Note on Methodological Issues Emerging from Previous ICP Cycles

ICP Global Office

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Since the ICP 2011 cycle the estimates of global and regional PPPs have reached remarkable stability thanks to both improvements in data collection and consistency in the methodology for their computation. However, a number of methodological questions have arisen during the latest ICP cycles. This note provides a summary of these issues and seek for guidance from ICP Technical Advisory Group (TAG) on how to address them going forward.

Contents

1. Treatment of Dual Participating Economies in ICP Methodology

The presence of economies participating in multiple regional comparison programs has raised some challenges to the current ICP methodology for the estimation of global PPPs. Dual participating (DP) economies par-take in distinct regional comparisons at the same time and each appears twice as separate entry in the global ICP results.

While efforts are made to fully harmonize the input data for these economies, the current methodological approach for the estimation of global PPPs leads to distinct results for each DP economy. This, in turn, implies a tradeoff between harmonization and regional fixity of final estimates. This short note lays out the current approach in relation to the treatment of DP economies for the estimation of PPPs and presents some of the key issues stemming from said trade off.

Background and current approach

In ICP 2021, the economies of Egypt, Mauritania, Morocco, Sudan and Tunisia participated in both ESCWA and AfDB regional comparisons. The PPPs estimation for this group of countries followed the steps below.

Regional comparison

Each DP economy collected the same set of global items prices and national account data, but distinct regional items, resulting in distinct regional PPPs in each regional comparison.

Global linking

BH PPPs: Linking factors were calculated including each DP economy in both regions, and then applied to the respective regional basic heading PPPs. Finally, a geometric mean of the two estimates was taken and applied to each DP economy BH PPPs.

GEKS Aggregation: DP economies are included only once in the GEKS aggregation, but considered separately in both regions when CAR-Volume procedure is applied. Finally, a geometric mean of the two estimates is taken and applied to each DP economy aggregate heading PPPs.

Time-series PPPs

For interim years BH PPPs of DP economies, the geometric mean is calculated between linked regional benchmark estimates by ESCWA and interpolated estimates using CPI data for AfDB, as illustrated in the table below. This is done to avoid breaks in the series with the benchmark estimates. GEKS aggregation follows the same procedure as for benchmark estimates.

To summarize, the current approach for both benchmark and time-series estimates favors harmonization**:** identical figures for the dual entries of Egypt, Morocco, Mauritania, Sudan and Tunisia are obtained by applying the geometric means of the two distinct estimates at the expenses of regional fixity.

	Before Harmonization		After Harmonization	
BH 1110111	**EGZ (WAS)**	**EGY (AFR)**	**EGZ (WAS)**	**EGY (AFR)**
2017	Global BM	Global BM	Global BM	Global BM
2018	Reg BM	Interpolated	GeoMean	GeoMean
2019	Reg BM	Interpolated	GeoMean	GeoMean
2020	Reg BM	Interpolated	GeoMean	GeoMean
2021	Global BM	Global BM	Global BM	Global BM

Table 1: Example of BH PPP estimation for DP economy Egypt in interim years

Issues with the current approach

1. ***Should CAR-Volume be applied at the BH level?***
    - The presence of DP economies means the data used to estimate global linking factors (distinct regional PPPs) and those included in the CAR procedure (harmonized through geo-mean) are different.
    - Application of CAR-Volume procedure to BH PPPs ensures consistency with further Aggregate Headings.
    - However, the global linking procedure already displays regional fixity for BH PPPs. Displaying BH PPPs without CAR-volume allows researchers and experts to replicate aggregate results.

2. **Should geo-mean of BH PPPs be applied for dual participating countries in interim years?**
    - Geo-mean ensures no breaks in the series between benchmark and interim years.
    - However, taking the geometric mean between the linked regional benchmark from ESCWA and interpolated estimates for AfDB means that the estimation no longer relies on benchmark estimates when available (one of the key ICP methodology principles), and regional fixity is lost for ESCWA DP estimates.

2. Calculating Productivity Adjustment Factors and Linking Government Compensation

Non-market services are typically difficult to compare across countries because they have no economically significant prices with which to value outputs. In addition, the institutional arrangements for their provision and the conditions of payment differ from country to country, and their quality varies between countries, but the differences cannot be easily identified and quantified. To account for differences in productivity between countries, the ICP estimates "Productivity Adjustment Factors", and applies this adjustment to the PPPs of non-market services. Without this productivity adjustment, the real consumption of government services would be overestimated in economies with relatively lower input costs and vice-versa.

Background

The "Productivity Adjustment Factors" in the ICP are applied in two stages: first at the regional level and second at the global level. At the regional level, each ICP region determines whether to apply PAFs or not based on the heterogeneity of the regional economies. In a region where all economies have similar levels of productivity, it may not be necessary to apply any adjustments. In a region where productivity levels vary significantly, PAFs are estimated based on: (i) capital per worker, (ii) share of labor compensation, and (iii) the relative costs of capital measured in PPP terms. These regional PAFs are then applied to the regional PPPs of the relevant non-market services. The second stage involves estimating global PAFs, using the same standard methodology for all ICP participating economies. The global PAFs are then applied to the linking factors maintaining the regional fixity of PPPs. This process ensures that the productivity differences between economies are accounted for.

Description of the current methodology

Data requirements

The calculation of **Productivity Adjustment Factors (PAFs)** requires the following inputs for each economy:

1. Number of persons employed
2. Current-cost net capital stock, in local currency units, which includes the following:
   - 2.1. Current-cost net capital stock of other machinery
   - 2.2. Current-cost net capital stock of electrical and optical equipment
   - 2.3. Current-cost net capital stock of transport equipment
   - 2.4. Current-cost net capital stock of residential and non-residential structures
   - 2.5. Current-cost net capital stock of other assets
3. Share of labor compensation in GDP, at current national prices
4. Regional and global PPPs from the indicated ICP classifications below:
   - 4.1. Other machinery
     - 4.1.1.Fabricated metal products, except machinery and equipment (1501111 - BH)
     - 4.1.2.General purpose machinery (1501115 - BH)
     - 4.1.3.Special purpose machinery (1501116 - BH)
   - 4.2. Electrical and optical equipment (1501112 - BH)
   - 4.3. Transport equipment (1501120 - Class)

4.4. Construction (1501200 - Group)
4.5. Other products (1501300 - Group)

5. Expenditures in local currency units, from the indicated ICP classifications below:
   5.1.1. Fabricated metal products, except machinery and equipment (1501111 - BH)
   5.1.2. General purpose machinery (1501115 - BH)
   5.1.3. Special purpose machinery (1501116 - BH)

Data sources

The data source for datasets 1 to 3 are the Penn World Tables (PWT). All PWT data is public, except the capital stock data for "other machinery" and "electrical and optical equipment"[1] categories. The data source for datasets 4 and 5 are the ICP Regional Implementing Agencies and the ICP Global Office. Although both PWT and the ICP specify the use of local currency units to express expenditure data, it may occur those different currencies are considered as local and thus any discrepancies have to be corrected[2].

Data gap-filling

Before proceeding with the calculation, it is necessary to estimating missing values to obtain a complete data set for all economies. In case there is missing data, the following estimates are made:

- If the *share of labor compensation* in GDP is not available for any economy, we take the respective regional average as the best estimate.
- If the *number of persons employed* is not available for any economy, we take the regional average of labor force participation and multiply it over the total active population.

