Are Medical Care Prices Still Declining? A Systematic Examination of Quality-Adjusted Price Index Alternatives for Medical Care

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Measuring the Medical Care Sector

- Well-known study by Cutler, McClellan, Newhouse, and Remler (1998) asked the question: “Are Medical Prices Declining?”

- Changes since 1998:
  - Health care spending growth: 13% of GDP to 17.9%
  - Life expectancy has grown by nearly 2 years
  - Experts believe growth in this sector is driven by innovation – Chernew and Newhouse (2011)

- Nearly half of the bias in the PCE deflator is due to unmeasured quality changes in the health sector
  - Lebow and Rudd (2003); Groshen, Moyer, Aizcorbe, Bradley and Friedman (2017)

Measuring the Medical Care Sector

- Measurement challenges
  - Rapid technological change
  - Non-medical factors influencing outcomes
  - Market distortions (e.g., third-party payers and information asymmetries)

- No consensus on methods for quality adjustment
  - Hall (2016) and Sheiner and Malinovskaya (2016)

Goal

- Comparison of quality-adjusted price indexes
  - Theoretical and empirical differences
  - Examine a more recent time period and broader set of conditions:
    - Claims data for three acute conditions from 2001-2014
    - Innovations from over 7,000 cost-effectiveness studies

- Four methods
  1. A utility-based cost-of-living index (COLI) – Cutler et al. (1998)
  2. Price per unit of health produced from treatment
  3. A hedonic index
  4. A quality adjustment based on the cost of producing the change in quality (BLS PPI method)

Preview of Findings

- Quality adjustment has a significant impact on measured inflation
- Alternative methods greatly over state inflation relative to the preferred utility-based approach
- Large declines in price from preferred utility-based index
- Evidence from claims data for three acute conditions:
  - Average annual price decline is 7.4%
  - Price decline ranges from 3% to 12% depending on value of a statistical life year ($50,000, $100,000 or $150,000)
- Evidence from 7,000+ cost-effectiveness studies:
  - Typical innovation results in a price decline of at least 20%

Real Output and Quality Adjustment

- Real output depends on the *quality* of the treatments, not just the quantity
  - Cutler et al. (1998) – Heart Attacks; Berndt et al. (2000) – Depression; Shapiro et al. (2001) – Cataracts; Frank et al., (2004) – Schizophrenia
- Implications
  - Cost-disease (Baumol (1967)) vs Innovation

Utility-based COLI – Cutler et al. (1998)

- Cost of Living Index (COLI) - expenditure change to achieve a fixed utility level given changing price:

$$COLI = \frac{e(p_1, U_0)}{e(p_0, U_0)} = \frac{e(p_0, U_0) - (e(p_0, U_0) - e(p_1, U_0))}{e(p_0, U_0)}$$

- Representative consumer utility:

$$U(H(\alpha_t \cdot m_t), x_t)$$
$$\text{s.t.} \quad p_t m_t + x_t \leq Y$$

m_t - medical care input
x_t - numeraire good
$H(\alpha_t \cdot m_t)$- health production function
α_t - health technology
p_t - price of medical care treatment

Utility-based COLI – Cutler et al. (1998)

- Compensating Variation (CV):

$$U(H(\alpha_1 \cdot m_1), Y - p_1 m_1 + CV) = U(H(\alpha_0 \cdot m_0), Y - p_0 m_0)$$

- Taylor series approximation:

$$CV = \frac{U_H}{U_x} H_m(\alpha_1 \cdot m_1 - \alpha_0 \cdot m_0) - (p_1 m_1 - p_0 m_0)$$

  - First Term
    - $\frac{U_H}{U_x}$ - dollar value of marginal improvements in health
    - $H_m\,(\alpha_1 \cdot m_1 - \alpha_0 \cdot m_0)$ - observed change in health
  - Second Term
    - $(p_1 m_1 - p_0 m_0)$ - change in the cost of treatment

Utility-based COLI - Cutler et al. (1998)

- Price of treatment: $s_t = p_t m_t$

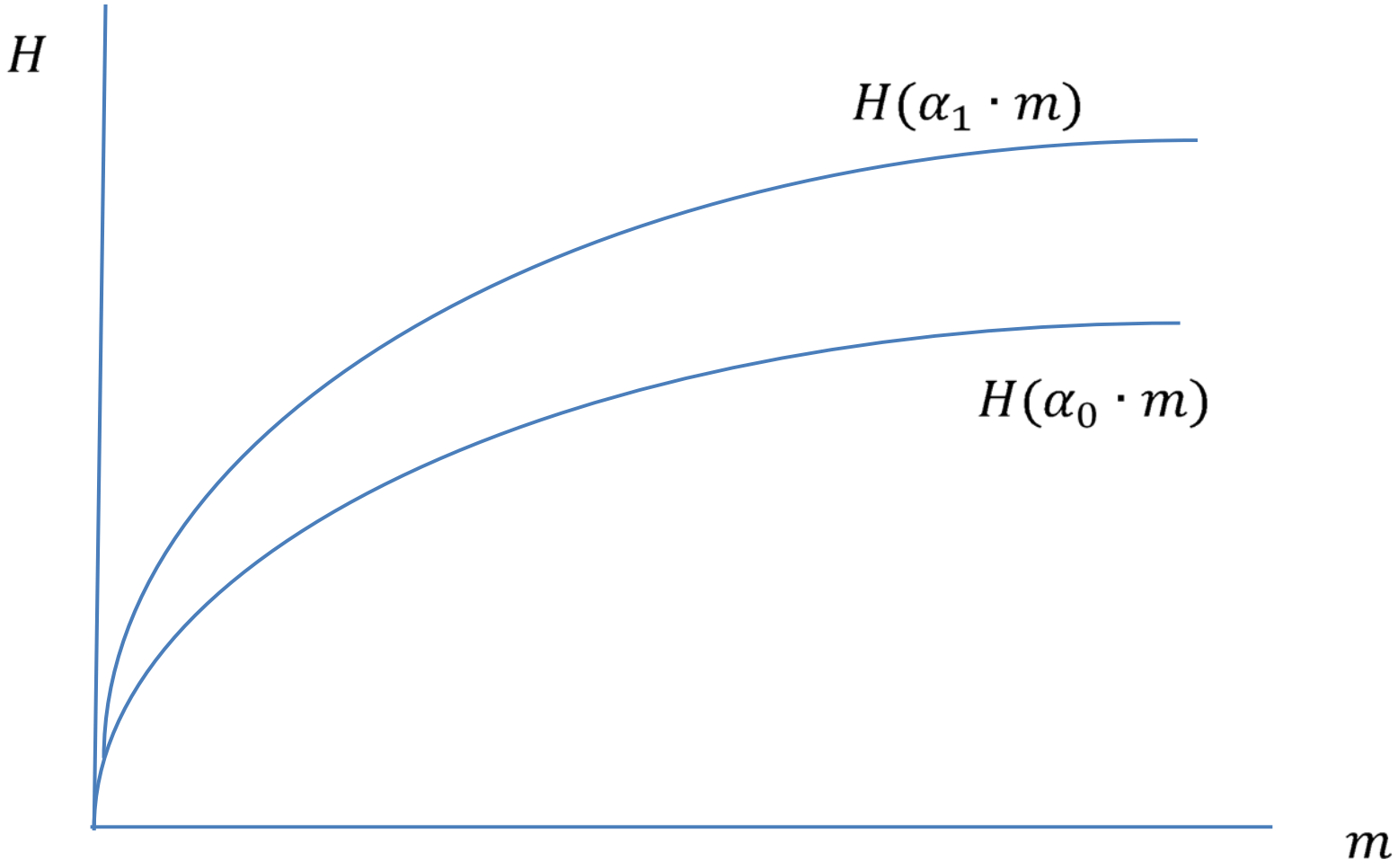
- Disease-specific COLI $= \frac{e(p_1, U_0) - x_0}{e(p_0, U_0) - x_0}$

