[03.05]

2011 ICP Construction and Civil Engineering Survey

Outstanding issues

Global Office



7th Technical Advisory Group Meeting

September 17-18, 2012

Washington, DC

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Preface

This note describes a methodology applied to calculate the Construction PPPs for the 2011 round of the International Comparison Program. The Technical Advisory Group is invited to discuss and comment on the points raised in the chapter *3. Outstanding issues with the 2011 ICP Construction Survey methodology*.

Note on 2011 Construction and Civil Engineering Survey Methodology¹

1. Introduction

The 2011 ICP Construction and Civil Engineering survey is based on an input approach, where countries price 50 basic and common resources for construction work which are selected to correspond with the main inputs to national construction output. In addition, respondents to a national survey provide information on importance, resource mixes, typical mark-ups and professional fees, and approximated project prices.

2. Overview of approach for Construction and Civil Engineering PPPs

Construction is one of the three categories under Gross Fixed Capital Formation Aggregate. The Category is further broken down into three Groups, Classes and Basic Headings (BHs) as shown in Table 1 below. The objective of the Construction and Civil Engineering survey is to estimate PPPs for the three BHs and to further aggregate these up to the Construction Category.

Level	ICP Code	Heading
Aggregate	150000	GROSS FIXED CAPITAL FORMATION
Category	150200	CONSTRUCTION
Group	150210	RESIDENTIAL BUILDINGS
Class	150211	Residential buildings
BH	150211.1	Residential buildings
Group	150220	NON-RESIDENTIAL BUILDINGS
Class	150221	Non-residential buildings
BH	150221.1	Non-residential buildings
Group	150230	CIVIL ENGINEERING WORKS
Class	150231	Civil engineering works
BH	150231.1	Civil engineering works

Table 1: Construction headings

In order to reach this objective, four separate and consecutive steps are to be taken. The first step is the formation of Sub-Headings, followed by the calculation of Sub-Heading PPPs. Next, PPPs are aggregated up to the level of Category. Finally, the Category level PPPs can be adjusted for productivity differentials. However, the need and means for the final step is still a subject for discussion. Each step is described below in detail.

¹ This note is prepared by Marko Rissanen with input from with input from Michel Mouyelo-Katoula and Nada Hamadeh, based on the material prepared by Jim Meikle.

2.1. Establishment of Sub-Headings

The 50 basic and common construction resources are grouped into three Sub-Headings as follows:

- <u>Materials</u> Sub-Heading: 38 material inputs;
- <u>Equipment</u> Sub-Heading: 5 types of equipment hire services;
- <u>Labor</u> Sub-Heading: 7 categories of construction labor.

These Sub-Headings are allocated under the three Construction BHs (Residential and Non-residential buildings and Civil engineering work), so that each BH has three Sub-Headings, totaling to nine Sub-Headings.

Inputs included in the <u>Equipment</u> and <u>Labor</u> Sub-Headings are identical for all BHs, but the number and set of material inputs included in the <u>Materials</u> Sub-Heading may differ depending on the BH. This is because items, such as concrete and steel reinforcement, can be relevant for all construction projects, and thus for all BHs, while other items, sheet roofing and sanitary ware, for example, may be used only in residential and non-residential projects. Annex 1 gives an indicative list of relevant materials for each BH.

National experts are required to indicate if a material is commonly used or, in other words, whether the material in question is relevant, for each type of construction project. This is done by deeming materials either important or not-important for each BH. It is suggested that the indicative list given in Annex 1 is used as a starting point. Table 2 below summarizes the headings and number of items included in each Sub-Heading and BH. The actual number of items under the Material Sub-Heading may vary between the BHs, as explained above.

