDP.

Imports (*imports*) Imports are goods and services purchased by residents from nonresidents, originally valued cost, insurance, and freight (c.i.f.) but converted to f.o.b. (United Nations, 2009, Chapter 15, Section B). *imports* is measured in millions of local currency units. *imports_GDP* is in percent of nominal GDP.

Current account balance (*CA*) The current account is defined as the sum of the balances on goods, services, primary income, and secondary income (United Nations, 2009, Chapter 16, Section B). It is considered a key indicator of an economy's saving-investment relationship with the rest of the world. *CA* is measured in millions of local currency units. *CA_GDP* is in percent of nominal GDP.

Real effective exchange rate (*REER*) The real effective exchange rate, or REER, is the trade-weighted average of bilateral exchange rates adjusted for relative price levels. REER is expressed as an index equal to 100 in the base year (2015) and thus measures (changes in) international competitiveness.

USD exchange rate (*USDfx*) The US dollar exchange rate is defined as the value of one U.S. dollar in terms of local currency units. Wherever possible we report end-of-period rates.

10.6 Government finance

Government finance statistics are among the most difficult to create harmonized time series for. Many sources are not consistent in only reporting *central* or *general* government data, where the latter also includes various types of local governments. This is true both across sources—some may only report central government debt—but also within the *same source*. For example, the data on government debt reported by a given source may for some countries cover general government debt, but in others only central government debt.

In fact, such inconsistencies even occur within a given source. A look at the appendix material of the widely-used “Public Finances in Modern History Database” produced by IMF staff (Mauro et al., 2015) is revealing. Even when looking at the same country over time, their series are sometimes based on data covering the general government, and sometimes on the central government alone. In Australia, for example, their reported government spending doubles from 11.2% to 22.3% of GDP in 1960, which likely results from using general rather than central government expenditures starting in 1960.

Partly because of the above, there is often considerably more disagreement about government statistics than other variables. It is thus not straightforward to combine data on government statistics from several sources. As an example, splicing either data on outstanding debt or on the ratio of debt to GDP will inevitably be based on contentious and often widely-differing data points. We are thus faced with a tough choice. If we chainlink these data, the resulting values can end up being entirely implausible. If we do not, this will introduce statistical breaks (and thus implausible year-on-year *changes* in a variable) when the differences in the underlying raw data are large.

To arrive at series that are as reliable as possible, we use the following procedure. First, we carefully combine data on general and central government statistics separately. In doing so, we attempt to select data that are as consistent as possible with each other in whether they cover only the central or general government. These have variable codes starting with the prefix *c* (e.g., *cgovdebt_GDP*) or *gen_* (e.g., *gen_govdebt_GDP*) for central and general government, respectively.

Second, equipped with these data, we further construct a combined measure of government debt, which combines these estimated general and central government series. Note that combining the statistics in this way is already standard practice in existing work (see e.g., Mauro et al., 2015). The resulting variables do *not* have a prefix (e.g., *govdebt_GDP*). It is in the nature of the exercise that these combined measures may have higher measurement error but, on the flipside, also larger coverage. Note that, for com-

bined variables, we also do not have “raw data” that could be accessed through, for example, the `gmd` Stata command.

For the remainder of the variable definitions, we will denote all the government finances to start with `*_` (e.g., `*_govdebt`) to highlight that the GMD contains three versions of each (central, general, and combined).

Government debt (`*_govdebt`) Government debt refers to the total liabilities of the government requiring future payments of interest and/or principal. It includes loans, debt securities, and other borrowings (United Nations, 2009, Chapter 22, Section D). `govdebt` is measured in millions of local currency units. `govdebt_GDP` is in percent of nominal GDP, so that 100 means 100%.

Government revenues (`*_govrev`) Government revenue is the increase in net worth of the government resulting from incoming transactions; it includes taxes, social contributions, grants, and other revenue (United Nations, 2009, Chapter 22, Section C). `govrev` is measured in millions of local currency units. `govrev_GDP` is in percent of nominal GDP.

Government tax revenue (`*_govtax`) Government tax revenues are compulsory transfers to government units, including taxes on income, profits, goods and services, and international trade (United Nations, 2009, Chapter 22, Section C). `govtax` is measured in millions of local currency units. `govtax_GDP` is in percent of nominal GDP.

