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Purpose

This tool generates a database of selected countries and periods with available per capita growth data by sector. Per capita output growth is decomposed into four components - contributions of productivity growth, employment growth, labor force growth, and change in working age population - using the Shapley decomposition method. The tool then calculates different sectors' contributions to aggregate productivity and employment growth. Multiple other data series are included for all countries on: population, employment, value added, and expenditure. Results for the target country can be compared to up to 10 countries and 5 periods.

Data

The tool uses value added, employment, demography and expenditure data from the WDI database

World DataBank:	http://databank.worldbank.org/data/home.aspx	Accessed 10 Jun 2023
World Bank Analytical Classifications of countries' Income Group over time	https://datahelpdesk.worldbank.org/knowledgebase/articles/906519	Accessed 10 Jun 2023

Step-by-Step

Step 1	Select Decomposition Method
Step 2	Select Countries and Years
Step 3	Load Growth Events
Step 4	View Summary Output
Step 5	View Detailed Output
Export	Export Results

Color coding

123-ABC Cells filled by the tool and can be modified by the user

All other cells filled by the tool and CANNOT be modified by the user

123-ABC	Do not modify	123-ABC	Do not modify
123-ABC	Do not modify	123-ABC	Do not modify
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123-ABC	Do not modify	123-ABC	Do not modify
123-ABC	Do not modify	123-ABC	Do not modify (check for errors)

Password Protection

To prevent the user from inadvertently overwriting formulas, a password is used protect all sheets.
If it becomes necessary to revise the structure of the file, use these buttons:
NB! The password is 'GROWTH' and must not be changed as it is included in macros.

Protect all sheets
Unprotect all sheets

Contact Details

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World Bank Group - Jobs Group
Jobs and Structural Change Excel (JSCE) Tool

Documentation

This tool generates a database of selected countries and periods with available per capita growth data by sector. Per capita output growth is decomposed into four components - contributions of productivity growth, employment growth, labor force growth, and change in working age population - using the Shapley decomposition method. The tool then calculates different sectors' contributions to aggregate productivity and employment growth. Multiple other data series are included for all countries on: population, employment, value added, and expenditure. Results for the target country can be compared to up to 10 countries and 5 periods.

Definitions & Concepts

Sectors of Economic Activity

The tool can be used to describe how each of the sectors of economic activity contributes to the total observed growth in value added and employment rate. The following sectors are considered: Agriculture, Industry, and Services.

Compound Annual Growth Rate (CAGR)

Growth rate is calculated as a geometric average growth rate between the beginning and end year (t, t+T) using the compound average growth rate (CAGR) formula. For example, for value added growth (Y):

$$g_{t,t+T} = (Y_{t+T}/Y_t)^{\frac{1}{T}} - 1 \quad \text{(Eq. 1)}$$

where

$g_{t,t+T}$ = Period average growth rate of value added between year t and t+T

Y_t = Value added in year t

Y_{t+T} = Value added in year t+T

Data Requirements

The following data series are obtained or calculated from the WDI database.

Source	Item	Code	Unit	Short	Abbrev	Main Sector
WDI	Agriculture, value added	NV.AGR.TOTL.KD	constant 2015 USD	Agriculture	Agric	Agriculture
WDI	Industry, value added	NV.IND.TOTL.KD	constant 2015 USD	Industry	Ind	Industry
WDI	Services, value added	NV.SRV.TOTL.KD	constant 2015 USD	Services	Serv	Services
WDI	GDP	NY.GDP.MKTP.KD	constant 2015 USD	Total GDP	Total	Total
WDI	Gross value added at factor cost	NY.GDP.FCST.KD	constant 2015 USD	Total GVA	Total	Total
calculated	Value Added	NY.GDP.MKTP.KD or NY.GDP.FCST.KD	million constant 2015 U!	Total Value Added	Total	Total
WDI	Population, total	SP.POP.TOTL	people	Population, total	POP	Total
WDI	Population ages 15-64 (% of total population)	SP.POP.1564.TO.ZS	share	Population 15-64	p 15-64	Total
WDI	Population ages 65 and above (% of total population)	SP.POP.65UP.TO.ZS	share	Population 65+	p 65+	Total
calculated	Population ages 15-64	SP.POP.1564.TO.ZS	1000 people	Population 15-64	WAP 15-64	Total
calculated	Population ages 15+	SP.POP.1564.TO.ZS, SP.POP.65UP.TO.ZS	1000 people	Population 15+	WAP 15+	Total
WDI	Labor force participation rate, total (% of total population ages 15-64) (modeled ILO estimate)	SL.TLF.ACTI.ZS	share	Labor force 15-64	l 15-64	Total
WDI	Labor force participation rate, total (% of total population ages 15+) (modeled ILO estimate)	SL.TLF.CACT.ZS	share	Labor force 15+	l 15+	Total
calculated	Labor force ages 15-64	from SL.TLF.ACTI.ZS	1000 people	Labor force 15-64	LF 15-64	Total
calculated	Labor force ages 15+	from SL.TLF.CACT.ZS	1000 people	Labor force 15+	LF 15+	Total
WDI	Unemployment, total (% of total labor force) (modeled ILO estimate)	SL.UEM.TOTL.ZS	share	Unemployment, total	1-e	Total
calculated	Employment ages 15-64	from SL.UEM.TOTL.ZS	1000 people	Employment 15-64	E 15-64	Total
calculated	Employment ages 15+	from SL.UEM.TOTL.ZS	1000 people	Employment 15+	E 15+	Total
WDI	Employment in agriculture (% of total employment) (modeled ILO estimate)	SL.AGR.EMPL.ZS	share	Agriculture Employment	Agric	Agriculture
WDI	Employment in industry (% of total employment) (modeled ILO estimate)	SL.IND.EMPL.ZS	share	Industry Employment	Ind	Industry

