On Measuring Regional or Global Growth and Inflation

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Outline

- Concepts for international comparison
  - Exchange rates (XR)
  - Purchasing power parities (PPPs)
- Comparisons of World GDP over time
  - Global Inflation
  - Global Growth

Key Concepts and Notation

Gross Domestic Product of country *j*

(in national currency units) $GDP^j = \sum p_n^j \cdot x_n^j$

Nominal GDP : GDP of country *j* expressed in reference currency units using exchange rates

$$NGDP^j = \frac{GDP^j}{XR^j}$$

Real GDP : GDP of country *j* expressed in reference currency units using PPPs

$$RGDP^j = \frac{GDP^j}{PPP^j}$$

Purchasing Power Parities (PPPs)

PPPs are amounts of currencies, of different countries, that have the same purchasing power as one unit of a reference currency (e.g. US$) with respect to a selected basket of goods and services (the scope). Methods were surveyed by Balk (2008), (2009).

Price Level Index (PLI)

Defined as the ratio of PPP to the exchange rate

$$PLI^j = \frac{PPP^j}{XR^j}$$

PLIs are transitive, but not invariant to choice of reference country.

Normalisation of PLIs

Adjust the PPPs by a positive scalar such that world real GDP at the new PPPs is equal to world nominal GDP at XRs:

$$\sum_j \frac{GDP^j}{PPP^j/\mu} = \sum_j \frac{GDP^j}{XR^j}$$

This represents current Eurostat National Accounting practice. PPPs are calculated according to the GEKS method.

Global Inflation and Growth (1)

Total real GDP in periods *s* and *t* (later) is given by

$$RGDP^s = \sum_{j=1}^{M} RGDP_j^s = \sum_{j=1}^{M} GDP_j^s / PPP_j^s$$

$$RGDP^t = \sum_{j=1}^{M} RGDP_j^t = \sum_{j=1}^{M} GDP_j^t / PPP_j^t$$

It is important to realize that these two aggregates are in the prices of periods *s* and *t* respectively. The ratio of these two aggregates is similar to the ratio of country-specific nominal GDP in two periods.

Global Inflation and Growth (2)

The objective is to decompose the total real GDP ratio into a price index and a quantity index,

$$\frac{RGDP^t}{RGDP^s} = WP(s,t)WQ(s,t).$$

Indices may be direct or chained. We prefer a symmetric (in time periods) to an asymmetric decomposition.

Global Inflation and Growth (3)

Using the logarithmic mean it appears that

$$\frac{\sum_{j=1}^{M} GDP_j^t / PPP_j^t}{\sum_{j=1}^{M} GDP_j^s / PPP_j^s} = \exp\left\{\sum_{j=1}^{M} \Psi^j \ln\left[\frac{GDP_j^t / PPP_j^t}{GDP_j^s / PPP_j^s}\right]\right\}$$

$$= \exp\left\{\sum_{j=1}^{M} \Psi^j \ln\left[\frac{RGDP_j^t}{RGDP_j^s}\right]\right\}$$

where the weights, adding up to 1, are defined by

$$\Psi^j = \frac{L\left[\frac{RGDP_j^s}{\sum_{k=1}^{M} RGDP_k^s}, \frac{RGDP_j^t}{\sum_{k=1}^{M} RGDP_k^t}\right]}{\sum_{j=1}^{M} L(.,.)} \quad \text{where } L(a,b) = \frac{a-b}{\ln a - \ln b} \text{ is the logmean.}$$

Global Inflation and Growth (4)

Using NA data country-specific nominal GDP change can be decomposed into price and quantity indices

$$\frac{GDP_j^t}{GDP_j^s} = P_j^{GDP}(s,t) \cdot Q_j^{GDP}(s,t) \quad \forall j$$

Then World Inflation and World Growth are measured by:

$$WI(s,t) = \exp\left\{\sum_{j=1}^{M} \Psi^j \ln\left(P_j^{GDP}(s,t) \cdot \frac{PPP_j^s}{PPP_j^t} \right)\right\}$$

$$WG(s,t) = \exp\left\{\sum_{j=1}^{M} \Psi^j \ln\left(Q_j^{GDP}(s,t) \right)\right\}$$

Global Inflation and Growth (5)

It appears that if the period *t* PPPs are obtained by extrapolating the period *s* PPPs then world inflation reduces to the price index of the numeraire country. Since there are M choices for the numeraire, an unweighted geometric mean makes sense.

