**Aggregate Workbooks**

Methodology change

1. Overview
2. IMF Methodology
3. Indicators
4. Methodology
   1. Real GDP and its components- New and Existing Methodology
   2. Indexes - New and Existing Methodology
5. Issues
6. Table Mapping

**Overview**

Applying IMF methodology for Global and Aggregate workbooks for a certain set of indicators like GDP and its components and Price indices (CPI, PPI, etc.). The new methodology (IMF Methodology) will be discussed in detail and in contrast with the existing methodology within the aggregate workbooks.

**IMF methodology**

* Regional divisions such as ASEAN5, EU and others are either sums or weighted averages of data for individual countries.
* Arithmetic weighted averages are used for all data for the emerging market and developing economies group except inflation and money growth, for which geometric averages are used
* Composites – whether growth rates or ratios – are weighted by GDP valued at purchasing power parity (PPP) as a share of total world or group GDP

**Indicators**

The indicators for which the methodology has changed are

**Real GDP and its components** **(in US$ at 2010) with series code**

* Real GDP (US$ at 2010 prices) - CGDP
* Real private consumption (US$ at 2010 prices) - CCPR
* Real government consumption (US$ at 2010 prices) - CGCE
* Real gross fixed investment (US$ at 2010 prices) - CFIN
* Real exports of G&S (US$ at 2010 prices) - CEXP
* Real imports of G&S (US$ at 2010 prices) - CIMP
* Real domestic demand (US$ at 2010 prices) - CDMD

**Real GDP and its components** **(in PPP US$ at 2010) with series code**

* Real GDP (PPP US$ at 2010 prices) - AGDP
* Real private consumption (PPP US$ at 2010 prices) - ACPR
* Real government consumption (PPP US$ at 2010 prices) - AGCE
* Real gross fixed investment (PPP US$ at 2010 prices) - AFIN
* Real exports of G&S (PPP US$ at 2010 prices) - AEXP
* Real imports of G&S (PPP US$ at 2010 prices) - AIMP
* Real domestic demand (PPP US$ at 2010 prices) - ADMD

**Real GDP and its components** **(% real change pa) with series code**

* Real GDP (% real change pa) - DGDP
* Real private consumption (% real change pa) - DCPR
* Real government consumption (% real change pa) - DGCE
* Real gross fixed investment (% real change pa) - DFIN
* Real exports of G&S (% real change pa) - DEXP
* Real imports of G&S (% real change pa) - DIMP
* Real domestic demand (% real change pa) - DDMD

**Real GDP and its components** **(2010=100;avg) with series code**

* GDP deflator(2010=100;av) - GDFI
* Private consumption deflator(2010=100;av) - CDFI
* Government consumption deflator(2010=100;av) - GOVI
* Gross fixed investment deflator(2010=100;av) - IDFI
* Exports of G&S deflator (2010=100;av)- EXDF
* Imports of G&S deflator(2010=100;av) - IMDF

**Indexes with series code**

* Consumer price index (2010=100; av) - CCPI
* Producer price index (2010=100; av) - CPPI
* Industrial production (2010=100; av) - CIPI
* Export volume of goods (2010=100) - CXGR
* Import volume of goods (2010=100) - CMGR
* Export prices (US$, 2010=100) - CIPX
* Import prices (US$, 2010=100) - CIPM
* Average nominal wage index (LCU, 2010=100) - CAWI
* Unit labour cost index (US$, 2010=100) - CULC

**Indexes (% change) with series code**

* Consumer prices (% change; av) - DCPI
* Producer prices (% change; av) - DPPI
* Industrial production (% change) - DIPI
* Export volume of goods (% change) - DXGR
* Import volume of goods (% change) - DMGR
* Export prices (% change; US$) - DIPX
* Import prices (% change; US$) - DIPM
* Average nominal wages (% change pa) - DAWA
* Unit labour costs (% change) - DULC

**Methodology**

Real GDP and its components:

***New Methodology - IMF***

Real GDP and its components (US$ at 2010 prices) are derived from their respective growth rates and Nominal counterpart (i.e.: Nominal GDP (US$) in case of deriving Real GDP (US$ at 2010 prices).

