Economics 210A
Spring 2015

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LECTURE 1
Measurement

January 21, 2015

I. Course Overview and Information

Course Overview

- Not comprehensive; focus on tools and approaches.
- Geographic coverage.
- Time periods considered.
- Subjects

Requirements

- Reading and class participation.
    - Most readings are through electronic links.
    - Reader for book chapters at Copy Central on Bancroft.
- Paper
- Final Exam (date and time to be confirmed)

II. Introduction to Measurement

Overview

- Data limitations are a general problem in economics, but particularly in economic history.
- Papers for today all talk about ways to deal with data limitations.
    - Nordhaus: case study
    - Hausman: creative use of proxies, generated variables
    - Romer: create consistently bad data

III. William Nordhaus:

"Do Real-Output and Real-Wage Measures Capture Reality? The History of Lighting Suggests Not"

How do we estimate real GDP or real wages?

- Start with nominal values.
    - Sources?
- Divide through by a price index.

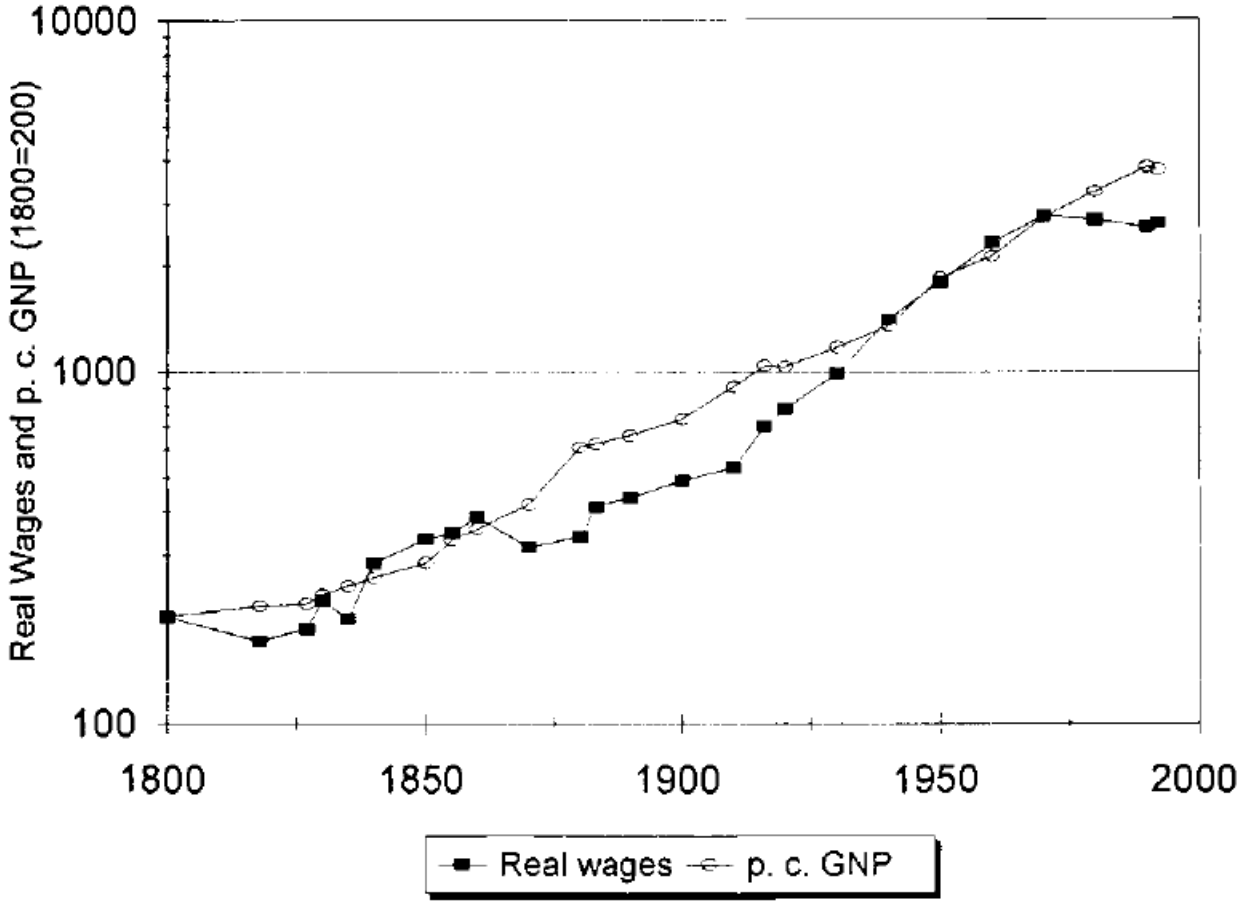


Fig. 1.1 Real wages and per capita GNP

From: Nordhaus, "Do Real-Output and Real-Wage Measures Capture Reality?"

Traditional versus True Price Indexes

Using this approach, we can distinguish traditional price indexes from true price indexes. A *traditional* price index, P_t, measures (some index of) goods or input prices:

$$P_t = \sum_{j=1}^{n} p_{j,t}\zeta_{j,t}, \tag{3}$$

where $p_{j,t}$ are the prices of the goods and $\zeta_{j,t}$ are the appropriate weights on the goods. By contrast, a *true* price index, Q_t, measures the trend in the prices of the service characteristics:

$$Q_t = \sum_{i=1}^{m} q_{i,t}\omega_{i,t}, \tag{4}$$

where $q_{i,t}$ are the prices of the characteristics and $\omega_{i,t}$ are the appropriate weights on the service characteristics.

From: Nordhaus, "Do Real-Output and Real-Wage Measures Capture Reality?"

Table 1.1 Milestones in the History of Lighting

1,420,000 B.C.	Fire used by *Australopithecus*
500,000 B.C.	Fire used in caves by Peking man
38,000–9000 B.C.	Stone fat-burning lamps with wicks used in southern Europe
3000 B.C.	Candlesticks recovered from Egypt and Crete
2000 B.C.	Babylonian market for lighting fuel (sesame oil)
1292	Paris tax rolls list 72 chandlers (candle makers)
Middle Ages	Tallow candles in wide use in western Europe
1784	Discovery of Argand oil lamp
1792	William Murdock uses coal-gas illumination in his Cornwall home
1798	William Murdock uses coal-gas illumination in Birmingham offices
1800s	Candle technology improved by the use of stearic acid, spermaceti, and paraffin wax
1820	Gas street lighting installed in Pall Mall, London
1855	Benjamin Silliman, Jr., experiments with "rock oil"
1860	Demonstration of electric-discharge lamp by the Royal Society of London
1860s	Development of kerosene lamps
1876	William Wallace's 500-candlepower arc lights, displayed at the Centennial Exposition in Philadelphia
1879	Swan and Edison invent carbon-filament incandescent lamp
1880s	Welsbach gas mantle
1882	Pearl Street station (New York) opens with first electrical service
1920s	High-pressure mercury-vapor-discharge and sodium-discharge lamps
1930s	Development of mercury-vapor-filled fluorescent tube
1931	Development of sodium-vapor lamp
1980s	Marketing of compact fluorescent bulb

From: Nordhaus, "Do Real-Output and Real-Wage Measures Capture Reality?"