Government expenditure (`*_govexp`) Government expenditure is a decrease in net worth of the government resulting from transactions, including compensation of employees, use of goods and services, and transfers (United Nations, 2009, Chapter 22, Section C). `govexp` is measured in millions of local currency units. `govexp_GDP` is in percent of nominal GDP.

Government deficit (`*_govdef`) Government deficit refers to net lending/borrowing by the government, i.e. the difference between revenue and expenditure (United Nations, 2009, Chapter 22, Section C). `govdef` is the primary measure of a country’s fiscal position and measured in millions of local currency units. `govdef_GDP` is in percent of nominal GDP.

10.7 Money and interest rates

Money supply (`M0`) `M0` is defined as notes and coins in circulation outside depository corporations (International Monetary Fund, 2016, Chapter 6, Section IV). It is considered

the most liquid monetary aggregate. M0 measured in millions of local currency units.

Money supply (M1) M1 is defined as currency in circulation plus transferable (demand) deposits (International Monetary Fund, 2016, Chapter 6, Section III). It is the most liquid monetary aggregate including bank deposits. M1 is measured in millions of local currency units.

Money supply (M2) M2 is defined as M1 plus time and savings deposits and includes less liquid monetary assets (International Monetary Fund, 2016, Chapter 6, Section III). M2 is measured in millions of local currency units.

Money supply (M3) M3 is defined as M2 plus marketable instruments issued by depository corporations (refer to (International Monetary Fund, 2016, Chapter 6, Section III)). It represents the broadest monetary aggregate measured within the banking system. M3 is expressed in millions of local currency units.

Money supply (M4) M4 is defined as M3 plus debt securities issued by the central government that are held by money holders (refer to (International Monetary Fund, 2016, Chapter 6, Section III)). It is the most comprehensive measure of the money supply. M4 is also expressed in millions of local currency units.

Central bank policy rate (cbrate) The central bank policy rate is the key interest rate used to implement or signal monetary policy stance (International Monetary Fund, 2016, Chapter 4, Section II). It usually applies to short-term liquidity operations. cbrate is measured in percent per annum.

Short-term interest rate (strate) The short-term interest rate is the market rate on short-term government securities or interbank rates, usually referring to three-months maturity (International Monetary Fund, 2016, Chapter 4, Section II). strate is measured in percent per annum.

Long-term interest rate (ltrate) The long-term interest rate is the market yield on long-term government bonds, usually referring to ten-year maturity (International Monetary Fund, 2016, Chapter 4, Section II). ltrate is measured in percent per annum.

10.8 Prices, labor market, and population

Consumer price index (CPI) The consumer price index (CPI) is a measure of the average change in prices paid by consumers, with the weights based on household consumption patterns (United Nations, 2009, Chapter 15, Section A). CPI is expressed as an index equal to 100 in the base year (2015).

House price index (HPI) The house price index (HPI) measures changes in residential property prices, where possible adjusted for quality (Eurostat, 2013). HPI is expressed as an index equal to 100 in the base year (2015).

Inflation (infl) Inflation is defined as the period-on-period percentage change in the consumer price index, which measures the rate of price level changes (United Nations, 2009, Chapter 15, Section A). infl is expressed in percent per annum.

Unemployment rate (unemp) The unemployment rate is defined as the number of unemployed persons as a percentage of the labor force (United Nations, 2009, Chapter 19, Section D). Wherever possible, it is based on International Labor Organization standards. unemp is expressed in percent.

Population (pop) Population is the total number of persons present in the economic territory, including both nationals and foreigners (United Nations, 2009, Chapter 19, Section B). pop is measured in millions of persons.

11 Priority Ordering of Data Sources

Our extensive experience working with macroeconomic time series has led us to develop a hierarchy for how different sources should be prioritized. This ordering reflects both the reliability of the data and the practical considerations of maintaining a comprehensive database. The hierarchy follows three main tiers:

11.1 Tier 1: Modern official sources

Modern official sources, particularly those from international organizations, national statistical offices, and central banks receive the highest priority. These institutions typically have the most accurate and up-to-date information for their respective countries, along with detailed documentation of methodologies and regular revision schedules.