$$= \frac{e(p_0, U_0) - x_0 - (e(p_0, U_0) - e(p_1, U_0))}{e(p_0, U_0) - x_0} = \frac{s_0 - CV}{s_0}$$

$$= \frac{s_1 - \frac{U_H}{U_x} H_m (\alpha_1 \cdot m_1 - \alpha_0 \cdot m_0)}{s_0}$$

- Life expectancy (LE) index

Health production – $H(\alpha_t \cdot m_t)$

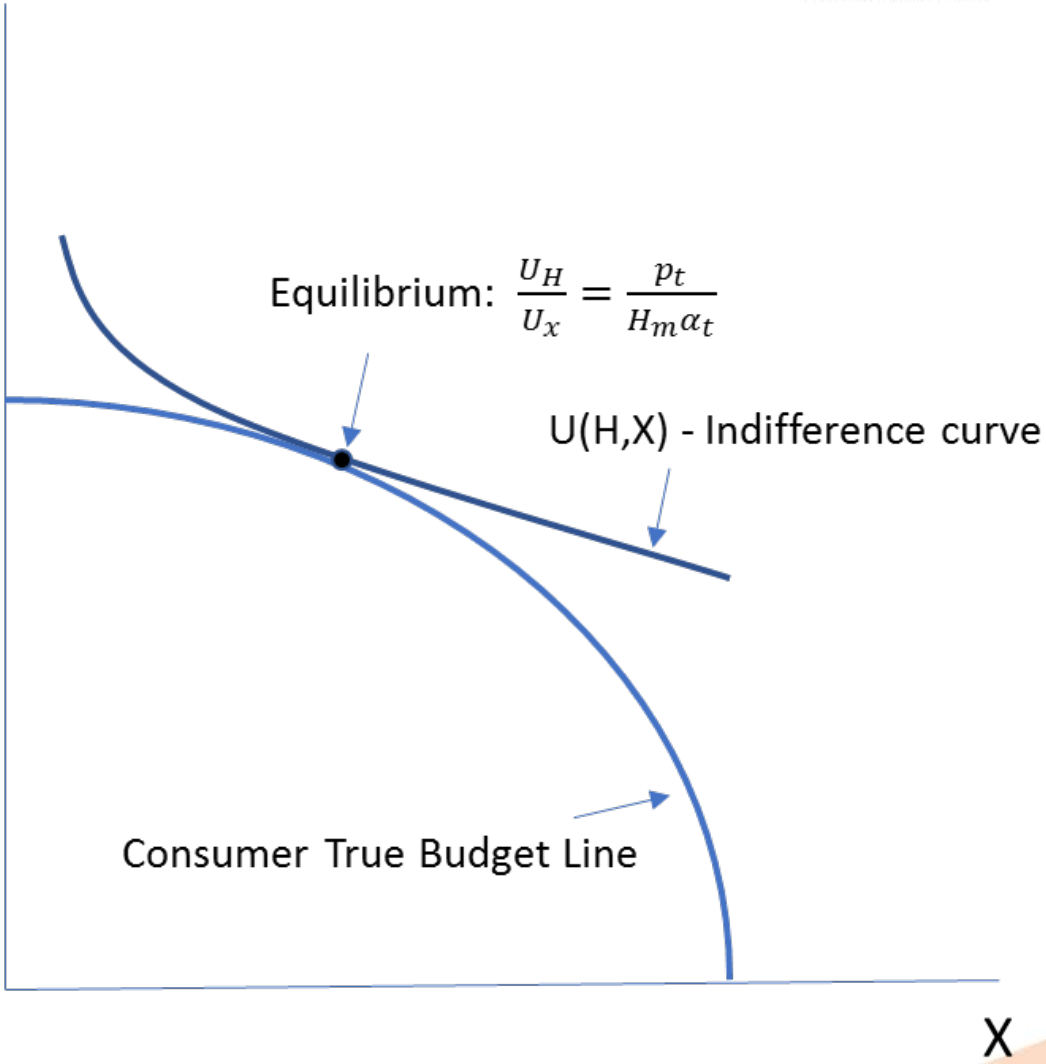


Consumer's problem in hypothetical scenario of no distortions

- Consumer problem:

  FOC: $\frac{U_H}{U_x} = \frac{p_t}{H_m \alpha_t}$

- Utility based valuation, $\frac{U_H}{U_x}$, holds when FOC do not.