Level	ICP Code	Heading	# Items
ВН	150211.1	Residential buildings	50
Sub-Heading		Materials	38
Sub-Heading		Equipment	5
Sub-Heading		Labor	7
ВН	150221.1	Non-residential buildings	50
Sub-Heading		Materials	38
Sub-Heading		Equipment	5
Sub-Heading		Labor	7
ВН	150231.1	Civil engineering works	50
Sub-Heading		Materials	19
Sub-Heading		Equipment	5
Sub-Heading		Labor	7

2.2. Sub-Heading PPPs

Having the Sub-Headings established for all countries and each BH, the next step is the calculation of the PPPs. For <u>practical computation reasons</u>, Sub-Headings are treated as "Basic Headings" in the subsequent process for calculating the PPPs, whereas actual BHs are treated as aggregate level as shown in Table 3 below.

Actual Levels	Considered as	ICP Code	Aggregate or BH	
Aggregate	Aggregate level	150000	GROSS FIXED CAPITAL FORMATION	
Category	Aggregate level	150200	CONSTRUCTION	
Group	Aggregate level	150210	RESIDENTIAL BUILDINGS	
Class	Aggregate level	150211	Residential buildings	
BH	Aggregate level	150211.1	Residential buildings	
Sub-Heading	Basic Heading	150211.11	Materials	
Sub-Heading	Basic Heading	150211.12	Equipment	
Sub-Heading	ding Basic Heading 150211.13 Labor		Labor	
Group	Aggregate level	150220	NON-RESIDENTIAL BUILDINGS	
Class	Aggregate level	150221	Non-residential buildings	
BH	Aggregate level	150221.1	Non-residential buildings	
Sub-Heading	Basic Heading	150221.11	Materials	
Sub-Heading	Basic Heading	150221.12	Equipment	
Sub-Heading	Basic Heading	150221.13	Labor	
Group	Aggregate level	150230	CIVIL ENGINEERING WORKS	
Class	Aggregate level	150231	Civil engineering works	
BH	Aggregate level	150231.1	Civil engineering works	
Sub-Heading	Basic Heading	150231.11	Materials	
Sub-Heading	Basic Heading	150231.12	Equipment	
Sub-Heading	Basic Heading	150231.13	Labor	

Table 3: Sub-Headings as	"Basic Headings"
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The method for calculating Sub-Heading PPPs is unweigted CPD. This method is selected instead of CPRD or weighted CPD, as all items included in the calculation of PPPs are deemed important, as explained above in section 2.1 Establishment of Sub-Headings². As all items are important, different calculation methods yield the same results.

² Classifying an item as important in the Construction and Civil Engineering survey means that the material in question is commonly used in residential, non-residential or civil engineering construction projects within a country. Respectively if an item is classified as not-important, it means that the material in question is not used commonly in construction projects within the country. As such, it is less likely to represent the construction material costs for the country realistically.

The next step is the aggregation of the Sub-heading PPPs to the actual BH level. As construction BHs are identical to their parent classes and groups, one single aggregation step will fill all these identical aggregation levels. In this process both National Account Expenditures and Resource mixes are used, as explained below.

2.2.1. Construction Expenditure and Resource Mixes

National Accounts Construction Expenditure data is reported for the Construction headings listed in Table 1 above.

Resource Mixes are the cost of materials, equipment and labor expressed as a percentage share of the total expenditure value of a BH. The shares in different clusters of countries are dependents to the skills and technology available in the countries and other factors, and average values can vary from country to country, and across the Construction BHs³. Primarily, information on Resource Mixes will be collected during the price survey. However, in cases where national construction experts are not able to provide this information or if there is considerable doubt on the reliability of this information, default values are estimated based on gross national income.

The clustering of countries is based on:

- Gross national income (GNI): Higher, Middle and Lower
- Relative construction labor costs: Higher, Middle and Lower

Gross national income (GNI) per capita is used as a proxy for estimating resource mix differentials, as it can be suggested that the main factors influencing resource mixes across countries, particularly for building work, are the relative wealth of the countries and, within countries, the relative wage levels of construction workers. The shaded areas indicate less plausible combinations of national wealth and cost of construction labor. Annex 2 gives clustering of countries based on GNI per capita and construction labor costs. <u>Countries will be further clustered based on the relative labor costs, based on the data derived from the Construction and Civil Engineering price survey.</u>

Table 3 below gives initial estimated Recourse Mix shares. However, it is important to note that provided estimates are based on initial data; only after resource mix data is gather across the countries, final figures can be produced. As such, the estimated values are as well a subject of validation.