11.2 Tier 2: Country-specific historical sources

The second tier consists of country-specific historical sources, often compiled by economic historians or research institutions focusing on particular countries or regions. These sources frequently offer invaluable historical data that has been carefully reconstructed and have often been evaluated through the academic peer review process. Notable examples include the historical statistics for Australia compiled by [Vamplew \(1987\)](#), Portuguese historical statistics by [Instituto Nacional de Estatística \(2001\)](#), and Argentinian long-run series by [Nakamura and Zarazaga \(2001\)](#).

11.3 Tier 3: Other aggregators

International aggregators such as the IMF, World Bank, or OECD form the third tier. While these sources provide extensive cross-country coverage and standardized definitions, they sometimes sacrifice historical depth or country-specific accuracy.

This ordering has proven robust through extensive testing and practical application. It balances the trade-offs between data accuracy, historical coverage, methodological consistency, and maintenance feasibility. The hierarchy is not rigid, however, and we document any deviations from this general ordering in our detailed source notes for each country and variable.

12 Measurement Issues

12.1 Data quality

A key contribution of our dataset is the systematic approach to data quality control through comprehensive visual inspection of all time series. For each of our 74 variables and 240 countries/territories, we plot the data from every available source on a single graph, allowing for detailed comparison and anomaly detection. This results in over 4,000 individual plots that we manually inspect for data quality issues.

Visual inspection process Our visual inspection process creates plots for each country-variable combination. These plots comprehensively display our final GMD estimates, a GMD forecast (where available), data points from all available sources, clear indication of splice points between different sources, and notes on major adjustments or concerns.

This visualization process allows us to identify several critical types of data quality issues. We detect level shifts, which appear as unexpected jumps in the series that might

indicate currency changes, definition changes, or data errors. We also identify source discrepancies, where different sources report substantially different values for the same period. The process also reveals outliers that deviate significantly from the series trend, inconsistencies in the units or currency in which a data series is recorded, and splicing problems where different data sources are not correctly “stitched together.”

Documentation and correction After identifying a potential data quality issue, we implement a systematic correction procedure. We begin by thoroughly documenting the nature of the anomaly and cross-referencing it with other sources and historical events. This investigation helps us determine whether the issue reflects a genuine economic event, a definitional change, or a data error requiring correction. Based on this assessment, we apply the necessary corrections while maintaining a detailed documentation of all adjustments. Throughout this process, we carefully flag any remaining uncertainties in the dataset to ensure full transparency.

We maintain a comprehensive set of PDF documents containing plots for each country and variable, accessible at www.globalmacrodata.com. This documentation provides extensive details, including a complete source information, the time spans each data source is used for constructing our time series, notes on specific adjustments or concerns, and detailed explanations of any splicing procedures applied.

As an illustrative example, consider the case of government expenditure data in Argentina. We use the following sources:

- [Mitchell \(2013\)](#): 1864-1989
- [International Monetary Fund \(2024\)](#): 1990-1992
- [International Monetary Fund \(2025b\)](#): 1993-2029

These plots serve dual purposes: they function as both a quality control tool and transparent documentation of our data construction process. This comprehensive approach allows users to evaluate the reliability of specific series and understand precisely how different sources were combined to create our final estimates.

12.2 Dealing with data revisions

A key challenge in maintaining a long-run macroeconomic database is the treatment of data revisions. Statistical offices and international organizations frequently revise their estimates as new information becomes available or methodologies improve. Without proper

treatment, these revisions would propagate through the entire historical series when using standard chain-linking procedures, causing implausible changes to historical values.

Anchor year approach To address the issue of data revisions, we implement an anchor year approach that effectively separates historical data from recent data revisions. We establish 2019 as our anchor year for the current version of the dataset, with historical data (pre-2019) chain-linked backwards and contemporary data (post-2019) chain-linked forwards from this anchor year. Note that, in the rare cases where countries do not have data available as of 2019, we use the most recent available year as anchor year.

This approach creates a clear framework for handling new data and revisions:

- Values before 2019 remain unchanged
- Values after 2019 incorporate all new information and revisions
- The anchor year serves to prevent the historical data from being continuously revised, while allowing for revisions to more recent data

Going forward, we will occasionally consider a change in the anchor year to take into account possible data revisions to 2019 values of the data.

