Quantifying Productivity Growth in Health Care Using Insurance Claims and Administrative Data

John A. Romley, Abe Dunn, Dana Goldman and Neeraj Sood

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There is a big debate about U.S. economic growth

Economists have long recognized that changes in the quality of existing goods and services, along with the introduction of new goods and services, can raise gross difficulties in measuring changes in the real output of the economy. Prominent economists have led and served on government commissions to analyze and report on the subject, including the Bigler Commission in 1951, the Task Force in 1965, and the National Research Council in 1985. And despite the attention to this subject in the professional literature, there remains insufficient understanding of just how imperfect the existing official estimates actually are.

After analyzing the methods used by the US government statistical agencies as well as the extensive previous academic literature on this subject, I have concluded that, despite the various improvements to statistical methods that have been made through the years, the official data understates the changes in real output and productivity. The measurement problem has become increasingly difficult with the rising share of services that has grown from about 20 percent of private sector GDP in 1950 to about 25 percent of private GDP now. The official measures provide at best a lower bound on the true real growth rate with no indication of the size of the underestimation. Thus, Feldstein (2014, p. 125) concludes the useful history of GDP

Underestimating the Real Growth of GDP, Personal Income, and Productivity

Martin Feldstein

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* For supplementary materials such as appendixes, datasets, and author disclosure statements, see the article page at https://doi.org/10.1257/jep.31.2.145

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Productivity growth in health care is a particular concern

Manufacturing, 1987-2006*: 1.4%
Services, 1987-2006*: 0.0%
Hospitals and nursing homes, 1987-2006*: -0.9%
Forecast for hospitals & other health care**: 0.4%
Forecast for rest of U.S. economy**: 1.1%

*BLS [Harper et al. (2010)]
**Medicare Trustees (2014)
Medicare payments to providers are tied to productivity growth

ACA reduces annual “updates” based on productivity growth in broader economy

- In FY 2019, 2.9% increase for inflation reduced by 0.8%

Adjustment has caused concern about viability of health care providers
Yet productivity measurement is particularly challenging in health care

Readily confounded by hard-to-measure aspects of

- Quality of care
- Patient severity
Dealing with the quality of health care is not a new challenge

Boskin Commission addressed CPI
- Found upward bias due to improvements in product quality

Cutler et al. analyzed heart-attack care
- Adjusting for better outcomes, price of treatment decreased

*ARE MEDICAL PRICES DECLINING? EVIDENCE FROM HEART ATTACK TREATMENTS*

We address long-standing problems in measuring medical inflation by estimating two types of price indices. The first, a Service Price Index, prices specific medical services, as does the current CPI. The second, a Cost of Living Index, measures a quality-adjusted cost of treating a health problem. We apply these indices to heart attack treatment between 1983 and 1994. More frequent reweighting and accounting for price discounts lowers the measured price change for heart attacks by three percentage points annually. Accounting for quality change lowers it further; we estimate that the real Cost of Living Index fell about 1 percent annually.

I. Introduction
The difficulties of deriving accurate price indices for service industries are well-known [Griliches 1992]. In this paper we address the issue of appropriate price indices for medical care. We focus on medical care because it is a large and growing part of the...
Accounting for quality, U.S. hospitals actually performed well over 2002-2011

- **Heart attack**: -0.6% - 0.8%
- **Heart failure**: -0.9% - 0.6%
- **Pneumonia**: -0.4% - 1.9%

- Hospital output is quantity of stays
- Adjusting stays for patient severity
- Severity-adjusted number of survivors with no unplanned readmissions
A comprehensive view — not limited to the hospital setting — is increasingly relevant
We analyze treatment episodes starting with hospitalization and ending 90 days after discharge

From 2002 through 2014…

• We are awaiting data for 2015 and 2016

Among older Americans in traditional (fee-for-service) Medicare…

• Medicare accounted for 20% of national health spend in 2017 (CMS)
• Traditional Medicare accounted for 66% of program beneficiaries in 2018 (KFF)

Using health insurance claims and administrative records…

• Data provide longitudinal perspective on care and outcomes

For episodes of heart attack, heart failure and pneumonia

• This focus naturally generalizes to other conditions and procedures
Empirical approach

We estimate

$$\ln Y_{ht} = \alpha + \ln I_{ht} \beta_I + S_{ht} \beta_S + O_{ht} \beta_O + g(t) + \epsilon_{ht},$$

in which $Y_{ht}$ is the number of “high-quality” episodes that started at “index” hospital $h$ in year $t$,

- $I_{ht}$ is the inputs used to deliver these episodes of care,
- $S_{ht}$ is severity measures for patients starting episodes at “index” hospital $h$ in year $t$,
- $O_{ht}$ is “other hospital output,” and
- $g(t)$ is a function of time

We interpret $g(t)$ as MFP

- Note that Cutler-type measure addresses allocative efficiency and social welfare
$Y_{ht}$: We use clinically validated and policy-oriented methodologies to identify episodes.
$Y_{ht}$: Episode duration and quality

The vast majority of providers have selected 90-day post-discharge windows for bundled payment, so we use this duration.

