Notes on the Inklaar Revised Productivity Adjustment Factors for Public Sector PPPs: Conclusions and Next Steps

Discussion Points by Erwin Diewert

Measuring the price of nonmarket Public Sector outputs by the price of labour used in public sector industries is obviously not a satisfactory solution and so productivity adjustments were used to adjust these public sector PPPs in past rounds of the ICP. The adjustments were based on economy wide estimates of capital-labour ratios and Robert Inklaar has worked out a useful modification of the method used in 2011 that takes into account natural resource inputs.

I have no objection to the Inklaar innovation in methodology but I am not able to make a strong recommendation at this time (before the meeting) on whether it should be adopted for the current round. We need to be guided by the consensus achieved at the meeting. The problem with the past adjustments and the new method suggested by Robert is that they are based on economy wide data on labour and capital. The labour/capital ratio in the overall economy will probably be related to the labour/capital ratio in the public sector but this relation will only be a very approximate one. Robert's suggested method does have the virtue that it tends to reduce the magnitude of the productivity adjustments as compared to the previous methods.

However, I do have some thoughts on what the next steps should be; i.e., for future ICP rounds, what is the way forward?

I think we have to look at how outputs are measured in the public sector by the current System of National Accounts. The 2010 OECD Statistics Directorate Working Paper 31 on measuring the most important public sector outputs, *Towards Measuring the Volume Output of Education and Health Services*, on page 15 notes that the (nonmarket) *value of outputs* produced in the health and education sectors is measured by total input costs, which are defined to be the sum of the following costs:

- Intermediate consumption (the goods and services used up in producing the service;
- Compensation of employees (costs of teachers, doctors, nurses, etc…);
- Consumption of fixed capital (depreciation of school and hospital buildings, of medical equipment) and
- Other taxes, less subsidies, on production.

The above sum of costs gives us the *value* of nonmarket production in public sector industries but this value needs to be decomposed into price and volume (quantity) components. This can be done in one of two ways:

- Find direct measures of the quantities of services provided and get the corresponding output prices residually by dividing the above costs by the relevant quantities or

- Form an aggregate input index of the intermediate inputs, labour inputs and capital services used in producing the nonmarket outputs. This aggregate input index is then regarded as the output price index.

Taxes cannot be deflated directly; they are allocated to the relevant inputs if public sector producers or services actually have to pay for their use (subsidies are ignored). I go into the index number details of the above two methods in the time series context in Diewert (2017), which is the discussion paper version of a chapter in the *Oxford Handbook of Productivity*.

Since the second method is the more widely used method, it is probably useful to look at the algebra involved in implementing it in the context of making cross country comparisons in a highly simplified case. (I will ignore subsidies). Thus consider the case of C countries that produce the same nonmarket public sector output using inputs of intermediate inputs (materials and various services like electricity and telecommunications), labour and capital. Denote the vectors of prices and quantities for intermediate inputs in country c by p_X^c and q_X^c and for labour services by w^c and q_L^c for c = 1,...,C. A practical problem is that these inputs need to be measured in the same (constant quality) units across countries. The prices are in units of domestic currency. For capital services, the situation is more complicated. Assume for simplicity that there are only two types of capital in use by the target public sector production units, structure capital and machinery capital. Denote the (geometric depreciation) capital stocks of structures and machinery for country c by K_S^c and K_M^c for c = 1,...,C. Again, these capital stocks need to be measured in the same (constant quality) units across countries. Denote the price of a new unit of structure and machinery in country c (again in domestic currency units) by P_S^c and P_M^c for c = 1,...,C. The geometric depreciation rates for these two types of capital are denoted by δ_S^c and δ_M^c for c = 1,...,C.

The *country c incomplete user cost of capital* for a unit of structure and a unit of machinery are defined as follows:

$$(1) \quad p_S^c \equiv P_S^c(\delta_S^c + \tau_S^c) \; ; \; p_M^c \equiv P_M^c(\delta_M^c + \tau_M^c) \; ; \; c = 1,...,C$$

where τ_S^c and τ_M^c are tax rates on the use of a unit of structure and a unit of machinery respectively (these tax rates may be 0). The corresponding quantities that should be matched to the above prices for capital services are the *capital stocks* are K_S^c and K_M^c for c = 1,...,C.