Table 1.3 Efficiency of Different Lighting Technologies

Device	Stage of Technology	Approximate Date	Lighting Efficiency (lumens per watt)	Lighting Efficiency (lumen-hours per 1,000 Btu)
Open fire[a]	Wood	From earliest time	0.00235	0.69
Neolithic lamp[b]	Animal or vegetable fat	38,000–9000 B.C.	0.0151	4.4
Babylonian lamp[a]	Sesame oil	1750 B.C.	0.0597	17.5
Candle[c]	Tallow	1800	0.0757	22.2
	Sperm	1800	0.1009	29.6
	Tallow	1830	0.0757	22.2
	Sperm	1830	0.1009	29.6
Lamp	Whale oil[d]	1815–45	0.1346	39.4
	Silliman's experiment: Sperm oil[e]	1855	0.0784	23.0
	Silliman's experiment: Other oils[f]	1855	0.0575	16.9
Town gas	Early lamp[g]	1827	0.1303	38.2
	Silliman's experiment[e]	1855	0.0833	24.4
	Early lamp[e]	1875–85	0.2464	72.2
	Welsbach mantle[e]	1885–95	0.5914	173.3
	Welsbach mantle[e]	1916	0.8685	254.5
Kerosene lamp	Silliman's experiment[e]	1855	0.0498	14.6
	19th century[h]	1875–85	0.1590	46.6
	Coleman lantern[i]	1993	0.3651	107.0
Electric lamp				
Edison carbon	Filament lamp[j]	1883	2.6000	762.0
Advanced carbon	Filament lamp[j]	1900	3.7143	1,088.6
	Filament lamp[j]	1910	6.5000	1,905.0
Tungsten	Filament lamp[j]	1920	11.8182	3,463.7
	Filament lamp[j]	1930	11.8432	3,471.0
	Filament lamp[j]	1940	11.9000	3,487.7
	Filament lamp[k]	1950	11.9250	3,495.0
	Filament lamp[k]	1960	11.9500	3,502.3
	Filament lamp[k]	1970	11.9750	3,509.7
	Filament lamp[k]	1980	12.0000	3,517.0
	Filament lamp[l]	1990	14.1667	4,152.0
Compact fluorescent	First generation bulb[m]	1992	68.2778	20,011.1

Note: The modern unit of illumination is the lumen which is the amount of light cast by a candle at one foot.

From: Nordhaus, "Do Real-Output and Real-Wage Measures Capture Reality?"

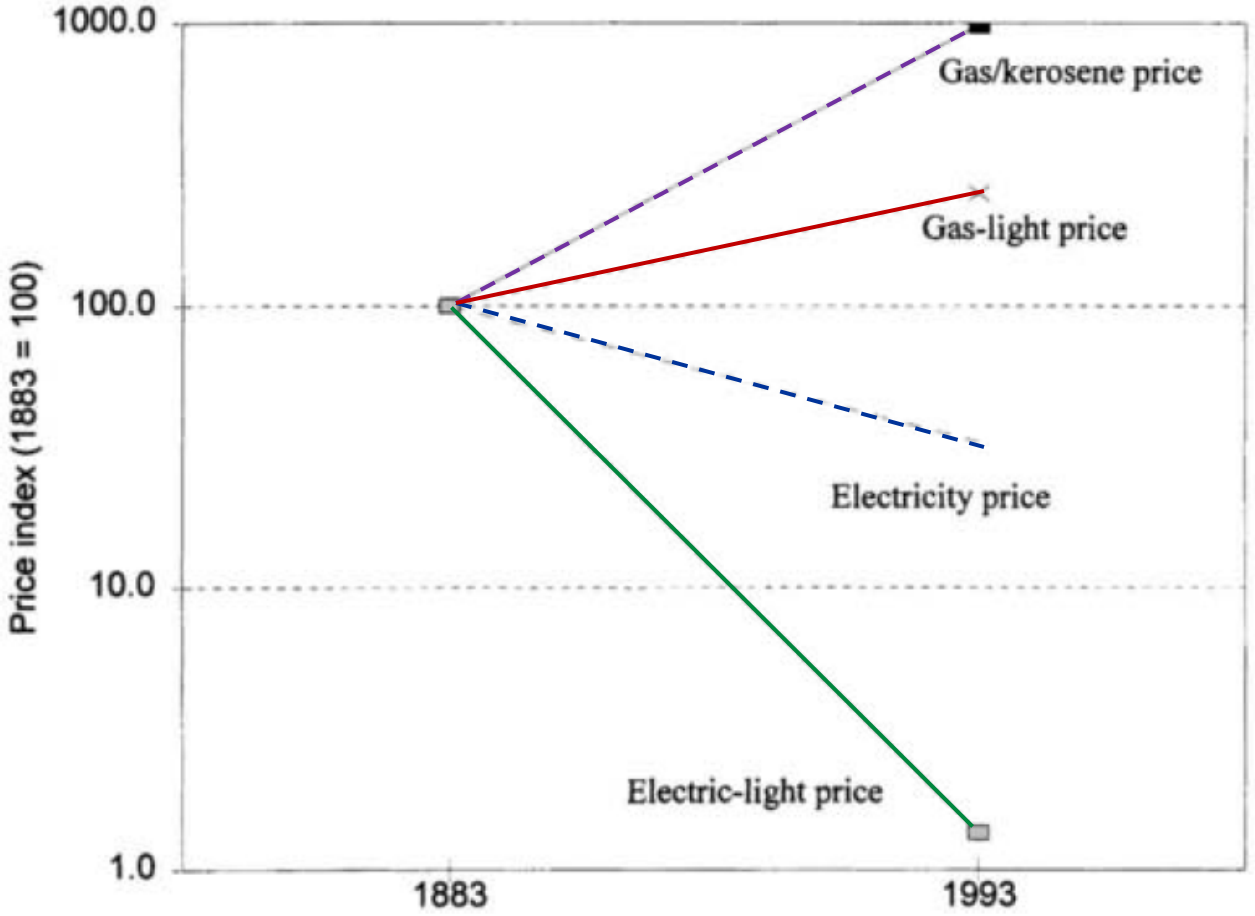


Fig. 1.2 Bias in price indexes

From: Nordhaus, "Do Real-Output and Real-Wage Measures Capture Reality?"