Example To illustrate our approach of fixing the anchor year, consider a hypothetical case for real GDP. We begin with a historical source providing data for 1850-1989 and a contemporary source (e.g., [International Monetary Fund \(2025b\)](#)) covering 1990-2024. When a new ([International Monetary Fund, 2025b](#)) release revises the values for the 2022-2024 period and adds 2025-2029 forecasts, the treatment of these revisions differs significantly under different approaches.

Under traditional chain-linking starting from the most recent data, revisions to recent years would affect the entire series back to 1850, meaning historical values would change despite no new historical information becoming available. In contrast, our anchor year approach provides a more stable framework:

- 2019 serves as the fixed anchor point
- Data for 1850-2019 is constructed by chain-linking backwards from 2019
- Data for 2020-2025 is constructed by chain-linking forwards from 2019
- Revisions to 2022-2024 and the addition of 2025 only affect post-2019 values

Implementation For each variable, we implement a systematic procedure that begins with fixing the level of the series in 2019 using our preferred contemporary source. For earlier years ($t < 2019$), we use growth rates from historical sources to chain-link backwards from 2019, with these values remaining fixed unless errors are discovered. For later years ($t > 2019$), we employ growth rates from contemporary sources to chain-link forwards from 2019, allowing these values to update with each new data release.

This methodology ensures that our historical estimates remain stable while still incorporating all relevant contemporary revisions and updates. We plan to periodically update the anchor year (e.g., to most recent years) in the next major releases of the dataset. At this point, the entire series will be recomputed to incorporate any important historical revisions.

12.3 Base years for index variables

Several variables in our dataset are expressed either in constant prices or as indices (e.g., Consumer Price Index, GDP deflator, real GDP). These variables require a common base year for meaningful comparison; we set the base year to 2015. We implement a systematic approach to standardize base years.

Primary reference source We use the IMF’s World Economic Outlook ([International Monetary Fund, 2025b](#)) as our primary reference source for base years. This choice is motivated by several key advantages: the WEO offers wide country coverage, maintains a regular updating schedule, employs consistent methodological treatment, and enjoys broad usage in applied research.

12.4 Rebasing methodology

To ensure consistency across countries and time periods, we rebase series to a common base year, set to 2015. To illustrate the rebasing procedure, we use real GDP as an example, which uses country-specific GDP deflators. Formally, the deflator is computed as:

$$\text{Deflator}_{c,t} = \left(\frac{\text{nGDP}_{c,t}}{\text{rGDP}_{c,t}} \right) \times 100, \quad (4)$$

where $\text{nGDP}_{c,t}$ and $\text{rGDP}_{c,t}$ denote nominal and real GDP for country c in year t , respectively.

We then loop over each country separately to anchor each series to the base year 2015 deflator value:

$$\text{rGDP}_{c,t}^{\text{rebased}} = \text{rGDP}_{c,t} \times \frac{\text{Deflator}_{c,2015}}{100}, \quad (5)$$

where $\text{Deflator}_{c,2015}$ is the GDP deflator value for country c in the base year 2015. After rebasing, we update the GDP deflator to reflect the recalculated real GDP values:

$$\text{Deflator}_{c,t}^{\text{updated}} = \left(\frac{\text{nGDP}_{c,t}}{\text{rGDP}_{c,t}^{\text{rebased}}} \right) \times 100. \quad (6)$$

This rebasing method ensures temporal consistency and comparability of real GDP figures across different countries in our dataset.

12.5 Changes in currency

The long-run nature of our dataset requires careful handling of currency changes and redenominations. Historical sources often report values in currencies that were in use at the time of recording, while modern sources typically adjust historical values to current currencies. We identify and address two distinct types of currency changes:

1. **Adoption of new currencies:** Complete changes in the monetary unit, such as:
 - Introduction of new national currencies post-independence
 - Currency union adoptions (e.g., Euro)
 - Post-hyperinflation currency reforms
2. **Redenomination of existing currencies:** Technical adjustments to the same basic monetary unit, typically:
 - Removal of zeros after hyperinflation periods
 - Technical currency reforms maintaining the same basic unit

For new currency adoptions, we apply the official conversion rate at the time of change. For example, in the case of Euro adoption, we use the irrevocable exchange rates set by the European Central Bank (e.g., 1.95583 Deutsche Mark = 1 Euro for Germany). All historical values are converted using these official rates, and we document the conversion rate and date in country-specific notes.