Global Inflation and Growth (6)

- The entire derivation can be repeated for total nominal GDP. This delivers XR-based global price and quantity indices. They will differ numerically from the PPP-based indices. Different decompositions of the same ratio.
- In both cases the global price index is not invariant to the choice of the reference country.
- Instead of Sato-Vartia one could use Fisher.
- Table 1 is based on ICP data: 2005, 2011, 141 countries.

ICP Inflation and Growth

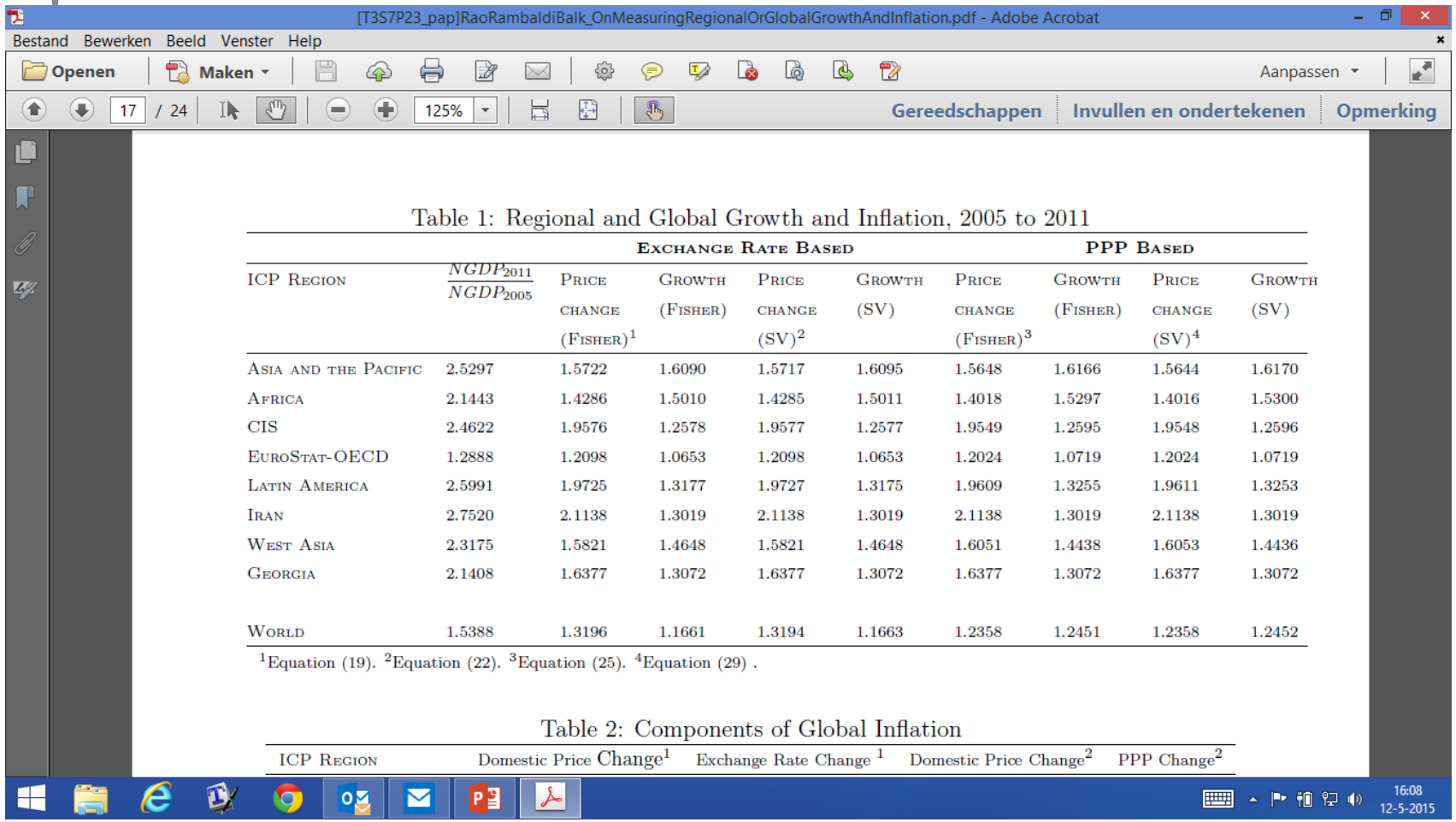

Table 1: Regional and Global Growth and Inflation, 2005 to 2011

ICP Region	$\frac{NGDP_{2011}}{NGDP_{2005}}$	Exchange Rate Based				PPP Based			
		Price change (Fisher)[1]	Growth (Fisher)	Price change (SV)[2]	Growth (SV)	Price change (Fisher)[3]	Growth (Fisher)	Price change (SV)[4]	Growth (SV)
Asia and the Pacific	2.5297	1.5722	1.6090	1.5717	1.6095	1.5648	1.6166	1.5644	1.6170
Africa	2.1443	1.4286	1.5010	1.4285	1.5011	1.4018	1.5297	1.4016	1.5300
CIS	2.4622	1.9576	1.2578	1.9577	1.2577	1.9549	1.2595	1.9548	1.2596
EuroStat-OECD	1.2888	1.2098	1.0653	1.2098	1.0653	1.2024	1.0719	1.2024	1.0719
Latin America	2.5991	1.9725	1.3177	1.9727	1.3175	1.9609	1.3255	1.9611	1.3253
Iran	2.7520	2.1138	1.3019	2.1138	1.3019	2.1138	1.3019	2.1138	1.3019
West Asia	2.3175	1.5821	1.4648	1.5821	1.4648	1.6051	1.4438	1.6053	1.4436
Georgia	2.1408	1.6377	1.3072	1.6377	1.3072	1.6377	1.3072	1.6377	1.3072