Calculating regional Productivity Adjustment Factors in ICP

STEP 1: The first step is to calculate regional PPPs for the component 4.1 "Other machinery", based on the ICP PPPs and expenditure data for the following basic headings using the EKS method:

- Fabricated metal products, except machinery and equipment (1501111 - BH)
- General purpose machinery (1501115 - BH)
- Special purpose machinery (1501116 - BH)

STEP 2: The PPPs for 4.1-4.5 are aggregated to obtain the regional PPPs of Capital Stock. This is done by applying the EKS method to the PPPs for categories (4.1-4.5) with the corresponding PWT current-cost net capital stock (2.1-2.5) as expenditure weights. With this third step all four data series are complete, and the calculation of regional productivity adjustment factor may proceed.

STEP 3: The next step is to calculate the regional "Capital stock per employee, PPP weighted" ($r.KS^w$). In the following notation we use "*r*" to refer to regional factors, "*u*" for unweighted factors and "*w*" for weighted factors. The "Capital stock per employee, PPP weighted" is calculated for each economy *i*, based on their regional PPPs, and the respective regional averages. This is given by the formula:

[1] In the public PWT dataset, these two categories are combined under the "machinery and (non-transport) equipment" category.

[2] As an example, the expenditures for the West Bank and Gaza are expressed in US Dollar in the PWT and in Israeli Shekel in the ICP data sources.

$$r.KS_i^w = Capital\ stock\ per\ employee, PPP\ adjusted = \frac{Capital\ stock_i}{Employment_i} \times \frac{1}{r.Capital\ stock\ PPP_i}$$

The regional average is equal to the geometric mean of all economies in the region.

STEP 4: Calculate the *regional Productivity Ratio (r.PR)* of each economy relative to the regional average, as given by:

$$r.PR_i = regional\ Productivity\ Ratio_i = \left(\frac{r.KS_i^w}{r.KS_{r.avg}^w}\right)^{1-\left(\frac{LS_i+LS_{r.avg}}{2}\right)}$$

Where KS^w is the PPP weighted capital stock, for economy *i* and for the regional average (*r.avg)*, and *LS* is the share of labor compensation, for economy *i* and for the respective regional average (*r.avg)*.

STEP 5: Calculate the *regional Productivity Adjustment Factor (r.PAF)* for each economy *i* relative to the base economy *b*, as given by their *Productivity Ratios*:

$$r.PAF_i = Productivity\ Adjustment\ Factor_i = \frac{r.PR_i}{r.PR_b}$$

Interpretation: If $PAF_i < 1$ then the productivity of economy *i* is lower than the base economy *b*.

To obtain the "regional PPPs *with* productivity adjustment" ($r.PPP^w$), multiply the "regional PPPs *without* productivity adjustment" ($r.PPP^u$), by the inverse of $r.PAF_i$ as given by:

$$r.PPP_i^w = r.PPP_i^u \times \frac{1}{r.PAF_i}$$

Note: When labor productivity for economy *a* is lower than the base economy *b*, the PPPs will adjust upwards, resulting in lower estimates of real expenditures in government compensation.

Calculating global Productivity Adjustment Factors in ICP

The calculation of global Productivity Adjustment Factors (g.PAFs) requires the same inputs from each economy as the calculation of regional PAFs, i.e.: level of employment, capital stock, share of labor compensation and current cost of net capital stock. However, instead of using the regional PPPs we use the global PPPs from the same Gross Capital Formation categories listed in the previous chapter.

STEP 1 and 2: Repeat the same calculation as STEP 1 and 2 in the previous section to obtain global PPPs for the component 4.1 "Other machinery" using global PPPs from the afore-mentioned categories.

STEP 3: To calculate the "Capital stock per employee, global PPP weighted" we now use the global averages and global PPPs. In the following notation we use *"g"* to refer to global factors, *"u"* for unweighted factors and "*w"* for weighted factors. This is done by the formula:

$$g.KS_i^W = Capital\ stock\ per\ employee, PPP\ weighted = \frac{Capital\ stock_i}{Employment_i} \times \frac{1}{g.Capital\ stock\ PPP_i}$$

The global average is equal to the geometric mean of all economies.

STEP 4: Calculate the *global Productivity Ratio (g.PR)* of each economy relative to the global average, which is given by the formula:

$$g.PR_i = global\ Productivity\ Ratio_i = \left(\frac{g.KS_i^w}{g.KS_{g.avg}^w}\right)^{1-\left(\frac{LS_i+LS_{g.avg}}{2}\right)}$$

Where KS^w is the PPP weighted capital stock, for economy *i* and for the global average (*g.avg)*, and *LS* is the share of labor compensation, for economy *i* and for the global average (*g.avg)*.

STEP 5: Calculate the global *Productivity Adjustment Factor (g.PAF)* for each economy *i* relative to the base economy *b*, as given by:

$$g.PAF_i = \ Productivity\ Adjustment\ Factor_i = \frac{g.PA_i}{g.PA_b}$$

The last step is the same as calculating regional PAFs and the interpretation of the results is the same. However, neither regional PAFs or global PAFs are used directly to adjust the global government compensation PPPs. The productivity adjustment factors at the global level are obtained by the method described in the next section.

Linking the Government PPPs at the ICP Global level

The linking of government compensation at the global level entails the following steps:

- **STEP 1:** Linking factors for the three compensation basic headings[3] (*BHs*) are calculated using compensation of government employees and regional BH purchasing power parities ($r.PPP^u$) without productivity adjustments[4], following the "standard" approach for estimating linking factors (*LFs*).
- **STEP 2**: Geometric means of global PAFs and regional PAFs are computed for each region. The regional PAFs are used as applied by the regions; for example, EUO has PAFs as unity in their regional computation.
- **STEP 3:** The regional adjustment factors (*RAF*) are then calculated to link each ICP region *(REG)* to the base region (i.e. *EUO*). RAFs are estimated as ratios of the geometric mean of global PAFs over the geometric mean of regional PAFs, both from STEP 2.

  $$RAF_{reg} = \frac{(\prod_{i=1}^{n} g.PAF_i)^{1/n}}{(\prod_{i=1}^{n} r.PAF_i)^{1/n}}$$

  The RAF_{reg} ratios are then normalized to EUO as the base region:

  $$n.RAF_{reg} = \ normalized\ Regional\ Adjustment\ Factor = \frac{RAF_{reg}}{RAF_{euo}}$$

[3] 1302211 Compensation of employees - Individual Govt Health; 1304211 Compensation of employees - Individual Govt Education; 1401111 Compensation of employees - Collective Govt

[4] The ICP regions are only requested to provide the unadjusted regional BH PPPs but may also provide their own regional Productivity Adjustment Factors, if applicable.

