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Productivity adjustment in ICP

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Introduction

The aim of this note is fourfold, namely to discuss:

1. The principle of productivity adjustment
2. The performance of the ICP 2011 approach for construction
3. The ICP 2011 methodology for public services
4. The ICP 2011 productivity adjustment implementation and a modification

On the basis of this, I make two concrete proposals for ICP 2017:

- A. *Maintain current practice in construction of relying solely on input prices for most regions and regional linking.*
- B. *Maintain the methodology but change the implementation of the productivity adjustment for public services.*

1. Principle of productivity adjustment

Comparing relative prices in comparison-resistant areas are among the most-enduring challenges of ICP. The approach chosen for ICP 2011 for construction and for government, health and education – referred to as ‘public services’ for short – can best be described as **input price measurement**, in contrast to the standard practice of measuring the price of goods and services – i.e. output prices. In the case of construction projects, but also for many public services, there are superior alternatives to input price measurement and these are applied in the Eurostat-OECD PPP program.¹ However, implementing these alternatives at a global level is not feasible because of the strenuous data demands. The discussion on productivity adjustment is thus one of reaching a **second-best** solution that moves us closer to our target concept, while recognizing that this can require strict assumptions.

2. The ICP 2011 approach for construction

It is important to distinguish construction and public services. For construction, ICP collects prices for all inputs into construction projects: different types of construction labourers, building materials and rental prices for construction equipment. If the first-best approach

¹ These alternatives involve detailed surveys of the price of construction projects and, for health and education, extensive data on quantity indicators of services delivered; see the Eurostat-OECD PPP Manual for details.

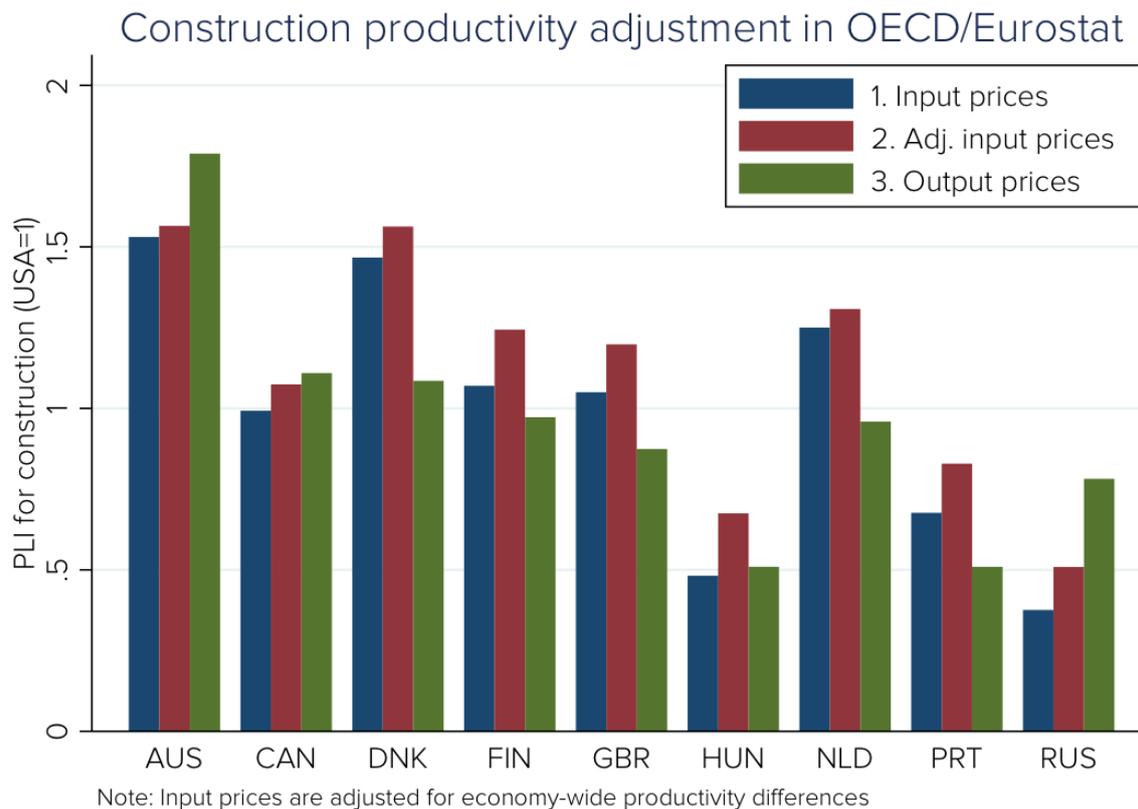
would be to collect prices of (model) construction projects, the current ICP approach falls short conceptually because it fails to allow for differences in total factor productivity (TFP) – differences in output prices that cannot be attributed to differences in input prices – and differences in markups of price over (marginal) costs.

