



15.482 Healthcare Finance

Spring 2017

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Unit 1, Part 4: Inflation

Unit Outline

- Market Efficiency
- The Time Value of Money
- Valuing Special Cashflows
- Inflation

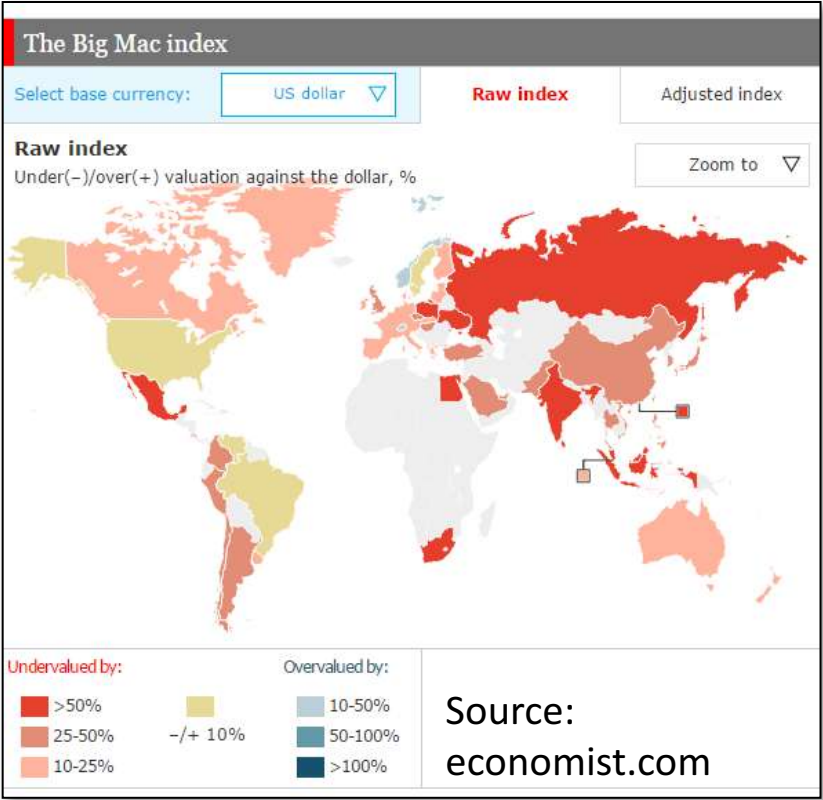
Inflation

Inflation

- Last year, a Big Mac cost \$5.00, and this year the price is \$5.10 (2% higher)
- If your wealth last year was \$100, you could afford 20 Big Macs; if the interest rate is 7.1%, you can afford $\$107.10/\$5.10 = 21$ Big Macs this year
- Your real wealth (as measured by Big Macs) has increased by 5%