- **STEP 4:** Regional PPPs *without* productivity adjustment (r.PPP^u) are then multiplied by the linking factors *(LF)* from STEP 1. These PPPs are subsequently multiplied by the normalized ratio of global and regional PAFs from Step 3 ($n.RAF_{reg}$). These steps ensure that regional fixity is maintained.

$$Linked\ global\ PPP_i^u = r.PPP_i^u \times LF_{reg}$$

$$Linked\ global\ PPP_i^w = Linked\ PPP_i^u \times n.RAF_{reg}$$

Issues with the current methodology

1. ***Degree variability between cycles***

The current methodology allows a degree of variability between PAFs of any given cycle. For reference, in 2021 at least 7 economies have either increased or decreased their productivity by a third relative to the previous cycle. In theory, the productivity factors should be stable, as the inputs they derive from are also stable. Data inputs such as the net stock of capital, employment or share of labor compensation, are not expected to change dramatically between every 3 or 4 years. Likewise, PPPs and national expenditures of construction, machinery and equipment are also expected to remain relatively stable between cycles. However, even when the individual changes on either of these inputs are small, their combined effect may have a substantial impact on the calculation of PAFs.

2. ***Reliance on the Penn World Tables data***

While most ICP data is sourced from ICP participating economies and Regional Implementation Agencies, the PAF inputs on net capital stock, total employment and share of labor compensation, are sourced from the PWT. Although the PWT are a reliable source for these measures, detailed data on capital stocks is typically difficult to compile. Additionally, PWT data follows an update and revision calendar that is outside the control of the ICP. As a result, the latest available data on the PWT may not coincide with the current ICP cycle. This was the case in 2021, where the latest available data was dated from 2019. As a solution to estimate PAFs without changing the methodology, the ICP Global Office extrapolated the 2019 PWT inputs to 2021, but this is not an ideal solution going forward.

3. ***Weight of Construction PPPs on PAFs***

In the current methodology, the PPPs of construction, machinery and equipment are used to estimate a "Capital Stock PPP" which is then used as an input in the calculation of PAFs. However, since the total expenditures on "Construction" are typically much higher than the selected basic headings of "Machinery and Equipment", the "Capital Stock PPP" is mainly determined by the "Construction PPP". This is an issue considering that the PPPs for Construction are themselves difficult to estimate. Furthermore, any future methodological change on the calculation of "Construction PPPs" will have an impact on PAFs, which in turn affects "Government Compensation PPPs".

Possible alternatives to current approach

1. One possible alternative to the current PAF approach, is to create clusters of countries that share the same productivity factor, instead of estimating an individual PAF for each country, based for

example on income levels. This has the advantage of stabilizing PAFs between ICP cycles and reduces the dependence on detailed country level data. To adopt this approach, it is required to establish clusters and PAFs levels assigned to each of them. This in turn might lead to other inconsistencies.

2. Another possibility to round up the PAFs to a certain degree i.e. one decimal space, and/or to limit their upper and lower levels. The latest 2021 PAFs varied from 0.5 in the most productive economy to 8 in the least productive. While the majority of countries' PAFs are situated between 0.5 and 3, the 30 least productive economies have PAFs between 3 and 8. It is questionable whether or not the differences between them are that significant or if it's a matter of data quality.

3. Subsidized Prices

Current approach

The ICP follows the System of National Accounts (SNA) and consistency between national accounts expenditures and prices collected for the ICP is crucial; this means the ICP requires data to be based on "purchasers' prices." These prices are defined as: the amounts paid by buyers, including discounts, surcharges, rebates, and, in certain cases, invoiced service charges or voluntary gratuities.

Issues

In some countries essential goods are subsidized in whole or in part, to a significant extent of the population. In these cases, market prices may not be representative for the majority of households' consumption patterns. These subsidies may take three forms: (i) subsidized prices are available to everyone; (ii) subsidized prices are available to a subset of the population; (iii) some goods are distributed freely to a subset of the population. The first point is not an issue since it falls under the definition of "purchaser' prices", i.e. volumes for the subsidized goods reflect priced items. The second point raises the issue that non-subsidized items, which likely make up significant portion of the volumes, may be not representative of household consumption. The third point can be viewed as a wealth transfer, social welfare in kind, that lowers the overall household expenditure on those goods, without directly affecting prices.

4. Simplifying Global Linking Procedure for Private Education

Current approach

EUO economies follow an output approach for the estimation of private education PPPs, and thus do not price items under the BH *Private Education* (1110111). This required the ICP methodology to develop an exception to the standard linking approach for this heading. The current approach bases the linking on the

PPPs for the Aggregate Heading (AH) *Production of Education Services* (1304200). More specifically, linking factors for BH Private Education obtained under the Region-Product-Dummy (RPD) approach for all core regions but EUO are adjusted by a scaler computed based on the global linking factors for the AH *Production of Education Services* aggregate as it follows.

Step 1 - Compute regional PPPs for AH "Production of Education Services" (1304200) for EUO through GEKS approach

EUO does not provide regional PPPs for this heading, so it is necessary to compute them.

Step 2 - Compute unrestricted global PPPs for AH "Production of Education Services" (1304200) through GEKS approach

Step 3 - Compute regional linking factors for AH "Production of Education Services" Step 3.a - Use CAR-PPP approach to estimate the regional linking factors.

$$LF_R^{GovEd}=\left[\prod_{c\in R} PPP_c^{L,GovEd}\right]^{\frac{1}{N_R}}/\left[\prod_{c\in R} PPP_c^{R,GovEd}\right]^{\frac{1}{N_R}}$$

Where $PPP_c^{L,GovEd}$ are the linked PPPs for country *C* in region *R* calculated in Step 2**,** $PPP_c^{R,GovEd}$ are the regional PPPs for country *C* in region *R*, and N_R are the number of countries in region *R*.

- Step 3.b - Rebase the linking factors on EUO.

$$LF_{R\_euo}^{GovEd}=LF_R^{GovEd}/LF_{EUO}^{GovEd}$$

Step 4 - Estimate private education linking factor

- Step 4.a - Compute a scaler *S* as the geometric mean for all core regions excluding EUO of private education (1110111) linking factors over the geometric mean of government education linking factors as estimated in Step 3.b

$$S=\left[\prod_{R\in G} LF_R^{PEd\_rpd}\right]^{\frac{1}{N_G}}/\left[\prod_{R\in G} LF_{R\_euo}^{GEd}\right]^{\frac{1}{N_G}}$$

Where $LF_R^{PEd\_rpd}$ are the linking factors obtained from the Region Product Dummy approach for BH *Private Education* (1110111) for region *R* and *G* are the *N* core regions excluding EUO.

- Step 4.b - Multiply the private education linking factors obtained from the RPD approach by the scaler computed in step 4.a

$$LF_R^{PEd}=LF_{R\_euo}^{PEd\_rpd} * S$$

- Step 4.c – Apply the private education linking factors obtained in Step 4.b to the BH *Education Benefits & Reimbursements* (1304111).

Possible simplified approach

Following the latest rounds of global computations, members of the Computational Task Team (COTT) proposed to simplify the approach for the global linking of private education PPPs, overcoming what is currently treated as an exception to the standard methodology. The proposal is to estimate private education PPPs as reference PPP of the *BH Compensation of employees - Ind. Edu. Govt* (1304211).