While the conceptual shortcomings are clear, an important question is whether there are feasible solutions that move ICP from current second-best closer to first-best. Such solutions are not obvious: both TFP and markups are tremendously difficult to measure as TFP is a residual by definition and markups do not lend themselves to ready surveying (as the experience in ICP 2011 demonstrated). To aid in this, I turn to the results from ICP 2011, where we can compare first vs. second-best approaches thanks to the fact that Eurostat-OECD countries survey prices of construction projects and can thus be considered first-best in principle. In addition, ten countries in the Eurostat-OECD region also collected input prices to enable regional linking.

Figure 1, below, shows the price level index (PLI) for nine countries, relative to the United States, the tenth country. The blue bars are based on aggregate of the input prices – wages, material prices and equipment rentals. The green bars are based on output prices, i.e. the relative prices used within the Eurostat-OECD region. Finally, the red bars adjust the relative input prices for economy-wide TFP differences, as estimated in the Penn World Table (PWT), version 9.0.² Using economy-wide TFP differences is problematic in principle, as productivity differences in the construction sector could be very different from productivity differences in other sectors. Yet on a global scale, this would be the only feasible adjustment for TFP differences available. It turns out to be a poor adjustment in practice, since adjusted input prices are not systematically closer to the observed output prices than the original, non-adjusted input prices. Though this is but a small sample of countries, the construction PLIs in this figure span most of the global range as the average PLI for non-Eurostat-OECD countries is ± 0.4 and does not systematically vary with income level.

² Feenstra, Inklaar and Timmer, (*American Economic Review* 2015); www.ggd.net/pwt.

Figure 1



What Figure 1 demonstrates is thus that adjusting input prices for economy-wide productivity differences is unlikely to move us closer to first-best. More broadly, it is unclear what type of adjustment would be more successful. For some countries, such as Canada or Hungary, the difference between relative input and relative output prices is small, which could indicate that the TFP level in the construction sector in those countries is similar to that in the United States. In several countries (Denmark, Finland, United Kingdom and Netherlands) relative output prices are notably lower than relative input prices, which is indicative of higher TFP levels than in the United States, while in others (Australia and Russia) the reverse is the case. So on the basis of this comparison, my conclusion would be that there is **no clear scope for a satisfactory productivity adjustment in construction** and, while relative input prices are second-best to relative output prices, there is **no clear evidence that relying on relative input prices introduces a systematic bias in ICP**.

3. The ICP 2011 methodology for public services

ICP price measurement in public services restricts itself to measuring wages of civil servants, teachers and medical workers.³ This means that not only will differences in TFP drive a wedge between input and output prices, but differences in capital intensity will, too. In ICP 2011, we did not address TFP differences (in effect assuming that there are no TFP differences) and, based on the analysis for the construction sector, there seems to be no reason to revisit that choice.

ICP 2011 did include a productivity adjustment based on differences in capital intensity with the methodology explained on pages 208–209 of the ICP 2011 global report and a detailed report for the TAG in 2013. In brief, we estimate a productivity adjustment factor based on a country's (economy-wide) level of capital per worker and its estimated contribution to output based on the share of capital income in GDP:

$$P_i = \frac{1}{2}(\alpha_i + \bar{\alpha}) \ln\left(\frac{k_i}{\bar{k}}\right), \quad (1)$$

Where k_i is the stock of capital assets (structures, machinery, equipment and other assets) per worker in country i , α_i is the share of capital income in GDP in country i and an upper bar indicates the cross-country arithmetic average. P_i can then be compared to a reference country b to arrive at the adjustment factor for relative wages in public services:

$$F_i = [\exp(P_i - P_b)]^{-1} \quad (2)$$

In equation (2), a higher F_i indicates a lower contribution from capital intensity differences and thus leading to an upward adjustment of the wage PPPs.