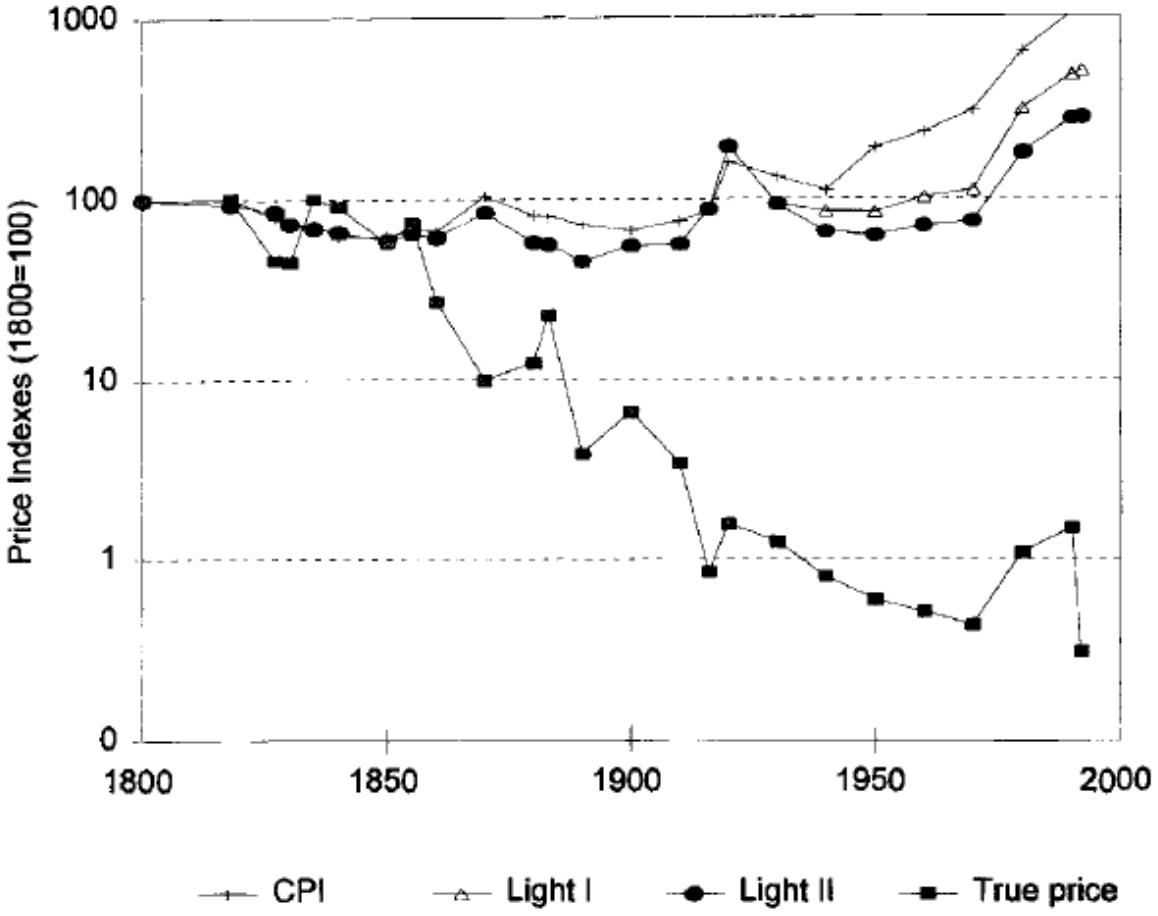


Fig. 1.4 Alternative light prices

From: Nordhaus, "Do Real-Output and Real-Wage Measures Capture Reality?"

Is Nordhaus right about lighting?

- Are we always at the technological frontier?
- Could other service characteristics matter?
- Is effect of service characteristics on utility constant over time?

Table 1.7 Treatment of the Great Inventions

Invention	Treatment in Price Indexes
Aeronautics, helicopter	Except for lower costs of transportation of intermediate goods, lower prices not reflected in price indexes
Air-conditioning	Outside of refrigerated transportation and productivity increases in the workplace, amenities and health effects not captured in price indexes
Continuous casting of steel	A process innovation that showed up primarily in lower costs of intermediate goods and thus was reflected in price indexes of final goods
DDT and pesticides	Some (now questionable) benefits probably included in higher yields in agriculture and therefore included in price indexes; health benefits and ecological damages largely excluded from price indexes
Diesel-electric railway traction	A process innovation that showed up primarily in the price of goods and services
Insulin, penicillin, streptomycin	Improved health status not captured in price index
Internal combustion engine	Except for lower costs of transportation of intermediate goods, lower prices not reflected in price indexes
Long-playing record, radio, television	Major product inventions that are completely omitted from price indexes
Photo-lithography	Largely reflected in reduced printing costs
Radar	A wide variety of improvements, some of which might have shown up in lower business costs and prices (such as lower transportation costs or improved weather forecasting)
Rockets	A wide variety of implications: major application in telecommunications showed up in consumer prices; improvements in television not captured in price indexes; improved military technology and nuclear-war risk not reflected in prices
Steam locomotive	Reduced transportation costs of businesses reflected in price indexes; expansion of consumer services and nonbusiness uses not reflected
Telegraph, telephone	Improvements over Pony Express or mail largely unreflected in price indexes
Transistor, electronic digital computer	As key inventions of the electronic age, impacts outside business costs largely omitted in price indexes
Xerography	Major process improvement: some impact showed up in reduced clerical costs; expansion of use of copied materials not captured in price index
Zipper	Convenience over buttons omitted from price indexes

From: Nordhaus, “Do Real-Output and Real-Wage Measures Capture Reality?”

Table 1.8 Consumption by Extent of Qualitative Changes, 1991 ($ billion)

Sector	Run-of-the-Mill Sectors	Seismically Active Sectors	Tectonically Shifting Sectors
Food			
Home consumption	419.2		
Purchased meals		198.5	
Tobacco		47.8	
Clothing			
Apparel	208.9		
Cleaning and services		21.1	
Watches and jewelry		30.6	
Personal care			
Toilet articles		38.2	
Services	24.0		
Housing			
Dwellings		574.0	
Housing operation			
Furniture and utensils	116.3		
Appliances			25.5
Cleaning and polishing		52.8	
Household utilities			143.2
Telephone and telegraph			54.3
Other	49.6		
Medical care			656.0
Personal business			
Legal and funeral	60.3		
Financial and other		257.5	
Transportation			438.2
Recreation			
Printed	42.9		
Toys		32.3	
Electronics and other goods			84.2
Other	51.7	51.2	27.4
Private education and research		92.8	
Religious and welfare	107.7		
Total	1,080.6	1,396.8	1,428.8
Percent of total	27.7	35.8	36.6

From: Nordhaus, “Do Real-Output and Real-Wage Measures Capture Reality?”

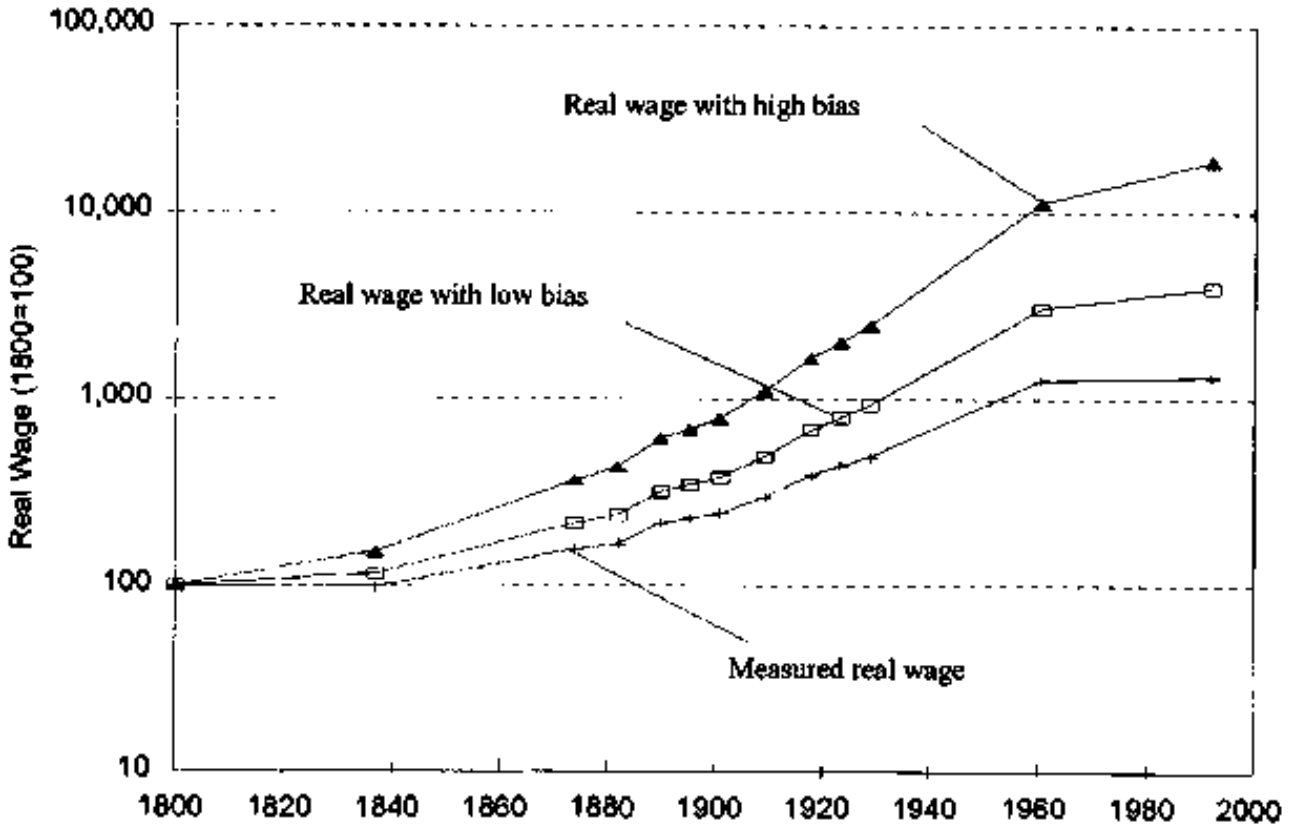


Fig. 1.8 Traditional and true real wages

From: Nordhaus, "Do Real-Output and Real-Wage Measures Capture Reality?"