$$\frac{1.071}{1.02} - 1 = 1.05 - 1 = 0.05 \approx 1.071 - 1.02$$

Inflation

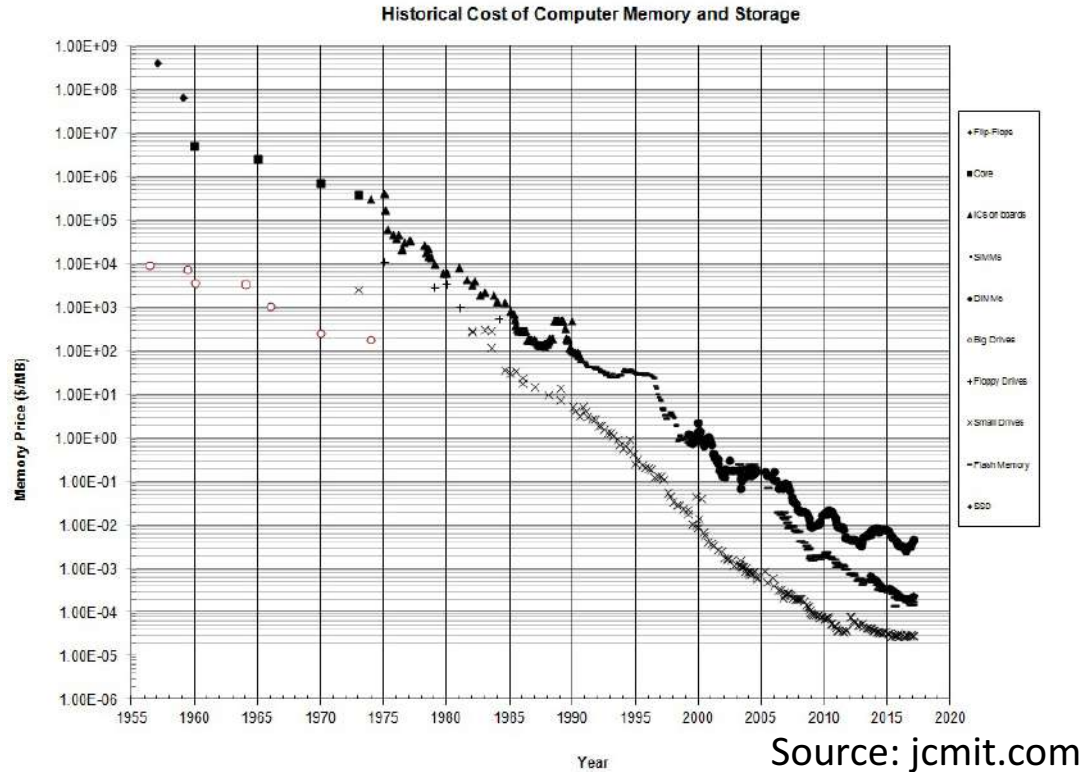


Big Mac Index vs. CPI



Source: capstoneinvest.com

Inflation



Inflation

What Is Inflation?

$W_t \equiv$ Nominal Wealth

$C_t \equiv$ Price Index of Consumption Basket

$$= P_{1t}Q_1 + P_{2t}Q_2 + \cdots + P_{nt}Q_n$$

$\Rightarrow \tilde{W}_t \equiv W_t/C_t$ (“Real Wealth” at date t)

$\tilde{W}_{t+1} \equiv W_{t+1}/C_{t+1}$ (“Real Wealth” at date $t + 1$)

$\tilde{W}_{t+1}/\tilde{W}_t =$ “Real” Return from t to $t + 1$

$$(1 + r_{\text{real}}) = \frac{W_{t+1}/W_t}{C_{t+1}/C_t} = \frac{(1 + r_{\text{nominal}})}{(1 + i)}$$

Inflation

What Is Inflation?

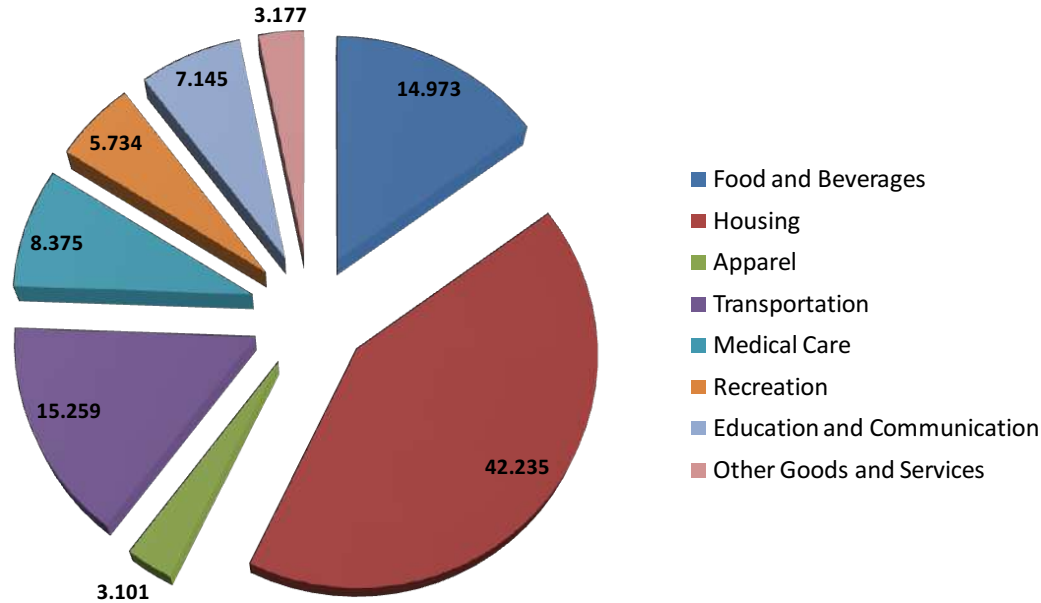
$$(1 + r_{\text{real}}) = \frac{(1 + r_{\text{nominal}})}{(1 + i)} \approx 1 + r_{\text{nominal}} - i$$