4. Implementing the productivity adjustment

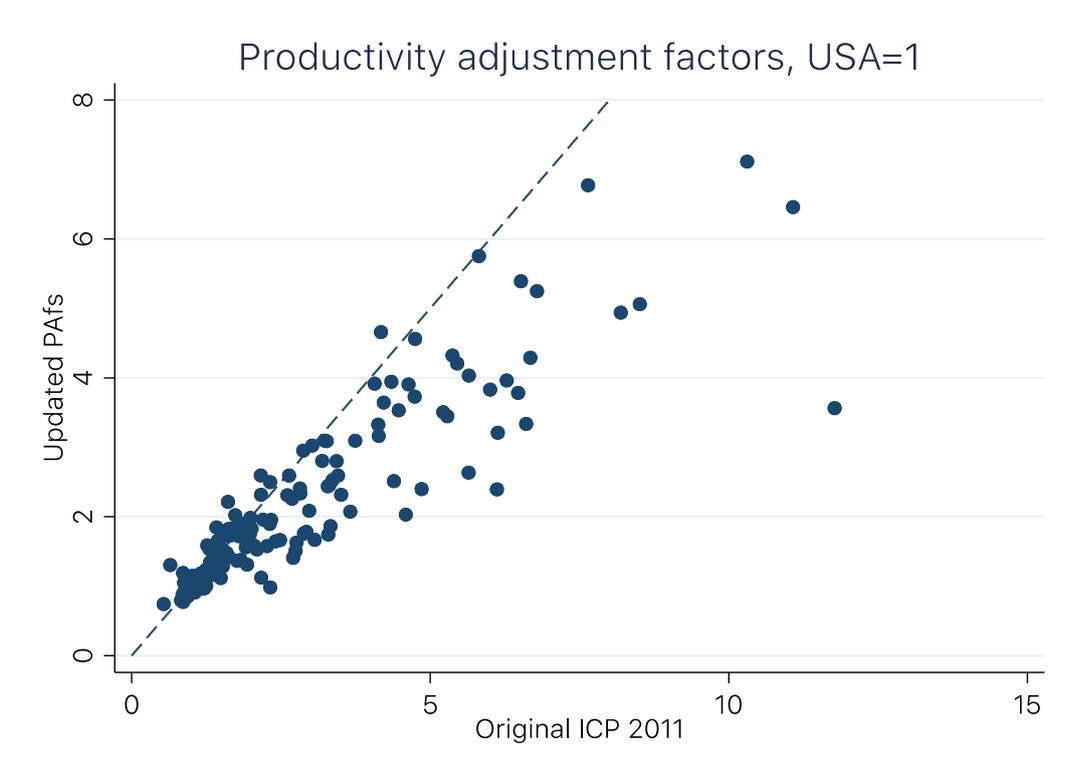
The productivity adjustment from equation (1) requires two pieces of information, the capital stock per worker and the share of capital income in GDP. The capital stock per worker is, in turn, based on estimates of the current-cost net capital stock at national prices and the PPPs for investment products from ICP 2011. The data on current-cost net capital stock for ICP 2011 were drawn from PWT, version 8.1 as was the share of labour income in GDP. The share of capital income in GDP was computed as one minus the labour share.

³ Intermediate inputs and operating surplus are covered by reference PPPs.

The most recent version of PWT, version 9.0, saw substantial improvements in the source material on the basis of which current-cost net capital stocks are estimated, in particular by more extensively relying on national sources of investment by asset. These data have become more widely adopted, most prominently in the World Bank's *Changing Wealth of Nations 2018* report as their measure for produced capital.

In addition, estimating the capital share in GDP as one minus the labour share in GDP has an important shortcoming in resource-rich countries. In those countries, such as several in Western Asia, rents from natural resources such as oil and gas make up a substantial fraction of GDP – see, again, the World Bank's *Changing Wealth of Nations 2018* report. A more accurate estimate of the capital share in GDP would thus be one minus the labour share minus the share of natural resource rents (available in the World Development Indicators).

Figure 2



Combining new source data for capital stocks and a new computation of the share of capital income in GDP leads to substantial changes to the productivity adjustment factors (PAFs), as shown in Figure 2. In particular, as most observations are below the 45-degree line, the productivity adjustment factors would become smaller. This may be a desirable feature in

itself, as the discussion for the construction sector illustrated that we should rather want to err on the side of smaller rather than larger adjustments. But, more importantly, the updated PAFs reflect more accurate and reliable source data and represent an improvement from that perspective.

My proposal is twofold:

1. PAFs for public services in ICP 2017 should be computed based on newer capital data and a measure of capital shares that accounts for resource rents.
2. The updated PAFs should be used for ICP 2017 but also to revise ICP 2011 PPPs.

Regarding the first part of my proposal, there is no alternative to using the newer capital data, as the data used in ICP 2011, from PWT 8.1, do not extend beyond the year 2011. The recommendation to change the capital share calculation is mostly to arrive at more suitable (and smaller) PAFs, especially in resource-rich countries.

The second part of the proposal stems from a desire to ensure time-series consistency. Adopting the first part of the proposal would lead to notably different PAFs in ICP 2017 than what would have been used in ICP 2011, introducing a source of differences between the two ICP rounds that can be avoided fairly simply. Given that revising ICP 2011 PPPs based on revised expenditure data is already in scope, this second part of my proposal would represent a modest extension of the scope of revisions.