Could he be right about overall growth?

IV. Joshua Hausman:

"Fiscal Policy and Economic Recovery: The Case of the 1936 Veterans' Bonus"

Average Bonus in 1936 was $547

Table 2: The magnitude of the bonus

	1936	2012	2012 bonus equivalent
Per-capita annual income	$ 535	$ 42,736	$ 43,661
Average annual wage of federal emergency workers	$ 595	-	-
Average hourly earnings in manufacturing	$ 0.62	19.08	$ 16,853
CPI (Index, 1936=100)	100	1656	$ 9,053
Nominal house prices (Index, 1936=100)	100	2506	$ 13,702
Price of cheapest Ford	$ 510	$14,000	$ 15,009

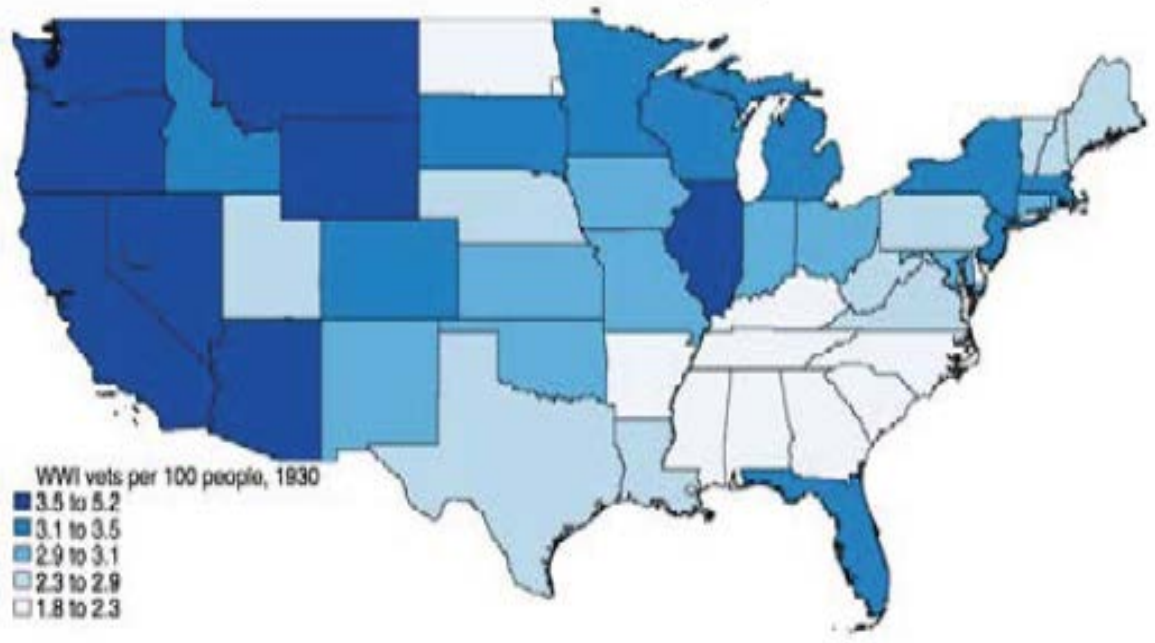
From: Hausman, "Fiscal Policy and Economic Recovery"

Did the bonus raise consumption of veterans (and overall consumption)?

- Time-series analysis not likely to be helpful because it was a one-time event.
- Need cross-section evidence.

Number of Veterans across States

Figure 1: Veterans per 100 people in 1930



Darker shades mean more veterans per 100 people.

Cross-State Analysis

- What is Hausman's data problem?
- How does he solve it?
- General lessons?

