

Treatment of basic headings with negative expenditure within the PPP aggregation procedures

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Content

This note refers to two points:

- **Impact of negative expenditure on aggregated PPPs**
- **Special treatment of BHs with negative expenditure in the PPP aggregation procedures**

Introduction

- All PPP and structural methods are based on the assumption that price data contains only positive values and expenditure / quantity data – only non-negative values
- This is not so in the ICP practice. GDP contains several basic headings (BH) where negative expenditure can occur
- Mainly, these are, so called, “Balancing categories”: “Net exports”, „Change in inventories“, „Net expenditures of residents abroad“, „Acquisitions less disposals of valuables“
- Several SNA positions like “Receipts from sales” in Government have negative expenditure by the definition.
- Additionally, even BHs from the „Machinery and Equipment“ can have negative values due to the export of „second hand equipment”

Former ICP phases with the use of the G-K method

- Additive aggregation methods like the GK or the IDB based on the simultaneous calculation of PPPs and international average prices are very sensitive to the presence of negative expenditure values
- Negative average prices or even negative aggregated PPPs can be obtained
- Recent version of the PWT10.1 (version of 23 Jan 2023) contains the cases where GK GDP-PPP/PLIs are negative. For example, Bermuda had for several years very specific structure of main GDP components. In effect, the indicator “pl_gdpo” => Price level of CGDPo (PPP/XR) [price level of USA GDPo in 2017=1] is negative!?

country	country	currenc	year	pl_con	pl_da	pl_gdpo	i_cig	i_xm	i_xr	i_outlie	i_irr	cs_h_c	cs_h_i	cs_h_g	cs_h_x	cs_h_m	cs_h_r
BMU	Bermuda	Bermudian	1999	1.232	1.307	-24.708	Interpolat	Benchmar	Market-ba	Outlier	Regular	-12	-3	-3	-2	33	-13
BMU	Bermuda	Bermudian	2000	1.229	1.296	-3.752	Interpolat	Benchmar	Market-ba	Outlier	Regular	-2	0	0	0	7	-3
BMU	Bermuda	Bermudian	2001	1.187	1.238	-3.274	Interpolat	Benchmar	Market-ba	Outlier	Regular	-1	0	0	0	6	-3
BMU	Bermuda	Bermudian	2003	1.266	1.285	-12.750	Interpolat	Benchmar	Market-ba	Outlier	Regular	-6	-1	-2	-2	21	-9

Theoretical assumptions and practice

- The cases with the negative PPPs were very rare in the actual ICP rounds (mostly in provisional calculations). However this does not mean that negative expenditure values have no impact on the accuracy / bias of PPPs
- PPPs are calculated by the assumption that expenditure/quantity are non-negative
- Therefore, negative expenditure bring inevitably distorting effect. The size of distortions depends on the aggregation method *per se*, on the size (shares) of negative expenditure and on the variation of underlying BH-PPP/PLIs

The most problematic categories

- The most important BH with potential negative expenditure is "Net exports". This category has very significant negative value in many countries (in some extreme cases, **the share of "Net exports" in GDP is minus 30-50% and respectively the share of Domestic Absorption (DA) 130-150 %!?**)
- Distorting effect can be significant. Therefore this topic was intensively discussed in the earlier ICP rounds by the use of the G-K aggregation
- The distribution of „Net exports“ expenditure (and „Change in stocks“) proportionally between representing BHs was used by the GK, to avoid special treatment of negative expenditure

Present state in the ICP (1)

- The EKS aggregation using in the recent ICP rounds is much less sensitive than the GK concerning the presence of the negative expenditure values
- The present ICP (as well EU-OECD) methodology and the practice ignore simply this problem
- BHs with negative expenditure are treated in the EKS in the standard way like all other BHs
- The EKS method is relatively rough method and extreme meaningless results like fully unpalusible or even negative PPPs are very rare. Therefore this problem was never discussed seriously in recent phases of the ICP

Present state in the ICP (2)

- Obviously, the absence of extreme PPP figures does not mean that the treatment is fully correct
- The aggregated Laspeyres and Paasche PPPs (and, in effect, F- and EKS-PPPs) can be calculated as correct averages only on the basis of non-negative input data for prices and quantities / expenditures
- Therefore the inclusion of the BHs with negative expenditure in the aggregation procedures without a special treatment leads inevitably to the distortions / not reliable PPPs

LPS as the indications on the distortion

- The reliability of the bilateral F-PPPs is measured usually by the analysis of the Laspeyres - Paasche Spread (LPS)
- The borders for acceptable LPS values are depended on homogeneity of the set of the countries
- The set of the ICP 2021 countries have very different structures of expenditure and prices (BH-PPPs). Therefore “liberal” borders of acceptable LPS values ($LPS < 0.9$ or $LPS > 2.0$) were selected
- The official set of the Global ICP bilateral F-PPPs contains very high no. of cases with extreme L/P ratios
- Total No. of bilateral Global F-PPPs for 159 countries in the ICP 2021 is = 12561 ($159 * 158 / 2$). Total No. of bilateral Global F-PPPs with L/P ratios outside the range $0.9 < L/P < 2.0$ is 2216
- The share (%) of extreme L/P ratios is 17.6% ($2216 / 12561 * 100$).
It means that circa 20% of bilateral F-PPPs are not very reliable

ICP 2021 (159 countries, free EKS calculation, Act. V, v16.04.24)