WDI	Employment in services (% of total employment) (modeled ILO estimate)	SL.SRV.EMPL.ZS	share	Services Employment	Serv	Services
calculated	Employment in agriculture	from SL.AGR.EMPL.ZS	1000 people	Agriculture	Agric	Agriculture
calculated	Employment in industry	from SL.IND.EMPL.ZS	1000 people	Industry	Ind	Industry
calculated	Employment in services	from SL.SRV.EMPL.ZS	1000 people	Services etc.	Serv	Services
WDI	General government final consumption expenditure (constant 2010 US$)	NE.CON.GOVT.KD	constant 2015 USD	Public Consumption	Public Cons	Total
WDI	Household final consumption expenditure (constant 2010 US$)	NE.CON.PRVT.KD	constant 2015 USD	Private Consumption	Private Cons	Total
WDI	Gross capital formation (constant 2010 US$)	NE.GDI.TOTL.KD	constant 2015 USD	Gross Capital Formation	GCF	Total
WDI	Imports of goods and services (constant 2010 US$)	NE.IMP.GNFS.KD	constant 2015 USD	Import	Import	Total
WDI	Exports of goods and services (constant 2010 US$)	NE.EXP.GNFS.KD	constant 2015 USD	Export	Export	Total
calculated	Not Defined	Balance between Expenditure and total GDP	constant 2015 USD	Not Defined	Not Defined	Total
WDI	Rural population (% of total population)	SP.RUR.TOTL.ZS	share	Rural Population share	% Rural Pop	Total
WDI	Urban population (% of total population)	SP.URB.TOTL.IN.ZS	share	Urban Population share	% Urban Pot	Total
WDI	Population in the largest city (% of urban population)	EN.URB.LCTY.UR.ZS	share	Population largest city share	% Largest City Pop	Total
WDI	Population in urban agglomerations of more than 1 million (% of total population)	EN.URB.MCTY.TL.ZS	share	Population cities >1M share	% City >1M Pop	Total
WDI	Wage and salaried workers, total (% of total employment) (modeled ILO estimate)	SL.EMP.WORK.ZS	share	Share Waged Employees	Waged Share	Total
WDI	Income Groups through history using GNI atlas method	OGHIST.xls (excl. Taiwan because it is included under China in WDI)	Income Group	Income Group	Income Group	Group

Note: GDP - used for VAP countries and countries without SNA price valuation indicated.
Note: Gross value added at factor cost - used for VAB countries.

Statistical Discrepancy
Due to statistical discrepancies, the sum of Value Added from each sector sometimes does not add up to the total Value Added. Similarly, the sum of employment from each sector sometimes does not add up to the total employment. In line with the approach in the WDI database, this discrepancy is included in the Services sector.
See: https://data.worldbank.org/indicator/NV.SRV.TOTL.KD
https://data.worldbank.org/indicator/SL.SRV.EMPL.ZS

Value Added Data
In this tool, the 'GDP' data series from WDI is used as a measure of total value added for all countries.

Value added by 3 sectors from WDI data are assumed to follow the SNA selection between GVA and GDP. In VAB countries 3-sector data should add up to the 'Gross value added at factor cost' (GVA) data series, whereas in VAP countries 3-sector data should add up to the 'GDP' data series. The following rules are used:

Total value added for VAB countries:
* If total GVA data exists, use it as total value added
* If there is no GVA data but there are data for 3 sectors, use sum of 3 sectors as total value added
* If there is no GVA data and data for only 1 or 2 sectors, exclude data point

Total value added for VAP countries:
* If total GDP data exists, use it as total value added
* If there is no GDP data but there are data for 3 sectors, use sum of 3 sectors as total value added
* If there is no GVA data and data for only 1 or 2 sectors, exclude data point