Veterans and Car Sales by State in 1936

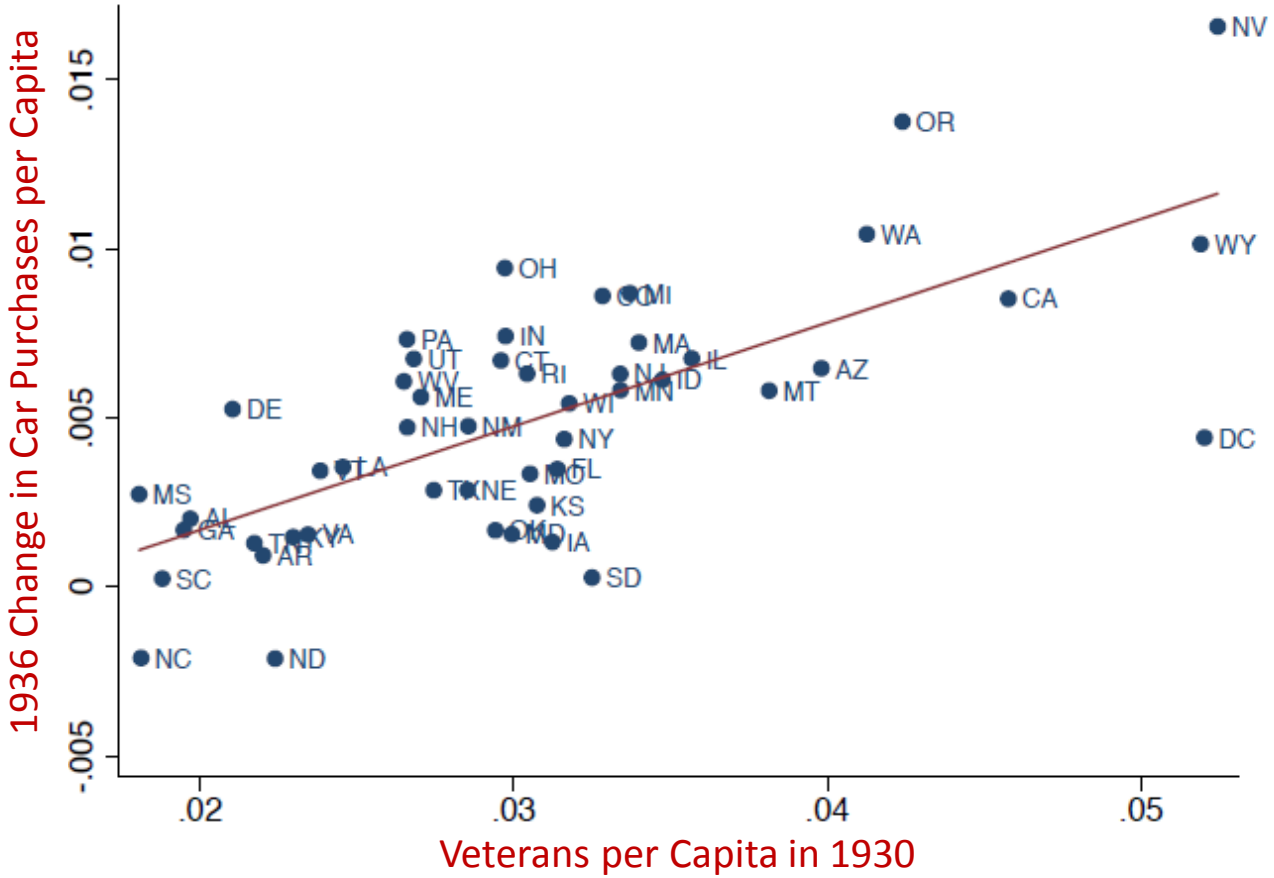


Table 10: Regression results for new car sales

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Veterans per capita, 1930	0.306***	0.315***	0.344***	0.209***	0.214**	0.276***	0.332*
	(0.0648)	(0.0875)	(0.0806)	(0.0692)	(0.0829)	(0.0750)	(0.191)
Per capita new car sales in 1929		-0.0116					
		(0.0600)					
Change in per capita new car sales in 1935			-0.121				
			(0.150)				
Midwest				-0.00180*			
				(0.00103)			
South				-0.00263***			
				(0.000728)			
West				0.000979			
				(0.000970)			
Black share of the population					-0.00302		
					(0.00462)		
Farm share of the population					-0.00654**		
					(0.00264)		
Excludes states with vets per cap < 0.02 or > 0.04						X	
Northeast and midwest only							X
Observations	49	49	49	49	49	38	21
R^2	0.492	0.493	0.500	0.604	0.585	0.225	0.155

Robust standard errors in parentheses

From: Hausman, "Fiscal Policy and Economic Recovery"

Individual-Level Analysis

- Has detailed consumer expenditure data based on a survey in 1935 and 1936.
- Key feature, some people were surveyed before the bonus, some after.
- If knew veteran status could do a difference-in-difference analysis to see if veterans raised consumption more than non-veterans following the bonus.

Hausman's Ideal Specification

$$\text{Consumption over previous 12 months}_i = \alpha + \beta_1 \cdot \text{Veteran dummy}_i + \beta_2 \cdot \text{Post bonus dummy}_i + \beta_3 \cdot \text{Veteran dummy}_i \cdot \text{Post bonus dummy}_i + Z_i'\beta_4 + \varepsilon_i,$$

Consumption over Previous 12 mos.

	Pre-Bonus	Post-Bonus
Non-Veteran	α	$\alpha + \beta_2$
Veteran	$\alpha + \beta_1$	$\alpha + \beta_1 + \beta_2 + \beta_3$

How much does consumption rise post-bonus for a non-veteran? β_2
How much does consumption rise post-bonus for a veteran? $\beta_2 + \beta_3$

So β_3 shows the effect on consumption post-bonus of a veteran versus a non-veteran.

Hausman's Data Problem

- Doesn't observe whether family got a bonus or veteran status.
- How does he get around this problem?

Hausman's Specification

$$\text{Consumption}_i = \alpha + \underbrace{\beta_1 \cdot \text{Prob. veteran}_i}_{\text{Not identifiable}} + \beta_2 \cdot \text{Post bonus dummy}_i$$

$$+ \beta_3 \cdot \text{Prob. veteran}_i \cdot \text{Post bonus dummy}_i + Z_i'\beta_4 + \varepsilon_i, \qquad (2)$$

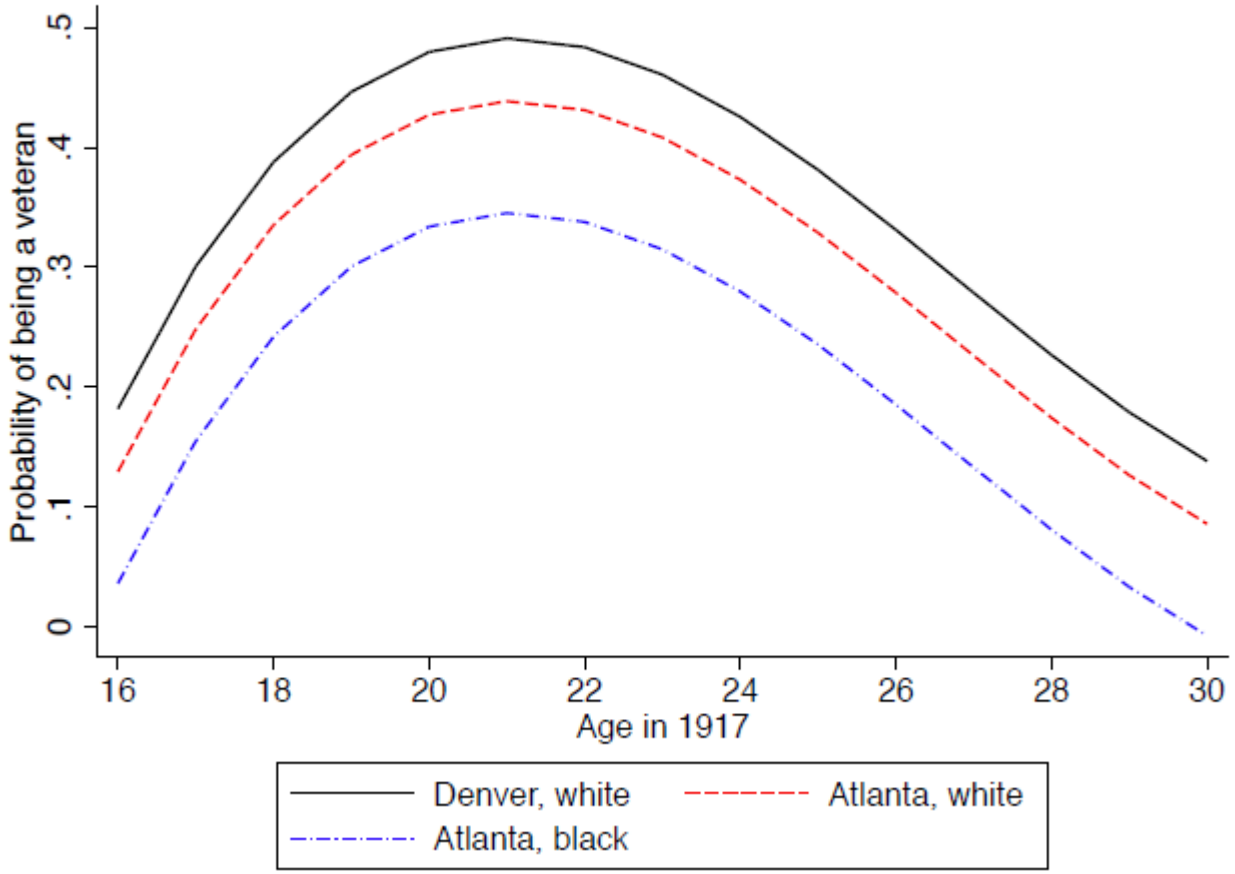
- Going to predict probability there was a veteran in the family using data from the 1930 Census.
- Key requirement is that the Z variables don't affect the difference in consumption pre- and post-bonus, except through probability that one was a veteran.

Predicting Veteran Status

$$V_j = \sum_{h=1}^{3} \beta_h 1(g_j = g_h) + \sum_{k=1}^{17} \gamma_k 1(s_j = s_k) + \sum_{l=1}^{17} \alpha_l 1(g_j = 2) 1(s_j = s_l)$$
$$+ \sum_{m=1}^{3} \theta_m a_j^m + \sum_{n=1}^{3} \lambda_n 1(g_j = 2) a_j^n + \zeta r_j + \eta 1(g_j = 2) \cdot r_j + \mu_j. \quad (6)$$

- V is World War I veteran status
- g is a generation indicator variable for whether a man was younger than 28, between 28 and 45 or older than 45 in 1930
- s is an indicator variable for state
- a equals age
- r is an indicator variable for race

Figure 1: Variation in probability man is a veteran



From: Hausman, "Fiscal Policy and Economic Recovery"

Table 6: Total expenditure and saving regressions

	(1) Total C	(2) Total C	(3) Insurance policies settled	(4) Gifts received
Post bonus dummy	264.1***	198.2***	-5.589	0.0779
	(70.52)	(43.18)	(4.292)	(6.854)
Interaction	647.0*	403.1**	95.93***	152.4***
	(379.4)	(169.6)	(22.87)	(46.44)
Omit if expen. > $5000	No	Yes	Yes	Yes
Observations	2745	2681	2681	2339
R^2	0.152	0.186	0.034	0.048

Bootstrap standard errors clustered at the city level in parentheses.