For instance, Real GDP (US$ at 2010 prices) is derived from **DGDP** (Real GDP % change) which is calculated as follows:

1. Nominal GDP (US$) is multiplied by Real GDP (% change) (and divide by 100 as one indicator is in percentage term) for all countries of the given aggregate and then sum it up
2. The sum (above) is the **weighted sum** and the calculation for the growth/contraction (DGDP) compares this with its unweighted sum i.e.; sum of Individual country’s Nominal GDP (US$):

(Weighted sum/unweighted sum)\*100

***GDP (% real change) = SumProduct (Real GDP growth for each country; Nominal GDP US$ for each country) / Aggregate Nominal GDP US$***

One exception: Domestic demand is calculated in the same manner as in the existing methodology which is the sum of Private, Government consumption , and Fixed investment

GDP (PPP US$ 2010) are derived in similar fashion. The only difference is that it is weighted in Nominal GDP (PPP $)\* **(see issue section)**

***Existing Methodology***

Real GDP and its components (US$ at 2010 / PPP US$ 2010) is the Sum of the country's components in the group.

For instance, Real GDP (US$ at 2010) of Aggregate is the sum of Individual country’s Real GDP (US$ at 2010) whereas Real GDP (PPP US$ 2010) is the sum of Individual country’s Real GDP (PPP US$ at 2010)

As discussed above, Domestic Demand is the the sum of Private, Government consumption , and Fixed investment

Given that GDP and its components are derived from summing up all country, growth rates (such as - DGDP) are then calculated using these level figures

Indexes

***New Methodology***

All indexes - CPI, PPI, Industrial Production, Export Volume and Price, Import Volume and Price, Average Nominal wage, Unit Labour cost are derived from their respective growth rates.

For instance, Consumer Price Index (2010=100) is derived from **DCPI** (Consumer prices (% change; av)) which is calculated as follows:

1. Taking Natural log of Inflation Growth and multiply it with Nominal GDP (PPP US$) for all countries of the given aggregate and then sum it up
   1. For eg: LN(1+ inflation growth/100)\*(Nominal GDP (PPP US$))
2. The sum (above) is the **weighted sum** and the calculation for the growth/contraction (DCPI) is based on its unweighted sum i.e.; sum of Individual country’s Nominal GDP (PPP US$). Given that Logarithm is used, so at the end exponent is used :
   1. Exponent (Weighted sum/unweighted sum)\*100)

Producer Price Index is derived in similar manner with Nominal GDP (PPP US$) as weights

*For other Indicators*:

All other indexes are derived in similar manner with differences in weights

* Industrial Production (% change): This is weighted in Industry/GDP ratio
* Export volume of goods (% change) AND Export prices (% change; US$): This is weighted in Nominal Exports of Goods & Services(US$)
* Import volume of goods (% change) AND Import prices (% change; US$): This is weighted in Nominal Imports of Goods & Services(US$)
* Average nominal wages (% change pa) and Unit labour costs (% change): This is weighted in Labour force

***Existing Methodology***

All indexes are Weighted Geometric Mean of all countries in the group with their respective weights as mentioned below:

* Consumer price index (2010=100; av) and Producer price index (2010=100; av): Weights are the share of an individual country in the global or regional (sum of individual countries) Nominal GDP (PPP US$) for the year 2010. Fixed weight (for the year 2010) is used throughout the data series.
* Industrial production (2010=100; av): Weights are the share of an individual country in the global or regional (sum of individual countries) Nominal Industry US$ for the year 2010. Fixed weight is used throughout the data series. **Note:** Nominal Industry US$ is calculated by using the Industry/GDP (INDP) and Nominal GDP US$ (GDPD).
* Export volume of goods (2010=100) and Export prices (US$, 2010=100): Weights are the share of an individual country in global or regional (sum of individual countries) Nominal Export volume of Goods and Services (US$) for the year 2010. Fixed weight (for the year 2010) is used throughout the data series.
* Import volume of goods (2010=100) and Import prices (US$, 2010=100): Weights are the share of an individual country in the global or regional (sum of individual countries) Nominal Import volume of Goods and Services (US$) for the year 2010. Fixed weight (for the year 2010) is used throughout the data series.
* Average nominal wage index (LCU, 2010=100) and Unit labour cost index (US$, 2010=100): Weights are the share of an individual country in the global or regional (sum of individual countries) Labour Force for the year 2010. Fixed weight (for the year 2010) is used throughout the data series.