Sector share for VAB countries:
* If data exists for 3 sectors, calculate each sector share as % of sum of 3 sectors
* If only "Services" data are missing, calculate each sector share as % of total GVA with "Services" as the balancing item
* If "Services" and total GVA data are missing, exclude data point

Sector share for VAP countries:
* If data exists for 3 sectors, calculate each sector share as % of sum of 3 sectors
* If only "Services" data are missing, calculate each sector share as % of total GDP with "Services" as the balancing item
* If "Services" and total GDP data are missing, exclude data point

Employment Data
This file includes labor data from WDI broken down by three major sectors of economic activity - measured in thousands of people.
This file also includes population and total employment data from WDI measured in thousands of people. The population aged 15-64 is interpreted as the working age population in this tool.
Data points are excluded for specific years:
* If population, labor force, and total employment data are not available
or * If employment data are not available for all three sectors.

Income Groups and GNI atlas method

This file includes data as presented in the WDI showing each country's income group through history using GNI atlas method.

LIC	L	Low income
LMC	LM	Lower middle income
UMC	UM	Upper middle income
HIC	H	High income

Income classifications are set each year on July 1 for all World Bank member economies, and all other economies with populations of more than 30,000. These official analytical classifications are fixed during the World Bank's fiscal year (ending on June 30), thus economies remain in the categories in which they are classified irrespective of any revisions to their per capita income data. The historical classifications shown are as published on July 1 of each fiscal year.

The Atlas methodology is used to reduce the impact of exchange rate fluctuations in the cross-country comparison of national incomes. The Atlas conversion factor for any year is the average of a country's exchange rate for that year and its exchange rates for the two preceding years, adjusted for the differences between the rate of inflation in the country and that in China, Japan, the United Kingdom, the United States, and the Euro area). A country's inflation rate is measured by the change in its GDP deflator. The inflation rate for the above countries, representing international inflation, is measured by the changes in the SDR deflator. (Special drawing rights, or SDRs, are the IMF's unit of account.)

Beginning in FY95, the Atlas methodology changed: international inflation as measured by the SDR deflator in US$ terms (see SecM94-661); previously it was measured by the U.S. GNP deflator. In FY02, a change in terminology was made to be in line with the 1993 System of National Accounts (SNA); the definition of GNI per capita remains the same as the previously used gross national product (GNP) per capita. The country's inflation rate is measured by the change in its GDP deflator; previously the GNP deflator was used. The World Bank's fiscal year is from July 1 to June 30.

Source: https://datahelpdesk.worldbank.org/knowledgebase/articles/906519
File: OGHIST.xls (excl. Taiwan because it is included under China in WDI)

If the GNI atlas method data does not provide an income group for the most recent year, the income group designation from the most recent WDI data are used.

Original Data: Go To 'Data Income Groups' Sheet (click 'Show' button first)
Align with WDI data: Go To 'Data Raw' Sheet (click 'Show' button first)
Merge with WDI data: Go To 'Data Raw' Sheet (click 'Show' button first)

Data Income Groups — Show | Hide

Data Raw — Show | Hide

Country Groups

Country Codes

Note that many data sources use different notations for the same country. In this tool, country names and 3-letter country codes are taken from the World Bank and WDI. The full list of countries is on the 'Lists' sheet. That table includes WDI's SNA Price Valuation by country (VAB or VAP).

Source: http://data.worldbank.org/products/wdi
File: WDI_excel.zip

Country Group	Description
World Bank Most Recent Classification	
Region	East Asia & Pacific, Europe & Central Asia, Latin America & Caribbean, Middle East & North Africa, North America, South Asia, Sub-Saharan Africa
Income Group	Most recent categories: Low income, Low & middle income, Lower middle income, Middle income, Upper middle income, High income
Lending Category	Country's eligiblity to borrow from IDA, Blend, or IBRD
Region excl. High Income	All regions excluding High income countries
Region and Lending	Regions and Lending category combined
LDC	Least developed countries (UN classification)
Small States (SS)	Small developing states: Caribbean small states, Other small states, Pacific island small states, Small states
FCS	Fragile and conflict affected situations
Demography Dividend	Demographic typology. Pre-dividend countries (PRE) are mostly low-income countries, lagging in key human development indicators and with current fertility levels above four births per woman. They face very rapid population growth. Early-dividend countries (EAR) are mostly lower-middle-income countries further along the fertility transition. Fertility rates have fallen below four births per woman and the working-age share of the population is likely rising considerably. Late-dividend countries (LTE) are mostly upper-middle-income countries where fertility rates are typically above replacement levels of 2.1 births per woman, but fertility continues to decline. Post-dividend countries (PST) are mostly high-income countries where fertility has transitioned below replacement levels.
Source:	https://datahelpdesk.worldbank.org/knowledgebase/articles/906519
File:	CLASS.XLS file (excl. Taiwan because it is included under China in WDI)
Jobs 2013 WDR Typology	
AGING	% population 65+ (2010, WDI)
Cut-off	Those countries with an old age dependency ration greater than 8 (2010, WDI)
FORMALIZING	PDB Provisional Pension Database, HDNSP, February 2012 % of "First Active Coverage" Definition of "First Active Coverage" = the total number of contributors / Labor Force
Cut-off	Those countries with a "First Active Coverage" ratio between 25% and 75%

