

International Comparison Program

[01.01]

A New Approach to International Construction Price Comparison

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A new approach to international construction price comparisons¹

1 Introduction

- 1.1 The International Comparison Program (ICP) is responsible for the production of Purchasing Power Parities (PPPs) for both national GDP and for sub-components of GDP. PPPs are alternatives to market exchange rates and are intended to reflect price level differences across countries more accurately. One of the sub-components of GDP is Construction, part of Gross Fixed Capital Formation. This note reviews development work over the last eighteen months and recommends an approach to the calculation of construction PPPs for the ICP 2011 round.
- 1.2 Construction is described in the report of the ICP 2005 results as ‘comparison resistant’. It is difficult to identify a range of comparable and representative construction products/ projects and virtually impossible to observe purchaser prices in a national average location at the same time in all countries. As a result, the methods adopted for the calculation of PPPs are mostly based on theoretical products/ projects and require adjustments to bring them to a common basis. Designing the data collection, collecting the price data and processing it requires specialist skills and knowledge.
- 1.3 The work outlined in this note applies to construction work undertaken by formal construction contractors using modern materials; a separate note has been prepared on so-called ‘informal’ construction, particularly construction work on informal residential buildings. Like other price indicators, the calculation of PPPs requires a list (or lists) of items, and weights and prices for these items. The challenge is to identify appropriate lists and reliable sources of prices and weights. The note is in four parts, including this introduction. Parts 2 and 3 discuss methods of establishing weights and collecting and validating prices, part 4 outlines how the proposed approach will be implemented.

2 Establishing weights

- 2.1 Two types of weights are required: weights for the items that represent the three basic headings (residential buildings, non-residential buildings and civil engineering) and weights that represent the contribution that each basic heading makes to all construction. The items representing basic headings can be the resource inputs or work items that make up construction projects or they can be whole construction projects.
- 2.2 Existing methods (notably the Eurostat and OECD methods and the BOCC method used in ICP 2005) are based on work items. They have been rejected for this round, in the case of Eurostat and OECD, largely because they are too

¹ Acknowledgement is due to Yuri Dikhanov who reviewed the paper.

expensive to implement, and, in the case of BOCC, largely because reliable weights were difficult to find to convert work items into projects.

- 2.3 While model projects provide a sound basis for the calculation of material resource inputs, the corresponding labour and equipment resource inputs are dependant on the skills and technology available in a country and other factors, and average values can vary widely from country to country and, within countries, across types of work. There can be trade-offs between the skill levels and the price of labour (highly skilled labour is usually expensive but the quantity of workers required is relatively low, and *vice versa*) but that is not always the case. There will also be trade-offs between the quantities of labour and equipment inputs (capital/ labour substitution) but there is relatively little information on that in most countries.
- 2.4 In most countries and in most types of work (although not necessarily in civil engineering work), materials and products represent the greatest proportion of construction value (typically, 50 – 70%) and, in building work, labour represents the next greatest (20 – 40%) and equipment the smallest proportion (5 – 20%). In civil engineering work, the relative significance of labour and equipment can be reversed and materials and products may not be the most significant component. Civil engineering also tends to be the most variable of the basic headings, particularly in smaller or less developed countries, where a dominant type of work can influence the mix – roads and tunnelling, for example, will have relatively low material content.
- 2.5 Input-output and Supply and use tables provide a useful indication of the labour input to all construction work via ‘compensation of employees’ in value-added and, in some countries, where there are multiple columns for construction, the labour inputs to different types of work can be calculated. But tables are not available for all countries and are often not up to date, and, even when they are, they usually only provide information on all construction, not basic headings.² And tables provide even less, and less reliable, information on the equipment inputs to construction.
- 2.6 In the Consultants’ pilot survey, questions were asked about the proportion by value that the three main resource inputs represented of the three main types of construction work (residential, non-residential and civil engineering). Table 1 sets out the proportions provided by respondents; these have been through one round of validation but are still subject to revision.

TABLE 1: RESOURCE MIXES BY BASIC HEADINGS

Country	Residential construction			Non residential construction			Civil engineering		
	M	E	L	M	E	L	M	E	L

² Generally, more, more detailed and more up to date information is available on European and OECD countries.