* $p < .10$, ** $p < .05$, *** $p < .01$

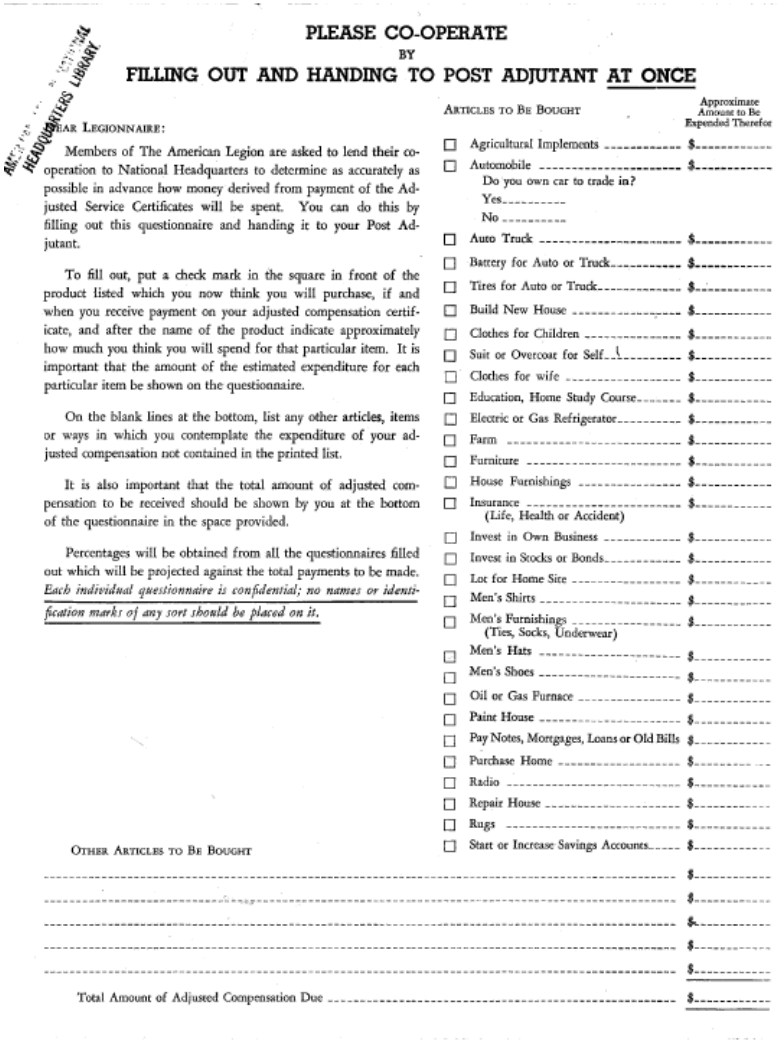
Note: See the text for a description of the controls.

From: Hausman, "Fiscal Policy and Economic Recovery"

American Legion Survey

- Another case where there is data one might not have expected.
- Under-utilized archivists can be your friend.

Figure 9: American Legion survey form



PLEASE CO-OPERATE
BY
FILLING OUT AND HANDING TO POST ADJUTANT AT ONCE

DEAR LEGIONNAIRE:

Members of The American Legion are asked to lend their co-operation to National Headquarters to determine as accurately as possible in advance how money derived from payment of the Adjusted Service Certificates will be spent. You can do this by filling out this questionnaire and handing it to your Post Adjutant.

To fill out, put a check mark in the square in front of the product listed which you now think you will purchase, if and when you receive payment on your adjusted compensation certificate, and after the name of the product indicate approximately how much you think you will spend for that particular item. It is important that the amount of the estimated expenditure for each particular item be shown on the questionnaire.

On the blank lines at the bottom, list any other articles, items or ways in which you contemplate the expenditure of your adjusted compensation not contained in the printed list.

It is also important that the total amount of adjusted compensation to be received should be shown by you at the bottom of the questionnaire in the space provided.

Percentages will be obtained from all the questionnaires filled out which will be projected against the total payments to be made. *Each individual questionnaire is confidential; no names or identification marks of any sort should be placed on it.*

ARTICLES TO BE BOUGHT	Approximate Amount to Be Expended Therefor
☐ Agricultural Implements	$
☐ Automobile	$
Do you own car to trade in? Yes____ No____	
☐ Auto Truck	$
☐ Battery for Auto or Truck	$
☐ Tires for Auto or Truck	$
☐ Build New House	$
☐ Clothes for Children	$
☐ Suit or Overcoat for Self	$
☐ Clothes for wife	$
☐ Education, Home Study Course	$
☐ Electric or Gas Refrigerator	$
☐ Farm	$
☐ Furniture	$
☐ House Furnishings	$
☐ Insurance (Life, Health or Accident)	$
☐ Invest in Own Business	$
☐ Invest in Stocks or Bonds	$
☐ Lot for Home Site	$
☐ Men's Shirts	$
☐ Men's Furnishings (Ties, Socks, Underwear)	$
☐ Men's Hats	$
☐ Men's Shoes	$
☐ Oil or Gas Furnace	$
☐ Paint House	$
☐ Pay Notes, Mortgages, Loans or Old Bills	$
☐ Purchase Home	$
☐ Radio	$
☐ Repair House	$
☐ Rugs	$
☐ Start or Increase Savings Accounts	$

OTHER ARTICLES TO BE BOUGHT

_____ $_____
_____ $_____
_____ $_____
_____ $_____
_____ $_____

Total Amount of Adjusted Compensation Due _____ $_____

From: Hausman, "Fiscal Policy and Economic Recovery"

Table 13: American Legion survey tabulations

Item	Amount per veteran	Percent of bonus
Repair present house	$ 37.90	6.71%
Paint house	$ 9.72	1.72%
Housing consumption total	$ 47.62	8.43%
Furniture	$ 17.37	3.07%
Rugs and carpets	$ 2.83	0.50%
Other house furnishings	$ 12.93	2.29%
Electric or gas refrigerator	$ 6.04	1.07%
Oil or gas furnace	$ 2.57	0.45%
Radio	$ 2.49	0.44%
Other durable gds total	$ 44.22	7.82%
Suit or overcoats	$ 9.84	1.74%
Shirts	$ 0.87	0.15%
Shoes	$ 0.99	0.18%
Hats	$ 0.48	0.08%
Other men's furnishings	$ 2.48	0.44%
Clothing for children	$ 12.01	2.13%
Clothing for wife	$ 13.10	2.32%
Clothing total	$ 39.76	7.04%
Passenger automobiles	$ 30.86	5.46%
Trucks	$ 4.02	0.71%
Automobile tires	$ 1.52	0.27%
Automobile batteries	$ 0.15	0.03%
Autos total	$ 36.55	6.47%
Purchase farm	$ 18.97	3.36%
Farm implements	$ 12.46	2.20%
Invest in own business	$ 37.90	6.71%
Build new house	$ 26.28	4.65%
Purchase home	$ 36.80	6.51%
Purchase lot for homesite	$ 9.03	1.60%
Investment total	$ 141.43	25.03%
Purchase insurance	$ 19.11	3.38%
Education	$ 5.08	0.90%
Miscellaneous	$ 22.72	4.02%
Other total	$ 46.91	8.30%
Pay old bills and debts	$ 177.26	31.36%
Savings accounts	$ 25.26	4.47%
Purchase stocks or bonds	$ 6.15	1.09%
Savings total	$ 208.68	36.92%

From: Hausman, "Fiscal Policy and Economic Recovery"

Narrative Evidence

- Another approach to measurement.
- Best sources may not be numbers at all.