URBANIZING		(1): 2000 % urban in pop (WDI)
		(2): 2010 % urban in pop (WDI)
		(3): Percentage change from 2000 and 2010
		Alternative source for manual check: Manufacturing Value Added as a % of GDP, average 2000-10 (WDI)
	Cut-off	Among those =<65% urbanized in 2000, those with a % change of 4.5 and above
AGARIAN		2010 % rural in pop (WDI)
		Alternative source for manual check: 2000-2010 average employ in agriculture as percent of tot employment (WDI). Incomplete series.
	Cut-off	Any country with a rural population of 60% and above in 2010
RESOURCE		Mineral exports as a % share of total exports, average 2005-2010 (World Integrated Trade Solution, WITS)
	Cut-off	Those countries with mineral exports as a % share of total exports of or exceeding 20%
FRAGILE		A combination of two sources defining fragile states
		(i) countries in the Uppsala Conflict Data Program database which have at least 1000 battle deaths in an internal or internationalized internal conflict in 2010 (their latest year).
		(ii) countries from the 2012 WB fragility list that have UN peace keeping and peace building missions.
	Cut-off	Defined by source
YOUTH		Youth Bulge index: computed from three variables: (N Youth UNE) divided by (N Total Pop)
		(1) N Tot Y employed 2010 (WDI)
		(2) N Tot Pop 2010 (WDI)
		(3) YUNE Rate, mean, 2001-10 average (WDI)
		Alternative sources: % population ages 15-24 (2010, UN).
		: % population aged 0 -14, WDI, 2009.
	Cut-off	Countries with Youth Bulge Index score of 0.90 and above.
SMALL ISLAND		UN Office of the High Representative for the Least Developed Countries, Landlocked Developing Countries and Small Island Developing States (UN OHRLLS) - list of "small island developing states" (SIDS).
	Cut-off	Any independent territories (SIDS) listed by the UN-OHRLLS with a population <1 million in 2010.

Jobs WDR Typology KEY

Original	Interpreted As	Original Note
1	Yes	Have data, makes the cut-off
10	No	Override - had data, did not qualify by set standard, overridden into that category
10w	No	Override - no data point, overridden into that category
0	No	Have data, does not make cut-off for that category
99	No	Missing data

NB: Small island countries that made the cut-off for the urban and agrarian categories were overridden out of those categories

Source: https://openknowledge.worldbank.org/handle/10986/11843
File: Jobs WDR 2013 Typology Grid.xlsx (Received Jan 2016)

Per Capita Growth Decomposition

Decomposition of of Aggregate Per Capita Growth—Shapley Decomposition Method

Growth in aggregate per capita value added can be described by growth in its components using the following identity:

$$\frac{Y}{N}=\frac{Y}{E}*\frac{E}{L}*\frac{L}{A}*\frac{A}{N} \quad \text{or} \quad y=w*e*p*a \qquad \text{(Eq. 2)}$$

where
Y = Total value added
N = Population
E = Employment
L = Labor Force
A = Working Age Population = Population ages

where
y = per capita value added
w = Value added per Worker
e = Employment Rate
p = Participation rate
a = Population ages / Total Population

The Shapley method allows us to decompose the total change in per capita value added (y) into a sum of value added changes attributable to each of its components (w, e, p, and a):

$$\Delta y = \Delta y^{w} + \Delta y^{e} + \Delta y^{p} + \Delta y^{a} \qquad \text{(Eq. 3)}$$

Where Δy^{w}, Δy^{e}, Δy^{p}, Δy^{a} each represent a marginal contribution of w, e, p, and a, respectively, to Δy while holding other variables constant.

