Workshop on Public administration output and productivity measurement: lessons from the international experience
April 23-24, 2009
Rome

Output, outcome and quality change – measuring the production of non-market services
Paul Schreyer, OECD
Background

- Much effort spent on measuring the value of GDP at current prices
- Even more important: volumes.
- Difficult when
  - Services are complex with changing quality
  - There are no economically significant prices
- Traditionally: volume (price) of inputs = volume (price) of outputs.
Background

- New effort to develop output-based measures of health and education volumes:
  - Eurostat (2001) & EU Regulation
  - Atkinson report (2005) in the UK
  - OECD:
    - Handbook
    - Data development (see also L. Lorenzoni’s presentation)
This presentation

- Terminology
- Capturing quality change
- Conclusions
Terminology

- Inputs
- Outputs
  - Processes without explicit quality adjustment
  - Processes with explicit quality adjustment
- Outcomes
  - Direct outcomes
  - Indirect outcomes
- Best explained by way of a graph
Information about outcome is a possible tool for quality adjustment

<table>
<thead>
<tr>
<th>Inputs</th>
<th>Outputs</th>
<th>Outcomes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Labour, capital, intermediate inputs</td>
<td>Process without explicit quality adjustment</td>
<td>Direct outcome</td>
</tr>
<tr>
<td>Example education: number of pupils/pupil hours by level of education</td>
<td>Process with explicit quality adjustment</td>
<td>Indirect outcome</td>
</tr>
<tr>
<td>Example health: number of complete treatments by type of disease</td>
<td>Knowledge and skills as measured by scores</td>
<td></td>
</tr>
<tr>
<td>Future real earnings, growth rate of GDP, well-rounded citizens etc.</td>
<td>Health status of population</td>
<td></td>
</tr>
<tr>
<td>Inhereted skills, socio-economic background, etc.</td>
<td>Hygene, lifestyle, infrastructure etc.</td>
<td></td>
</tr>
<tr>
<td>Environmental factors</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Terminology

→ National accounts should strive at measuring outputs, in the form of quality-adjusted processes
→ Quality adjustment may be implicit or explicit
→ Outcomes (as used here) is indicative of results of the education or health system as a whole
→ Although outcome ≠ output, they are not independent
What is special about non-market production?

Prices no more economically significant
→ wedge between marginal utility from consumption and marginal costs of production
→ theory of producer price indices, [Fisher and Shell (1972), Archibald (1977), IMF et al. (2004)] relies on revenue functions for producers and stipulates revenue-maximising behaviour
→ theory of PPIs no more applicable
Non-market production (2)

- Measurement can be based on *unit costs*.
- *Unit costs (quasi prices)*: unobserved prices that emulate a competitive situation where prices equal average costs per product.
- Observable unit costs treated *as if they were prices*
Non-market production (3)

- Can outputs, inputs & productivity be measured?
- Yes if unit costs (quasi prices) of outputs = costs per unit of output (such as the costs for one treatment of a heart attack or the costs for one year of schooling)
- This is different from prices of inputs = costs per unit of input (such as wages per hour of a nurse or the salary of a teacher)
- If costs per unit of output rise less quickly than costs per unit of input → productivity growth
- Cost-based productivity measures are well established
Non-market production (4)

- Instead of deflating total costs by unit costs (quasi prices), one could also directly construct a volume index.
- At least in concept the result would be equivalent, as long as the volume index is a volume index of *outputs*, not of *inputs*.
Quality change

• Health and education services change over time
• In particular, health services undergo rapid quality change
• Health industry = large ICT investor in OECD economies
• Quality change looms prominent in price index literature:
• Is there anything particular in the case of non-market production?
Methods to capture quality change:

1. Implicit quality adjustment via stratification
2. Implicit quality adjustment via re-definition of products (human capital approach: education)
3. Explicit quality adjustment with non-market hedonics
4. Explicit quality adjustment via re-definition of products as marginal contribution to outcome (e.g., QALYs, exam scores)
Capturing quality change via stratification

- Basic idea: matching products: services are stratified such that only similar services are compared
- Criterion for classification: similarity in direct outcomes, and not similarity in how services are produced
- Example: different treatments *for the same disease* (in a particular type of establishment) should be in one stratum, and not similar medical procedures for different diseases
- Implies: most detailed stratification = not necessarily best choice with cost weights and imperfect markets
Capturing quality change via stratification (2)

2 treatments, traditional and laser surgery
- Same effect on outcome
- Laser is cheaper
- Laser surgery diffuses progressively