Countries with extreme high No. of extreme L/P ratios for GDP

	Shares of Net Exports	L/P	L/P	No. of L/P	No. of L/P	No. of L/P
	(%)	MAX	MIN	> 2.0	< 0.9	(>2.0; <0.9)
AGO	31.0	2.248	0.492	1	33	34
COM	-20.0	3.691	0.849	32	1	33
CPV	-36.6	3.469	0.334	11	24	35
MWI	-16.5	4.203	1.000	45	0	45
RWA	-15.6	4.005	1.000	30	0	30
SLE	-24.5	4.074	1.000	37	0	37
KGZ	-28.7	4.633	0.861	34	2	36
TJK	-23.5	4.952	0.682	37	2	39
CHE	12.3	9.427	1.000	82	0	82
DNK	6.7	6.560	1.000	34	0	34
IRL	40.1	12.011	1.000	94	0	94
LUX	33.3	8.225	1.000	78	0	78
NOR	12.9	6.712	1.000	42	0	42
ARE	18.7	4.689	1.000	42	0	42
KWT	2.0	4.830	1.000	38	0	38
LBN	-31.2	4.626	0.930	48	0	48
QAT	24.8	6.280	1.000	47	0	47
SYR	-48.3	12.011	1.000	152	0	152

OECD 2021 (50 countries, free EKS calculation, Act. V, v16.04.24)

Countries with extreme high No. of extreme L/P ratios for GDP

	Shares (%) of Net Exports	MAX	MIN	No. L/P >1.5	No. L/P <0.95	Total no. (>1.5;<0.95)
ALB	-13.4	2.227	0.951	13	0	13
AUS	5.4	2.211	1.000	8	0	8
AUT	0.9	2.022	1.000	1	0	1
BEL	1.8	2.161	1.000	4	0	4
BGR	1.8	2.050	1.000	3	0	3
BIH	-11.3	2.214	0.997	6	0	6
CAN	0.0	1.838	1.000	1	0	1
CHE	12.3	3.295	1.000	15	0	15
CHL	-0.8	1.484	1.000	0	0	0
COL	-7.6	2.185	1.000	5	0	5
CRI	1.6	1.836	1.000	3	0	3
CYP	4.0	1.707	1.000	1	0	1
CZE	3.0	1.673	0.992	1	0	1
DEU	5.4	2.240	1.000	6	0	6
DNK	6.7	2.246	1.000	6	0	6
ESP	1.0	1.720	1.000	1	0	1
EST	-1.0	1.570	1.000	1	0	1
FIN	0.0	1.750	0.983	1	0	1
FRA	-1.9	1.816	1.000	1	0	1
GBR	-0.2	1.961	1.000	2	0	2
GRC	-7.8	1.497	0.981	0	0	0
HRV	-2.7	1.761	0.925	3	1	4
HUN	0.2	1.620	1.000	3	0	3
IRL	40.1	3.669	1.000	17	0	17
ISL	-2.0	1.698	0.961	1	0	1
ISR	3.6	1.865	1.000	1	0	1
ITA	2.2	1.948	1.000	1	0	1
JPN	-0.5	1.975	1.000	3	0	3
KOR	3.6	1.807	1.000	2	0	2
LTU	4.5	1.512	0.976	1	0	1
LUX	33.3	3.456	1.000	16	0	16
LVA	-3.2	1.555	1.000	1	0	1
MEX	-1.9	1.721	1.000	3	0	3
MKD	-15.8	2.705	0.968	12	0	12
MLT	17.8	1.768	0.993	1	0	1
MNE	-19.4	2.319	0.864	12	1	13
NLD	11.3	2.226	1.000	6	0	6
NOR	12.9	2.429	1.000	9	0	9
NZL	-3.2	1.912	1.000	4	0	4
POL	3.3	1.710	0.986	3	0	3
PRT	-2.8	1.523	1.000	1	0	1
ROU	-5.7	1.841	1.000	3	0	3
SRB	-8.0	2.128	1.000	6	0	6
SVK	-0.1	1.492	0.990	0	0	0
SVN	5.8	1.737	0.961	1	0	1
SWE	4.7	1.947	1.000	1	0	1
TUR	0.4	2.491	0.986	9	0	9
USA	-3.6	2.302	1.000	9	0	9
GEO	-16.4	3.669	1.000	31	0	31
UKR	-1.3	2.848	0.864	9	2	11
			Total =>	248	4	252
MAX	40.1	3.669				
MIN	-19.4		0.864			
			Total No. No.of prob. L/P Sh.(%)	1225 252 20.6		

What do do?

Attempts done in the past

- ❖ **Eurostat – the use of selective EKS procedure**
 - (As the experiments only)

F-PPPs with the LPS outside the selected range (mostly these are LPS for the countries with high share of negative expenditure) are excluded from the EKS procedure and replaced by GM of indirect PPPs from “reliable” linked PPPs

- ❖ **ICP ToolPack – the use of Tornqvist index for bilateral PPPs instead of F-PPPs (at least, in the experimental ICP calculations)**

Selective EKS

This approach softs the impact of negative expenditure within the EKS procedure. The differences with the official results are rather moderate. Only few countries have differences more than +/-1%

Differences in the GDP results by the use of the LPS [0.9; 2.0]

ICP 2021 (159 countries, free EKS calculation, Act. V, v16.04.24)

AggrL	Exp. (mio. NC)		Shares of Net Exports (%)	Free EKS PPPs (\$=1)		Free EKS PPPs GDP (\$=1)			Volume Index pc (ICP159=100)		
	5th	4th		Free EKS PPPs (\$=1)		Free EKS PPPs GDP (\$=1)			Volume Index pc (ICP159=100)		
	GDP	Net Exports		DA	NetExp-XR	Official	LPS (0.9,2.0)	% Diff.	Official	LPS (0.9,2.0)	% Diff.
COM	558 319	-111 398	-20.0	192.556	415.956	187.668	195.779	4.3	18.9	18.2	-3.6
CPV	164 544	-60 271	-36.6	49.068	93.218	49.521	48.595	-1.9	29.5	30.2	2.5
GNQ	6 803 761	604 119	8.9	235.754	554.531	234.125	238.470	1.9	92.8	91.7	-1.3
MWI	9 975 522	-1 649 065	-16.5	316.370	799.650	303.702	317.889	4.7	8.6	8.3	-3.9
SGP	569 364	203 635	35.8	0.974	1.344	0.902	0.916	1.6	604.3	598.1	-1.0
CHE	743 330	91 571	12.3	1.107	0.914	1.032	1.051	1.9	432.1	426.6	-1.3
IRL	434 070	173 949	40.1	0.812	0.845	0.723	0.778	7.5	624.3	584.0	-6.5
LUX	72 361	24 099	33.3	0.951	0.845	0.811	0.828	2.2	727.9	716.6	-1.6
ARE	1 524 744	285 085	18.7	2.557	3.673	2.478	2.457	-0.9	343.0	348.0	1.4
LBN	192 669 936	-60 141 536	-31.2	4416.086	11200.000	4167.482	4350.902	4.4	43.2	41.6	-3.7
PSE	58 526	-22 475	-38.4	1.923	3.232	1.987	1.954	-1.6	29.4	30.1	2.2
SYR	25 936 805	-12 517 413	-48.3	498.627	2150.833	423.146	434.058	2.6	11.9	11.7	-2.0
		MIN	-65.7				MIN	-1.9		MIN	-6.5
		MAX	40.1				MAX	7.5		MAX	2.5