Growth rates of these indicators (such as -DCPI) are then calculated using these indexes

**Missing Data**

Missing data for a particular country/countries within an aggregate/region causes issues with the overall aggregate calculation of a particular indicator. Consider the example of Nominal GDP US$ being measured for the Big four (Western Europe) region, which consists of Germany, France, Italy and the UK, from 1980-2025. The aggregate (Big Four) Nominal GDP US$ is the sum of individual country Nominal GDP US$ values. However, in case of missing historical data for say UK from 1980-1985, would mean that the aggregate Nominal GDP US$ would witness a significant increase/jump from 1986, with the inclusion of UK in its calculation. In such cases there is a requirement to extrapolate the historic data for the UK, using common techniques like:

* Moving averages
* Linear extrapolation
* NOCB (Next observation carried backward), LOCF (Last Observation Carried Forward)

The usage of specific techniques depends on the data series it needs to be applied on.

**Issues**

The IMF methodology, when followed for all the indicators mentioned above, poses two problems:

* Average Nominal Wage (% change) and Unit labour cost (% change): With the new methodology (and existing), wages and Unit labour cost are weighted by Labour force whose sum may not be available for some aggregates (given that group composites are computed if 90 percent or more of the share of group weights is represented). However, instead of the Labour force, if wages and labour cost are weighted with Nominal GDP (PPP US$) (similar to CPI and PPI new methodology) then computation is possible.

***The issue exists both, in current and the new methodology, as LABF is used as a weight in both***

* Real Gross Fixed Investment (US$ at 2010): The calculation pertaining to investment requires adding up investment to stock building and then calculating it by growing it with the combined growth (investment and stock building). The issue arises as there is no growth rate section for stock building and calculating it within an excel formula, which is problematic. (given that it will throw #Div/0 as many countries have no stock building)
* Industrial Production index (2010=100): The calculation for this is also problematic as these are in ratios and converting them to levels/growth and using it within an excel formula is prone to excel errors
* \*GDP Components (PPP US$ 2010 price): GDP components for PPP US$ at 2010 prices is also problematic to calculate given that Aggregates does not have component data in PPP US$. However, another approach could be summing up all the countries for 2010 year and then using the Nominal GDP (PPP US$) as weights

The second and third issue relates to the aggregate workbook structure and lack of indicators which are to be used for calculation. Altering the structure would be required for all Aggregate for this calculation to take place

**Table Mapping**

This table has been generated to contrast between Methodologies and it also helps in tracing the series dependencies.

For instance, Row-1 (CGDP) is derived from DGDP in New Methodology and DGDP is calculated as weighted average growth, with weight being Nominal GDP US$ (GDPD)