<table>
<thead>
<tr>
<th></th>
<th>Traditional surgery</th>
<th>Laser surgery</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Period 0</td>
<td>Period 1</td>
</tr>
<tr>
<td>Unit cost</td>
<td>100</td>
<td>100</td>
</tr>
<tr>
<td>Number of interventions</td>
<td>50</td>
<td>40</td>
</tr>
<tr>
<td>Total cost</td>
<td>5000</td>
<td>4000</td>
</tr>
</tbody>
</table>

Laspeyres volume index period 1 to period 2:
\[ s_T(5/40)+s_L(45/10) \] - 1 = -7.1%

where \( s_T = 82\% \) and \( s_L = 18\% \) are the period 1 cost shares
Capturing quality change via stratification (3)

- Measured output declines! → Counter-intuitive
- Problem: 2 medical procedures have been treated as 2 different services
- Note also implicit assumption:
  - consumer valuation of the two ‘products’ is captured by the relative unit costs,
  - so if laser surgery is cheaper than traditional surgery, this method implicitly quality-adjusts *downward* the quantity of laser surgery when it is combined with traditional surgery.
Capturing quality change via stratification (4)

• In a perfect market, the price of the traditional treatment would instantaneously adjust downward and/or traditional treatment would disappear
• In practice and in a non-market context, this does not happen
  → 2 treatments should be treated as the same product
  → no cost weighting, volume change = zero
Capturing quality change via stratification (5)

- A more sophisticated method would be to keep both treatments in the same stratum but explicitly adjust one of the treatments.
- For example put a coefficient of 0.8 on the traditional treatment.
- Such adjustments would have to rely on medical effectiveness studies.
- There is some way to go before practical implementation.

- For more on this, see Triplett (2001): What’s different about health? Human repair and car repair in national accounts and in national health accounts.
Capturing quality change via stratification (6)

- But note: even if we do not explicitly quality-adjust products, the decision how to group them cannot be made without *some* reference to effects on outcome.
- Otherwise, no statement can be made about substitutability of services and how they should be classified.
- Nearly everything that has been said about quality adjustment via stratification applies also to market production.
- Only difference: price statisticians or national accountants who have to deal with it.
Non-market hedonics?

- Market case:
  - identify price-determining characteristics
  - hedonic regression
  - Coefficients: market valuation of characteristics
- Can the idea be transposed to non-market case?
- Maybe.
- Consider:
  \[
  \ln u_i^t = \ln c_i^t + \ln g_i^t(z_i^t) \rightarrow \text{Hedonic function}
  \]
  \[u_i^t: \text{unadjusted, observed unit cost} \]
  \[c_i^t: \text{adjusted (‘true’) but unobserved unit costs} \]
  \[z_i^t: \text{vector of characteristics} \]
Non-market hedonics?

\[ \ln u_i^t = \ln c_i^t + \ln g_i^t(z_i^t) \]

Non-market context:

- Regress unadjusted costs \( \{u_i^t\} \) (e.g. for a cataract treatment) against observed characteristics of service \( z_i^t \) (e.g. single room in hospital, patient characteristics that affect treatment)
- Result: regression identifies those changes in unit costs that are not ‘inflation’ but are due to a change in characteristics
Non-market hedonics?

- Ok, but how should the z’s be chosen?
- Market: price-determining characteristics
- Non-market: those cost-determining characteristics that are related to outcomes
  - Medical characteristics: patient structure, e.g. age of patient may require different treatment for same outcome
  - Non-medical characteristics: patient experience, catering services etc.
Non-market hedonics?

- Choice of characteristics implies some subjectivity, and expert knowledge is required but to some degree that is also true for market hedonics.
- Unlike market hedonics, marginal valuation of characteristic = marginal cost, not marginal market valuation.
- Choice of characteristics brings in outcomes and therefore the consumer side.
- Method needs testing!
Conclusions (1)

- Output and outcome are different and should not be confused
- National accounts and productivity studies of establishments need measures of output, not of outcome
- But output and outcome are not independent
- In the presence of quality change, all existing methods require some implicit or explicit information or reasoning about outcome.
Conclusions (2)

- Problems of quality adjustment arise whether services are provided by market or non-market producers.
  - an observable market transaction in one period and another market transaction in the next does not imply that they are comparable

- A pragmatic approach will be called for to proceed with services measurement
  - no reason to approach every type of service with the same method for quality adjustment
  - methodologies should be robust and transparent
Conclusions (3)

• Measuring output for complex services is difficult
• But conclusion should not be that it is simply too difficult to do anything.
• Health and education account for a too large and growing part of the economy to ignore output measurement for them.
• It may take a while before consensual and internationally comparable methods are agreed upon but active research and data development is vital to achieve this objective.