EKS-F vs. EKS-T

- Fisher-PPP is undefined if negative or zero Laspeyres or Paasche PPPs are occurred
- T-index guarantees **formally** the obtaining positive bilateral PPPs by negative expenditure
- Generally, F-PPP and T-PPP are not very far from each other =>
- In effect, the differences “EKS-F vs. EKS-T” are generally very small

“EKS-F vs. EKS-T” differences more than +/-3% for the VIpC (World159=100)

(ICP 2021 (159 countries, free EKS calculation, Act. V, v16.04.24)

AggrL	Exp. (mio. NC)		Shares of Net Exports (%)	Free EKS DA PPPs (\$=1)			Free EKS PPPs GDP (\$=1)			Volume Index pc (ICP159=100)		
	5th	4th		EKS-F	EKS-T	% Diff.	EKS-F	EKS-T	% Diff.	EKS-F	EKS-T	% Diff.
	GDP	Net Exports										
BDI	7 506 400	-1 435 000	-19.1	674.472	681.465	1.0	639.454	643.798	0.7	4.9	4.7	-3.5
CAF	1 431 537	-257 750	-18.0	256.315	257.433	0.4	250.281	251.555	0.5	5.5	5.3	-3.3
COM	558 319	-111 398	-20.0	192.556	198.223	2.9	187.668	195.244	4.0	18.9	17.7	-6.6
GNQ	6 803 761	604 119	8.9	235.754	239.892	1.8	234.125	235.062	0.4	92.8	89.9	-3.2
LBR	621 270	-130 957	-21.1	77.682	79.351	2.1	75.531	77.534	2.7	8.3	7.8	-5.3
MDG	55 744 386	-4 965 967	-8.9	1281.582	1300.355	1.5	1231.952	1239.181	0.6	8.2	7.9	-3.4
MWI	9 975 522	-1 649 065	-16.5	316.370	321.177	1.5	303.702	306.993	1.1	8.6	8.3	-3.8
SSD	4 245 061	-54 302	-1.3	139.207	141.667	1.8	136.616	138.074	1.1	15.1	14.5	-3.8
CHE	743 330	91 571	12.3	1.107	1.108	0.1	1.032	1.035	0.3	432.1	418.6	-3.1
KWT	42 766	850	2.0	0.205	0.216	5.2	0.202	0.210	4.2	254.8	237.8	-6.7
LBN	192 669 936	-60 141 536	-31.2	4416.086	4446.346	0.7	4167.482	4192.235	0.6	43.2	41.7	-3.4
QAT	654 225	162 083	24.8	2.506	2.373	-5.3	2.424	2.246	-7.4	512.7	537.9	4.9
SAU	3 278 085	275 572	8.4	1.967	2.003	1.9	1.946	1.952	0.3	257.8	249.9	-3.1
SDO	18 703 277	-820 711	-4.4	78.473	73.930	-5.8	75.018	69.721	-7.1	28.5	29.8	4.6
		MIN	-65.7			-5.8		MIN	-7.4		MIN	-6.7
		MAX	40.1			5.2		MAX	4.2		MAX	4.9

Drawbacks (selective EKS and T-PPP)

- The use of LPS limits does not solve the general problem because all Laspeyres – Paasche PPPs are calculated in any case with the actual expenditure values. The aggregated Laspeyres and Paasche PPPs (and, in effect, EKS-PPPs) can be calculated as correct averages only on the basis of non-negative input data quantities / expenditures
- The use of the T-PPPs this is not the solution of the problem. The aim is not to obtain somehow any positive PPPs but to obtain the reliable PPPs in a straightforward way. The aggregated PPPs are defined as weighted average indices. Correct averages can be obtain only by positive weights
- The use of the LPS borders as well as the Tornqvist bilateral indexes is applicable only for the EKS method. How should be treated negative expenditure in other multilateral aggregation methods like GK or IDB?
- To guarantee meaningful results for the aggregates in the general case, special treatment for „balancing“ categories is needed for all methods based on averaging of input data

Treatment of balancing BH within the EKS

- The mechanical application of standard formulae to L-P-PPPs violates the average test if the BHs with negative value have significant share
- This can lead to non-reliable bilateral F-PPPs with extreme LPS or even to fully meaningless results - negative Laspeyres or Paasche PPPs
- To avoid such cases, it is possible to use a simple modification of the standard formulas of Laspeyres and Paasche PPPs =>
- To use absolute nominal expenditure values instead of actual nominal values of expenditure data for the calculation of the weights for BHs

Modified EKS - calculations of L- and P-PPPs

The use of the absolute expenditure weighs (shares, %) for the calculations of L- and P-PPPs

Laspeyres - Type:

$$PPP_L^{j/k} = \frac{\sum p_j * |q_k|}{\sum p_k * |q_k|} = \frac{\sum ppp^{j/k} * |w_k|}{\sum |w_k|}$$