| Indicator | Series Name | Existing Methodology | New Methodology |
| --- | --- | --- | --- |
| DGDP | Real GDP (% change pa) | Derived from CGDP  *% change of CGDP* | Weighted average growth, with weight being Nominal GDP US$ (GDPD)  *SumProduct(DGDP, GDPD) / Aggregate GDPD* |
| DCPR | Private consumption (real % change pa) | Derived from CCPR  *% change of CCPR* | Weighted average growth, with weight being Nominal Private Consumption US$ (PCRD)  *SumProduct(DCPR,PCRD) / Aggregate PCRD)* |
| DGCE | Government consumption (% real change pa) | Derived from CGCE  % change of CGCE | Weighted average growth, with weight being Nominal Government Consumption US$ (GCED)  *SumProduct(DGCE, GCED) / Aggregate GCED* |
| DFIN | Gross fixed investment (% real change pa) | Derived from CFIN  *% change of CFIN* | Weighted average growth, with weight being Nominal Gross Fixed Investment US$ (FIND)  *SumProduct (DFIN, FIND) / Aggregate FIND* |
| DSTK | Stockbuilding, contribution to real GDP growth (% points) | Not Applicable | Not Applicable |
| DEXP | Exports of G&S (% real change pa) | Derived from CEXP  *% change of CEXP* | Weighted average growth, with weightbeing Nominal Exports of G&S US$ (EXPD)  *SumProduct (DSTK,EXPD) / Aggregate DEXP* |
| DIMP | Imports of G&S (% real change pa) | Derived from CIMP  *% change of CIMP* | Weighted average growth, with weight being Nominal Exports of G&S US$ (IMPD)  *SumProduct (DIMP,IMPD) / Aggregate IMPD)* |
| DDMD | Domestic demand (% real change pa) | Derived from CDMD | Derived from CDMD |
| CGDP | Real GDP (US$ at 2010 prices) | Sum of individual country Real GDP (US$ at 2010) | Derived from DGDP  *Base year 2010:*  *2010 = Nominal GDP US$ (GDPD). Other years derived using weighted growth rates DGDP* |
| CCPR | Real private consumption (US$ at 2010 prices) | Sum of individual country Real Private consumption (US$ at 2010) | Derived from DCPR  *Base year 2010:*  *2010 = Nominal Private consumption US$ (PCRD). Other years derived using weighted growth rates DCPR* |
| CGCE | Real government consumption (US$ at 2010 prices) | Sum of individual country Real Government consumption (US$ at 2010) | Derived from DGCE  *Base year 2010:*  *2010 = Nominal Govt consumption US$ (GCED). Other years derived using weighted growth rates DGCE* |
| CFIN | Real gross fixed investment (US$ at 2010 prices) | Sum of individual country Real Fixed Investment (US$ at 2010) | Derived from DFIN  *Base year 2010:*  *2010 = Nominal Fixed Investment US$ (FIND). Other years derived using weighted growth rates DFIN* |
| CEXP | Real exports of G&S (US$ at 2010 prices) | Sum of individual country Real Exports of G&S (US$ at 2010) | Derived from DEXP  *Base year 2010:*  *2010 = Nominal Exports US$ (EXPD). Other years derived using weighted growth rates DEXP* |
| CIMP | Real imports of G&S (US$ at 2010 prices) | Sum of individual country Real Imports of G&S (US$ at 2010) | Derived from DIMP  *Base year 2010:*  *2010 = Nominal Imports US$ (IMPD). Other years derived using weighted growth rates DIMP* |
| CDMD | Real domestic demand (US$ at 2010 prices) | Sum of Private Consumption, Government Consumption, and Gross Fixed Investment (all at US$ 2010) | Sum of Private Consumption, Government Consumption, and Gross Fixed Investment (all at US$ 2010) |
| GDFI | GDP deflator (2010=100; av) | Weighted Geometric Mean of individual country index values, where weights are the share of an individual country in the global or regional (sum of individual countries) Nominal GDP (US$) - GDPD- for the year 2010 | Nominal and Real GDP |
| CDFI | Private consumption deflator (2010=100; av) | Weighted Geometric Mean of individual country index values, where weights are the share of an individual country in the global or regional (sum of individual countries) Nominal Private Consumption (US$) - PCRD - for the year 2010 | Nominal and Real Private Consumption |
| GOVI | Government consumption deflator (2010=100; av) | Weighted Geometric Mean of individual country index values, where weights are the share of an individual country in the global or regional (sum of individual countries) Nominal Government Consumption (US$) - GCED - for the year 2010 | Nominal and Real Government Consumption |
| IDFI | Fixed investment deflator (2010=100; av) | Weighted Geometric Mean of individual country index values, where weights are the share of an individual country in the global or regional (sum of individual countries) Nominal Fixed Investment (US$) - FIND - for the year 2010 | Nominal and Real Fixed Investment |
| EXDF | Export deflator (2010=100; av) | Weighted Geometric Mean of individual country index values, where weights are the share of an individual country in the global or regional (sum of individual countries) Nominal Exports G&S (US$) - EXPD - for the year 2010 | Nominal and Real Exports |
| IMDF | Import deflator (2010=100; av) | Weighted Geometric Mean of individual country index values, where weights are the share of an individual country in the global or regional (sum of individual countries) Nominal Imports G&S (US$) - IMPD - for the year 2010 | Nominal and Real Imports |
| AGDP | Real GDP (PPP US$ at 2010 prices) | Sum of individual country Nominal GDP (US$ at ppp) - GDPP | Derived from DGDP and GDPP |