From: Hausman, "Fiscal Policy and Economic Recovery"

A useful check on the quantitative evidence of previous sections comes from newspaper reports at the time: given my results, it would be troubling if newspapers did not report high spending by veterans. In fact, they reported a spending boom.

For example, the *Los Angeles Times* wrote on June 19, 1936, four days after the bonus was distributed (p. A1):

> All signs yesterday pointed to a real spending spree by veterans. . . . Downtown department stores reported yesterday's sales were more than 30 percent above a week ago.

The *Wall Street Journal* reported a couple weeks later, on July 3 (p. 1):

> Unusual gains in retail sales of new passenger cars the latter part of last month lifted the June retail sales totals of the largest automobile units to new peaks for the year. . . . Such a development was not expected, the belief of automobile people being that June sales would not be able to maintain the fast pace of April and May, usual months for peak in new car sales. No doubt the bonus had something to do with pushing sales into new high ground, but generally strong business throughout most of the country played an equal part in providing support.

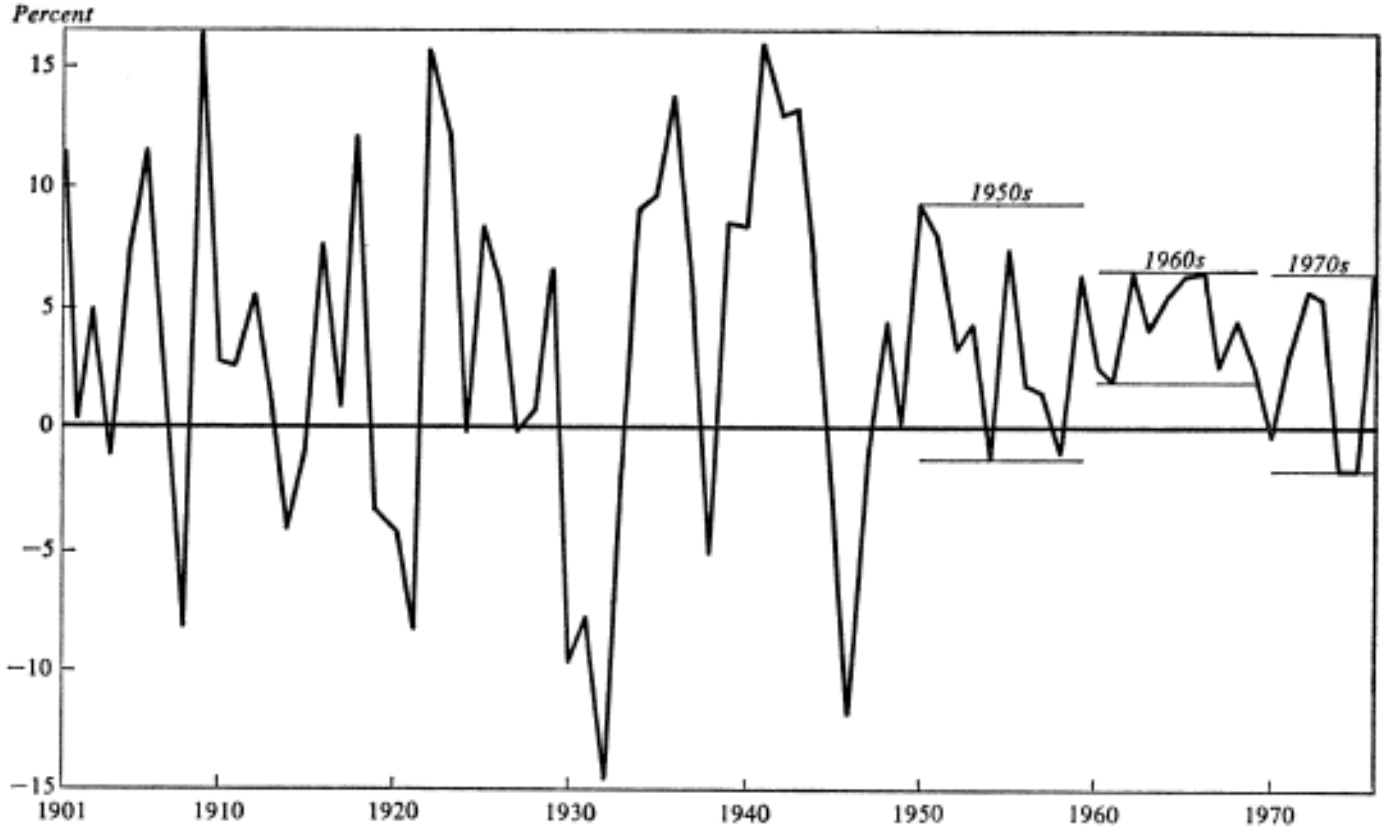
From: Hausman, "Fiscal Policy and Economic Recovery"

V. Christina Romer:

"Spurious Volatility in Historical Unemployment Data"

Conventional GDP Data

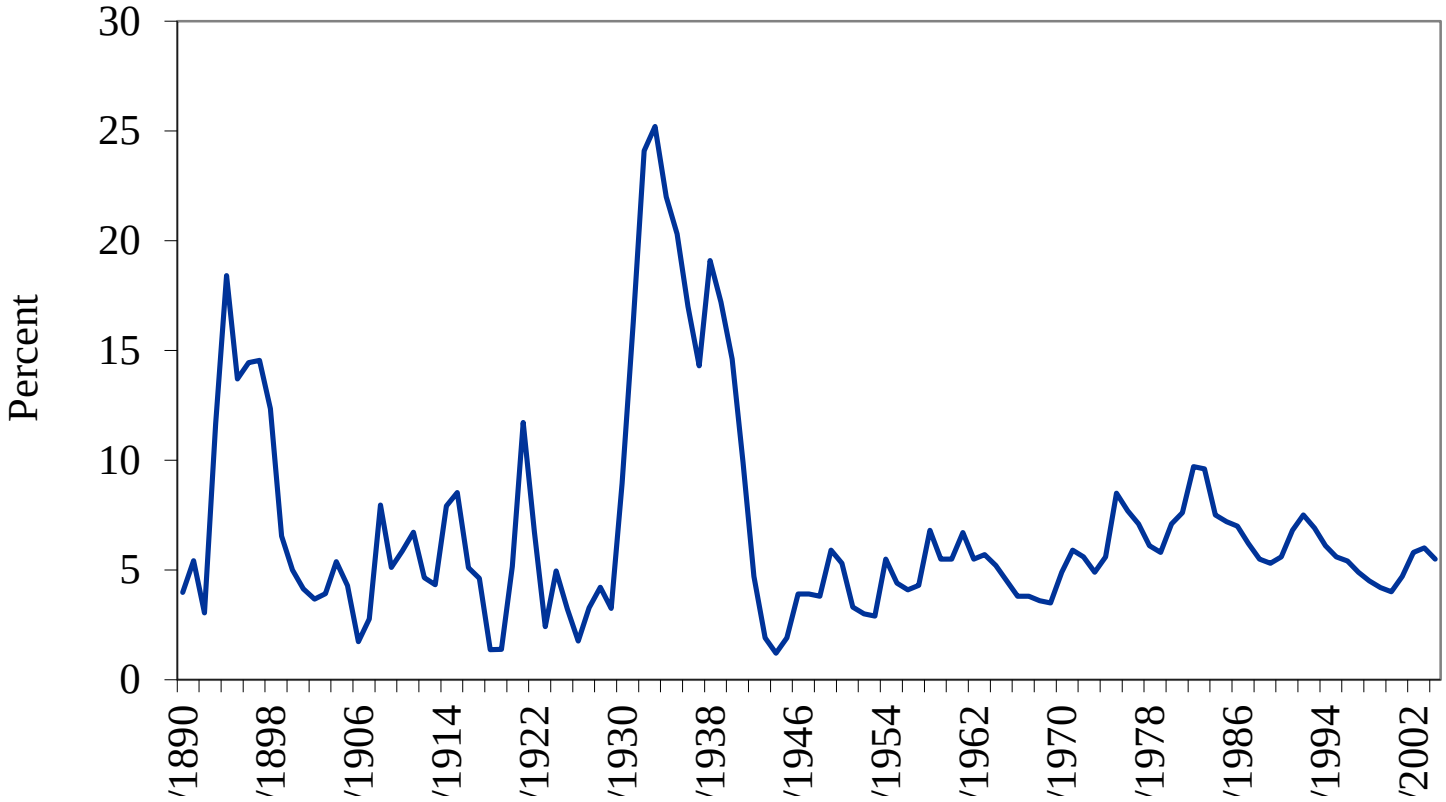
Figure 1. The Rate of Growth of Real Gross National Product, 1901–76