$$r_{\text{real}} \approx r_{\text{nominal}} - i, \quad \text{for small } i$$

Different baskets of goods yields different /

- Consumer price index (CPI), producer price index (PPI), biomedical R&D price index (BRDPI)

U.S. CPI Components, Dec 2016



See <https://www.bls.gov/news.release/cpi.t07.htm>



DEPARTMENT OF HEALTH & HUMAN SERVICES

Public Health Service

National Institutes of Health
Bethesda, Maryland 20892

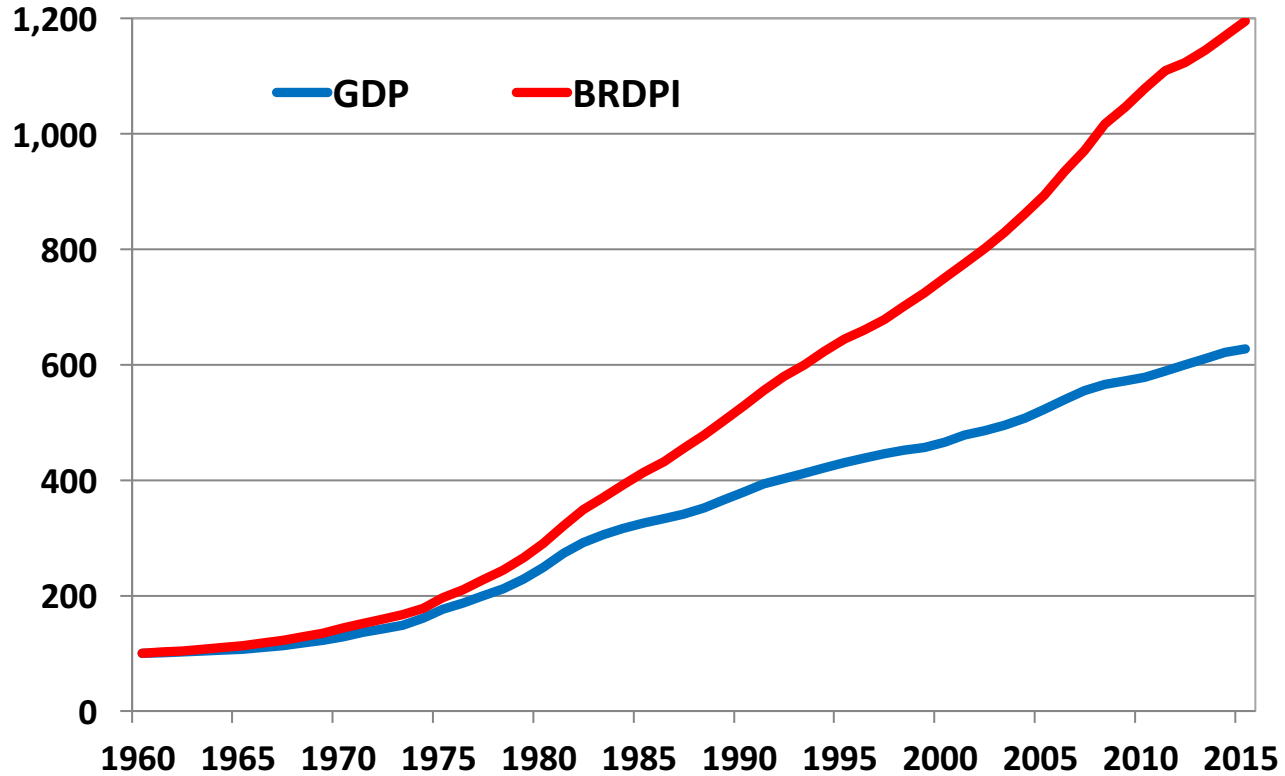
DATE: January 19, 2016
SUBJECT: Biomedical Research and Development Price Index (BRDPI): Fiscal Year 2015
Update and Projections for FY 2016-FY 2021