Using the Shapley method, the marginal contribution of productivity per worker (w) to the change in per capita value added (y) from t0 to t1, denoted as $\Delta y^{w}_{t0,\,t1}$, is calculated as:

$$\begin{aligned}\Delta y^{w}_{t0,t1} &= \alpha^{w}(s,m) \\ &* [(w_{t1}e_{t0}\,p_{t0}\,a_{t0}) - (w_{t0}e_{t0}\,p_{t0}\,a_{t0}) + (w_{t1}e_{t1}\,p_{t1}\,a_{t1}) - (w_{t0}e_{t1}\,p_{t1}\,a_{t1}) \\ &+ (w_{t1}e_{t1}\,p_{t0}\,a_{t0}) - (w_{t0}e_{t1}\,p_{t0}\,a_{t0}) + (w_{t1}e_{t0}\,p_{t1}\,a_{t0}) - (w_{t0}e_{t0}\,p_{t1}\,a_{t0}) \\ &+ (w_{t1}e_{t0}\,p_{t0}\,a_{t1}) - (w_{t0}e_{t0}\,p_{t0}\,a_{t1}) + (w_{t1}e_{t1}\,p_{t1}\,a_{t0}) - (w_{t0}e_{t1}\,p_{t1}\,a_{t0}) \\ &+ (w_{t1}e_{t1}\,p_{t0}\,a_{t1}) - (w_{t0}e_{t1}\,p_{t0}\,a_{t1}) + (w_{t1}e_{t0}\,p_{t1}\,a_{t1}) - (w_{t0}e_{t0}\,p_{t1}\,a_{t1})]\end{aligned} \qquad \text{(Eq. 4)}$$

which simplifies to:

$$\Delta y^{w}_{t0,t1} = \alpha^{w}(s,m) * [\Delta w(e_{t0}\, p_{t0}\, a_{t0}) + \Delta w(e_{t1}\, p_{t1}\, a_{t1}) + \Delta w(e_{t1}\, p_{t0}\, a_{t0}) + \Delta w(e_{t0}\, p_{t1}\, a_{t0}) + \Delta w(e_{t0}\, p_{t0}\, a_{t1}) + \Delta w(e_{t1}\, p_{t1}\, a_{t0}) + \Delta w(e_{t1}\, p_{t0}\, a_{t1}) + \Delta w(e_{t0}\, p_{t1}\, a_{t1})]$$ (Eq. 5)

The first term on the right hand side in Eq. 5, $\alpha^{w}(s,m)$, is a parameter vector which determines the weights of each term in the square brackets. Under the Shapley approach, the parameter values are given by the formula:

$$\alpha^{w}(s,m) = \frac{s!\,(m-s-1)!}{m!}$$ (Eq. 6)

where

S = number of variables other than w taken at t = t1
m = Total number of variables.

In this case, m=4 (w, e, p, and a), and for the first two terms in the bracket when s is equal to 0 or 3, the coefficient value is 1/4. Equivalently, when s is 1 or 2, the coefficient value is 1/12.

$$\frac{0!\,(4-0-1)!}{4!} = \frac{6}{24} = \frac{1}{4} \qquad \frac{1!\,(4-1-1)!}{4!} = \frac{2}{24} = \frac{1}{12}$$

Thus, the Shapley value of the contribution of w to the change in y is given by:

$$\Delta y^{w}_{t0,t1} = \frac{1}{4}[\Delta w(e_{t0}\, p_{t0}\, a_{t0}) + \Delta w(e_{t1}\, p_{t1}\, a_{t1})] + \frac{1}{12}[\Delta w(e_{t1}\, p_{t0}\, a_{t0}) + \Delta w(e_{t0}\, p_{t1}\, a_{t0}) + \Delta w(e_{t0}\, p_{t0}\, a_{t1}) + \Delta w(e_{t1}\, p_{t1}\, a_{t0}) + \Delta w(e_{t1}\, p_{t0}\, a_{t1}) + \Delta w(e_{t0}\, p_{t1}\, a_{t1})]$$ (Eq. 7)

And analogously, the Shapley values of the contributions of e, p, and a to changes in y is given by:

$$\Delta y^{e}_{t0,t1} = \frac{1}{4}[\Delta e(w_{t0}\, p_{t0}\, a_{t0}) + \Delta e(w_{t1}\, p_{t1}\, a_{t1})] + \frac{1}{12}[\Delta e(w_{t1}\, p_{t0}\, a_{t0}) + \Delta e(w_{t0}\, p_{t1}\, a_{t0}) + \Delta e(w_{t0}\, p_{t0}\, a_{t1}) + \Delta e(w_{t1}\, p_{t1}\, a_{t0}) + \Delta e(w_{t1}\, p_{t0}\, a_{t1}) + \Delta e(w_{t0}\, p_{t1}\, a_{t1})]$$ (Eq. 8)

$$\Delta y^{p}_{t0,t1} = \frac{1}{4}[\Delta p(w_{t0}\, e_{t0}\, a_{t0}) + \Delta p(w_{t1}\, e_{t1}\, a_{t1})] + \frac{1}{12}[\Delta p(w_{t1}\, e_{t0}\, a_{t0}) + \Delta p(w_{t0}\, e_{t1}\, a_{t0}) + \Delta p(w_{t0}\, e_{t0}\, a_{t1}) + \Delta p(w_{t1}\, e_{t1}\, a_{t0}) + \Delta p(w_{t1}\, e_{t0}\, a_{t1}) + \Delta p(w_{t0}\, e_{t1}\, a_{t1})]$$ (Eq. 9)