Paasche - Type:

$$PPP_P^{j/k} = \frac{\sum p_j * |q_j|}{\sum p_k * |q_j|} = \frac{\sum |w_j|}{\sum |w_j| / ppp^{j/k}}$$

- The modified method guarantees the obtaining strictly positive L-, P-PPPs
- Absolute values are used for the calculation of bilateral L-, P-PPPs only
- Real values, etc. are calculated on the basis of actual nominal values (with actual signs)
- This approach is possible to use also in other PPP aggregations like GK/IDB

Modified GK

Use of absolute notional quantities

$$(A.1) \quad \pi_i = \sum_{j=1}^N (P_{ij} * f_j) * |q_{ij}| / \sum_{j=1}^N |q_{ij}|; \quad i = 1, 2, \dots, M$$

$$(A.2) \quad f_j = \sum_{i=1}^M (\pi_i * |q_{ij}|) / \sum_{i=1}^M (p_{ij} * |q_{ij}|); \quad j = 1, 2, \dots, N$$

- The absolute quantities are used within the GK-method for the calculations of international prices only
- Consequently the PPPs (A.2) are used for the calculation of the average international prices only
- The actual quantities (with sign) and the international prices calculated by formula (A.1) are used for calculations of real values and respective volume indices
- The final PPP „International currency/National currency“ are calculated as the ratio of Real GDPs at international prices to nominal GDPs at national prices

“Net exports” $\Leftrightarrow$ “Exports” / “Imports”

- **Separate BHs for “Exports”/“Imports” but XRs as ref. PPPs**
- **EKS:** The GDP results are the same as by the use “Net exports”
- **GK:** The GDP results are different and it is better to use “Net export” to decrease the danger for meaningless results
- BH „Net purchases abroad“ is included in the GDP twice with opposite signs: in the „FCP (national)“ and in the „Net exports“ => Expenditure data for these two BHs („Net purchases abroad“ and „Net exports“) should be combined before the calculation of the PPP for GDP
- **Separate BHs for Exports” / “Imports” and different PPPs**
- **EKS:** The GDP results are different as by the use “Net exports”
- **GK:** The GDP results are different
- Ref. PPPs for “Net purchase abroad” => Should be average PPPs from “Exports”/“Imports”!

Impact of modified EKS (1) – No. of LPS

- Total No. of bilateral Global F-PPPs with L/P ratios outside the range $0.9 < L/P < 2.0$ is 950 $\Rightarrow$ The share (%) of extreme L/P ratios by the use of absolute expenditure weights is 7.6% ($950 / 12561 \times 100$)
- There is drastic reduction the share of the cases with problematic LPS relatively the official version with the use of actual expenditure weights

	Shares of Net Exports	L/P MAX	L/P MIN	No. of L/P > 2.0	No. of L/P < 0.9	No. of L/P (>2.0; <0.9)
	(%)					
AGO	31.0	1.795	0.838	0	13	13
BFA	-0.6	3.012	0.943	11	0	11
CMR	-3.7	3.173	0.950	13	0	13
ETH	-9.7	2.958	1.000	12	0	12
GNQ	8.9	2.988	1.000	20	0	20
MDG	-8.9	2.975	0.976	10	0	10
MLI	-8.5	3.076	0.989	11	0	11
MWI	-16.5	3.380	1.000	22	0	22
RWA	-15.6	2.693	1.000	12	0	12
TZA	-0.9	3.191	0.884	9	1	10
CHE	12.3	5.287	1.000	53	0	53
IRL	40.1	7.059	1.000	73	0	73
LUX	33.3	4.570	1.000	48	0	48
NOR	12.9	3.812	1.000	21	0	21
NZL	-3.2	3.306	1.000	10	0	10
USA	-3.6	3.974	1.000	15	0	15
ARE	18.7	2.897	1.000	19	0	19
KWT	2.0	2.965	1.000	17	0	17
LBN	-31.2	3.275	1.000	14	0	14
QAT	24.8	3.845	1.000	32	0	32
SYR	-48.3	7.059	1.000	122	0	122
Max	40.1	7.059				
Min	-65.7		0.832			
			Total	920	30	950

Impact of modified EKS (2a) – Vlpc

➤ Vlpc (World=100) differences less than - 5%

Only few countries have the Vlpc difference less than -10%: GMB, BTN, NPL, KGZ, TJK, UZB, SYR. These are the countries with very high negative share of “Net exports”