Summary

- The estimated growth in the BRDPI for FY 2015 is 2.2 percent.
- The updated rate for FY 2014 is 2.2 percent, an increase of 0.2 percent from the preliminary estimate of 2.0 percent posted last year. The higher than anticipated growth is driven primarily by unexpected growth in salaries, wages, fringe benefits and indirect costs.
- The following pattern of future growth in the BRDPI is projected: 2.3 percent for FY 2016, 2.4 percent for FY 2017, 2.8 percent for FY 2018, 3.0 percent for FY 2019, 3.2 percent for FY 2020, and 3.2 for FY 2021.

Inflation

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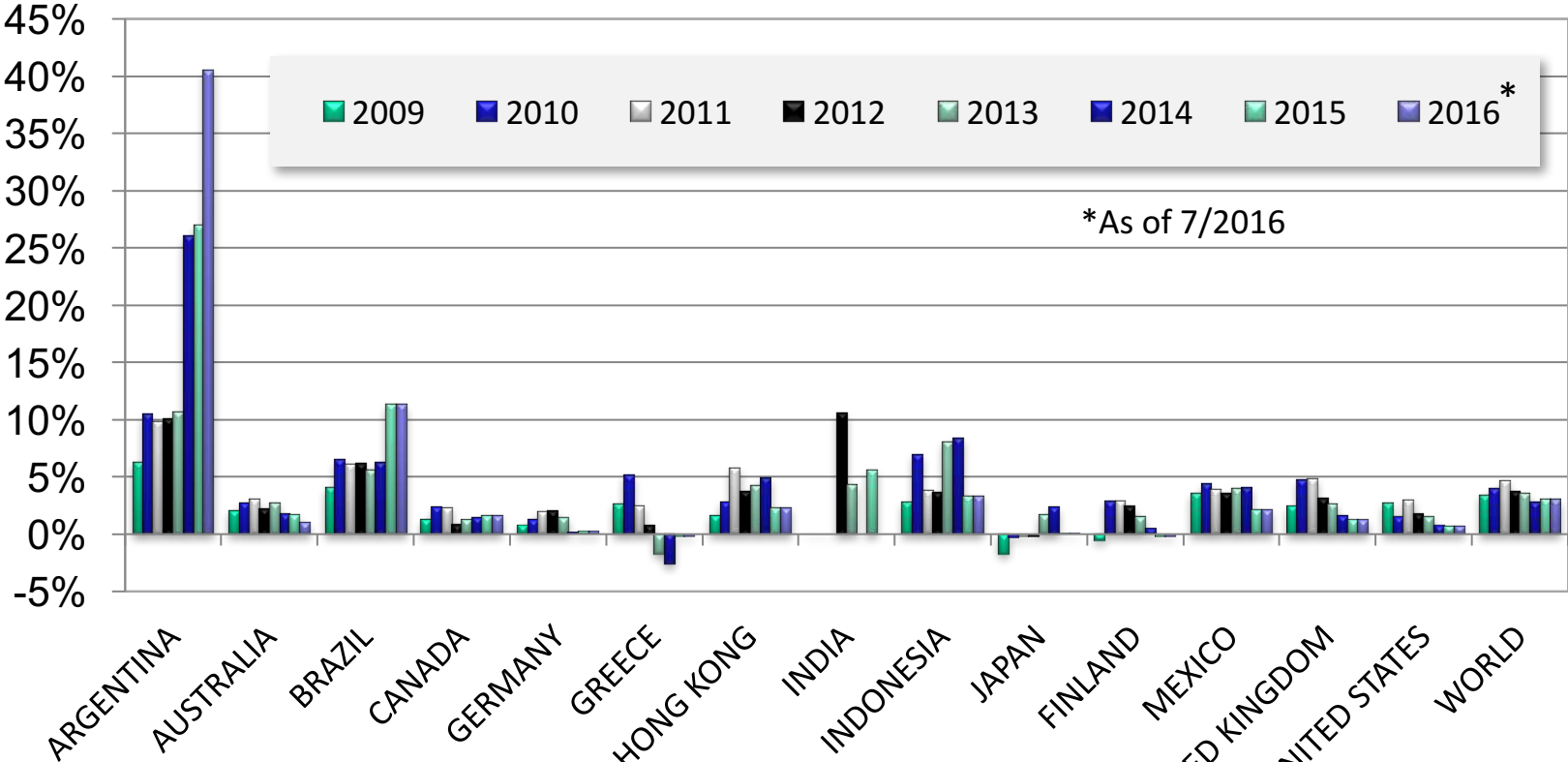