³ In most countries and in most types of work, with possible exception of civil engineering work, Material inputs represent the greatest proportion of construction value, typically as high as 50 - 75%. Building work labor represents the next greatest share, approximately 20 - 40%, whereas Equipment has the smallest proportion with 5 - 20% share. In civil engineering work, the relative significance of labor and equipment can be reversed, and materials and products may not be the most significant component.

Relative cost of	Gross national income (GNI)					
construction labor	Higher	Middle	Lower			
Residential building						
	Labor 30%					
Higher	Equipment 7.5%					
	Materials 62.5%					
	Labor 25%	Labor 25%				
Middle	Equipment 5%	Equipment 5%				
	Materials 70%	Materials 70%				
	Labor 20%	Labor 20%	Labor 20%			
Lower	Equipment 2.5%	Equipment 5%	Equipment 7.5%			
	Materials 77.5%	Materials 75%	Materials 72.5%			
Non-residential build	ling					
	Labor 30%					
Higher	Equipment 10%					
	Materials 60%					
	Labor 25%	Labor 25%				
Middle	Equipment 7.5%	Equipment 7.5%				
	Materials 67.5%	Materials 67.5%				
	Labor 22.5%	Labor 20%	Labor 17.5%			
Lower	Equipment 5%	Equipment 7.5%	Equipment 10%			
	Materials 72.5%	Materials 72.5%	Materials 72.5%			
Civil engineering	1					
	Labor 20%					
Higher	Equipment 30%					
	Materials 50%					
	Labor 22.5%	Labor 22.5%				
Middle	Equipment 27.5%	Equipment 27.5%				
	Materials 50%	Materials 50%				
	Labor 25%	Labor 20%	Labor 15%			
Lower	Equipment 25%	Equipment 30%	Equipment 35%			
	Materials 50%	Materials 50%	Materials 50%			

 Table 3: Initial estimated Resource Mixes

Generally, labor percentages tend to increase and material percentages decrease, as national wealth and the cost of construction labor increase. Where construction labor is relatively cheap, contractors prefer to use labor rather than equipments. Civil engineering is most variable area across countries and over time, particularly in small and developing countries. Normally, there are more options in richer than in poorer, countries. Australia, for example, tends to use relatively expensive and highly skilled local labor, while Singapore uses relatively cheap, and unskilled migrant labor (Australia and Singapore are both wealthy countries with similar income levels). As such, Australia would be located in the higher labor costs row, whereas Singapore would belong to the lower row of higher GNI column.

2.2.2. Establishment of Sub-Heading weights

Aggregation of the Sub-Heading PPPs to the actual BH level requires Sub-Heading Expenditure. These are formed by breaking down the BH level Expenditure over each Sub-Heading using Resource Mixes as weights. As an example in Table 4 below, Nominal Expenditure for Construction Category is 70, which is further broken down into Groups and Classes, as shown in the Table. Column "RM Shares" gives Resource Mix shares for each Sub-Heading. The last column gives the Nominal Expenditures to be applied, when the Sub-Headings are aggregated up to the BH level.

