Quality-Adjusted Prices for High Tech Goods/Services: Current Work and Future Plans

Dave Wasshausen
BEA Advisory Committee Meeting
Suitland, MD
November 3, 2017
BEA’s Digital Economy Initiative

• BEA is studying new data sources to improve the way we measure digital goods and services in the National Accounts

• Price indexes are an important piece of that

• For the 2018 Comprehensive Update, focusing on three areas:
  – Custom & own-account software
  – Electro-medical equipment
  – Cell phones
Custom & Own-Account Software

• Currently use input-cost based price index and PPI for packaged software
  – Input-cost uses domestic wages for software developers

• Goal of our ongoing research some combination of:
  – Output price index based on function points
  – Other analysis to inform our current method (e.g. a productivity adjustment)
“Function points are used to compute a functional size measurement (FSM) of software.” (Wikipedia)

Pros
• Generally accepted metric in the industry
• The only metric that we’ve been able to identify

Cons
• Not necessarily homogenous
• More not necessarily better
• FP databases are not representative samples
Function Points Database

Graph showing trends of:
- Index Points
- Hours/FP
- BEA Custom Software Price
- Dollars/FP
- Dollars/Hour

Years: 2006 to 2013

Index Points range from 0.0 to 1.8.
Justification for Use of Hedonics

• Heterogeneity in P/FP across projects suggests FPs depend on a lot of things

• Use hedonic regression to control for some of these factors:
  – Client & Client Industry
  – Project Type & Size
  – Maturity of Firm
  – Others......
Software Price Indexes

![Software Price Indexes Graph](image-url)
Medical Equipment

• Private fixed investment in electro-medical equipment over $40 billion

• Rapid rates of product innovation

• Initial analysis suggests that price declines for imaging equipment range from about 25% per year for MRI and CTSCAN machines to about 10% per year for ultrasound machines

Source: Authors’ calculations based on ECRI data
Matched Model Price Indexes

Source: Authors’ calculations based on ECRI data
## Which Attributes Are Relevant?

<table>
<thead>
<tr>
<th>DETECTOR</th>
<th>X-RAY TUBE</th>
<th>RADIATION DOSE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Field of view (standard), cm</td>
<td>Heat storage, MHU</td>
<td>Dose-modulation technique</td>
</tr>
<tr>
<td>Field of view (extended), cm</td>
<td>Heat dissipation rate, kHU/min</td>
<td>Pediatric-specific dose control</td>
</tr>
<tr>
<td>Total detector width, z-axis, mm</td>
<td>Tube cooling</td>
<td>Prospective ECG gating</td>
</tr>
<tr>
<td>Reconstructed slice width options, mm</td>
<td>Tube focal spots, mm</td>
<td>Retrospective ECG editing</td>
</tr>
<tr>
<td>Optional minimum slice width, mm</td>
<td>Expected tube life, scan sec (and</td>
<td>Iterative image reconstruction</td>
</tr>
<tr>
<td>Standard rotation times, sec, 360°</td>
<td>Max mA for smallest tube spot</td>
<td>Sliding collimation (overbeaming</td>
</tr>
<tr>
<td>Optional minimum rotation time, sec</td>
<td>Max scan time at max mA, sec</td>
<td>Axial cardiac</td>
</tr>
<tr>
<td>PERFORMANCE</td>
<td>X-RAY GENERATOR</td>
<td>IMAGE RECONSTRUCTION</td>
</tr>
<tr>
<td>High-contrast spatial resolution</td>
<td>kW output</td>
<td>Computer CPU</td>
</tr>
<tr>
<td>MTF kernel</td>
<td>kVp range</td>
<td>Reconstruction FOVs, cm</td>
</tr>
<tr>
<td>Low-contrast resolution, mm at % at</td>
<td>Patient TABLE</td>
<td>Reconstruction matrices</td>
</tr>
<tr>
<td>Noise, % at ≤25 mGy (2.5 rads)</td>
<td>Range of movement</td>
<td>Max reconstruction rate, (512 x 512),</td>
</tr>
<tr>
<td>Noise kernel</td>
<td>Scannable range, cm</td>
<td>Per slice, sec</td>
</tr>
<tr>
<td>GANTRY</td>
<td></td>
<td>SYSTEM INTEGRATION</td>
</tr>
<tr>
<td>Gantry tilt, °</td>
<td>Optional max load capacity, with</td>
<td></td>
</tr>
<tr>
<td>Gantry dimensions, H x W x D, cm</td>
<td>RECOMMENDED ROOM SIZE, m²</td>
<td>DICOM</td>
</tr>
<tr>
<td>Gantry weight, kg</td>
<td>Minimum W x L, m</td>
<td>IMAGE PROCESSING</td>
</tr>
<tr>
<td>Gantry aperture, cm</td>
<td>POWER REQUIREMENTS</td>
<td>Standard or optional</td>
</tr>
<tr>
<td>Scan localizer</td>
<td>SHIELDING REQUIREMENTS</td>
<td>Recommended postprocessing</td>
</tr>
</tbody>
</table>

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Notes:
- **Computer CPU**
- **Reconstruction FOVs, cm**
- **Reconstruction matrices**
- **Max mA for smallest tube spot**
- **Axial cardiac**
- **Prospective ECG gating**
- **Retrospective ECG editing**
- **Iterative image reconstruction**
Smart Phones

- Business and government purchases included in fixed investment in communications equipment

- Consumer expenditures included in telephone and facsimile equipment

- Smart phones are imported
iPhone Pilot

- Completed pilot for iPhones
  - Matched model indexes, 2015-2016
  - Researching hedonic regressions

- Purchased historical data back to 2004
  - Will construct historical indexes for all phones, we think in time to inform the 2018CU
Rapid Rate of Product Innovation

[Diagram showing the release dates and storage capacities of various iPhone models from 2007 to 2015.]

- iPhone (1G) 4GB
- iPhone 3G 8GB
- iPhone 3G 16GB
- iPhone 3G 32GB
- iPhone 4 8GB
- iPhone 4 16GB
- iPhone 4S 32GB
- iPhone 5 16GB
- iPhone 5 32GB
- iPhone 5S 64GB
- iPhone 6 128GB
- iPhone 6 Plus 128GB
- iPhone 6 Plus 128GB