The AH *Production of Education Services* currently used to adjust private education linking factors is indeed the aggregate of five BHs, four of which are reference PPPs as displayed below:

1304200	PRODUCTION OF EDUCATION SERVICES	
1304211	Compensation of employees - Ind. Edu. Govt (BH)	
1304221	Intermediate consumption - Ind. Edu. Govt (BH)	stage 1 ref PPPs
1304231	Gross operating surplus - Ind. Edu. Govt (BH)	stage 1 ref PPPs
1304241	Net taxes on production - Ind. Edu. Govt (BH)	stage 2 ref PPPs
1304251	Receipt from sales - Ind. Edu. Govt (BH)	stage 2 ref PPPs

Expenditure data from ICP 2021 shows that BH *Compensation of employees - Ind. Edu. Govt* (1304211) makes up on average 77% of the aggregate total volume. Thus, the simplified approach would likely have only a moderate impact on PPPs estimates for private education, while contributing to overcome one of the exceptions in the current PPP estimations and improve the standardization of the methodology. A full simulation of the proposed changes should be conducted to fully assess the impact on the Private Education PPP as well as on GDP aggregates.

5. Construction Wages and Their Effects on GDP and other Aggregates

Introduction

The International Comparison Project converts nominal expenditure on GDP and its components into real terms via estimated corresponding PPPs (Purchasing Power Parities). The construction sector plays an important role in nominal expenditures, and thus has a great impact on the real GDP as well.

The current construction methodology in ICP assumes direct estimates of wages in construction sector (hourly rates). The resulting labor inputs in real terms (i.e., nominal wage bill divided by those rates) produces in many cases unrealistic results which may significantly impact the GDP and GFCF aggregates.

The labor inputs are combined with inputs for construction materials and equipment hire to produce Construction aggregates for three Construction basic headings: Residential, Non-Residential and Civil Engineering. Thus, the three basic headings of Construction are estimated based on nine sub-headings, out of which three sub-headings are labor inputs. The three wage sub-headings are the same for each country as they are based on the same hourly rates[5].

Case of six countries

To see the impact of the construction wages we start with a few country cases. Namely, with Bangladesh, India, Indonesia, Hong Kong, USA and China. The choice of countries is somewhat arbitrary, but it does include some major economies and some of the most populous countries, as well as two base countries – Hong Kong and USA. Table 1 below describes main indicators of the Construction sector and GDP for those countries. The data used are from the ICP database, ILO database (construction employment), and national country statistics (for lines [12], [13]).

Table 1. Construction sector in ICP and National Accounts, by country

	BGD	CHN	HKG	IDN	IND	USA
Total economy						
[1] GDP, PPP, bln. USD	**1,328**	**28,874**	**489**	**3,537**	**10,983**	**23,594**
[2] Employment, total	65,534	798,808	3,864	131,171	497,616	158,141
[3] labor factor share	52.2%	58.6%	51.9%	46.4%	52.2%	59.7%
[4] Wages, economy-wide, real ([1]/[2]*[3])	**10,574**	**21,191**	**65,656**	**12,505**	**11,517**	**89,084**
Construction, labor						

[5] The construction wage component PPP is estimated based on hourly rates for seven professions using the CPD [*country-product-dummy*] aggregation procedure.

[5] Wages, nominal, bln. LCU	2,270	7,970	156	896,678	8,361	844
[6] PPP for labor input (from global linking)	*2.263*	*1.031*	*3.491*	*459.3*	*2.243*	*1*
[7] Wages total in construction, real, PPP ([5]/[6]), bln. USD	**1,003**	**7,728**	**45**	**1,952**	**3,727**	**844**
[8] construction employment	6,104	52,020	326	8,041	48,835	8,018 *)
[9] Wages per empl. in construction ([7]/[8])	**164,318**	**148,557**	**136,974**	**242,788**	**76,319**	**105,274**
[10] Relative wages in construction vs. economy-wide wages ([9]/[4])	**1554%**	**701%**	**209%**	**1942%**	**663%**	**118%**
[11] Construction wage bill to GDP ratio, in PPP ([7]/[1])	**75.5%**	**26.8%**	**9.1%**	**55.2%**	**33.9%**	**3.6%**
from National Accounts:						
[12] Construction Value Added, share	**9.8%**	**6.9%**	**4.0%**	**10.4%**	**8.1%**	**4.1%**
[13] Construction employment, share	**9.3%**	**6.5%**	**8.4%**	**6.1%**	**9.8%**	**5.1%**
[14] Relative Construction productivity ([12]/[13])	**105%**	**106%**	**47%**	**170%**	**83%**	**81%**

*) ILO database reports a somewhat different number for Construction employment in the US – 11,743,000, which would result in lower real wage values for that country, or, $72,014 instead of $105,274.

Sources: ICP 2021, ILO, National Accounts statistics of individual countries.

Notation used:

1. Y: GDP, in USD, in PPP terms (source: ICP)
2. s: Labor factor share (source: ICP)
3. L: Total employment (source: ICP)
4. W_{NOM}: Total construction wage bill, in LCU (source: ICP)
5. PPP_{CON}: PPPs for construction wages (measured salaries) (source: ICP)
6. L_{CON}: Employment in construction (source: ILO)
7. w: Real wages (national), per empl., in USD, in PPP terms
8. w_{CON}: Real wages in Construction, per empl., in USD, in PPP terms
9. W_{REAL}: Total construction wage bill, in PPP (W_{NOM}/ PPP_{CON})

From Table 1 we can compare construction data across countries as well as relate construction sector to total economy.

Let us start with line [4], which describes average national wage ***w*** in PPP terms (note that only labor factor inputs are considered – ***w = Y / L * s***).

Now consider line [7], which describes the total construction wage bill converted by PPPs. This indicator can be interpreted as a proxy for construction labor factor input in real terms. According to this indicator, China and India massively exceed the USA: $7,728 bln. and $3,727 bln. in China and India, respectively, vs.

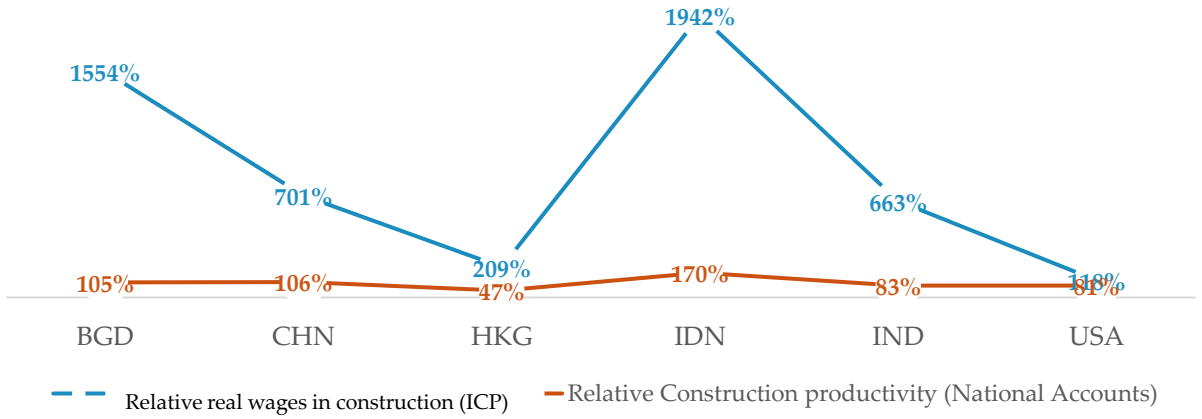
bln. $844 in the US. When divided by Construction employment (line [8]), the resulting implied real wage in the Construction sector (w_{CON}) in China and India reaches $148,557 and $76,319, respectively, vs. $105,274 in the US [$72,014 if we use the ILO employment data for all countries]. At the same time, Bangladesh and Indonesia post even real wages: $164,318 and $242,788, respectively.