Actual Levels	Considered as	Code	Aggregate or BH	Nominal Expenditure (LCU)	RM Shares	RM weighted Nominal Expenditure (LCU)
Aggregate	Aggregate level	150000	GROSS FIXED CAPITAL FORMATION	120		
Category	Aggregate level	150200	CONSTRUCTION	70		
Group	Aggregate level	150210	RESIDENTIAL BUILDINGS	18		
Class	Aggregate level	150211	Residential buildings	18		
BH	Aggregate level	150211.1	Residential buildings			
Sub-Heading	Basic Heading	150211.11	Materials		70%	12.6
Sub-Heading	Basic Heading	150211.12	Equipment		5%	0.9
Sub-Heading	Basic Heading	150211.13	Labor		25%	4.5
Group	Aggregate level	150220	NON-RESIDENTIAL BUILDINGS	12		
Class	Aggregate level	150221	Non-residential buildings	12		
BH	Aggregate level	150221.1	Non-residential buildings			
Sub-Heading	Basic Heading	150221.11	Materials		67.5%	8.1
Sub-Heading	Basic Heading	150221.12	Equipment		7.5%	0.9
Sub-Heading	Basic Heading	150221.13	Labor		25%	3.0
Group	Aggregate level	150230	CIVIL ENGINEERING WORKS	40		
Class	Aggregate level	150231	Civil engineering works	40		
BH	Aggregate level	150231.1	Civil engineering works			
Sub-Heading	Basic Heading	150231.11	Materials		50%	20.0
Sub-Heading	Basic Heading	150231.12	Equipment		27.5%	11.0
Sub-Heading	Basic Heading	150231.13	Labor		22.5%	9.0

Table 4: Establishment of BH weights

2.2.3. Aggregation of PPPs

After the Sub-Headings weights are established, the Sub-Heading PPPs can be aggregated to BH, Class, Group and finally up to the level of Construction Category, using the selected aggregating method⁴.

2.3. Adjustment for productivity

The final step in the calculation process is the adjustment of the Category level PPPs for productivity differentials, if necessary. The main reason for productivity differentials across countries is on how efficiently the material, labor and capital inputs are used in the transformation into output quantity. If this efficiency is lower, the output price will be higher, as more input quantities are needed to arrive at the same output quantity. Respectively if this efficiency is higher, the output price will be lower as less input quantities are needed to get the same output quantity.

3. Outstanding issues with the 2011 ICP Construction Survey methodology

To arrive at a proxy output PPP for construction, needed first are the prices of all relevant inputs, then the weights of these inputs for the output, and finally a productivity adjustment. The 50 basic and common construction resources are representing the relevant construction project inputs. The weights in output are needed to adjust for potential substitution effects some countries might use more labor instead of capital, for instance. This is done using Resource Mix shares and Expenditures as explained in section 2.2.2. above.

However, the 2011 ICP Construction methodology needs further discussion on the following points:

- Adjustment of prices for professional fees and mark-ups; and
- Adjustment for productivity.

These points are covered in the subsequent sections 3.1. and 3.2.

3.1. Adjustment of prices for professional fees and mark-ups

Information on the professional fees and markups are collected with the 2011 ICP Construction Survey Questionnaire. Table 5 below gives an example of a completed questionnaire.

⁴ The selected method can be Elteto, Koves, Szulc (EKS), Geary-Khamis (GK) or Iklé.

Table 5: Example of a completed questionnaire

Сс	ontractors' mark-ups			
	Cost headings	Residential buildings	Non- residential buildings	Civil engineering works
1	Total mark-up of which:	<u>25.0%</u>	<u>30.0%</u>	<u>25.0%</u>
2	General site costs and temporary works	18.0%	21.0%	18.0%
3	Head office overheads	2.0%	4.0%	2.0%
4	Profit	5.0%	5.0%	5.0%
5	Other contractors costs (please specify)	N/A	N/A	N/A

Pr	ofessional fees			
	Cost headings	Residential buildings	Non- residential buildings	Civil engineering works
1	Overall percentage addition for professional services	12.0%	13.0%	11.0%

However, it is not clear how this information should be used in the calculation of the Construction PPPs. Possibilities are either to adjust each construction material inputs, or the subsequent BH PPPs, for markups and professional fees (37 % Residential, 43 % Non-residential and 36 % Civil Engineering work BHs, based on the example).