Currency redenominations, particularly following periods of hyperinflation, require special attention. For instance, Turkey removed six zeros from the Lira in 2005, requiring all pre-2005 values to be divided by 1,000,000 to maintain consistency. Brazil presents a more complex case, with multiple changes between 1942 and 1994:

- 1942-1967: Cruzeiro
- 1967-1970: Cruzeiro Novo, 1000:1 redenomination
- 1970-1986: Cruzeiro
- 1986-1989: Cruzado, 1000:1 redenomination
- 1989-1990: Cruzado Novo, 1000:1 redenomination
- 1990-1993: Cruzeiro
- 1993-1994: Cruzeiro Real, 1000:1 redenomination
- 1994-present: Real, 2750:1 conversion

For such complex cases, we implement a systematic procedure in four steps. First, we document the complete chain of currency changes. Second, we apply conversions sequentially using official exchange rates. Third, we cross-validate the results with multiple sources when available. Fourth, we record potential measurement uncertainties in periods of extreme inflation.

To ensure accurate currency conversions, we employ several quality control measures. These start with an automated detection of unusual jumps in series around known currency change dates and a cross-validation with multiple sources where available. Most importantly, we manually review all major currency changes.

For each country-year observation affected by currency changes, we maintain detailed documentation of the original currency and value, applied conversion rate(s), and final adjusted value. This information is available in the country-specific technical notes. In cases where sources disagree about the appropriate conversion rate, particularly during periods of high inflation, we use geometric averages of available estimates and flag these observations for higher uncertainty.

12.6 Accounting identities and internal consistency

Some variables in the dataset, such as nominal GDP, have several components that should in principle add up to the total. In the case of GDP, the expenditure approach implies that $Y = C + I + G + NX$. Ideally, this accounting identity should thus always hold in the data. In practice, data providers such as Eurostat include an unexplained “statistical discrepancy” even for recent data points that would have to be incorporated for the components to add up to GDP.

Because we construct time series from many different underlying sources using ratio-splicing, accounting identities such as the one outlined above will not hold exactly. While we do not explicitly provide it, the statistical discrepancy in our data can be calculated as the difference between GDP and the sum of its underlying components.

The alternative to accepting a statistical discrepancy would be to use a hierarchical reconciliation method. These methods rescale the underlying components so that they exactly add up to the total. Because using a statistical discrepancy is the standard approach taken by almost all data providers, however, we do not use hierarchical reconciliation. To ensure the highest possible data quality, we instead manually investigate all cases where the statistical discrepancy is large to identify potential errors before each release.

12.7 Adjusting for source changes and series breaks

Series breaks occur when the same variable exhibits a discontinuity due to methodological changes, redefinitions, or changes in source data. We identify a series break when either:

- There is an explicit documentation of methodological change
- There is an unexplained jump in the series that unambiguously cannot be attributed to economic events
- Other sources than the one in use report substantially different growth rates or values for the same period

We employ two distinct methodologies for addressing series breaks, depending on the availability of overlapping data.

Method 1: Overlapping data available When we have overlapping observations between two sources at the break point t_0 , we adjust the historical series using the ratio splicing method:

$$\hat{y}_s = y_s^{next} \times \frac{y_{t_0}^{previous}}{y_{t_0}^{next}} \quad \text{for all } s < t_0 + 1 \quad (7)$$

where:

- \hat{y}_s is the adjusted value for period s
- y_s^{next} is the value from the next series used in the chain-linking process
- $y_t^{previous}$ is the value from the previous series at the break point
- y_t^{next} is the value from the next series at the break point

Method 2: No overlapping data In a few cases, there is no overlapping data to “connect” the raw data from adjacent years. In these cases, we use an ad-hoc approach to estimate a plausible growth rate for the year where we have no information available. Specifically, we adjust the data using a “representative” growth rate around the year of the break:

1. **Compute growth rates from the new source after the break:**

$$g_t^{\text{previous}} = \frac{y_{t_0}^{\text{previous}} - y_{t_0-1}^{\text{previous}}}{y_{t_0-1}^{\text{previous}}}, \quad \text{for } t \in \{t_0 + 1, t_0 + 2, t_0 + 3\} \quad (8)$$

2. **Compute growth rates from the old source before the break:**

$$g_t^{\text{next}} = \frac{y_{t_0}^{\text{next}} - y_{t_0-1}^{\text{next}}}{y_{t_0-1}^{\text{next}}}, \quad \text{for } t \in \{t_0 - 3, t_0 - 2, t_0 - 1\} \quad (9)$$

3. **Create a combined growth rate series:**

$$g_t = \begin{cases} g_t^{\text{previous}} \\ g_t^{\text{next}} \end{cases} \quad (10)$$

This series pools available growth rates from both sources to increase robustness.

4. **Compute the median growth rate:**

$$\bar{g} = \text{median}(g_t) \quad (11)$$

The median is used for robustness against outliers and to adjust the pre-break value:

5. **Adjust the pre-break value using the median growth rate:**

$$y_{t_0+1}^{\text{break_adjusted}} = \frac{y_{t_0+1}^{\text{previous}}}{1 + \bar{g}} \quad (12)$$

6. **Compute the chainlinking ratio:**

$$\theta = \frac{y_{t_0+1}^{\text{break_adjusted}}}{y_{t_0}^{\text{next}}} \quad (13)$$

7. Apply adjustment to historical series:

$$\hat{y}_s = y_s^{next} \times \theta \quad \text{for all } s < t_0 + 1 \quad (14)$$

Implementation notes We strictly give preference to Method 1 whenever overlapping data is available. Method 2 is only used when no overlapping observations exist. When multiple breaks exist in a series, we apply these methods sequentially. Crucially, all series breaks and adjustment methods are documented in the country-specific notes.

12.8 Doubtful data points

In compiling a comprehensive macroeconomic database, we systematically identify and address doubtful data points that may reflect measurement errors rather than genuine economic phenomena. We classify these into two main categories: outliers and definitionally impossible values.

Outliers We define outliers as observations that exhibit implausible changes in the level of a series. Our identification process combines economic validation and source comparison. For economic validation, we cross-reference flagged observations with other sources, verify if large changes can be explained by known economic shocks, and compare with related economic variables for consistency. The source comparison involves checking alternative data sources for the same period and evaluating the reliability of different sources.

When outliers are identified, we follow a three-step protocol. First, we replace values with another source if a more reliable source is available. Second, if no reliable alternative exists, we set the observation to missing. Third, all adjustments are meticulously recorded in the country-specific notes.

Definitionally impossible values Certain variables have natural constraints on their possible values based on economic definitions. We systematically check for and address two types of constraints. First, sign restrictions dictate that stock variables (e.g., money supply, population), price indices, and exchange rates must be positive, while flow variables (e.g., government deficit, current account) can be negative. Second, logical bounds require that percentages (e.g., unemployment rate) must lie between 0 and 100, and ratios (e.g., debt-to-GDP) must be non-negative.

When encountering impossible values, we implement a three-step verification process. First, we compare the values with alternative sources to identify correct values. Second,

we check for potential unit or sign errors in the source data. Third, we investigate possible definitional changes or special circumstances that might give rise to unusual values.

Quality control process For both types of doubtful data points, we implement a systematic review process:

1. Automated flagging of potential issues
2. Manual review of flagged observations
3. Cross-validation with multiple sources
4. Documentation of all adjustments
5. Regular review of flagging thresholds

All identified doubtful data points and their resolution are recorded in our technical documentation, allowing users to assess the reliability of specific observations and understand any adjustments made to the raw data.

13 Planned Improvements

We are currently working on:

- Major overhaul of the R and Python packages
- Further improvements to the government finance statistics, especially to better take into account the different reporting of measures referring to central and general government
- Further harmonizing the definition of monetary aggregates across sources
- Adding measures of total factor and labor productivity
- Extending the coverage of exchange rate data, especially for former colonies
- Adding several new sources we already processed but that are not yet integrated
- Quantifying statistical uncertainty across sources

We always welcome additional suggestions. Just open an issue on our [GitHub repo](#) or reach out to us at kmueller@globalmacrodata.com.

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