Country	Residential construction			Non residential construction			Civil engineering		
	M	E	L	M	E	L	M	E	L
Australia	60	5	35	70	5	25	30	20	50
USA	42	3	55	45	5	50	40	40	20
UK	52	8	40	45	15	40	35	35	30
Egypt	85	5	10	75	10	15	40	50	10
Lebanon	70	5	25	75	5	20	20	60	20
UAE	65	15	20	65	15	20	65	15	20
Yemen	70	10	20	60	20	20	40	50	10
Tanzania	70	10	20	65	20	15	55	35	10
South Africa	40	5	55	40	15	45	45	35	20
Thailand	70	7	23	70	7	23	na	na	na
Brunei	75	10	15	75	10	15	60	20	20
China	75	15	10	78	12	10	70	20	10
Macau	50	30	20	50	30	20	60	20	20
Hong Kong	62	3	35	65	5	30	55	25	20
India	70	10	20	70	10	20	60	20	20
Indonesia	65	20	15	60	25	15	65	20	15
Japan	55	10	35	55	10	35	55	18	27
South Korea	70	5	25	68	7	25	33	26	41
Malaysia	65	10	25	65	10	25	35	35	30
Philippines	60	5	35	70	5	25	30	20	50
Pakistan	45	20	35	45	20	35	35	35	30
Singapore	70	10	20	70	10	20	na	na	na
Vietnam	70	8	23	70	8	23	60	32	8

- 2.7 The percentages in the table are only partially validated and there are still a few slightly surprising figures (eg. the labour proportions in South Africa, Egypt and China). Reliable data of this kind is not readily available and difficult to collect, even from experienced professionals; the consultants are currently in bilateral discussions with a number of survey respondents.
- 2.8 Generally, the value of materials and products is more consistent internationally than either equipment or labour. The range in the table is 40 – 85% but the majority of material and product values fall between 50 and 75%. There is much greater variability both between and within the values for equipment and labour. The main reasons for this are the capital: labour mix adopted in local industries, the cost of local labour and local levels of productivity.
- 2.9 In the CIS survey, quantities are provided for materials and products and one type of labour (and no equipment). Factors are provided by countries to adjust labour quantities relative to a base quantity. Based on 2005 data, the proportions of labour in total project value for a sample of projects varied between 13 and 37% in nine countries, similar to the range in the pilot survey. The percentages,

however, look low for some types of work in some countries, particularly non-residential building work in all but Belarus and Russia. The consultants are currently undertaking further analysis of the CIS data and are attempting a comparison of the CIS model projects approach with consultants' input-output approach.

- 2.10 The CIS method utilises 104 model projects (23 residential, 61 non-residential and 20 civil engineering). Not all of the projects are representative of construction work in all countries and an asterisk system is used to indicate representivity – projects considered unrepresentative are omitted from the calculation of that country's PPPs. Some, at least, of the CIS projects will be suitable as a basis for the calculation of quantity weights for materials and products in the proposed approach.
- 2.11 Eurostat and OECD projects can also provide quantity weights for examples of the three basic headings.³ The bills of quantities will be analysed and quantities of materials and products extracted. The Consultants have other sources of quantity weights including an analysis of 83 UK housing projects and a model of a non-residential commercial building project used in Rick Best's PhD thesis.
- 2.12 Broad resource input weights for the three basic headings can, therefore, be derived from expert responses to the ICP construction survey. These will need to be thoroughly checked and validated but offer probably the best source of overall value weights. Quantity weights for materials and products representing different types of construction work can be derived from a range of model projects and value weights for labour inputs can be derived from Input-output and Supply and use tables for at least some countries. All of these various sources provide a sound basis for calculating PPPs for construction basic headings. Section 4, below, describes PPP calculations and presents results for CIS and pilot survey data.
- 2.13 The value of construction work in each basic heading will vary from country to country and from year to year. In larger more mature economies there may be long term regular patterns in construction investment but, in smaller and less developed economies, the mix can vary substantially from year to year. Countries go through phases of construction investment depending on some combination of the state of the general economy, government policy, the volume and nature of development aid programmes, and other factors.
- 2.14 Construction output data is usually available from national statistical offices or other government departments that indicates the mix by value of the different types of construction produced each year, and this type of data is usually relatively up to date and in categories that can be matched to the three basic

³ A test exercise undertaken by the consultants reworked the 2009 bill of quantity price data into resource input data and applied their input-out approach to weighting. The results for all EU member states were within $\pm 10\%$ for all construction PPPs but less good for basic heading PPPs.

headings. This data will need to be collected from government departments, preferably for a number of years. Assessments will also need to be made of what output is included in, and excluded from, official figures.