Another way to look at these data is to compare the implied real wages in Construction sector to the average national wage (line [10]=[9]/[4]). While the US is not much different from 100% (it is 118%), for other countries there are drastic differences: from 209% (Hong Kong) to 1942% (Indonesia) and 1554% (Bangladesh). There is no reason to expect the real wage in construction to be that much different from the national average. Construction sector is not a high-tech industry, and its employment composition reflects that of the national structure to a large degree.

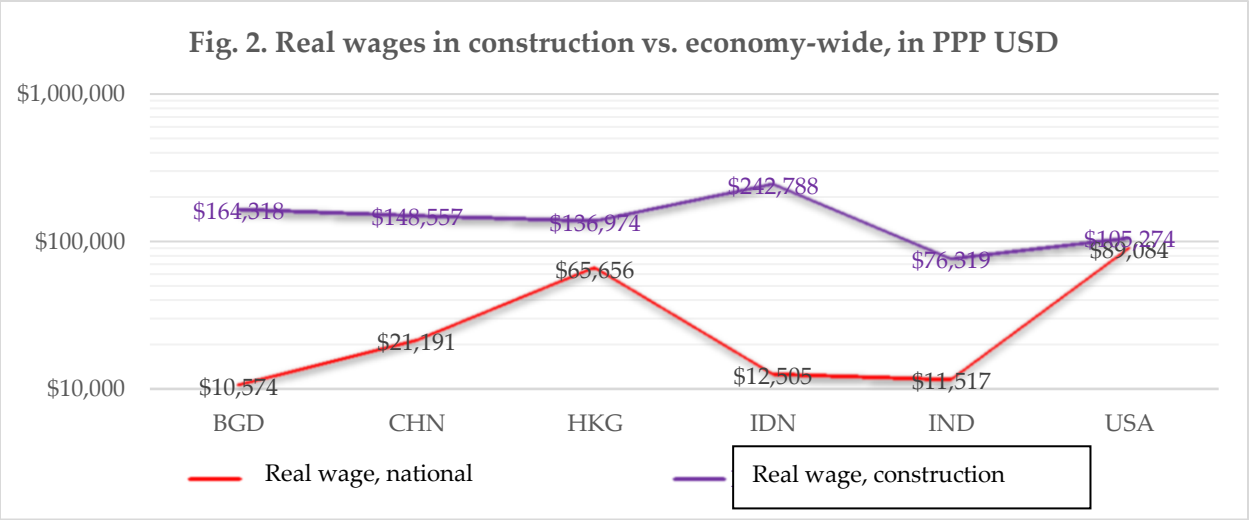
We can consider Construction sector real wages from the production side as well (in this case the real wage will act as a proxy for productivity of labor inputs). Line [12] shows Construction value added share in GDP from the National Accounts of respective countries. The ratio of line [12] to the Construction share in total employment (line [13]) is productivity in Construction sector relative to the total economy (line [14]). In general, this ratio is hovering around 100%, except for Hong Kong (47%) and Indonesia (170%). From the ICP data, for the US we get 118% for the implied relative productivity in Construction sector (and a somewhat lower number if we use the ILO database).

We can observe the drastic differences between line [10] and line [14] in the Table below. The expectation is that these two lines should not deviate significantly from each other, as the skill composition of the construction workforce [measured, for example, by educational attainment] is not expected to be significantly different from the national average.

FIG. 1. RELATIVE REAL WAGES IN CONSTRUCTION (ICP), LINE [10] VS. RELATIVE CONSTRUCTION PRODUCTIVITY (NATIONAL ACCOUNTS), LINE [14]

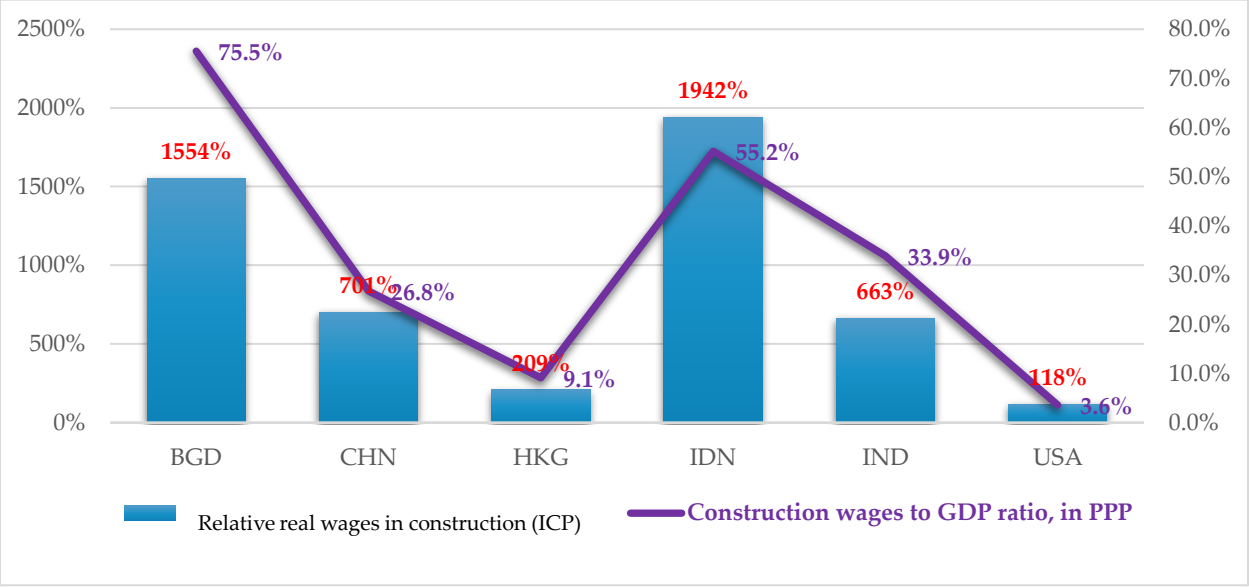


The ICP data can be analyzed from another perspective as well: we can compare line [9] describing the real wages per empl. in construction using the ICP data (W_{REAL}/L_{CON}) to national average wage *w* (line [4]).



Looking at the problem from yet another angle, we can contrast the relative real wage in construction from ICP (line [10]) with the ratio of Construction wage bill to the GDP in PPP terms (line [11][6]).

Fig.3. Relative wages in construction vs. Construction wage bill to GDP ratio (in PPP)



[6] Due to the non-additive nature of the GEKS index, a distortion in the ratio of Construction wage bill to the GDP in PPP terms (W_{REAL}/Y) due to mismeasurement of the construction wage component does not translate 1:1 into a distortion of the real GDP.