| DCPI | Consumer prices (% change; av) | Derived from LCPI  *% change of LCPI* | Weighted average growth, with weight being Nominal GDP PPP$ (GDPP)  *Exp(SumProduct(LN(DCPI, GDPP)/ Aggregate GDPP)* |
| DPPI | Producer prices (% change; av) | Derived from LPPI  *% change LPPI* | Weighted average growth, with weight being Nominal GDP PPP$ (GDPP)  *Exp(SumProduct(LN(DPPI, GDPP)/ Aggregate GDPP)* |
| DIPI | Industrial production (% change) | Derived from CIPI  *% change CIPI* | Weighted average growth, with weight being Industry/GDP weights |
| XGRO | Export volume of goods (% change) | Derived from CXGR  *% change CXGR* | Weighted average growth, with weight being EXPD as weights  *Exp(SumProduct(LN(XGRO, EXPD)/ Aggregate EXPD)* |
| MGRO | Import volume of goods (% change) | Derived from CMGR  *% change CMGR* | Weighted average growth, with weight being IMPD as weights  *Exp(SumProduct(LN(MGRO, IMPD)/ Aggregate IMPD)* |
| DIPX | Export prices (% change; US$) | Derived from CIPX  *% change CIPX* | Weighted average growth, with weight being EXPD as weights  *Exp(SumProduct(LN(DIPX, EXPD)/ Aggregate EXPD)* |
| DIPM | Import prices (% change; US$) | Derived from CIPM  *% change CIPM* | Weighted average growth, with weight being IMPD as weights  *Exp(SumProduct(LN(DIPM, IMPD)/ Aggregate IMPD)* |
| DAWA | Average nominal wages (% change pa) | Derived from CAWI  *% change CAWI* | Weighted average growth, with weight being LABF  *Exp(SumProduct(LN(DAWA, LABF)/ Aggregate LABF)* |
| DULC | Unit labour costs (% change) | Derived from CULC  *% change CULC* | Weighted average growth, with weight being LABF  *Exp(SumProduct(LN(DULC, LABF)/ Aggregate LABF)* |
| CCPI | Consumer price index (2010=100; av) | Weighted Geometric Mean of individual country index values, where weights are the share of an individual country in the global or regional (sum of individual countries) Nominal GDP (US$ at PPP) - GDPP - for the year 2010 | Derived from DCPI  *Base year 2010:*  *2010 = 100. Other years derived using weighted growth rates DCPI* |
| CPPI | Producer price index (2010=100; av) | Weighted Geometric Mean of individual country index values, where weights are the share of an individual country in the global or regional (sum of individual countries) Nominal GDP (US$ at PPP) - GDPP - for the year 2010 | Derived from DPPI  *Base year 2010:*  *2010 = 100. Other years derived using weighted growth rates DPPI* |
| CIPI | Industrial production (2010=100; av) | Weighted Geometric Mean of individual country index values, where weights are the share of an individual country in the global or regional (sum of individual countries) Nominal Industry (US$) for the year 2010.  Nominal Industry (US$) derived from Industry/GDP (INDP) and Nominal GDP US$ (GDPD) | Derived from DIPI  *Base year 2010:*  *2010 = 100. Other years derived using weighted growth rates DIPI* |
| CXGR | Export volume of goods (2010=100) | Weighted Geometric Mean of individual country index values, where weights are the share of an individual country in the global or regional (sum of individual countries) Nominal Exports G&S (US$) - EXPD - for the year 2010 | Derived from XGRO  *Base year 2010:*  *2010 = 100. Other years derived using weighted growth rates XGRO* |
| CMGR | Import volume of goods (2010=100) | Weighted Geometric Mean of individual country index values, where weights are the share of an individual country in the global or regional (sum of individual countries) Nominal Imports G&S (US$) - IMPD - for the year 2010 | Derived from MGRO  *Base year 2010:*  *2010 = 100. Other years derived using weighted growth rates MGRO* |
| CIPX | Export prices (US$, 2010=100) | Weighted Geometric Mean of individual country index values, where weights are the share of an individual country in the global or regional (sum of individual countries) Nominal Exports G&S (US$) - EXPD - for the year 2010 | Derived from DIPX  *Base year 2010:*  *2010 = 100. Other years derived using weighted growth rates DIPX* |
| CIPM | Import prices (US$, 2010=100) | Weighted Geometric Mean of individual country index values, where weights are the share of an individual country in the global or regional (sum of individual countries) Nominal Imports G&S (US$) - IMPD - for the year 2010 | Derived from DIPM  *Base year 2010:*  *2010 = 100. Other years derived using weighted growth rates DIPM* |
| CAWI | Average nominal wage index (LCU, 2010=100) | Weighted Geometric Mean of individual country index values, where weights are the share of an individual country in the global or regional (sum of individual countries) Labour Force - LABF - for the year 2010 | Derived from DAWA  *Base year 2010:*  *2010 = 100. Other years derived using weighted growth rates DAWA* |
| CAWR | Average real wage index (LCU, 2010=100) | Average nominal wage index (LCU, 2010=100) / Consumer price index (2010=100; av) | Average nominal wage index (LCU, 2010=100) / Consumer price index (2010=100; av) |
| CULC | Unit labour cost index (US$, 2010=100) | Weighted Geometric Mean of individual country index values, where weights are the share of an individual country in the global or regional (sum of individual countries) Labour Force - LABF - for the year 2010 | Derived from DULC  *Base year 2010:*  *2010 = 100. Other years derived using weighted growth rates DULC* |