Inflation

For NPV Calculations, Treat Inflation Consistently

- Discount **real cashflows** using **real interest rates**
- Discount **nominal cashflows** using **nominal interest rates**
 - Nominal cashflows \Rightarrow expressed in actual-dollar cashflows
 - Real cashflows \Rightarrow expressed in constant purchasing power
 - Nominal rate \Rightarrow actual prevailing interest rate
 - Real rate \Rightarrow interest rate adjusted for inflation

Inflation

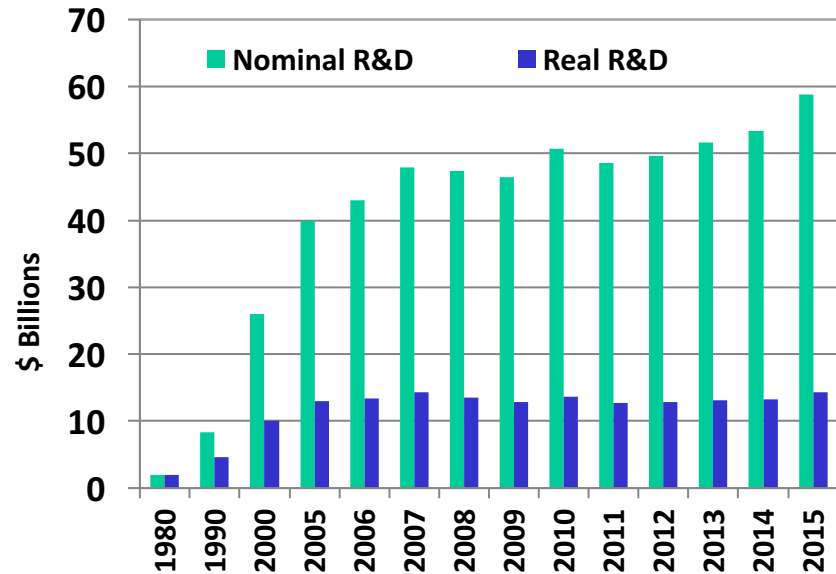


*As of 7/2016

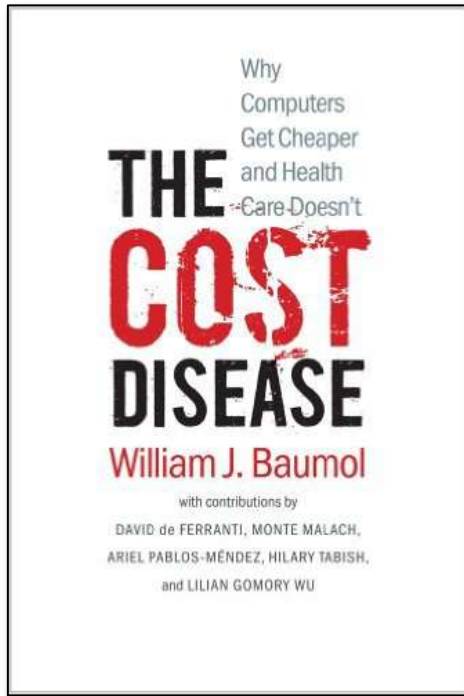
Example: R&D Spending

True or false: “Pharma spends more on R&D today than ever before”?

Year	R&D	BRDPI	BRDPI/100	Real R&D (1980\$)
1980	\$2.00	100.0	1.00	\$2.00
1990	\$8.40	182.0	1.82	\$4.62
2000	\$26.00	258.2	2.58	\$10.07
2005	\$39.90	307.5	3.07	\$12.98
2006	\$43.00	321.7	3.22	\$13.37
2007	\$47.90	333.9	3.34	\$14.35
2008	\$47.40	349.5	3.50	\$13.56
2009	\$46.40	359.8	3.60	\$12.90
2010	\$50.70	370.7	3.71	\$13.68
2011	\$48.60	381.3	3.81	\$12.75
2012	\$49.60	386.2	3.86	\$12.84
2013	\$51.60	393.4	3.93	\$13.12
2014	\$53.30	401.9	4.02	\$13.26
2015	\$58.80	410.9	4.11	\$14.31



Inflation in Healthcare



$$\begin{aligned}
 \text{Inflation } i &= \frac{C_{t+1}}{C_t} - 1 \\
 &= \frac{P_{1t+1}Q_1 + P_{2t+1}Q_2 + \dots + P_{nt+1}Q_n}{P_{1t}Q_1 + P_{2t}Q_2 + \dots + P_{nt}Q_n} - 1 \\
 &= \left(\frac{P_{1t+1}}{P_{1t}} - 1 \right) \cdot \frac{P_{1t}Q_1}{C_t} + \dots + \left(\frac{P_{nt+1}}{P_{nt}} - 1 \right) \cdot \frac{P_{nt}Q_n}{C_t}
 \end{aligned}$$