3 Collecting and validating prices

- 3.1 The prices required are mid-year national average prices, as paid by the purchasers, for all construction and three sub-headings (basic headings) of construction work, residential, non-residential and civil engineering. The pilot survey collected input prices (the prices paid by contractors) for 38 materials and products (including fuel and electricity), seven types of labour and five types of equipment; the proportions that the three groups represented of the total value of construction and of the basic headings; and the mark-ups required to add to input prices to produce output prices. The survey also collected m² output prices for different types of projects representing the basic headings, and respondents' views on their price levels relative to neighbouring countries'.
- 3.2 The input prices, weighted as appropriate, are intended to be the primary basis of construction PPPs, but the m² prices and the respondents' views on relative prices will also help to confirm, or inform the checking of, the input prices. A first round of validation of the pilot survey data has been undertaken based on an analysis of responses and identification of price outliers, and 17 out of 23 countries have responded. The initial validation provided initial PLIs and asked respondents to comment on their own price level and their price level relative to other countries; it also asked for confirmation, clarification or completion of particular items of information. A second round of validation will be undertaken where it is considered necessary to obtain further information.
- 3.3 The survey forms, except for Tanzania and Yemen, were completed by construction experts from Davis Langdon, an international firm of construction consultants; the Tanzanian and Yemeni surveys were completed by local consultants. Generally the quality of responses was very good and most sections were completed fully and properly. All the forms required some adjustment of some prices as a result of respondents' changes to item descriptions and units. The pilot survey also identified shortcomings in the survey forms that are being addressed.
- 3.4 After adjustment, price and other data were entered into a spreadsheet model that produced summary tables and initial PPPs and PLIs. Gaps are taken care of using established calculation tools, eg. the Quaranta programme or similar. Unweighted geometric means of item price relatives were calculated for materials, labour and equipment for each of the three basic headings, and mark-ups were added to produce basic heading PPPs; these were then aggregated to produce 'all construction' PPPs. PPPs were also calculated based on m² rates and efforts were made to rank countries based on respondents' views of their price levels relative to their neighbours (this latter was less successful than it should have been because the question in the survey was poorly framed – this will be addressed in the revised form).

- 3.5 Validation questionnaires, including summary tables, tables and diagrams of PLIs, and prices identified as outliers, were sent to each respondent. Outliers were set as item prices that were more than 2.5 times, or less than 0.4 times, the price level for that country. That produced an average of 8.1% of priced items as outliers (11% of materials, less in the other groups) or between zero and 10 items per country. Reducing the outlier range to 2.0 to 0.5 produced 15.2% outliers, between zero and 16 items per country; a range of 1.5 to 0.67 gave 34% outliers, 5 to 29 items per country. The validation to date, has reduced outliers to 6.0% of priced items and a maximum of 9 items per country)
- 3.6 M² prices and respondents' views of relative prices will mainly be used to inform the validation process. The consultants will also review the availability and reliability of published construction price data. Generally, however, the countries with good supplementary data will tend to be the countries where major construction contracting and consultancy firms are active and where it should be possible to obtain good survey responses. The section on survey respondents' views of price levels in neighbouring countries should help confirm the relative position of countries and may help provide price level indicators where little or no price data can be obtained.

4 Implementation

- 4.1 The pilot survey demonstrates that, with a carefully designed survey and expert respondents, useful price and other data can be collected successfully. To ensure reliability, some manual adjustment of data and at least two validation rounds are probably necessary.
- 4.2 The basic method of calculating PPPs is well understood and will be adopted for construction PPPs: price relatives for selected items are weighted and aggregated using geometric means. Weights for material and product resource inputs will be taken from project models; relative weights for other inputs and mark-ups will be taken from the price survey, and basic heading PPPs will be produced. Basic heading PPPs will be aggregated to all construction PPPs using weights from national statistical offices. The Consultants have developed and tested spreadsheet models for these calculations
- 4.3 The main survey is planned for July 2011. Prior to that:
- The survey forms and instructions will be finalised and translated;
 - Briefing notes will be compiled for regional coordinators and national statistical offices; and
 - Notes on selection criteria will be prepared for national construction experts.
- All of these activities are in hand.
- 4.4 In parallel, the consultants will identify suitable model projects representing construction work internationally under the three basic headings and compile material and product quantities for each of them. They will also collect data on

the relative proportions of the basic headings in all construction output; and the coverage of formal and informal construction in the national accounts.