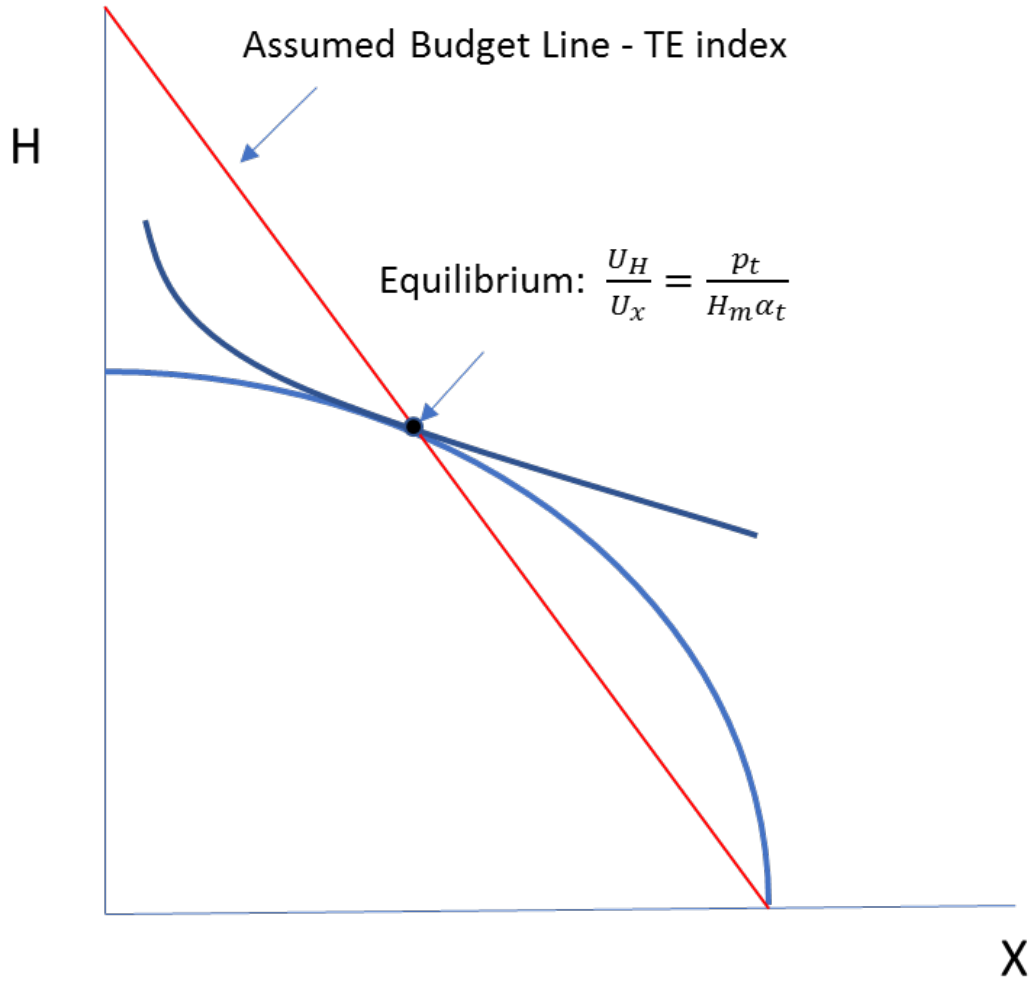
Price per Unit of Health Index (i.e., Treatment Endpoint (TE) Index)

- Measures the price of achieving a level of health, $H(m_t \alpha_t) = H(t)$:
  - $TE = \frac{{}^{S_1}/_{H(1)}}{{}^{S_0}/_{H(0)}} = \frac{S_1 - \frac{p_1}{(H(1)/m_1)}(H(1)-H(0))}{S_0}$
  - Health improvements are valued at the **average** price per unit of health produced: $\frac{p_1}{(H(1)/m_1)}$
  - The average price is less than the marginal price: $\frac{p_1}{(H(1)/m_1)} < \frac{p_t}{H_m \alpha_t}$
  - For health improvements: $\big(H(1) - H(0)\big) > 0$

$\rightarrow$ LE price *index growth* $\leq TE$ *price index* growth

TE Index undervalues changes in health

- The average price of producing a unit of health is less than the marginal value for a unit of health.



Two methods to contrast empirically

1. Life expectancy (LE) index – utility-based COLI

2. Treatment endpoint (TE) index – treatment price per unit of health produced

Two data sources

1. Claims data for three acute illnesses

2. Cost-effectiveness database of innovations covering 7,000+ studies

Medicare claims data

- Medicare Fee-For-Service (FFS) Claims (5% sample)

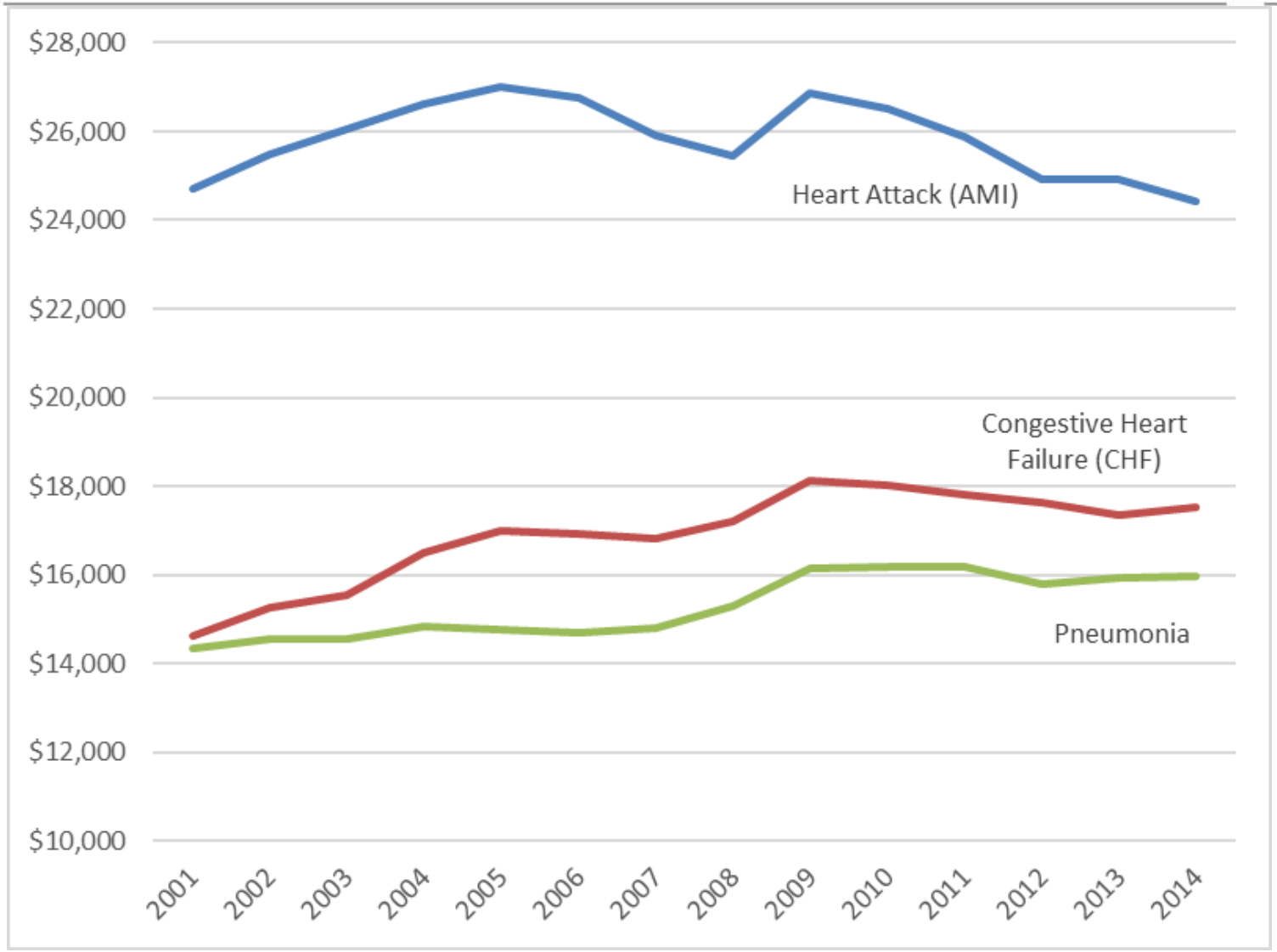
- Sample includes patients with inpatient admission for:
  - Heart attack
  - Congestive heart failure
  - Pneumonia