Sources: U.S. Bureau of the Census, *Historical Statistics of the United States: Colonial Times to 1970*, pt. 1 (Government Printing Office, 1975), series F3; *Economic Report of the President, January 1977*, p. 188; *Survey of Current Business*, vol. 57 (July 1977), table 1.2.

From Baily, "Stabilization Policy and Private Economic Behavior" (*BPEA*, 1978)

Conventional Unemployment Data



From *Historical Statistics of the United States*

Lebergott's Methodology

Unemployed = Labor Force – Employed

- Labor force is assumed to rise linearly between decadal census estimates.
- Employment in some sectors is assumed to move one-for-one with output.
- Both assumptions may exaggerate the cyclical volatility in estimated unemployment.

Romer's Methodology: "Reverse Alchemy"

- Create consistently bad series.
- Make replication easier by assuming some components have no errors.

Discussion and Concerns

- Might Romer's approach overestimate, or underestimate, how much Lebergott's procedures exaggerate cyclical movements in the prewar era?
- Two general possibilities:
  - "Structural change."
  - Imperfect replication.

Addressing the Concerns

Again, two general possibilities:

- Making a case the addressing potential problems would only strengthen the conclusions.
- Examining auxiliary evidence.

More Consistent Unemployment Data

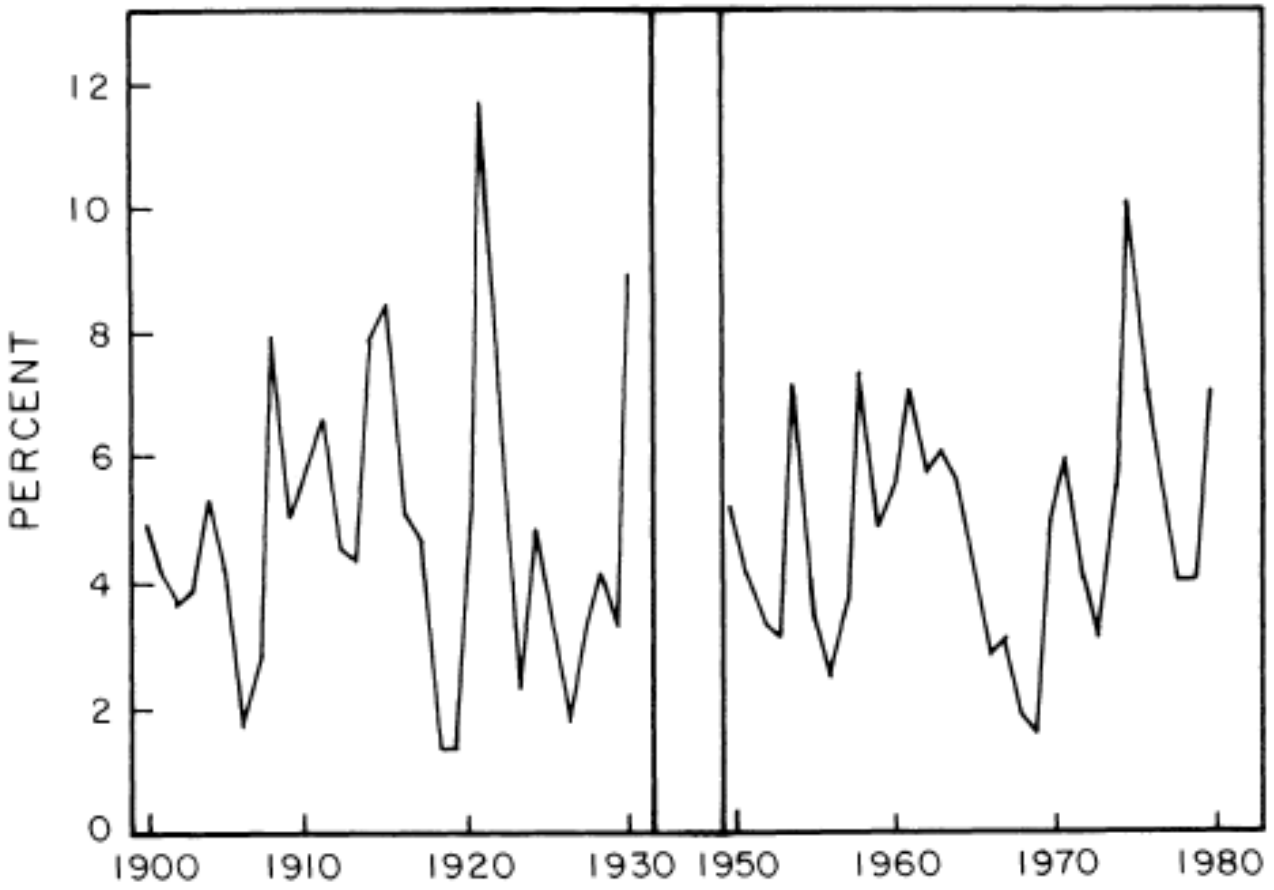


FIG. 1.—Consistent unemployment rate series. The series for 1900–1930 is Lebergott's unemployment rate series. The series for 1950–80 is the constructed unemployment series *UI*50.

From Christina Romer, "Spurious Volatility in Historical Unemployment Data"

TABLE 4

Standard Deviations

Period	Series	Standard Deviation*
1900–1930	*U*LEB	2.38
1948–78	*UI*48	2.19
1949–79	*UI*49	2.48
1950–80	*UI*50	1.90
1951–81	*UI*51	1.98
1952–82	*UI*52	2.14
1948–82	*UA*	1.58

* The standard deviation of the level of the unemployment rate around its mean.

From Christina Romer, ”Spurious Volatility in Historical Unemployment Data”

TABLE 6

Standard Deviations of the Change in Unemployment

Period	Series	Standard Deviation*
1900–1930	*U*LEB	2.86
1948–78	*UI*48	2.19
1949–79	*UI*49	2.15
1950–80	*UI*50	2.15
1951–81	*UI*51	2.11
1952–82	*UI*52	2.19
1948–82	*UA*	1.22

* The standard deviation of the change in the unemployment rate around its mean.

From Christina Romer, ”Spurious Volatility in Historical Unemployment Data”

Implications of Findings

- Quality of the data matters.
- Depression stands out more.
- Why wasn’t there a stabilization?
- What changed in the early 1980s?