ICP 2021: Differences in the GDP results by different treatment of balancing BHs

AggrL	Exp. (mio. NC)		Shares of Net Exports (%)	Free EKS PPPs (\$=1)		Free EKS PPPs GDP (\$=1)			Volume Index pc (ICP159=100)		
	5th	4th		DA	NetExp-XI	Act. Value	Abs. Values	% Diff	Act.V	Abs.V	% Diff
	GDP	Net Exports									
BDI	7 506 400	-1 435 000	-19.1	674.472	1975.951	639.454	718.252	12.3	4.9	4.5	-7.9
DJI	609 208	170 548	28.0	92.582	177.721	91.260	100.892	10.6	31.5	29.8	-5.5
EGY	7 226 500	-560 600	-7.8	4.434	15.645	4.238	4.775	12.7	81.5	75.4	-7.5
ETH	5 249 281	-507 357	-9.7	15.230	48.567	14.570	16.264	11.6	15.6	14.6	-6.6
GIN	154 656 800	-31 143 700	-20.1	3439.807	9728.774	3258.614	3685.064	13.1	18.3	16.9	-7.8
GMB	105 487	-30 447	-28.9	17.106	51.484	15.926	18.590	16.7	13.1	11.7	-10.8
MDG	55 744 386	-4 965 967	-8.9	1281.582	3829.978	1231.952	1376.917	11.8	8.2	7.6	-6.7
MOZ	1 058 442	-332 118	-31.4	26.417	65.465	25.175	28.122	11.7	6.8	6.4	-6.7
RWI	9 975 522	-1 649 065	-16.5	316.370	799.650	303.702	333.911	9.9	8.6	8.2	-5.2
RWA	10 929 200	-1 707 000	-15.6	335.419	988.625	318.854	359.598	12.8	13.3	12.3	-7.5
SLE	44 359 564	-10 883 417	-24.5	3633.245	9829.927	3424.932	3897.920	13.8	8.0	7.4	-8.3
SOM	7 628	-5 012	-65.7	0.436	1.000	0.409	0.466	13.8	5.7	5.2	-8.3
TUN	130 466	-13 178	-10.1	0.980	2.794	0.943	1.048	11.2	58.9	55.3	-6.2
UGA	153 589 883	-15 238 045	-9.9	1290.416	3587.052	1245.517	1369.436	9.9	14.0	13.3	-5.1
BTN	204 664	-39 265	-19.2	21.723	73.940	20.322	23.679	16.5	69.5	62.2	-10.5
IND	227 242 946	-5 478 906	-2.4	22.236	73.918	21.548	23.723	10.1	40.3	38.1	-5.4
LAO	184 982 069	-10 960 088	-5.9	3326.694	9697.916	3221.288	3569.900	10.8	40.9	38.5	-5.9
LKA	17 600 190	-1 301 049	-7.4	58.048	198.880	55.578	62.272	12.0	74.6	69.4	-7.0
NPL	4 543 219	-1 550 409	-34.1	36.871	118.134	33.747	40.677	20.5	24.2	20.9	-13.5
PAK	61 229 896	-6 475 177	-10.6	47.156	162.625	44.853	51.048	13.8	31.7	29.0	-8.4
ARM	6 991 778	-549 344	-7.9	153.096	503.770	147.227	162.542	10.4	83.7	78.4	-6.3
KGZ	782 854	-224 289	-28.7	21.236	84.641	19.277	23.738	23.1	31.0	26.2	-15.4
MDA	242 079	-65 781	-27.2	6.075	17.682	5.711	6.563	14.9	84.6	76.8	-9.3
TJK	101 076	-23 715	-23.5	2.680	11.309	2.450	2.984	21.8	22.0	18.7	-15.0
UZB	738 425 246	-121 802 161	-16.5	2740.154	10609.980	2561.255	2988.322	16.7	43.1	38.2	-11.5
MKD	729 445	-115 498	-15.8	19.403	52.113	18.659	20.539	10.1	104.5	98.8	-5.5
NIC	497 524	-66 960	-13.5	11.689	35.236	11.183	12.518	11.9	33.9	31.6	-6.8
EGZ	7 226 500	-560 600	-7.8	4.117	15.645	3.927	4.477	14.0	87.9	80.4	-8.6
LBN	192 669 936	-60 141 536	-31.2	4416.086	11200.000	4167.482	4613.582	10.7	43.2	40.6	-5.9
SDO	18 703 277	-820 711	-4.4	78.473	370.791	75.018	85.960	14.6	28.5	25.9	-9.2
SYR	25 936 805	-12 517 413	-48.3	498.627	2150.833	423.146	553.068	30.7	11.9	9.3	-22.1
TUO	130 466	-13 178	-10.1	0.926	2.794	0.889	0.995	12.0	62.5	58.2	-6.9
	MIN		-65.7				MIN	-2.6		MIN	-22.1

Impact of modified EKS (2b) – Vlpc

➤ Vlpc (World=100) differences more than - 5%

There are only very few countries with such Vlpc difference – GRC, ISL, NZL and surprisingly PSE

ICP 2021: Differences in the GDP results by different treatment of balancing BHs

AggrL	Exp. (mio. NC)		Shares of Net Exports (%)	Free EKS PPPs (\$=1)		Free EKS PPPs GDP (\$=1)			Volume Index pc (ICP159=100)		
	5th	4th									
	GDP	Net Exports		DA	NetExp-XI	Act. Value	Abs. Values	% Diff	Act.V	Abs.V	% Diff
GRC	181 500	-14 107	-7.8	0.573	0.845	0.574	0.571	-0.5	155.0	162.8	5.0
ISL	3 250 399	-65 146	-2.0	147.801	126.951	147.744	144.294	-2.3	308.4	330.0	7.0
NZL	353 054	-11 437	-3.2	1.546	1.414	1.549	1.541	-0.5	232.8	246.0	5.7
PSE	58 526	-22 475	-38.4	1.923	3.232	1.987	1.936	-2.6	29.4	31.5	7.2
										MAX	7.2

So, the differences in the results between the official and modified methods are remarkable in several cases but generally these are not drastic

Disputable points (1)

➤ There was in the past the discussions on this point with the OECD (with some parallels with the NA practice)

➤ **The OECD opinion was the following:**

*GDP includes only domestic production and therefore the influence of imports should offset. It is possible to ignore the presence negative expenditure during the PPP calculations. The distortion of the average test for L-, P-PPPs in the case of high negative “Net exports” even logical. It is a problem with countries, of which net exports are negative and exchange rates are significantly higher than PPPs for DA (low PLI). One can conclude that because Net exports are negative and their XRs relatively high compared to DA-PPPs then => **PPPs for total of GDP must be lower than PPPs for Domestic Absorption***

➤ The GDP is Domestic absorption adjusted by Net Exports. However, it is impossible to calculate straightforwardly the PPPs for the domestic production without the impact of imported products with purchaser's prices collected for the expenditure on GDP simply by ignorance of the theoretical assumptions of applied index methods

Disputable points (2)

- The Laspeyres and Paasche PPPs are defined in terms of average indices. The "true" L- , P-PPP as average indices can be calculated on only the basis of non-negative weights. If the aggregated PPPs are defined in terms of average indices then one should follow the rules of this concept by the PPP calculations
- If one wants to use the OECD concept straightforwardly then the Gerardi method is much more appropriate - the use of GM of national prices (= the use of GM of national price structures) as quasi-international prices for the direct calculation of the real values / volumes
- The price indices are only „collateral product“ by the Gerardi method. To obtain the Real Value-Total one does not need meaningful aggregated price indices. It means, price indices for the total can be outside the range of the price indices of the BHs and the aggregate price indices can be, at all, infinite
- There is a parallel with the situation with double deflation in the NA. Aggregated deflators can be doubtful but the volumes (Real values) can be still correct. *Therefore NA price indices are often not shown.*