$$\Delta y^{a}_{t0,t1} = \frac{1}{4}[\Delta a(w_{t0}\, e_{t0}\, p_{t0}) + \Delta a(w_{t1}\, e_{t1}\, p_{t1})] + \frac{1}{12}[\Delta a(w_{t1}\, e_{t0}\, p_{t0}) + \Delta a(w_{t0}\, e_{t1}\, p_{t0}) + \Delta a(w_{t0}\, e_{t0}\, p_{t1}) + \Delta a(w_{t1}\, e_{t1}\, p_{t0}) + \Delta a(w_{t1}\, e_{t0}\, p_{t1}) + \Delta a(w_{t0}\, e_{t1}\, p_{t1})]$$ (Eq. 10)

See Muller (2008), Gutierrez, et al (2007), and World Bank (2009) for more detail.

A typical output table can look like this:

	Total Period: 2001 to 2006		
	Percent	% Contribution	Notation
Annual Growth per capita Value Added	3.87	100%	Δy
Change in Productivity	2.77	72%	Δy^{w}
Change in Employment rate	0.14	4%	Δy^{e}
Change in Participation Rate	0.45	12%	Δy^{p}
Change in Share of Working Age Population	0.51	13%	Δy^{a}

Decomposing Changes in Value added Per Worker – by Sector

To understand the way in which each sector contributed to the aggregate productivity change, we can decompose the value added per worker (Y/E) in (Eq. 2) by sector:

$$\frac{Y}{E} = \sum_{i=1}^{n} \frac{Y^i}{E^i} * \frac{E^i}{E} \quad \text{or equivalently} \quad w = \sum_{i=1}^{n} w^i\, \theta^i \qquad \text{(Eq. 11) and (Eq. 12)}$$

where

Y = Total value added
Y^i = Value added in sector i
E = Employment
E^i = Employment in sector i
w = Value added per Worker
w^i = Value added per Worker in sector i
θ^i = E^i / E = share of sector i in total employment

This tool lets the user select between two ways of decomposing productivity by sector. One method is from the World Bank's Job Generation and Growth (JoGG) Decomposition Tool (World Bank, 2009). We refer to this method as "Shift-share". The second alternative is from de Vries et al. (2015) and we refer to it as the "Canonical" method.

The current Tool is set to use the 'Canonical' method of sectoral decomposition.

Canonical method - de Vries et al. (2015)

Changes in aggregate value added per worker between periods t_0 and t_1 can be decomposed as (see McMillan and Rodrik, 2011):

$$\Delta w = \sum_{i=1}^{n} \Delta w^i * \theta_{to}^i + \sum_{i=1}^{n} \Delta\theta^i * w_{t1}^i \qquad \text{(Eq. 13)}$$

where

Δw = Change in value added per worker
Δw^i = Change in value added per worker in sector i
θ^i_{t0} = Share of employment in sector i in total employment, year t0
$\Delta\theta^i$ = Change in share of employment in sector i in total employment
w^i_{t1} = Value added per worker in sector i in year t1

The first term is the sum of changes in value added per worker in sector i, i=1..n. The Second term can be interpreted as the change in value added per worker due to inter-sectoral employment changes (i.e., net movements of workers between sectors). The inter-sectoral reallocation (i.e. structural change) can be further decomposed into a "static" and a "dynamic portion" (see de Vries et al., 2015):

$$\Delta w = \underbrace{\sum_{i=1}^{n} \left(w_{t1}^i - w_{t0}^i\right) * \theta_{to}^i}_{\text{"within-sector"}} + \underbrace{\sum_{i=1}^{n} \left(\theta_{t1}^i - \theta_{to}^i\right) * w_{t0}^i}_{\text{"static reallocation"}} + \underbrace{\sum_{i=1}^{n} \left(w_{t1}^i - w_{t0}^i\right) * \left(\theta_{t1}^i - \theta_{t0}^i\right)}_{\text{"dynamic reallocation"}} \qquad \text{(Eq. 14)}$$

where

Δw = Change in value added per worker
w^i_{t0} = Value added per worker in sector i in year t0
w^i_{t1} = Value added per worker in sector i in year t1
θ^i_{t0} = Share of employment in sector i in total employment, year t0
θ^i_{t1} = Share of employment in sector i in total employment, year t1

“Static reallocation” shows that workers are moving to sectors with higher productivity growth regardless of whether it is rising or falling. “Dynamic reallocation” measures the joint effects of changes in employment and sector productivity growth. "Dynamic reallocation" is positive if workers are moving to sectors with positive productivity growth.

Shift-share method - JoGGs tool

An alternative way of decomposing productivity by sector is aligned with the original JoGGs tool.