$$i = i_1\omega_1 + i_2\omega_2 + \dots + i_n\omega_n, \quad \omega_j \equiv \frac{P_{jt}Q_j}{C_t}$$

- For a given level of inflation i , if i_1 is very negative, what does that imply about the other i 's?

Inflation in Healthcare

- Consider a company HiTek that manufactures flat-panel TVs

HiTek Business Model Before Automation	
Total hours of labor required:	150
Wages:	\$50/hour
Machinery costs:	\$2,500
Total cost per TV:	\$10,000
Price:	\$15,000
Profit:	\$5,000



HiTek Business Model After Automation	
Total hours of labor required:	20
Wages:	\$75/hour
Machinery costs:	\$3,500
Total cost per TV:	\$5,000
Price:	\$14,000
Profit:	\$9,000

- Everybody wins—except the companies from which HiTek hired new workers, like academia (e.g., Uber and CMU!)




Inflation in Healthcare

FORTUNE | Tech **March 21, 2016**

UBER

One Year After Announcing Pact, the Uber-Carnegie Mellon Partnership Is Stalled

Reuters
Mar 21, 2016

More than a year after Uber [announced a research pact](#) with Carnegie Mellon University—[and then hired away four of the institution's faculty and 36 researchers and technicians](#)—the ride-hailing company and university have not collaborated on a single project, according to CMU faculty and administrators.

Herman Herman, director of CMU's National Robotics Engineering Center, former employer of the experts Uber hired, said the center currently has no plans for research projects with Uber, adding, "certainly we are open to it in

- Is healthcare more like HiTek or a string quartet?
- Key is labor intensity and productivity increases