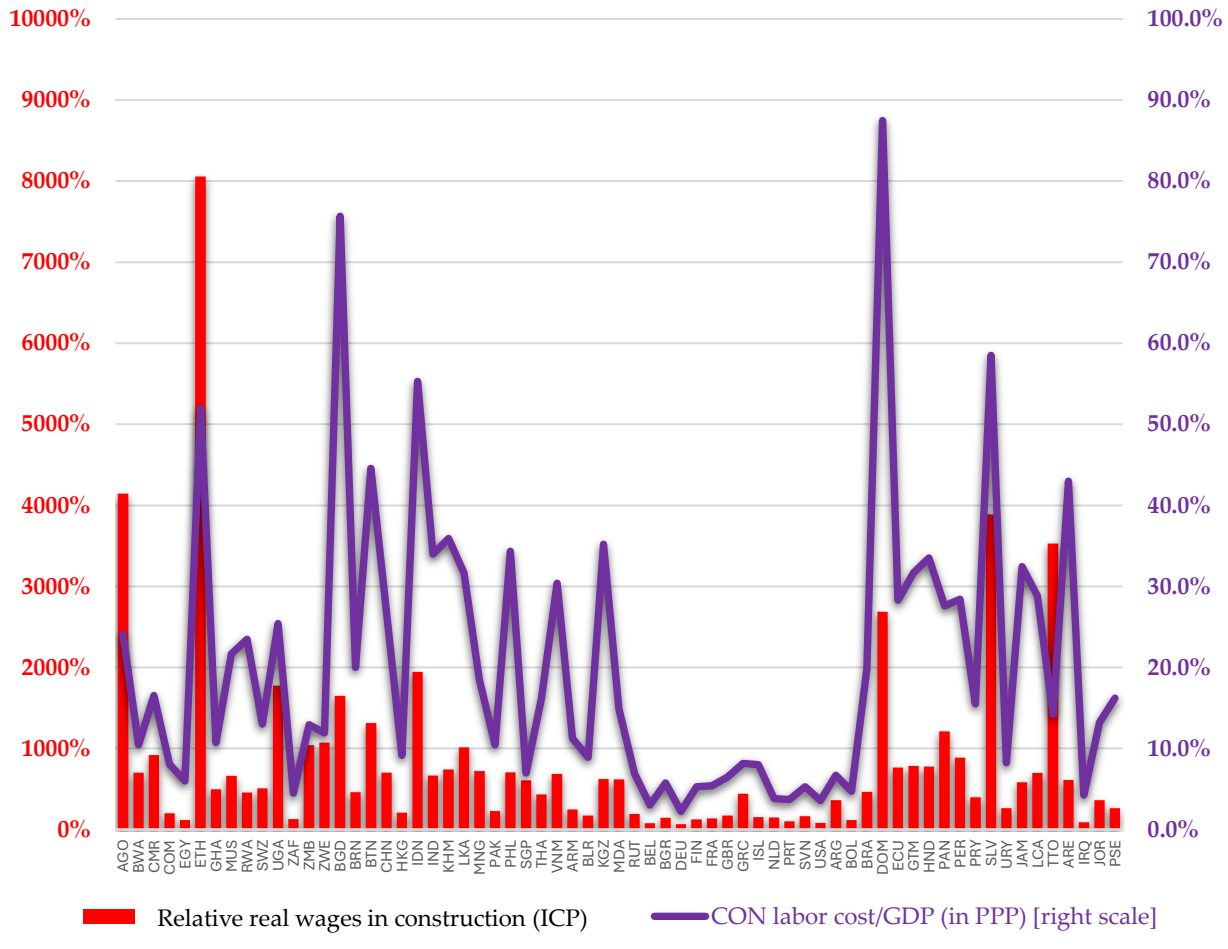
We definitely see a correlation here between the two indicators (more on that below). In the extreme case the construction wage bill to GDP ratio in real terms reaches 75.5% in the case of Bangladesh.

Case of 62 countries

A sample of 62 ICP countries, for which data was available, and which participated in the ICP global linking exercise, was utilized for this analysis[7]. Data-wise, availability of employment in construction sector in the ILO database was the limiting factor in selecting the countries. The dataset in presented in the Annex. Only indicators present in lines [1] – [11] of Table 1 were available.

Figure 4 below reproduces the six-country case depicted in Figure 3, but for 62 countries.

Fig. 4. Construction real wages to national average wages ratio, vs. Construction labor cost-to-total GDP ratio (in PPP terms)



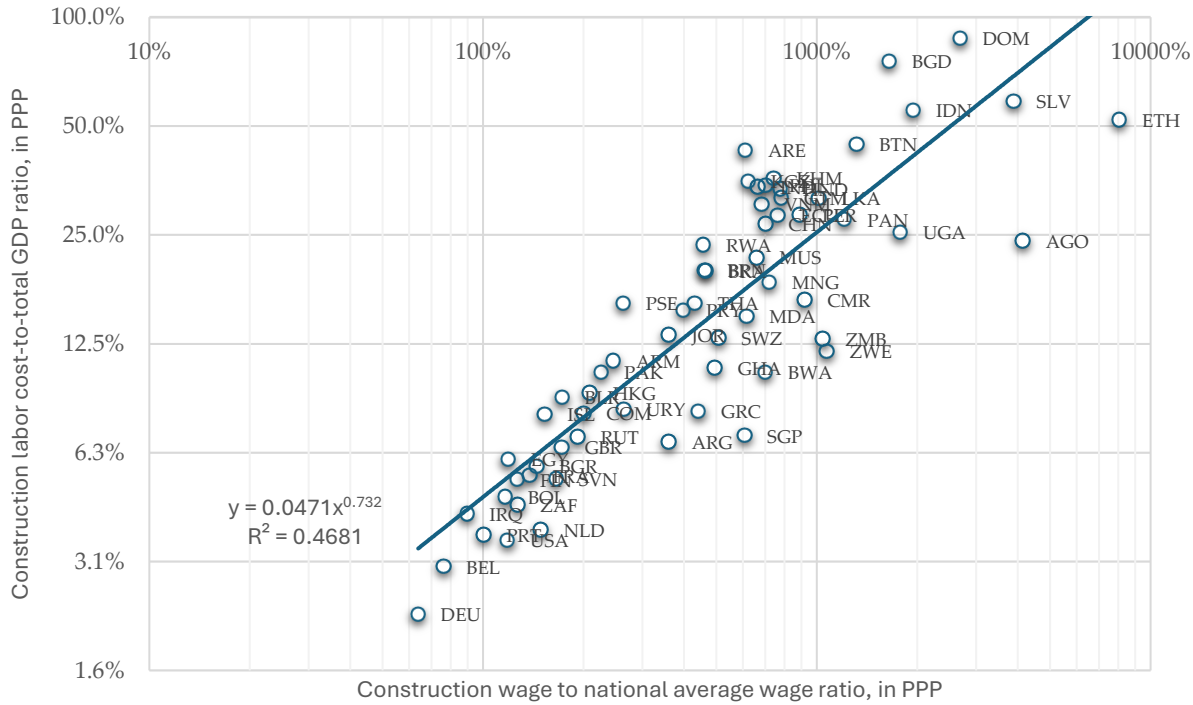
[7] The dataset was compiled with the assistance of Giovanni Tonutti (World Bank).

We can observe that Figure 4 depicts a pattern very similar to the one in Figure 3: namely, that there are *drastic* variations of *Relative construction wages* and *Real construction labor cost-to-total GDP ratio* across the world, and there is a relatively significant positive relationship between those two indicators.