Original JoGGs tool formula:

$$\Delta w = \underbrace{\sum_{i=1}^{n} \Delta w^i \left(\frac{\theta_{t0}^i + \theta_{t1}^i}{2}\right)}_{\text{"within-sector"}} + \underbrace{\sum_{i=1}^{n} \Delta\theta^i \left(\frac{w_{t0}^i + w_{t1}^i}{2} - \frac{w_{t0} + w_{t1}}{2}\right)}_{\text{"reallocation"}} \qquad \text{(Eq. 15)}$$

where

Δw = Change in value added per worker
Δw^i = Change in value added per worker in sector i
θ^i_{t0} = Share of employment in sector i in total employment, yea
θ^i_{t1} = Share of employment in sector i in total employment, yea
$\Delta\theta^i$ = Change in share of employment in sector i in total employment
w^i_{t0} = Value added per worker in sector i in year t0
w^i_{t1} = Value added per worker in sector i in year t1
w_{t0} = Value added per worker in year t0
w_{t1} = Value added per worker in year t1

The first term is the sum of changes in value added per worker in sector i, i=1..n. The Second term can be interpreted as the change in value added per worker due to inter-sectoral employment changes (i.e., net movements of workers between sectors). That is, labor flows from low productivity sectors to high productivity sectors (compared to the average) should increase aggregate productivity (total value added per worker), and labor flows from high productivity sectors (compared to the average) to low productivity sectors should reduce aggregate productivity.

A typical output table can look like this:

	Canonical		***Shift-Share***	
	Total Period: 2001 to 2006		**Total Period: 2002 to 2016**	
	Percent	**% Contribution**	**Percent**	**% Contribution**
Change in Productivity	2.77	72%	2.77	72%
Contribution of within-sector productivity change	2.06	53%	2.09	54%
Agriculture	-0.20	-5%	-0.20	-5%
Industry	0.60	16%	0.61	16%
Services	1.65	43%	1.67	43%
Intersectoral reallocation	0.71	18%	0.69	18%
Agriculture	-0.54	-14%	0.25	6%
Industry	0.49	13%	0.23	6%
Services	0.77	20%	0.21	5%
Static reallocation	0.66	17%	.	
Agriculture	-0.55	-14%	.	
Industry	0.47	12%	.	
Services	0.73	19%	.	
Dynamic reallocation	0.05	1%	.	
Agriculture	0.00	0%	.	
Industry	0.01	0%	.	
Services	0.03	1%	.	

Decomposing Changes in Employment per Labor Force Employment Rate – by Sector

To understand way in which each sector contributed to the change in employment rate, we can decompose the employment rate (i.e, employment per labor force) (E/L) in Eq. 2 by sector:

$$\frac{E}{L} = \sum_{i=1}^{n} \frac{E^i}{L} \quad \text{or equivalently} \quad e = \sum_{i=1}^{n} e^i \qquad \text{(Eq. 16) and (Eq. 17)}$$

where

E = Total employment
E^i = Employment in sector i
L = Total labor force

e = Total employment rate
e^i = Employment rate in sector i

Changes in aggregate employment rate can be decomposed as:

$$\Delta e = \sum_{i=1}^{n} \Delta e^i \qquad \text{(Eq. 18)}$$

where

Δe = Change in total employment rate
Δe^i = Change in employment rate in sector i

A typical output table can look like this:

	Total Period: 2001 to 2006	
	Percent	**% Contribution**
Change in Employment rate	0.14	4%
Agriculture	-0.71	-18%
Industry	0.26	7%
Services etc.	0.58	15%

Read more about the Shapley Decomposition in Gutierrez et al. (2007).

Limitations

* The choice of components are ad-hoc and based on data availability
* Further and further decomposition have trade-offs because of implicit assumption of identical dynamic evolutionary process. The user should keep in mind that different components in the decomposition develop at different speed. For example, productivity shifts likely to happen more quickly than demographic shifts.
* Shapley decomposition forces component residual to zero. As a result errors are distributed proportionally across all components.