Disputable points (3)

- The problem concerns not only "Net export" for poor countries but, also other BHs, for example, BHs from "Machinery and equipment" can be rather a problem for rich countries (Eurostat 1997 case)
- The problem in the aggregation EKS PPP procedure is much more complicated than in NA. The task is not the recalculation by prices of another period or into constant prices but the multilateral recalculation into a common currency
- The bilateral PPPs are only input data for further intricate treatment in the EKS. All usual considerations which are correct for simple methods like the standard recalculation of NA data into constant prices are not valid for more complicated methods like EKS or GK
- It is better to use meaningful bilateral PPPs for further EKS calculation

Disputable points (4)

- The EKS method cannot be explained in economic terms. The EKS procedure is rather a formal mathematical approach to obtain mechanically transitive results with equal impact of all countries
- It is very difficult to apply intuitive considerations to EKS-PPP which is a complicated capricious conglomerate from direct and indirect PPPs obtained by very different weights and BH-PPP structures
- The EKS process may change considerably results relatively intuitive considerations and it is hard to say in general case anything about the size or even direction of possible differences
- Intuitive considerations like *"PPP for GDP-Total should go down compared to the PPP for DA by negative Net exports"* are not always valid neither for bilateral F-PPPs nor for final multilateral EKS results.
- The respective examples can be found in the actual international comparisons – see the examples from ICP 2017 and ICP 2021, to demonstrate possible distorting effect of the categories with negative expenditure in the EKS PPP calculations without a special treatment

Several EKS / F-PLI examples from ICP 2017 (1)

➤ First example: F-PPP between STP and LUX

		A	B	A	B	
		STP	LUX	STP	LUX	(A+B)/2
	PLI A/B (B=100)	Sh Exp A (%)	Sh Exp B (%)	PLI A (W=100)	PLI B (W=100)	T-Sh
DA	45.8	150.7	64.8	68.7	150.1	1.078
Net exports	100.0	-50.7	35.2	100.0	100.0	-0.078
GDP	50.0	100.0	100.0	67.1	134.2	1.000
Bilateral F-PLI from DA and Net exports						
L-PLI STP/LUX (LUX=100)		64.9				
P-PLI STP/LUX (LUX=100)		35.9				
F-PLI STP/LUX (LUX=100)		48.3				
T-PLI STP/LUX (LUX=100)		43.1				

STP has very high negative “Net export” (~ - 50%) and low PLI for DA = ~ 46% (LUX=100). What sense to calculate HM Paasche PLI with the exotic STP weights = 150% (DA) and – 50% (Net exports)? In effect, Paasche-PLI for STP (LUX =100) was outside the PLIs for underlying categories. **Both STP PLIs (LUX=100) for GDP - multilateral EKS as well as bilateral F-PLI - are higher than PLI for DA!**

Several EKS / F-PLI examples from ICP 2017 (2)

➤ Second example: F-PPP between SDN and CHE

		A	B	A	B	
		SDN	CHE	SDN	CHE	(A+B)/2
	PLI A/B (B=100)	Sh Exp A (%)	Sh Exp B (%)	PLI A (W=100)	PLI B (W=100)	T-Sh
DA	19.7	106.0	89.4	34.8	176.5	0.977
Net exports	100.0	-6.0	10.6	100.0	100.0	0.023
GDP	20.0	100.0	100.0	33.8	169.0	1.000
Bilateral F-PLI from DA and Net exports						
L-PLI SDN/CHE (CHE=100)		28.2				
P-PLI SDN/CHE (CHE=100)		18.8				
F-PLI SDN/CHE (CHE=100)		23.0				
T-PLI SDN/CHE (CHE=100)		20.5				

SDN has moderate share of negative “Net export” (~ - 6%) but very low PLI for DA = ~ 20% (CHE=100). In effect, Paasche-PLI for SDN (CHE =100) was outside the PLI for underlying categories even the share of negative expenditure is relatively small. **Both SDN PLIs (CHE=100) for GDP - EKS as well as bilateral F-PLI- are higher than PLI for DA!**

Several EKS / F-PLI examples from ICP 2017 (3)

➤ Third example: F-PPPs between NPL and CHE

		A	B	A	B	
		NPL	CHE	NPL	CHE	(A+B)/2
	PLI A/B (B=100)	Sh Exp A (%)	Sh Exp B (%)	PLI A (W=100)	PLI B (W=100)	T-Sh
DA	26.2	133.8	89.4	46.2	176.5	1.116
Net exports	100.0	-33.8	10.6	100.0	100.0	-0.116
GDP	25.3	100.0	100.0	42.8	169.0	1.000
Bilateral F-PLI from DA and Net exports						
L-PLI NPL/CHE (CHE=100)		34.0				
P-PLI NPL/CHE (CHE=100)		20.9				
F-PLI NPL/CHE (CHE=100)		26.7				
T-PLI NPL/CHE (CHE=100)		22.4				

NPL has high negative “Net export” (~ - 33%) and low PLI for DA = ~ 25% (CHE=100). What sense to calculate HM Paasche PLI with the exotic NPL weights = 133% (DA) and – 33% (Net exports)? In effect, Paasche-PLI for STP (LUX =100) was outside the PLIs for underlying categories. Bilateral NPL F-PLI for GDP (CHE=100) was higher than PLI for DA but multilateral EKS NPL GDP PLI was lower than PLI for DA. What PLI is more “true”?