- Additional selection rules:
  - Full year of FFS enrollment prior to the index admission (for risk adjustment based on diagnoses)
  - Full year after the admission or death within the year after the admission, to measure outcomes

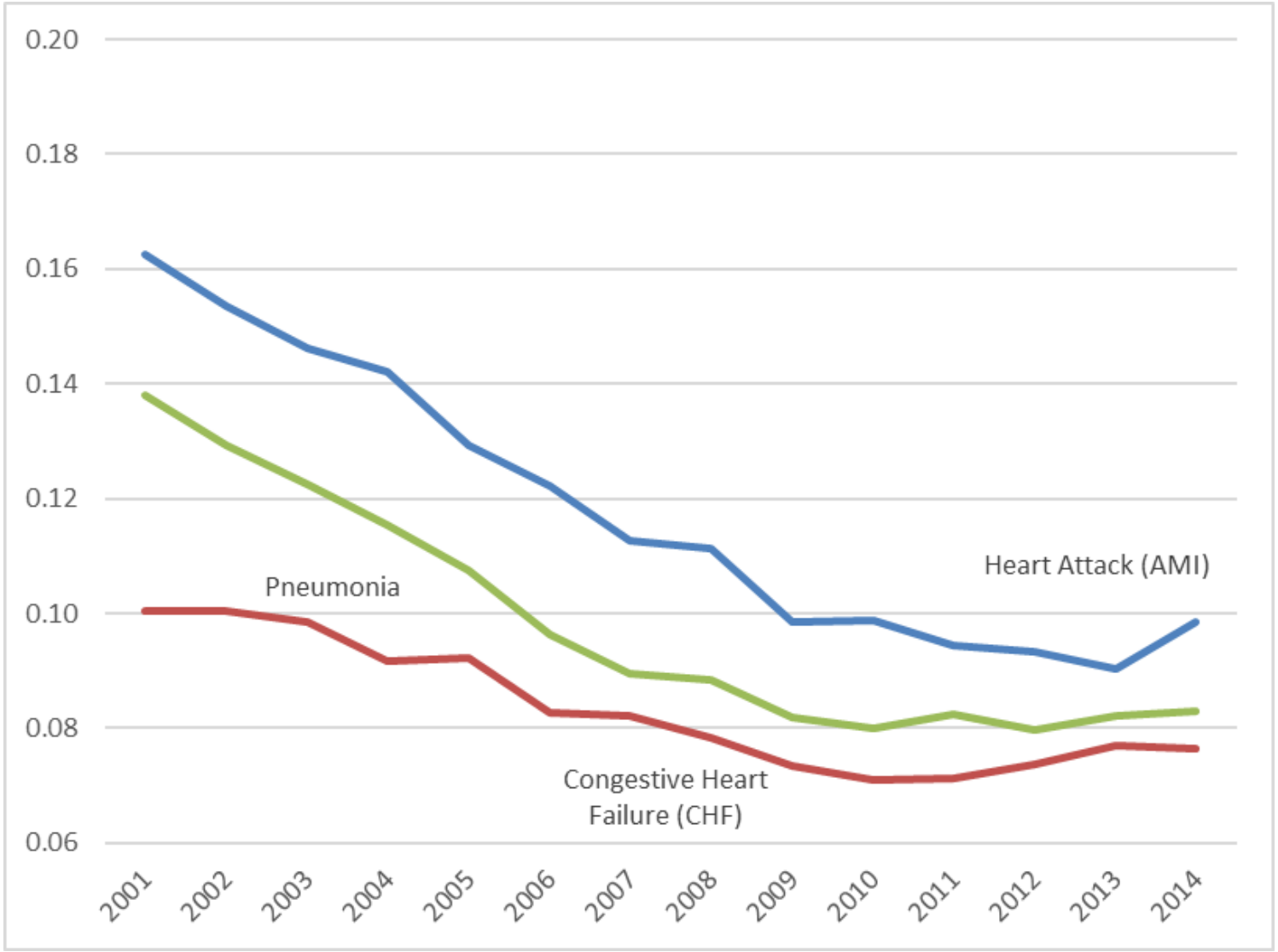
Distribution of patients

	Acute myocardial infarction	Congestive heart failure	Pneumonia
Male	44.2%	37.6%	39.0%
Age group:			
Age: 65-69	12.0%	8.3%	9.1%
Age: 70-74	17.2%	13.0%	14.2%
Age: 75-79	19.7%	17.7%	18.3%
Age: 80-84	20.5%	21.9%	21.4%
Age: 85-89	17.4%	21.1%	19.7%
Age: >=90	13.2%	17.9%	17.3%
Race			
White	88.6%	85.9%	88.6%
Black	7.3%	10.3%	7.1%
Asian	1.0%	0.9%	1.1%
Hispanic	1.7%	1.8%	1.8%
Others	1.4%	1.2%	1.5%
Number of observations for each condition	173,277	314,560	340,675