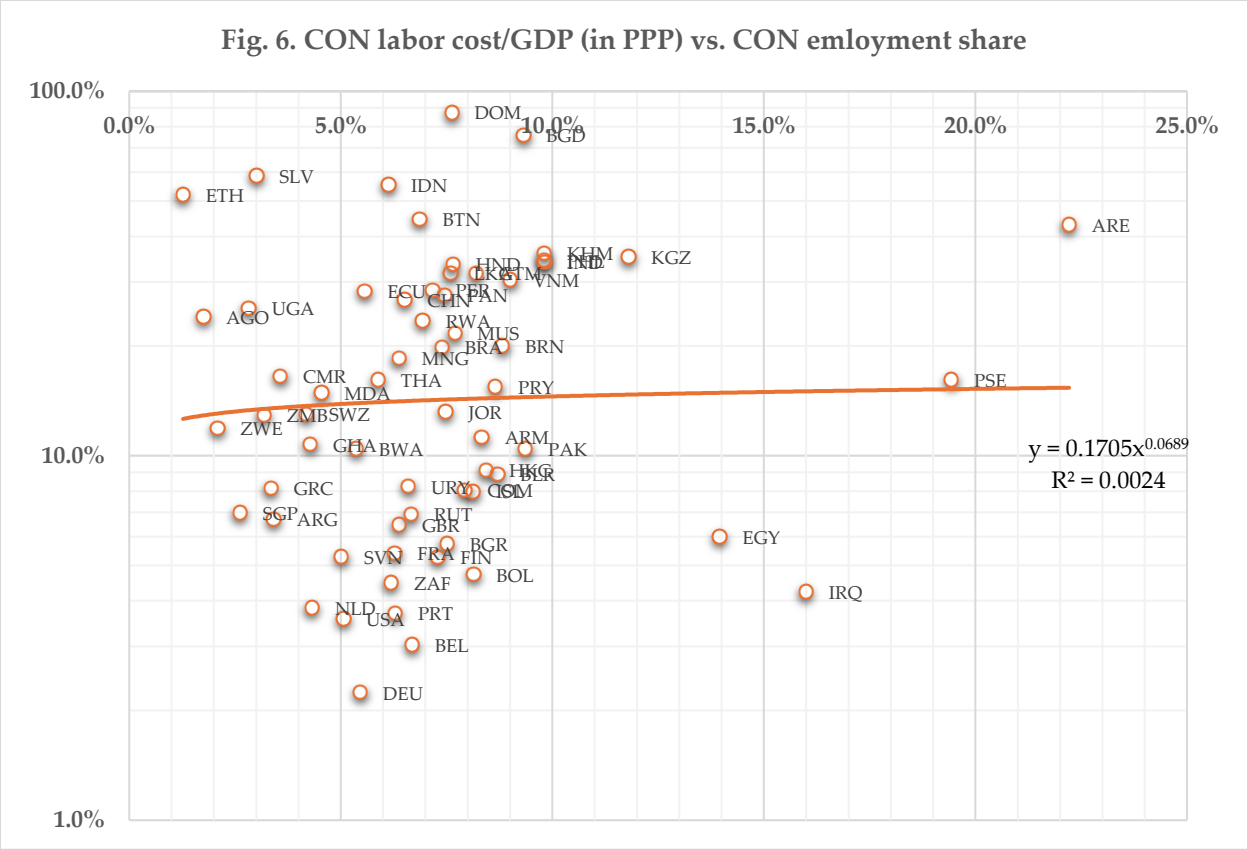
The maximum value of W_{REAL}/Y is observed for the Dominican Republic (87.5%), and the maximum value of $W_{REAL}/L_{CON}/w$ (implied relative wage in construction) reaches 8,058% in Ethiopia. I.e., this means that in Ethiopia the real wage is construction is 80.58 times higher than its real national average wage.

The relationship between those two indicators (with a relatively significant correlation) is shown in Figure 5 below.

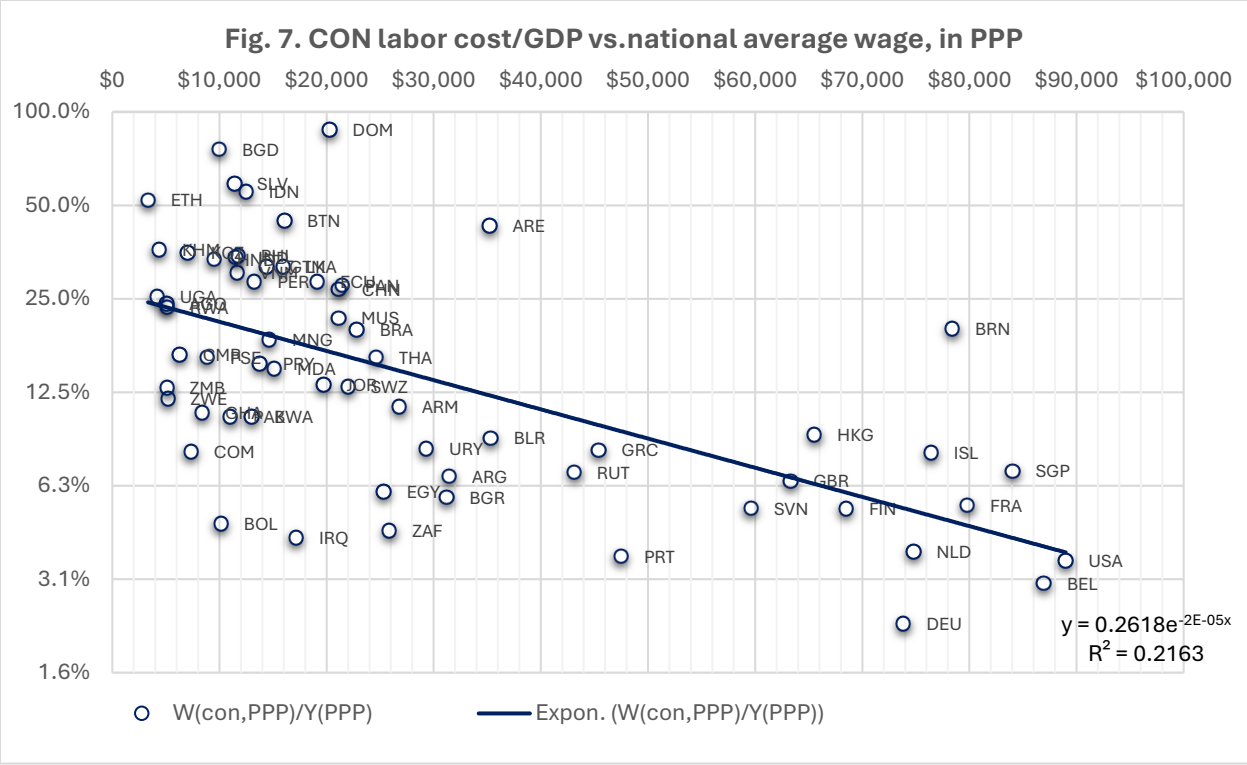
Fig. 5. Construction real wage to national average wage ratio, vs. Construction labor cost-to-total GDP ratio (in PPP terms)



At the same time, little or no correlation is observed between construction labor cost/GDP (in PPP) [W_{REAL}/Y] and the employment share of Construction sector [L_{CON}/L] (see Figure 6 below). Normally, we would expect W_{REAL}/Y to be correlated with L_{CON}/L. This indicates that construction salaries (PPP_{CON}), which are supposed to reflect labor factor productivity in construction, and possibly, to some extent, Total construction wage bill, in LCU (W_{NOM}) are the main culprits behind the deviations observed in Figure 4.