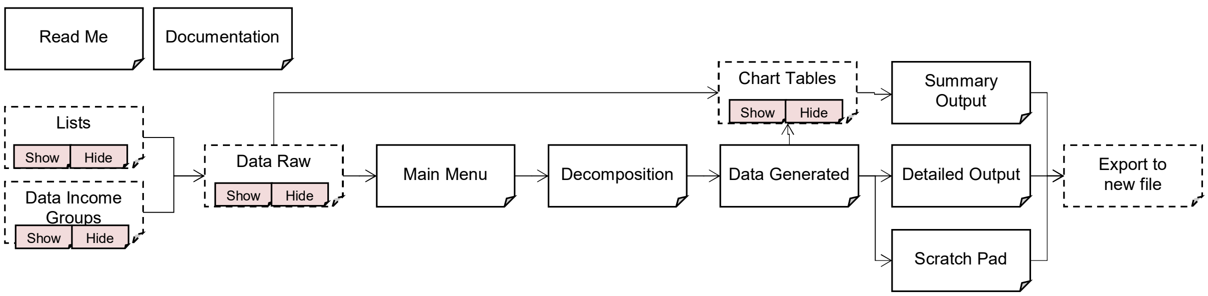
Documentation

References

* *de Vries G., M. Timmer, and K. de Vries (2015) Structural Transformation in Africa: Static Gains, Dynamic Losses, The Journal of Development Studies, 51:6, 674-688, DOI: 10.1080/00220388.2014.997222. https://doi.org/10.1080/00220388.2014.997222*
* *Gutierrez, C., C. Orecchia, P. Paci, P. Serneels (2007). Does Employment Generation Really Matter for Poverty Reduction? Policy Research Working Paper 4432, The World Bank Group, Washington DC.*
* *McMillan, M.S. and D. Rodrik (2011). Globalization, Structural Change and Productivity Growth. National Bureau of Economic Research, NBER Working Paper 17143 June 2011, Cambridge, Massachusetts. http://www.nber.org/papers/w17143*
* Muller (2008). "Clarifying Poverty Decomposition." Working Papers in Economics 217, Göteborg University, Department of Economics, revised 17 Nov 2008.
* *Shapley, Lloyd S. (1953). A Value for n-Person Games, in Contributions to the Theory of Games, vol. II, H. W. Kuhn and A. W. Tucker, editors, Ann. Math. Studies 28, Princeton University Press, Princeton, New Jersey, pp. 307-17*
* *Shorrocks, Anthony F. (2013). Decomposition procedures for distributional analysis: a unified framework based on the Shapley value. The Journal of Economic Inequality. March 2013, Volume 11, Issue 1, pp 99-126*
* *World Bank (2009). Job Generation and Growth (JoGG) Decomposition Tool. Understanding the Sectoral Pattern of Growth and its Employment and Productivity Intensity. Reference Manual and User's Guide Version 1.0. Poverty Reduction and Economic Management (PREM). World Bank.*

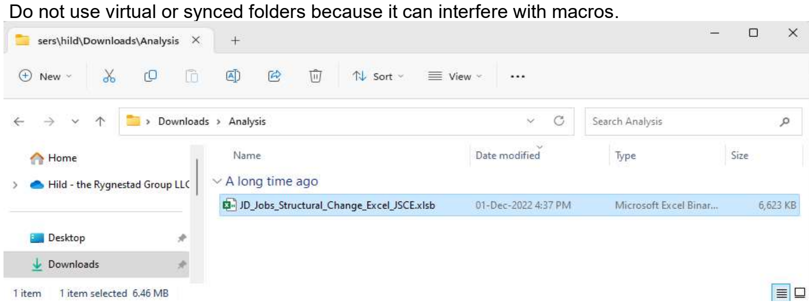
Excel File Structure

This Excel file includes the following sheets, and the arrows illustrate the main flow of data between them.

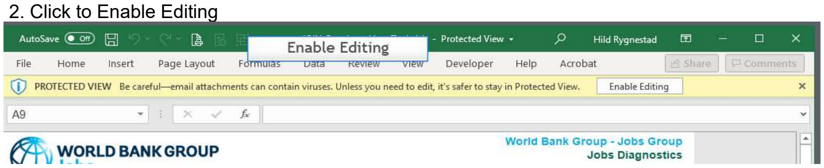


Troubleshoot Opening Excel File and Enabling Macros

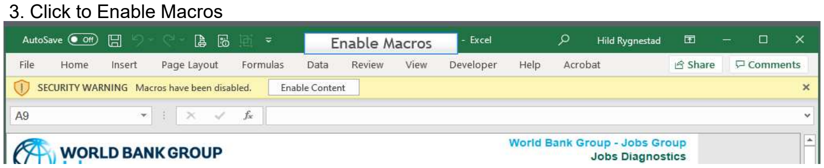
1. Make sure the Excel file is saved in a physical folder on your computer.
Do not use virtual or synced folders because it can interfere with macros.



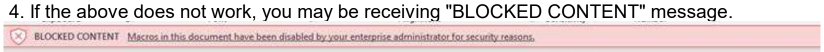
2. Click to Enable Editing



3. Click to Enable Macros



4. If the above does not work, you may be receiving "BLOCKED CONTENT" message.



For an individual file, such as a file downloaded from an internet location or an email attachment the user has saved to their local device, the simplest way to unblock macros is to remove "Mark of the Web". To remove, right-click on the file, choose Properties, and then select the Unblock checkbox on the General tab.
Finally, return to points 2 and 3 above.

Documentation