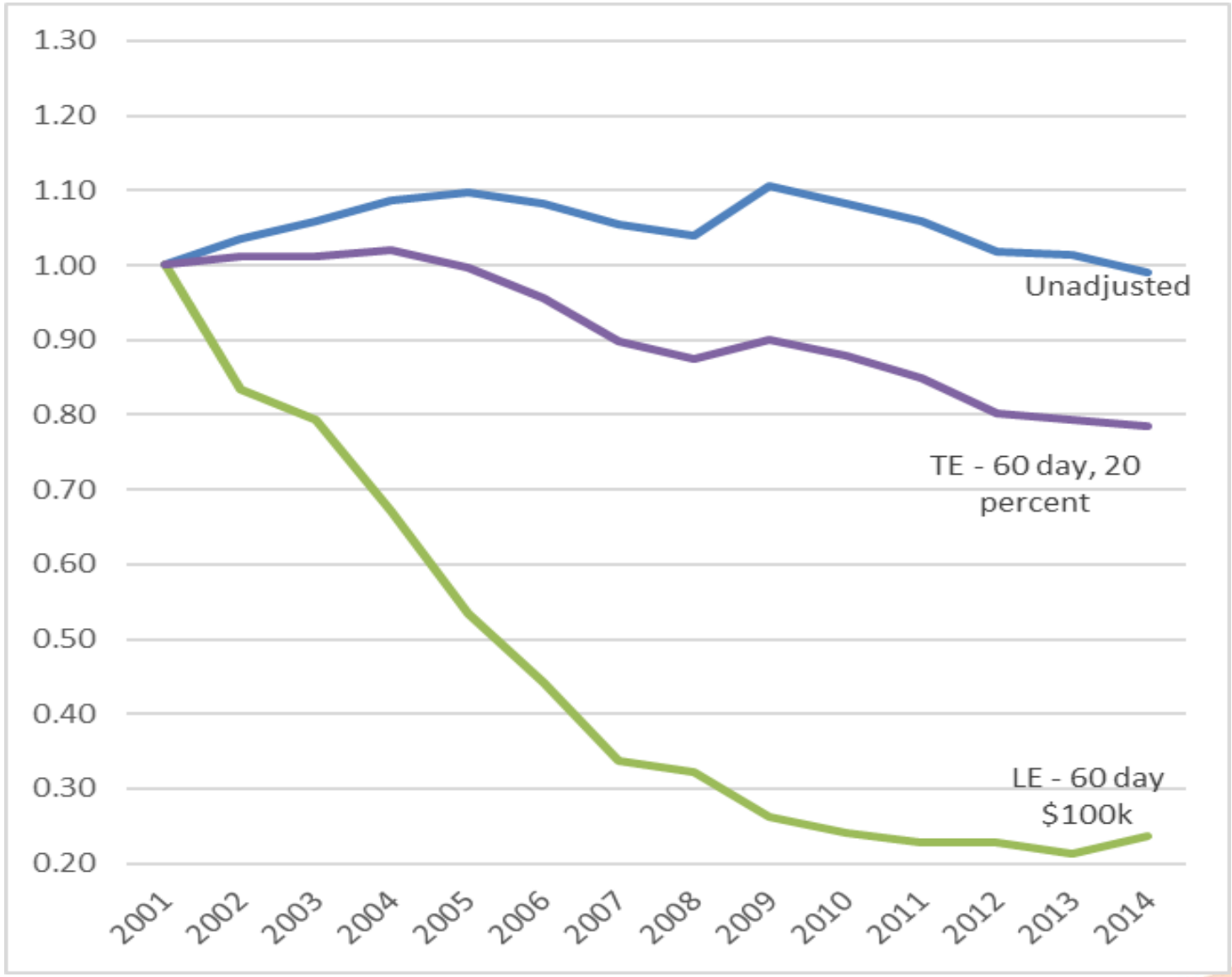
Risk Adjusted Spending, 30-Day



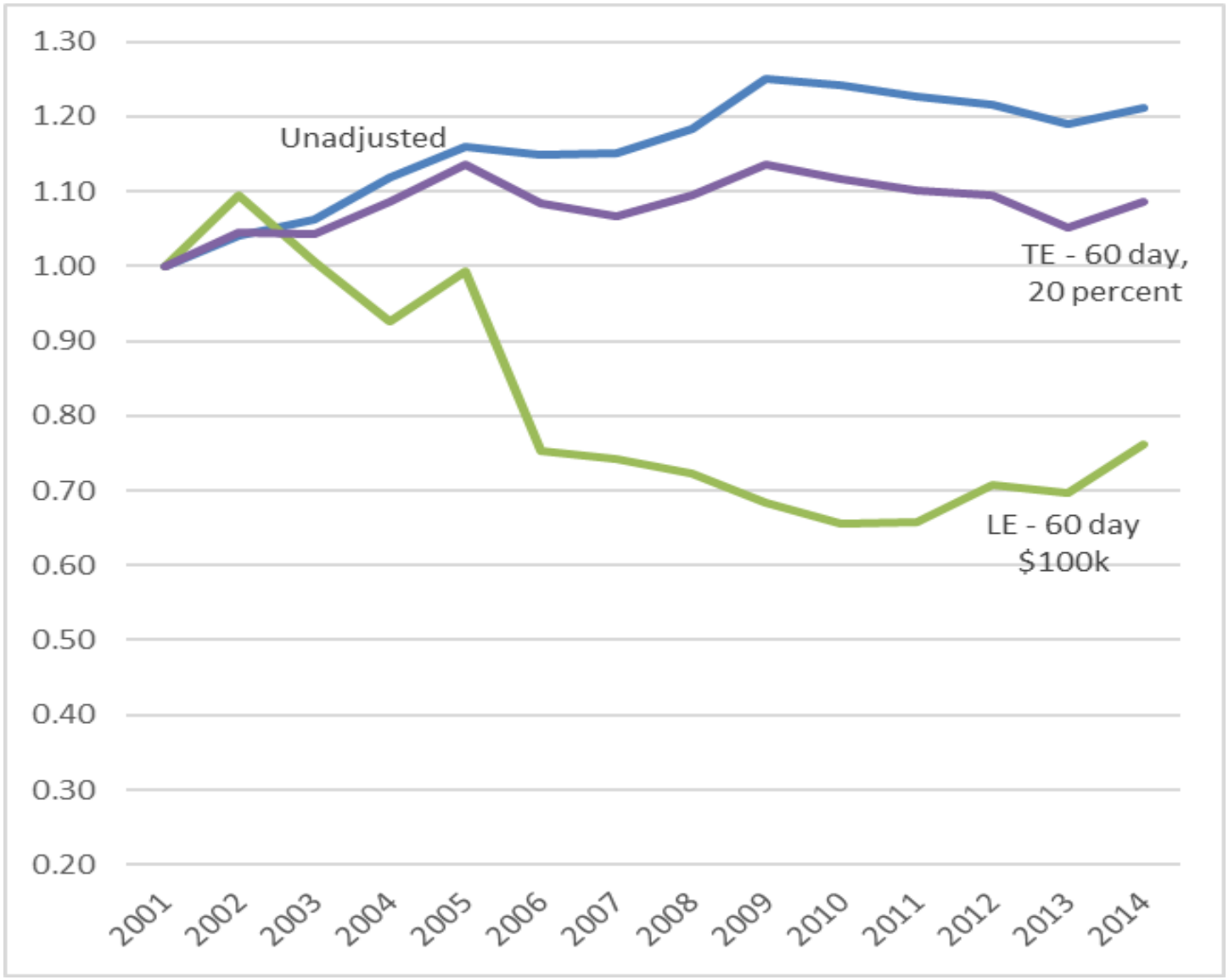
Risk Adjusted Mortality Rate, 30-Day



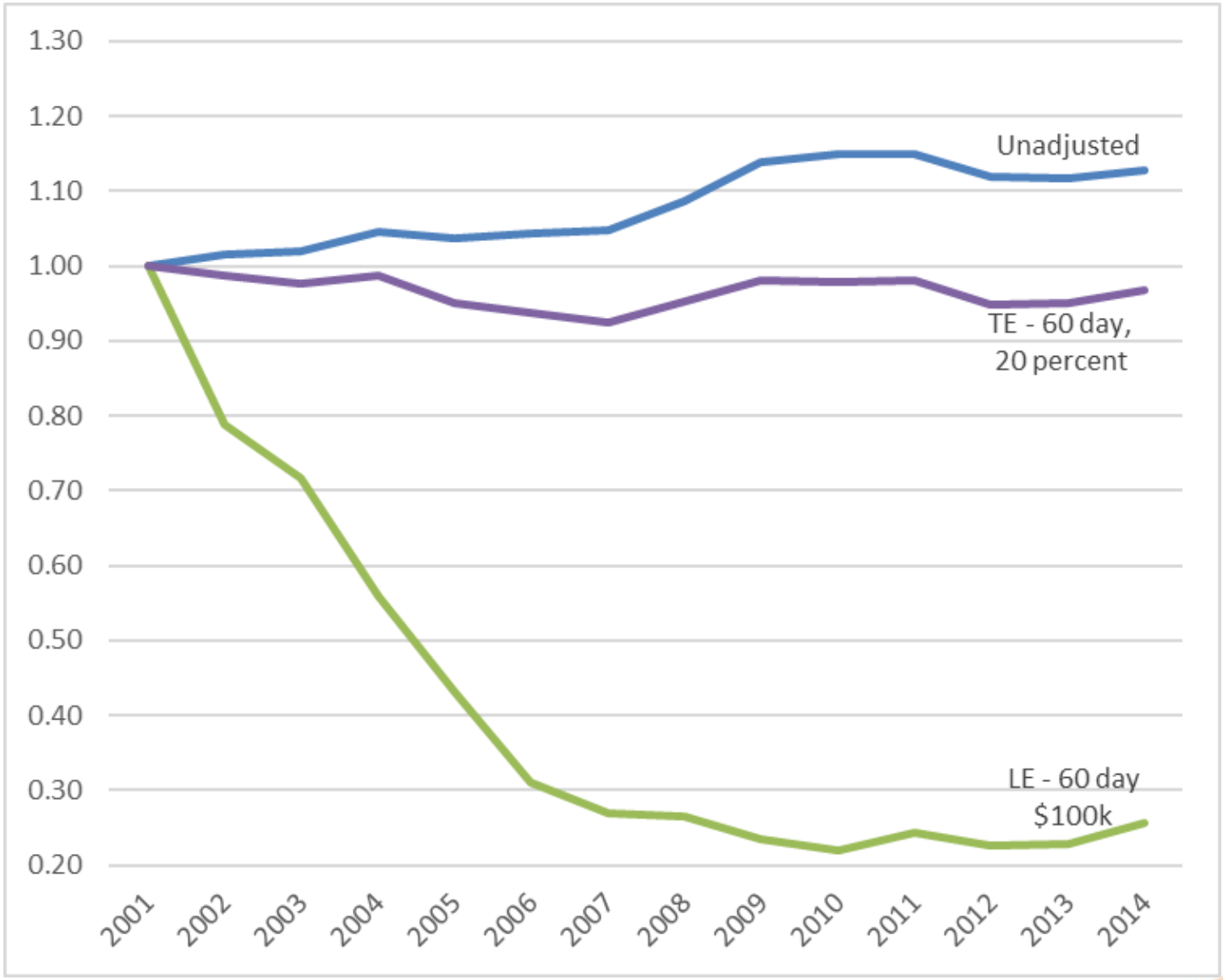
Comparison of Indexes – Heart Attack (AMI)



Comparison of Indexes – Congestive Heart Failure



Comparison of Indexes – Pneumonia



Evidence from Medical Innovations

- Cost-Effectiveness Analysis Registry (CEAR) database from the Tufts Medical Center

- 7,287 studies - 90% of studies from 2004 to 2017

- Four key elements:
  - (1) Price of innovative treatment; (2) price of prior standard treatment
  - (3) QALY from innovation; (4) QALY from prior standard treatment

TE Index for cost-effectiveness data

– Hult, Jaffe, and Philipson (2018) – use the database to form TE quality-adjusted indexes:

$$\frac{\text{(Price Innovation/QALY Innovation)}}{\text{(Price Standard Treatment/QALY Standard Treatment)}}$$

– TE Index = 1.04 at the median (Hult, Jaffe, and Philipson (2018))

CEA Registry Data - Descriptive Statistics

	Mean	Median	p5	p95	sd	obs
Innovator QALY	9.76	8.05	0.19	25.56	9.90	10,066
SOC QALY	9.36	7.50	0.10	25.56	9.81	10,048
Innovator Price	$108,682	$22,799	$265	$372,886	$459,697	10,537
SOC Price	$92,513	$17,723	$77	$318,882	$414,086	10,525
Innovator Price per QALY	$22,630	$4,563	$28	$91,267	$142,215	9,905
SOC Price per QALY	$19,851	$3,796	$16	$84,969	$239,409	9,740
ICER	$69,437	$16,407	-$133,495	$405,937	$612,663	17,459

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LE Index for cost-effectiveness Data

$$\frac{(\text{Price Innov.} - \frac{U_H}{U_X} \cdot (\text{QALY Innov.} - \text{QALY } SOC)}{(\text{Price SOC})}$$