With the above data in hand, apply an appropriate multilateral index number formula to the country price and quantity data, $p^c \equiv (p_X^c, w^c, p_S^c, p_M^c)$ and $q^c \equiv (q_X^c, q_L^c, K_S^c, K_M^c)$, for c = 1,...,C. The resulting input price indexes will serve as PPPs for the public sector under consideration.

Thus my *first suggestion* for the way forward is for the ICP to work with national statisticians to develop the above decomposition of their national estimates for the value of nonmarket public sector production into price and volume components along the lines suggested above.

My *second longer run suggestion* is that the international statistical community change their methodology for the valuation of nonmarket public sector outputs. The appropriate opportunity cost of using capital goods for nonmarket production is not just depreciation; it is depreciation plus an imputation the cost of capital that is tied up in the production process. In other words, a more complete user cost for the use of structures and machinery in public sector nonmarket production is given by the following user costs:

(2) $p_S^c \equiv P_S^c(r^c + \delta_S^c + \tau_S^c)$; $p_M^c \equiv P_M^c(r^c + \delta_M^c + \tau_M^c)$; $c = 1,...,C$

where r^c is an appropriate real rate of return for country c.

This change to international accounting standards would of course greatly increase the nominal value of nonmarket public production in countries with relatively large capital stocks that are used in public production. There is another reason by including a financial cost for the use of fixed assets in the user cost of capital: the present methodology totally ignores the contribution of land to production. Thus we should add another asset to structures and machinery: namely the land that supports any structure used in production. Thus in the longer run, we need to add land services to the list of inputs and user costs. The user cost of land is:

(2) $p_L^c \equiv P_L^c(r^c + \tau_L^c)$; $c = 1,...,C$

where P_L^c is the price of a unit of land in country c and τ_L^c is the land tax rate. The corresponding quantity of land for country c is K_L^c (measured in the same units across countries) for $c = 1,...,C$.

In Diewert (2017), I provided the following commentary on the neglect of land problem:

"In section 3, we provided an extensive discussion on how to measure the value of capital services in the public sector. These measurement problems deserve a lot more attention than they have received in the past. Statistical agency measures of the value of capital services in the government sector do not include the imputed interest cost of the fixed capital that is used in this sector, due to national income accounting conventions. This convention has led to a very large downward bias in both the nominal and real GDP of all countries, with the bias being bigger for rich countries that generally have larger public sectors than poorer countries. The only cost associated with capital inputs used in the public sector that is allowed in the international System of National Accounts is depreciation. Thus the user costs of government buildings are vastly understated. In addition to the understatement of the costs associated with the use of structures, there is a further understatement due to the complete neglect of land user costs for government owned land. Because land does not depreciate, the costs associated with the land that sits under public schools and hospitals are set equal to zero, which is the ultimate understatement! If a government owned office building were instead rented from the private sector, the explicit rent would be recognized in the SNA and this explicit rent would include the interest opportunity cost of capital that is tied up in the structure and the land plot that supports the

structure.[1] The neglect of the land that roads and government owned railways sit on also will lead to a substantial downward bias in the GDP of the public sector."

References

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Hill, P. (1975); *Price and Volume Measures for Non-Market Services*, Brussels: Statistical Office of the European Communities.

Schreyer, P. (2010), "Towards Measuring the Volume Output of Education and Health Services: A Handbook"; OECD Statistics Working Paper No 31, Paris: OECD.

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[1] Many national income accountants recognize that the current treatment of government owned capital in the SNA is not consistent with general accounting principles: "The fact that exactly the same kind of service may be provided on both a market and on a non-market basis raises an important question for this report. It is proposed as a matter of principle that the basic methodology used to measure changes in the volume of real output should always be the same irrespective whether the service is provided on a market or on a non-market basis." Hill (1975; 19). Atkinson (2005; 49) explicitly recommended that the opportunity cost of capital be added to depreciation charges to account for the cost of capital: "We recommend that the appropriate measure of capital input for production and productivity analysis is the flow of *capital services* of an asset type. This involves adding to the capital consumption an interest charge, with an agreed interest rate, on the entire owned capital."