Both of these options are potentially problematic, mainly because:

- Reliable estimation of "true mark-up", which is the part of the output price that cannot be explained by differences in input prices or productivity, but by having market power in the construction output market, maybe very difficult;
- Adjustment for professional fees may not fit into the overall methodology, as these may be better considered as compensation input (professional services), but then they should be considered as such, and a PPP should be calculated.

As the adjustment for mark-ups and professional fees can have a substantial impact on the construction PPPs, conducting this step should be carefully weighted. However, it should also be noted that if prices or PPPs are not adjusted for mark-ups, the methodology assumes competitive markets, or alternatively, markets that have the same structure across the countries that are being compared.

3.2. Adjustment for productivity

The productivity adjustments may be needed to allow for any difference in the efficiency with which the inputs are being used. It indicates how efficiently the quantities of labor capital and intermediate inputs are used in the transformation into output quantity. If this efficiency is lower, the output price will be

higher: more input quantities are needed to arrive at the same output quantity. It should be noted that even if the Resource Mixed weighted Expenditures do give an estimation of the weights of different inputs (materials, equipment and labor) in outputs, it may not address how efficiently these inputs are translated into outputs sufficiently.

However, even if the need for adjustment for productivity may be valid, it should be considered can this adjustment be done in practice using the available data and methodology. More specifically, it should be considered that the adjustment for productivity be done by applying factors based on specific capital and productivity levels of a country, as described by Robert Inklaar and Marcel Timmer in *PPPs for Government Services*⁵.

Applying this method would mean that capital stocks are be estimated based on investment flows by asset type for each country, and that total factor productivity level would be derived from labor and capital income shares, using a production function framework.

⁵ <u>http://siteresources.worldbank.org/ICPINT/Resources/270056-1255977007108/6483550-</u> 1257349667891/6544465-1344612273634/03.01 ICP-TAG07 PPPsGovServices.pdf

Annex 1: Indicative allocation	n of Material inputs
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		Use in			
	Material or product	Residential building	Non-residential building	Civil engineering works	
1	Aggregate for concrete	Х	Х	Х	
2	Sand for concrete and mortar	Х	Х	Х	
3	Softwood for carpentry	Х	Х	X	
4	Softwood for joinery	Х	Х		
5	Exterior plywood	Х	Х	Х	
6	Interior plywood	Х	Х		
7	Chipboard sheet	Х	Х		
8	Petrol/ gasoline	Х	X	Х	
9	Diesel fuel	Х	Х	Х	
10	Oil paint	Х	Х		
11	Emulsion paint	Х	Х		
12	Ordinary Portland cement	Х	Х	Х	
13	Ready-mix concrete	Х	Х	Х	
14	Precast concrete slabs	Х	Х		
15	Common bricks	Х	Х	Х	
16	Facing bricks	Х	X		
17	Hollow concrete blocks	Х	X	Х	
18	Solid concrete blocks	Х	X	X	
19	Clay roof tiles	Х			
20	Concrete roof tiles	Х			
21	Float/ sheet glass	Х	Х		
22	Double glazing units	Х	X		
23	Ceramic wall tiles	Х	Х		
24	Plasterboard	Х	X		
25	White wash hand basin	Х	X		
26	High yield steel reinforcement	Х	X	X	
27	Mild steel reinforcement	Х	X	X	
28	Structural steel sections	Х	X	X	
29	Sheet metal roofing	Х	X		
30	Metal storage tank		X	X	
31	Cast iron drain pipe	Х	X	X	
32	Copper pipe	Х	X		
33	Electric pump		X	X	
34	Electric fan		X		
35	Air-conditioning equipment	X	X		
36	Stand-by generator		X		
37	Solar collector	X	X	X	
38	Electricity	X	X	X	
	Totals	34	36	19	

Annex 2: Classification of countries into income groups

215 economies are divided into income groups according to 2010 gross national income (GNI) per capita and calculated using the World Bank Atlas method. The groups are:

- Low income, \$1,005 or less;
- Middle income, \$1,006 \$12,275; and
- High income, \$12,276 or more.