Several EKS / F-PLI examples from ICP 2017 (4)

➤ Fourth example: F-PPP between STP and LSO

		A	B	A	B	
		STP	LSO	STP	LSO	(A+B)/2
	PLI A/B (B=100)	Sh Exp A (%)	Sh Exp B (%)	PLI A (W=100)	PLI B (W=100)	T-Sh
DA	110.3	150.7	141.6	68.7	62.3	1.462
Net exports	100.0	-50.7	-41.6	100.0	100.0	-0.462
GDP	112.6	100.0	100.0	67.1	59.6	1.000
Bilateral F-PLI from DA and Net exports						
L-PLI STP/LSO (LSO=100)		114.5				
P-PLI STP/LSO (LSO=100)		116.3				
F-PLI STP/LSO (LSO=100)		115.4				
T-PLI STP/LSO (LSO=100)		115.4				

Both countries (STP and LSO) have high share of negative “Net export” (~ - 50% and ~ - 40%), DA PLI between these countries (LSO=100) = 110% was close to 100%. In effect, Laspeyres, Paasche and Fisher PLIs for STP (LSO = 100) were higher than the PLI for underlying categories!

Several EKS PLI examples from ICP 2021

The Countries with high negative Net exports

➤ PLI (World =100) differences: PLI-GDP > PLI-DA

AggrL	Exp. (mio. NC)		Shares of										Free EKS PLIs		PLI
	5th	4th	Net Exports	Free EKS PPPs (\$=1)	Free EKS PPPs GDP (\$=1)			Volume Index pc (ICP159=100)			Av.	(World = 100)		Ratio	
	GDP	Net Exports	(%)	DA	NetExp-XR	Act. Value	Abs. Values	% Diff.	Act.Val	Abs.Val	% Diff.	Te	DA	GDP	DA / GDP
CPV	164 544	-60 271	-36.6	49.068	93.218	49.521	49.885	0.7	29.5	30.6	3.6	1	78.7	80.8	0.974
SYC	26 751	-2 784	-10.4	8.999	16.921	8.881	9.238	4.0	147.7	148.3	0.4	0	79.5	79.8	0.996
ZWE	36 044	-1 979	-5.5	0.559	1.000	0.552	0.569	3.1	21.3	21.6	1.3	0	83.5	84.0	0.995
CHL	240 371 473	-1 832 326	-0.8	465.363	758.955	458.805	475.400	3.6	139.0	140.1	0.8	0	91.7	92.0	0.997
EST	31 169	-313	-1.0	0.557	0.845	0.550	0.568	3.3	222.4	224.8	1.1	0	98.5	99.0	0.996
FRA	2 502 118	-47 098	-1.9	0.755	0.845	0.750	0.762	1.6	255.3	262.5	2.8	0	133.5	134.9	0.990
GBR	2 284 079	-3 518	-0.2	0.688	0.727	0.679	0.695	2.3	261.9	267.6	2.2	0	141.5	142.2	0.996
GRC	181 500	-14 107	-7.8	0.573	0.845	0.574	0.571	-0.5	155.0	162.8	5.0	1	101.4	103.4	0.981
HRV	58 408	-1 604	-2.7	0.469	0.845	0.463	0.474	2.5	166.6	169.6	1.8	0	82.9	83.3	0.996
ISL	3 250 399	-65 146	-2.0	147.801	126.951	147.744	144.294	-2.3	308.4	330.0	7.0	1	174.1	177.0	0.983
JPN	549 379 200	-2 952 200	-0.5	109.104	109.754	107.927	109.720	1.7	211.8	217.7	2.8	0	148.6	149.6	0.994
LVA	33 349	-1 051	-3.2	0.505	0.845	0.499	0.516	3.3	185.3	187.2	1.0	0	89.3	89.8	0.995
MEX	26 619 086	-515 362	-1.9	10.829	20.272	10.656	11.102	4.2	102.2	102.4	0.2	0	79.9	80.0	0.999
NZL	353 054	-11 437	-3.2	1.546	1.414	1.549	1.541	-0.5	232.8	246.0	5.7	0	163.5	166.6	0.981
PRT	216 053	-6 098	-2.8	0.606	0.845	0.601	0.608	1.2	182.3	188.1	3.2	0	107.1	108.1	0.991
SVK	100 256	-80	-0.1	0.538	0.845	0.530	0.549	3.7	181.6	182.9	0.7	0	95.1	95.3	0.997
USA	23 594 031	-858 239	-3.6	1.000	1.000	1.000	1.000	0.0	370.7	387.5	4.5	0	149.5	152.1	0.983
PSE	58 526	-22 475	-38.4	1.923	3.232	1.987	1.936	-2.6	29.4	31.5	7.2	1	89.0	93.5	0.952