World	1.5388	1.3196	1.1661	1.3194	1.1663	1.2358	1.2451	1.2358	1.2452

[1]Equation (19). [2]Equation (22). [3]Equation (25). [4]Equation (29) .

Table 2: Components of Global Inflation

ICP Region	Domestic Price Change[1]	Exchange Rate Change [1]	Domestic Price Change[2]	PPP Change[2]

Why SV is preferred

- **Simpler functional form.**
- **Decomposable (into 3 components; or contributions of groups of countries).**
- **See Table 2 and Table 3 (in paper).**

Components of Inflation

[T3S7P23_pap]RaoRambaldiBalk_OnMeasuringRegionalOrGlobalGrowthAndInflation.pdf - Adobe Acrobat

Bestand Bewerken Beeld Venster Help

Openen Maken Aanpassen

17 / 24 150% Gereedschappen Invullen en ondertekenen Opmerking

[1]Equation (19). [2]Equation (22). [3]Equation (25). [4]Equation (29) .

Table 2: Components of Global Inflation

ICP Region	Domestic Price Change[1]	Exchange Rate Change [1]	Domestic Price Change[2]	PPP Change[2]
Asia and the Pacific	1.3945	1.1271	1.4354	1.0899
Africa	1.6089	0.8878	1.6257	0.8621
CIS	2.1326	0.9180	2.1478	0.9102
EuroStat-OECD	1.1104	1.0896	1.1244	1.0693
Latin America	1.6809	1.1736	1.6968	1.1557
Iran	2.5035	0.8444	2.5035	0.8444
West Asia	1.5661	1.0103	1.6155	0.9937
Georgia	1.5237	1.0748	1.5237	1.0748
World	1.2148	1.0861	1.3058	0.9464

[1]Equation (21). [2]Equation (28).

whereby the Sato-Vartia indices possess the virtue of simple decomposability. The pair formed

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Thank you!