Further details are given on the World Bank website at:

http://data.worldbank.org/about/country-classifications

Low-income economies (\$1,005 or less)

Afghanistan	Gambia, The	Myanmar	
Bangladesh	Guinea	Nepal	
Benin	Guinea-Bisau	Niger	
Burkina Faso	Haiti	Rwanda	
Burundi	Kenya	Sierra Leone	
Cambodia	Korea, Dem Rep.	Somalia	
Central African Republic	Kyrgyz Republic	Tajikistan	
Chad	Liberia	Tanzania	
Comoros	Madagascar	Тодо	
Congo, Dem. Rep	Malawi	Uganda	
Eritrea	Mali	Zimbabwe	
Ethiopia	Mozambique		

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Middle-income economies (\$1,006 to to \$12,275)

Albania	Guyana	Paraguay
Algeria	Honduras	Peru
American Samoa	India	Philippines
Angola	Indonesia	Romania
Antigua and Barbuda	Iran, Islamic Rep.	Russian Federation
Argentina	Iraq	Samoa
Armenia	Jamaica	São Tomé and Principe
Azerbaijan	Jordan	Senegal
Belarus	Kazakhstan	Serbia
Belize	Kiribati	Seychelles
Bhutan	Козоvо	Solomon Islands
Bolivia	Lao PDR	South Africa
Bosnia and Herzegovina	Latvia	Sri Lanka
Botswana	Lebanon	St. Kitts and Nevis
Brazil	Lesotho	St. Lucia
Bulgaria	Libya	St. Vincent and the Grenadines
Cameroon	Lithuania	Sudan
Cape Verde	Macedonia, FYR	Suriname
Chile	Malaysia	Swaziland
China	Maldives	Syrian Arab Republic
Colombia	Marshall Islands	Thailand
Congo, Rep.	Mauritania	Timor-Leste
Costa Rica	Mauritius	Tonga
Côte d'Ivoire	Mayotte	Tunisia
Cuba	Mexico	Turkey
Djibouti	Micronesia, Fed. Sts.	Turkmenistan
Dominica	Moldova	Tuvalu
Dominican Republic	Mongolia	Ukraine
Ecuador	Montenegro	Uruguay
Egypt, Arab Rep.	Morocco	Uzbekistan
El Salvador	Namibia	Vanuatu
Fiji	Nicaragua	Venezuela, RB
Gabon	Nigeria	Vietnam
Georgia	Pakistan	West Bank and Gaza
Ghana	Palau	Yemen, Rep.
Grenada	Panama	Zambia
Guatemala	Papua New Guinea	

High-income economies (\$12,276 or more)

Andorra	Germany	Norway
Aruba	Gibraltar	Oman
Australia	Greece	Poland
Austria	Greenland	Portugal
Bahamas, The	Guam	Puerto Rico
Bahrain	Hong Kong SAR, China	Qatar
Barbados	Hungary	San Marino
Belgium	Iceland	Saudi Arabia
Bermuda	Ireland	Singapore
Brunei Darussalam	Isle of Man	Sint Maarten
Canada	Israel	Slovak Republic
Cayman Islands	Italy	Slovenia
Channel Islands	Japan	Spain
Croatia	Korea, Rep.	St. Martin
Curaçao	Kuwait	Sweden
Cyprus	Liechtenstein	Switzerland
Czech Republic	Luxembourg	Trinidad and Tobago
Denmark	Macao SAR, China	Turks and Caicos Islands
Estonia	Malta	United Arab Emirates
Equatorial Guinea	Monaco	United Kingdom
Faeroe Islands	Netherlands	United States
Finland	New Caledonia	Virgin Islands (U.S.)
France	New Zealand	
French Polynesia	Northern Mariana Islands	