BIPM Symposium

to celebrate the 10th anniversary of the
CIPM MRA

8-9 October, 2009

Measurement and Wealth Creation

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Measurement and Wealth Creation

This lecture draws on a report I have written for the UK National Measurement Office and Department of Business, Innovation and Skills, entitled:

The Economics of Metrology and Measurement
Measurement and Wealth Creation

1. Historical perspective
2. Three main economic processes
3. Other Users of Measurement
4. Estimates of Macroeconomic Effects
1a) Mediaeval Thinking about Measurement

“A false balance is an abomination to the Lord, but a just weight is His delight.”
*The Bible: Proverbs 11:1*

“Around this temple let the merchants’ law be just, their weights true, and their contracts fair.”
*S. Giacomo di Rialto, Venice, Italy (1073)*

“Who seek to find eternal treasure, Must use no guile in weight or measure.”
*Market Hall, Truro, England (1615)*

Steele (ISO) on “world in turmoil”
1b) History of Economic Thought about Measurement

• Adam Smith (1776): the compass and the growth of trade

• Charles Babbage (1835): measurement reduces the “cost of verification”

• Karl Marx (1863)
  – “the clock is the first automatic machine applied to practical purposes; the whole theory of production and regular motion was developed through it”

• Werner Sombart (1902) and J.A. Hobson (1906)
  – the evolution of capitalism depended on book-keeping, exact measurement of time and place, land surveying, weights and measures, city plans, public accounts, etc.
Measurement and Wealth Creation

1. Historical perspective
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2a) Measurement and Transaction Costs

- **Transaction costs**: the *friction* in the market
  - As transaction costs fall, trade increases

- How does measurement reduce transaction costs?
  - Reduces risk and uncertainty in transactions
  - Reduces communication/verification costs
  - Measurement infrastructure is an institution that builds confidence
  - Having a local measurement infrastructure reduces costs for companies
CIPM MRA

• Reduces risk and uncertainty in transactions?
  – Magaña (BIML) on legal metrology; Steele (ISO)

• Reduces verification costs?
  – KIM (KRISS)

• Measurement infrastructure is an institution that builds confidence?
  – Goonatiliake (UNIDO), Wallard (BIPM)

• Having a local measurement infrastructure reduces costs for companies?
  – Session 4; also Totarong (Thailand) and Tan (Singapore)

• CIPM MRA has played an important role in reducing technical barriers to trade?
  – Göbel (CIPM and PTB)
2b) Measurement and Productivity

- Process Control and Advanced Manufacturing
- Better Decisions
- Reduced Costs of Meeting Regulations
- Interchangeable Parts

- Quinn’s message to President Obama
Thomas Jefferson, 1785
(after a journey to France)

“An improvement is made here in the construction of muskets, which it may be interesting to Congress to know .... It consists in the making every part of them so exactly alike, that what belongs to any one, may be used for every other musket in the magazine ... I put several together myself, taking pieces at hazard as they came to hand, and they fitted in the most perfect manner. The advantage of this when arms need repair are evident ... He thinks he shall be able to furnish the musket two livres cheaper than the common price.”

here quoted from Gilbert (1958, pp. 437-438)
2c) Measurement and Innovation

- R&D and Innovation
- Demonstrate Product Characteristics
  - Case Study of Taylor Hobson
Measurement and the ‘Wright Flyer’

• As their wings did not deliver the lift they needed, the Wright brothers designed measurement tools and carried out some experiments in their wind-tunnel.
• From these measurements they could understand better why their original wing did not work as expected and from that could hypothesise a better design for the wing.

• We heard a similar message in the presentation by Tinseth (Boeing).
A ‘Virtuous Circle’ of Metrology, Measurement, R&D and Innovation
Case Study of Taylor Hobson (Leicester, UK)

• To support marketing of lenses of greater accuracy, it was necessary for the company to have an instrument that would measure and demonstrate their perfection.

• As there was nothing available on the market, the company created its own measurement instrument.

• Measurement supports innovation by enabling the innovator to provide a convincing demonstration of the superiority of his devices.
## 2d) NIST Studies of the Economic Effects of Measurement

<table>
<thead>
<tr>
<th>Outcomes</th>
<th>Number of Citations</th>
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<tbody>
<tr>
<td>(a) Lower transaction costs</td>
<td>12</td>
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<tr>
<td>(b) Increase productivity</td>
<td>12</td>
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<tr>
<td>(c) Increase R&amp;D efficiency</td>
<td>11</td>
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<tr>
<td>(c) Enable new markets</td>
<td>3</td>
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<tr>
<td>(c) Increase product quality (or durability)</td>
<td>3</td>
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<tr>
<td>(b) Cheaper / More efficient regulatory compliance</td>
<td>2</td>
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<tr>
<td>(b) Energy cost savings / conservation</td>
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Measurement and Wealth Creation

1. Historical perspective
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4. Estimates of Macroeconomic Effects
3) Benefits to Other Users of Measurement

a) Consumer
   – Magaña (BIML), Semerjian

b) Health
   – Besley (next), Semerjian, Kim (KRISS)

c) Environment
   – Zhang (WMO), Besley (next), Semerjian,

d) Education and Training

*In all these cases, measurement contributes to wealth creation, in a broad sense*
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4) Estimates of Macroeconomic Effects

- Many case studies demonstrate huge rates of return on measurement
- But some finance ministries are sceptical – “sample selection bias”
- Economy-wide effects estimated by econometric methods
  - but econometric estimates subject to quite a high margin of error
4a) Estimates of Macroeconomic Effects

- King *et al* (NPL, BIS) found statistically significant evidence of a strong positive influence of NMS activity on innovation in UK
  - Impact is stronger for product innovation than process innovation, although important for both
  - Benefits *also depend on*:
    - a competitive and innovative testing and measurement sector
    - an innovative instrument sector
    - standards that create competitive markets for goods and services
4c) Estimates of Macroeconomic Effects

- Temple and others (Williams; Choudhary et al) used econometric analysis to assess the macro-economic effects on metrology and measurement on GDP and trade:
  - Measurement R&D has a significant impact on growth
  - The presence of a measurement infrastructure is important in supporting investment and export activity
  - A strong measurement infrastructure correlates with intra-industry trade
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The End

Thank you for your attention