In a high-quality episode, the patient:
- is alive at the end of the episode
- avoids an unplanned readmission within 30 days of discharge
- returns to the community (i.e., is not institutionalized)
CMS has developed a complex algorithm for flagging unplanned readmissions

Figure 4.2.1 – Index Cohort Sample in the July 2012-June 2013 Dataset

Initial Index Cohort
July 2012 – June 2013
Dataset:
N = 7,542,880

Discharges against medical advice (AMA) (0.37%)*

Without at least 30 days post-discharge enrollment in FFS Medicare for index admissions (0.47%)**

Admissions to Prospective Payment System (PPS)-exempt cancer hospitals (0.26%)*

Admissions for primary psychiatric diagnoses (0.26%)*

Admissions for rehabilitation (0.10%)*

Admissions for medical treatment of cancer (2.12%)*

Final Index Cohort
July 2012 – June 2013
Dataset:
N = 7,279,853
We use a 20% sample of Medicare Inpatient Files to identify index stays / episodes

<table>
<thead>
<tr>
<th>Stays / Episodes</th>
<th>Beneficiaries</th>
<th>Hospitals</th>
<th>Description</th>
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<tbody>
<tr>
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<td>All stays at short term acute care hospitals in 20% sample</td>
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<td>Stays / episodes meeting CMS readmission measure criteria</td>
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$Y_{ht}$: Measuring other aspects of quality

Master Beneficiary Summary Files from CMS report validated dates of death

Institutional claims (Inpatient Files, etc.) report discharge to home
  - We use last such claim
\( I_{ht} \): We measure inputs using treatment costs

Common in health economics and policy

We deflate institutional / facility costs using inflation measures from CMS

- Health care professionals do not report costs, so we assume zero price-cost margins in 2002 and apply CMS inflation measure
I_{ht}: We include everything but prescription drugs using various claims files

- Inpatient
- Outpatient
- Skilled nursing
- Home health
- Hospice
- Durable medical
- Carrier
Carrier Files include a wide array of professional services:

- Primary care doc
- Surgeon
- Anesthesiologist
- Chiropractor
- Physician assistant
- Optician
- And more…
These claims files are big-ish data

Within 20% sample, 2014 Carrier File includes 178 million claims

24.6 million of these claims matched to our patients

5.3 million fell within episode windows
For institutions / facilities, we use “Medicare Cost Reports”
Consider acute-care hospitals

Cost reports have cost-to-charge ratios (CCR)

Claims have charges covered by Medicare
  • For covered charges, we have to link line-level records from Inpatient Files to claims

So estimated cost of a hospital stay = Charges * CCR
  • Similar for other institutional claims, e.g., home health reports cost per visit and visits are on claim
$I_{ht}$: Cost data is not infrequently missing

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$S_{ht}$ and $O_{ht}$: Patient severity and other hospital output

Patient severity measures include

- AHRQ Inpatient Quality Indicators for risk of inpatient death
- Age, sex and race / ethnicity
- Comorbidities from the index hospital record
- For heart attack, location within heart (e.g., N-STEMI)
- Zip-code sociodemographics from 2000 Census

Other hospital output includes

- Residents per bed from annual CMS IPPS Impact Files
- Tertiary care capabilities
Analytic sample for heart attack episodes

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<td>457,120</td>
<td>415,562</td>
<td>4,753</td>
<td>Episodes meeting AHRQ IQI risk measure criteria</td>
</tr>
<tr>
<td>449,950</td>
<td>409,423</td>
<td>3,859</td>
<td>Excluding index hospital-years with no sociodemographic data</td>
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Focusing on heart attack, a/k/a AMI, a simple first look

Cost per "High-Quality" Episode (000s of 2014 Dollars)
The rate of high-quality episodes has improved

Rate of "High-Quality" Episodes


56.3% 61.9%
Some of this improvement stems from better survival rates.
And also greater avoidance of unplanned readmissions.
Return to community has not improved
Cost per high-quality episode has grown due to cost growth

![Graph showing average cost of episode over time](graph.png)
Turning to severity, predicted survival during index stay has declined somewhat.
Patient age increased, then returned to level

Average Age at Admission


78.2 78.3 78.4 78.5 78.6 78.7 78.8 78.9 79.0 79.1

78.5
The comorbidity burden grew
From our regression, we create an aggregate index of patient severity.
For heart attack episodes, MFP declined, then stagnated
The picture would be more dismal, if quality had not improved.
Hospital readmission costs may be a culprit here

Decomposition of Cost per AMI Episode

Post-index acute inpatient care
All other costs
There is a similar pattern for heart failure and pneumonia.
When we focused on hospital stays (Romley et al. 2015), MFP improved
Near- and longer-term refinements

Address missing facility costs
Episodes with complete costs differ from those with missing costs
Near- and longer-term refinements

- Address missing facility costs
- Incorporate prescription drugs?
- Incorporate custodial nursing into return to community
- Risk adjust using pre-admission claims
- Address diagnostic coding behavior
- Analyze 2015 and on, including ICD-10 transition
- Analyze additional conditions / procedures
Conclusions

If our current findings hold up, MFP in delivering episodes declined substantially in the 2000s, and then stagnated.

A different picture of health care MFP may emerge when episodes of care are analyzed.