➤ PLI (World =100) differences: PLI-GDP < PLI-DA

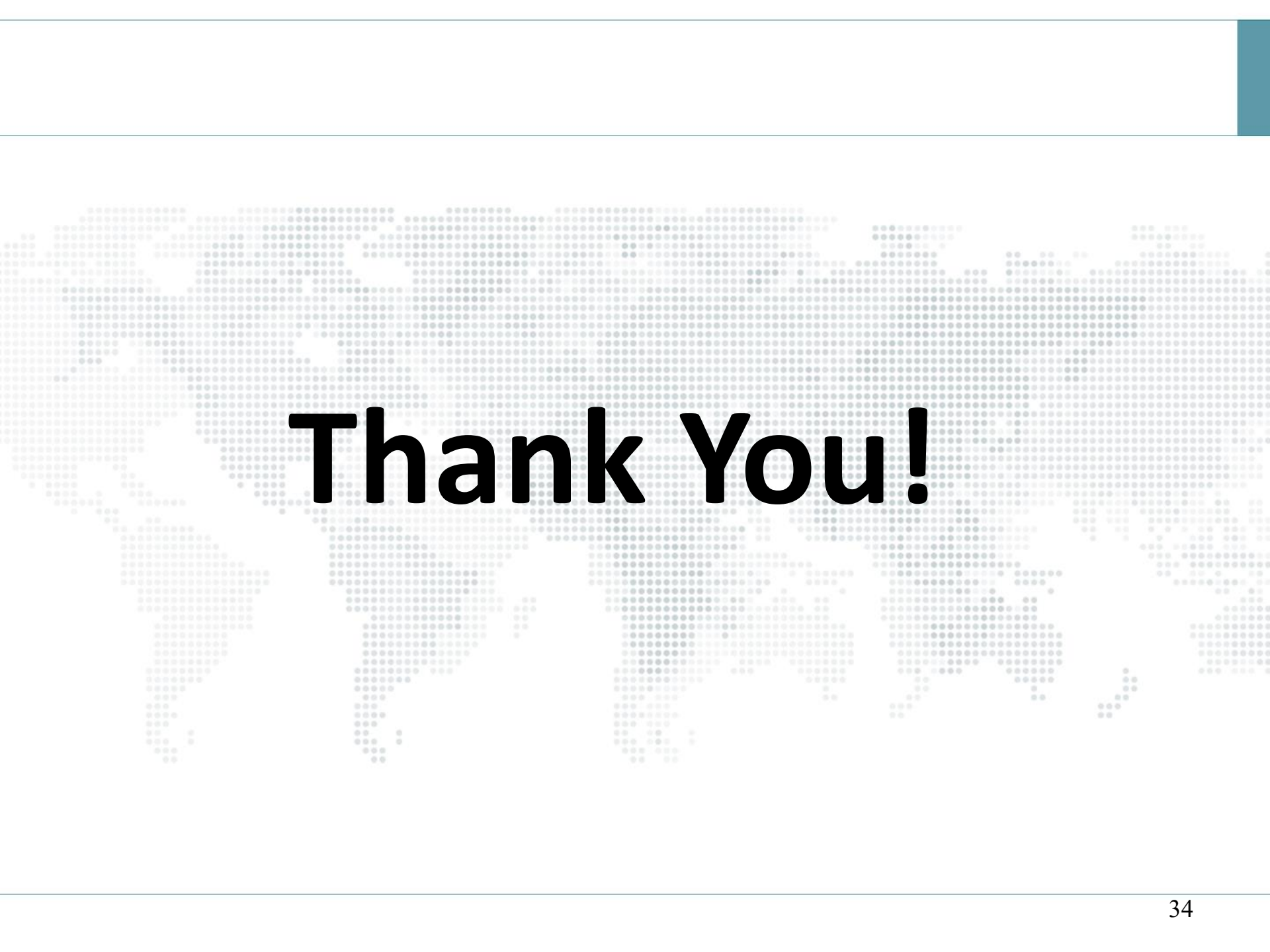
AggrL	Exp. (mio. NC)		Shares of										Free EKS PLIs		PLI	
	5th		4th	Net Exports	Free EKS PPPs (\$=1)		Free EKS PPPs GDP (\$=1)			Volume Index pc (ICP159=100)			Av.	(World = 100)		Ratio
	GDP	Net Exports	(%)	DA	NetExp-XR	Act. Value	Abs. Values	% Diff.	Act.Val	Abs.Val	% Diff.	Te	DA	GDP	DA / GDP	
GMB	105 487	-30 447	-28.9	17.106	51.484	15.926	18.590	16.7	13.1	11.7	-10.8	0	49.7	47.1	1.056	
BTN	204 664	-39 265	-19.2	21.723	73.940	20.322	23.679	16.5	69.5	62.2	-10.5	0	43.9	41.8	1.051	
NPL	4 543 219	-1 550 409	-34.1	36.871	118.134	33.747	40.677	20.5	24.2	20.9	-13.5	0	46.7	43.5	1.074	
KGZ	782 854	-224 289	-28.7	21.236	84.641	19.277	23.738	23.1	31.0	26.2	-15.4	0	37.5	34.6	1.083	
TJK	101 076	-23 715	-23.5	2.680	11.309	2.450	2.984	21.8	22.0	18.7	-15.0	0	35.4	33.0	1.075	
UZB	738 425 246	-121 802 161	-16.5	2740.154	10609.980	2561.255	2988.322	16.7	43.1	38.2	-11.5	0	38.6	36.7	1.052	
SYR	25 936 805	-12 517 413	-48.3	498.627	2150.833	423.146	553.068	30.7	11.9	9.3	-22.1	0	34.7	29.9	1.158	

Conclusions (1)

- All PPP and structural methods are based on the assumption that expenditure / quantity data contains only non-negative values =>
- BHs with negative values lead inevitably to some special treatment during the calculations of aggregate PPPs: *“All of the commonly considered methods are designed to compare physical volumes. It is not to be expected that without appropriate adjustments they can be routinely applied to net items in the national accounts that are different in character from the physical flows of the other components of final expenditures on GDP.” (I. Kravis, R. Summers and A. Heston)*
- The present ICP methodology ignores this problem. The treatment of „balancing“ categories with negative nominal values in a standard way is not correct from the point of view of average price indices
- The absence of special treatment of BH with negative nominal values can lead to the „biased“ results even at the GDP level. The distortion depends on two factors: the shares of „negative“ expenditure and variation of BH-PPPs: very broad range in the ICP for both factors

Conclusions (2)

- The EKS-PPPs should be calculated on the basis of meaningful reliable bilateral PPPs
- The use of the LPS borders as well as the Tornqvist bilateral PPPs are not the solution of the problem in the EKS. The aim is not to obtain somehow any positive PPPs but to obtain the reliable PPPs in a straightforward way based on strong theoretical assumptions
- To obtain the reliable results in general case, a modified procedure was developed. **The main idea is the use of absolute nominal values (for the PPP calculation only) instead of actual nominal values of expenditure data.** This approach is consistent with the theory of the calculation of average indices and is applicable not only for the EKS but also for the GK, IDB, ...
- Proposed approach is, maybe, the simplest but not necessary the best and further investigations can lead to better solutions

A world map composed of small dots, with the text "Thank You!" overlaid in the center.

Thank You!