At the same time, Figure 7 below shows that there exists some negative correlation between construction labor cost/GDP (in PPP) [W_{REAL}/Y] and national average wage *w*.

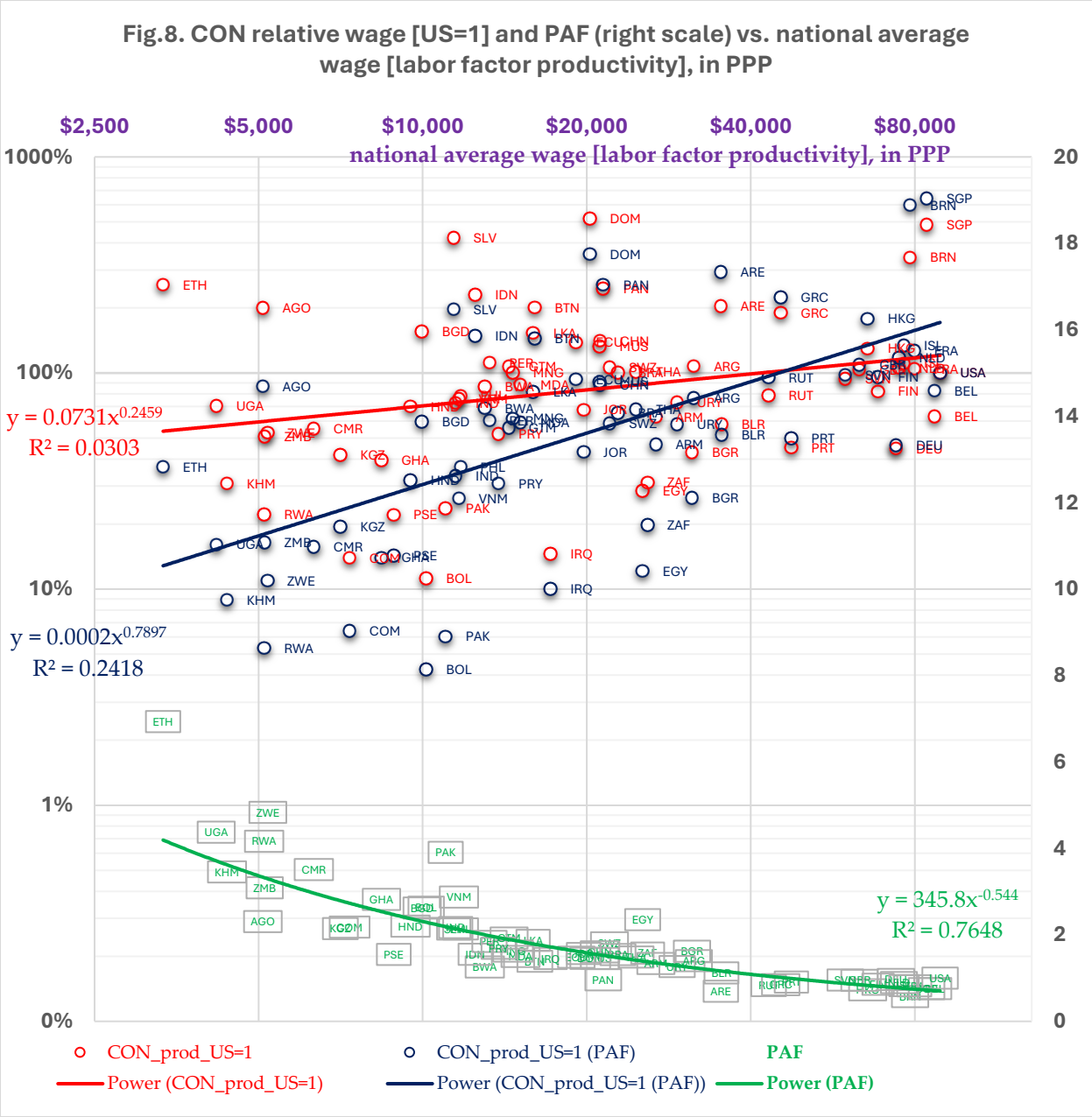


If we take real national average wage *w* as a proxy for national labor factor productivity [as it is defined as ***w = Y / L * s***], and thus a proxy for an indicator of economic development, we must admit that there is some systematic overestimation of [equivalent] construction salaries in poorer countries that causes these observations.

Applying PAF

The PAF (Productivity Adjustment Factor) is widely used in ICP to adjust the salaries of government workers. In general, it works quite well for that particular purpose, and it exhibits a relatively strong correlation with national productivity levels (as depicted by the green line in Figure 8 below).

However, applying the PAF to construction salaries, while improving the overall trend, still results in drastic variations in relative construction wages (in PPP) for countries with similar levels of development.



From Figure 8 we can observe that even after the PAF correction, multiple low- and middle-income countries exhibit real wages in the Construction sector that is close to or [much] higher than that of the US. At the same time, the biggest problem is the disparity in the resulting real wages for countries with similar levels of development. For example, while SLV and BOL are quite close in overall productivity ($11,400 vs. $10,148), the real wages in construction differ by about 40(!) times, - 421% vs. 11%. This suggests that not only there is an overall bias in construction salaries (as reflected by the red regression line in Figure 8), but, more importantly, the results are dominated by non-systematic errors, which cannot be overcome by a single adjustment factor.

Conclusions

The current methods for measuring construction salaries have a significant impact on both GFCF and GDP. For the 2024 round, which is already in progress, substantial changes to data collection cannot be implemented. However, it is evident that a productivity adjustment for construction labor is necessary, akin to the one applied in Government Services, though *not necessarily identical*. It is important to note that this issue cannot be fully addressed by a single adjustment factor, as in the government sector, since it is not systematic—this is evidenced by the red markers in Figure 8.

Hence, looking ahead to future ICP rounds, we should consider new methodologies and/or revisit past alternatives, such as the BOCC approach (2005 ICP methodology), the OECD/Eurostat approach, and the CIS methodology.

Ultimately, proper data validation is crucial as well and should play an important role in improving the results for the construction sector.

6. Other Operational Matters

Consistency in the estimation of regional and global reference PPPs

The ICP 2017 round established the same computational approach to the estimation of regional and global reference PPPs .[8](During the ICP2021 cycle, members of the Computational Task Team (COTT) identified some discrepancies between regional and global approaches, as reported in the examples. As the ICP 2024 cycle is underway, a review of the current reference PPPs approach would be desirable.

Examples of discrepancies between regional and global reference PPPs computations:

1. Unweighted geometric mean used for the calculation of all ref PPPs (with more than 1 ref. BH) in two regional comparisons instead of using aggregated EKS PPPs (with expenditure weights).

1. BHs "1110111 Education" and "1304111 Education benefits and reimbursements" should have the same PPPs due to the concept of "Full prices" (like it is done for "Hospital services"). This was not the case in at least one regional comparison.

2. BHs "1104111 Actual rentals for housing", "1201111 Housing - NPISH" and "1301111 Housing - GG" should have the same PPPs but this was not the case in two regional comparisons, where PPPs for BH "1104211 Imputed rentals for housing" is used as reference for BH "1201111 Housing - NPISH" instead.

[8] See document on reference PPPs agreed upon the 2019 Inter Agency Coordination Group (IACG) meeting available here: https://www.worldbank.org/en/programs/icp/brief/iacg08-doc.