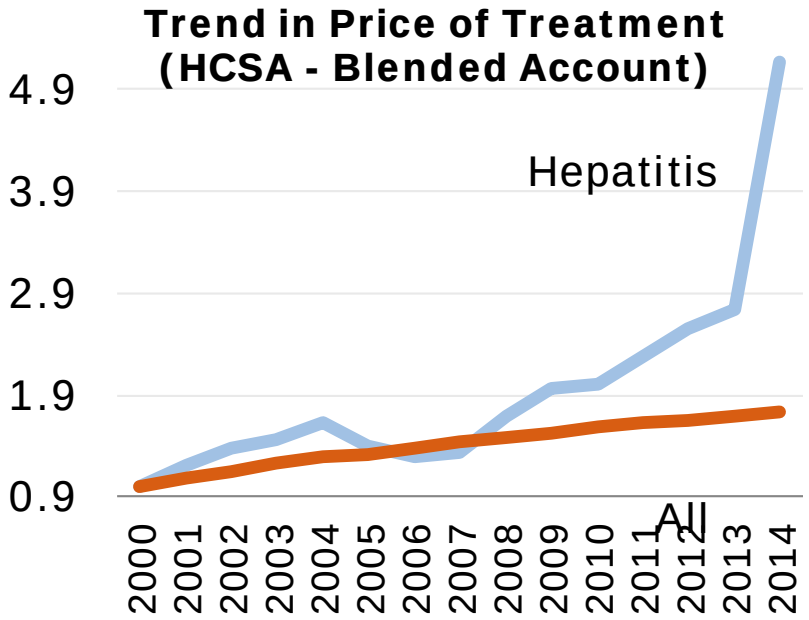
CEA Registry Data – Quality Adjusted Indexes

TE Index	Mean	Median	p5	p95	sd	obs
	1.35	1.04	0.65	2.86	1.14	9,455

LE Index	Mean	Median	p5	p95	sd	obs
VSLY $50k	0.21	0.94	-4.04	2.54	4.69	9,455
VSLY $100k	-1.17	0.79	-10.26	2.51	9.55	9,455
VSLY $150k	-2.55	0.63	-16.72	2.57	14.65	9,455

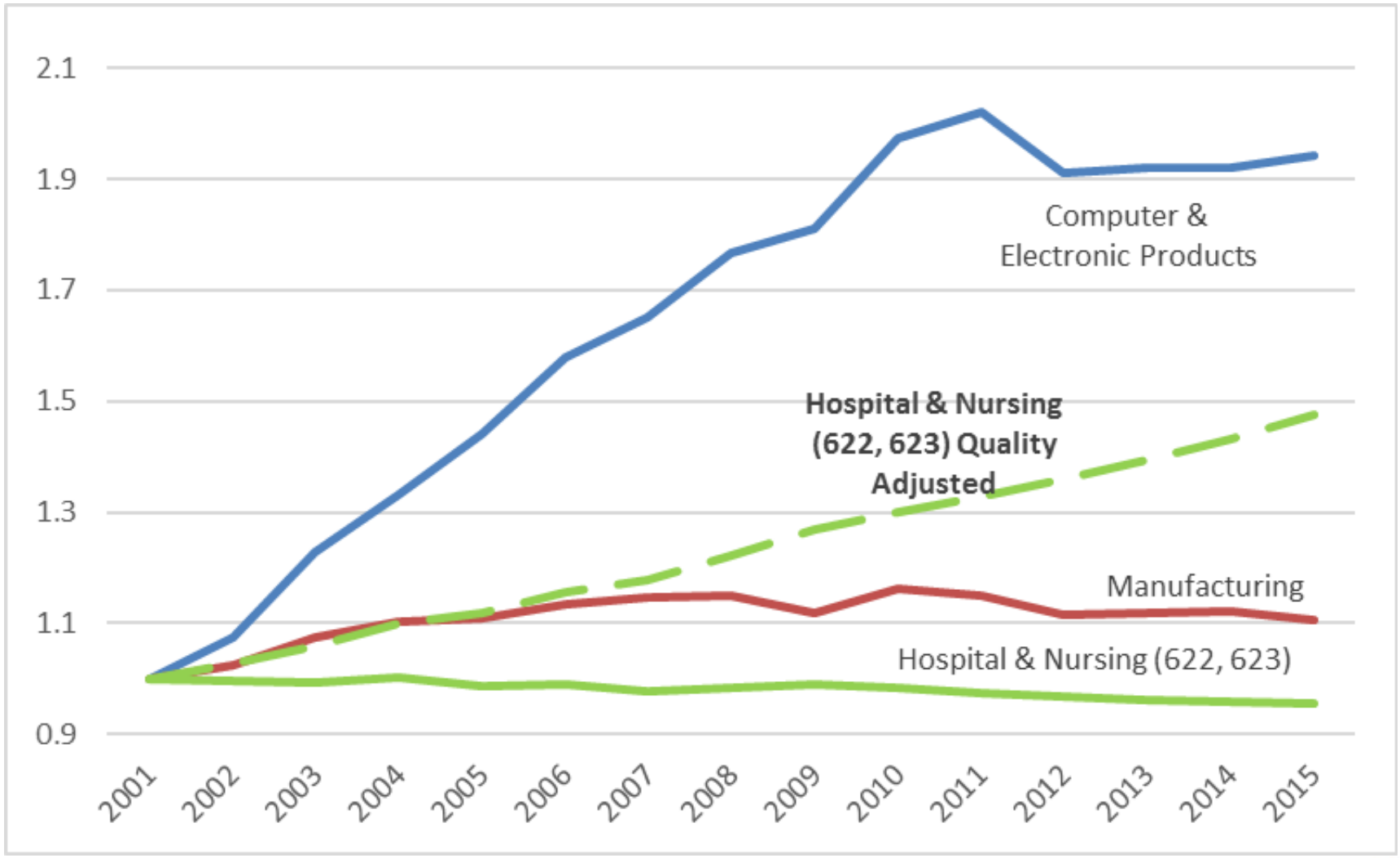
Evidence from Medical Innovations: Hepatitis

- Solvaldi treatment
  - Price of treatment – $99,908
  - QALY – 9.40
- Previous standard care
  - Price of treatment – $76,915
  - QALY – 8.28



- TE Index = 1.14
- LE Index = 0.57 (assuming $50,000 VSLY)

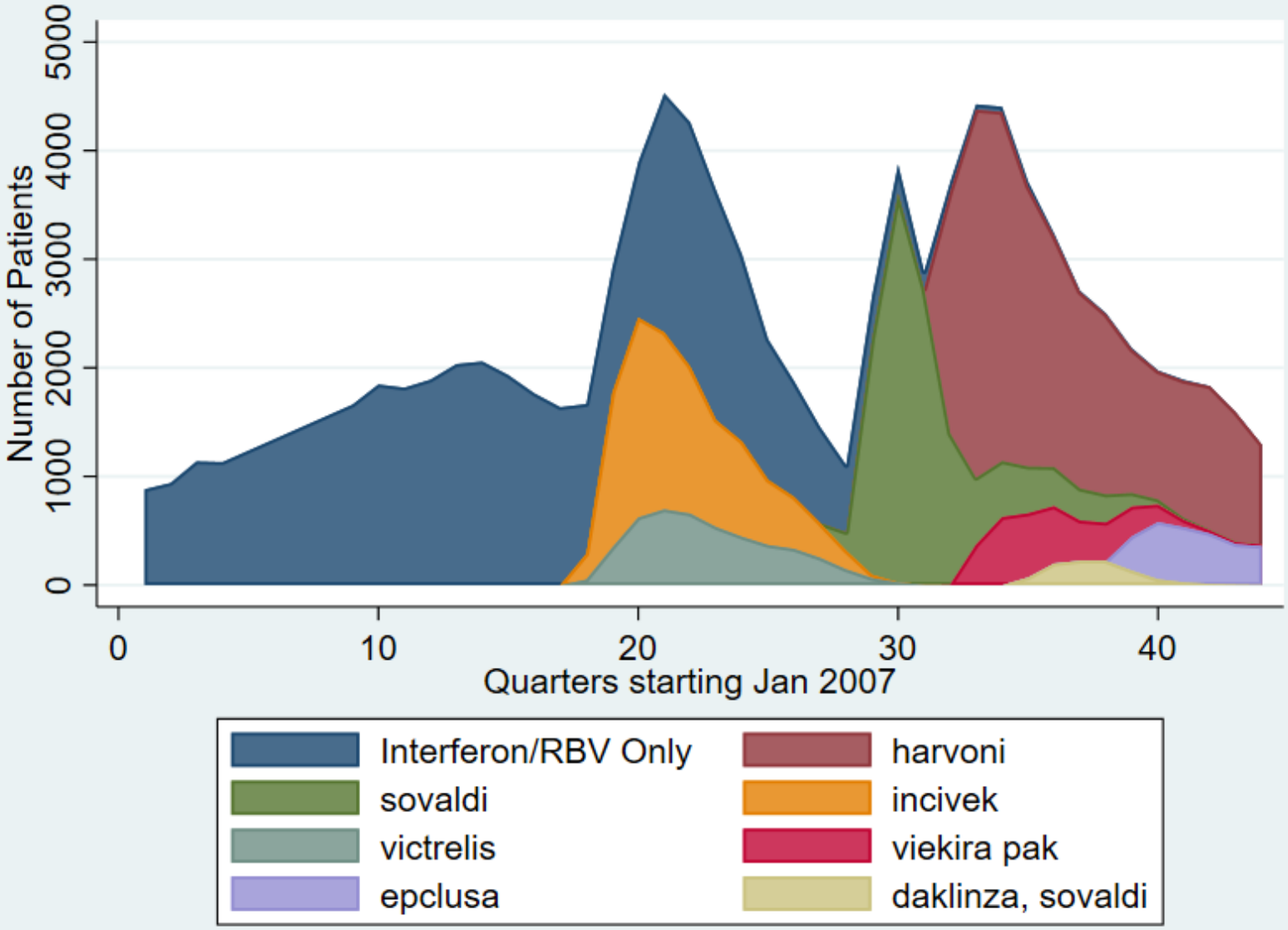
Implication for Productivity



Conclusion

- How we measure quality and output in the health care matters
- Substantial evidence that quality-adjusted medical prices are declining
- Implications for medical care productivity
  - Official productivity growth: -0.3%
  - Corrected productivity growth: +2.8%

Hepatitis C drugs dissemination (MarketScan data)



Quality Adjusted Indexes – Reservation Price LE index

$$Reservation\ price\ LE\ index = \frac{S_1}{S_1 + CV} = \frac{S_1}{S_0 + \left(\frac{U_H H_m (\alpha_1 \cdot m_1 - \alpha_0 \cdot m_0)}{U_x}\right)}$$

LE Index	Mean	Median	p5	p95	sd	obs
VSLY $50k	0.80	0.92	0.07	1.64	6.69	9,453
VSLY $100k	0.77	0.79	0.04	1.58	0.56	9,453
VSLY $150k	0.75	0.69	0.02	1.60	3.22	9,453

LE Reservation Price Index (VSLY $100k): By Disease Category

Disease Category	Obs.	Mean	Median	Obs	Mean	Median
Cardiovascular	1,577	0.77	0.78	1,149	0.76	0.77
Digestive	479	0.90	0.91	277	0.85	0.90
Endocrine Disorders	700	0.71	0.74	466	0.76	0.82
Infectious	1,792	0.65	0.64	1,234	0.65	0.64
Malignant Neoplasms	1,855	0.83	0.85	1,267	0.85	0.86
Maternal/Child	68	0.74	0.89	32	0.79	0.91
Musculoskeletal/Rheumatologic	804	0.81	0.87	509	0.80	0.88
Neuro-Psychiatric/Neurological	718	0.88	0.90	500	0.92	0.92
Other	1024	0.73	0.73	519	0.77	0.81
Respiratory	278	0.76	0.74	184	0.78	0.75
Sense Organ	158	0.74	0.73	101	0.76	0.69

LE Reservation Price Index (VSLY $100k): By Intervention

	All			High Score		
Intervention	Obs.	Mean	Median	Obs	Mean	Median
Care Delivery	342	0.75	0.80	198	0.74	0.82
Device	324	0.68	0.68	202	0.67	0.66
Diagnositc	372	0.85	0.93	253	0.91	0.96
Education	204	0.75	0.76	141	0.78	0.87
Immunization	276	0.68	0.76	195	0.74	0.80
Pharmaceutical	4,951	0.77	0.77	3,474	0.79	0.78
Procedure	1,200	0.75	0.75	746	0.73	0.75
Screening	1,196	0.83	0.96	724	0.84	0.97
Surgical	497	0.72	0.68	268	0.71	0.75

LE Reservation Price Index (VSLY $100k): By Funding Source

	All			High Score		
Disease Category	Obs.	Mean	Median	Obs	Mean	Median
Foundation	679	0.72	0.86	463	0.74	0.88
Government	2,702	0.79	0.87	1,761	0.81	0.88
Health Care Organization	442	0.85	0.86	317	0.83	0.86
Other	2,525	0.76	0.76	1,609	0.78	0.80
Pharma or Device Manuf.	2,969	0.75	0.75	2,035	0.75	0.76
Prof Member Organization	136	0.71	0.66	53	0.67	0.62

LE Reservation Price Index (VSLY $100k): By Word Search in Abstract and Title

	All			High Score		
Disease Category	Obs.	Mean	Median	Obs	Mean	Median
Meta-Analysis	565	0.82	0.82	415	0.84	0.85
Other	2,112	0.83	0.85	1,146	0.84	0.88
Randomized	3,147	0.76	0.76	2,115	0.77	0.77
Simulation	3,629	0.73	0.80	2,562	0.74	0.81