The Great Depression May Have Started Sooner Than We Thought!

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Great Depression Remains Mysterious

- **(i) Unprecedented policies in late 1929 – Hoover's White House conferences with mfg. CEOs following stock market decline.**
- **CEOs agreed to keep nominal wages fixed & share work across employees in event of a downturn.**
- **Ohanian (2009) assessed effect of those policies**
- ***Why were these policies adopted?***

Great Depression Remains Mysterious

- **(ii) Immediately severe, long before widely-cited factors in literature: deflation, banking distress, money supply declines**
- **In 1930, -13% Real GDP, -33% Business Investment**
- **Why did economy fall so far, so fast?**

Great Depression Remains Mysterious

- **(iii) 80% drop in investment at trough**
- ***By comparison, WWII investment fell 60%***
  - ***WWII had rationing***
  - ***Wartime conversion of factories for military use***
  - ***Government spending = 50% of output***
- ***Why did investment fall so much?***

Great Depression Remains Mysterious

- **(A) Why were labor/industrial policies implemented?**
- **(B) Why was Depression so immediately severe, before commonly-cited shocks occurred?**
- **(C) Why did investment fall so much in 1930s?**
- **These issues trouble me about the Great Depression**
- **Specifically, that we are missing something important**

"What We Missed" Might be Found in 1920s Economy

- **This paper shows 1920s economy - in some ways - as much of a "one off" event as 1930s**

"What We Missed" Might be Found in 1920s Economy

- **This paper shows 1920s economy - in some ways - as much of a "one off" event as 1930s**
- **Large 1920s deviations in quantities, prices, & income distribution (capital/labor) from standard model**

"What We Missed" Might be Found in 1920s Economy

- **This paper shows 1920s economy - in some ways - as much of a "one off" event as 1930s**
- **Large deviations in quantities, prices, & income distribution in 1920s relative to standard model**
  - **(1) 1920s labor, investment, output far below predicted values from standard growth theory**
  - **(2) Large gap between Y/H & real wages emerges in 1920s – wage growth far below Y/H**
  - **(3) Record capital share of income (40%)**

What Happened during 1920s? Big Technical & Management Innovations

- **Literature focuses on two different innovations:**
  - **(1) Era of the creation of the *modern firm:* changes in management, organization, & efficiency of businesses**
    - **Focus of much research by business historians**
  - **(2) Continuation of *electrification process* in factories**
    - **Focus of much research by economic historians**
- **Modify neoclassical model based on nature of large technological change occurring around that time**

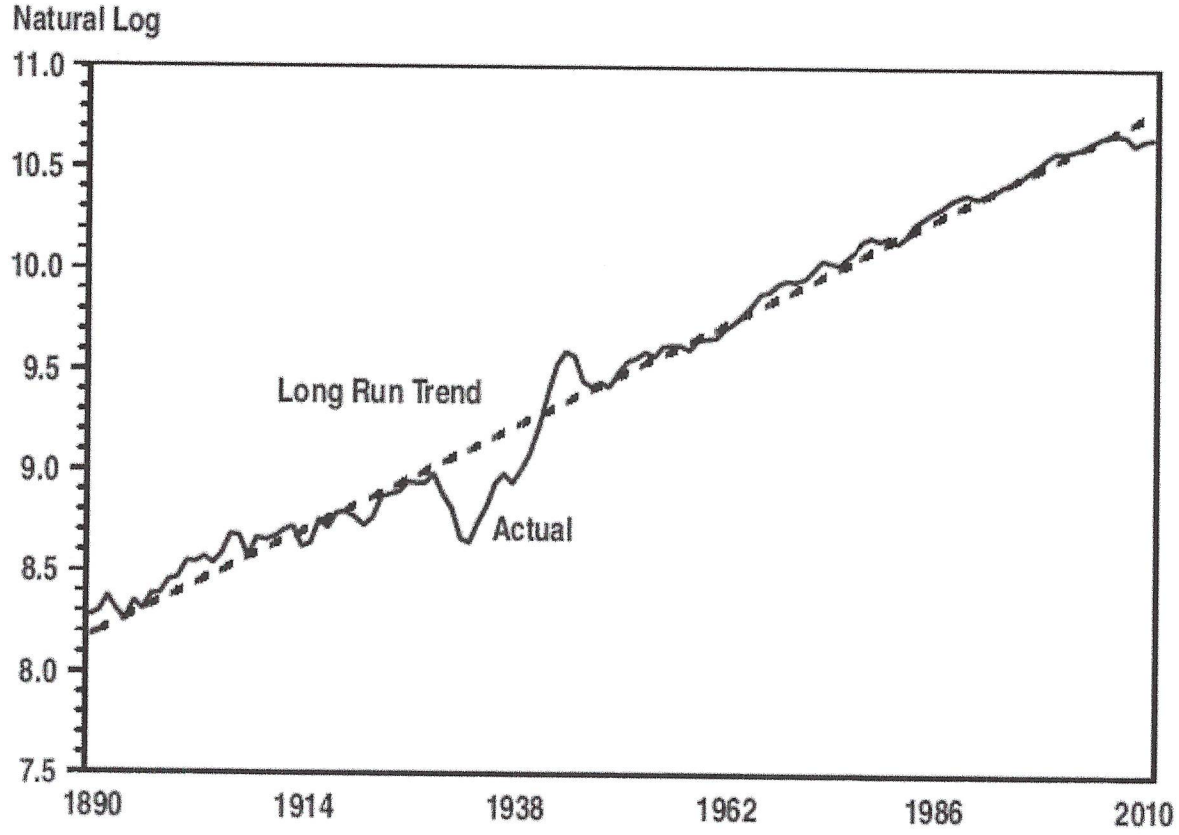
A Possible Resolution for Understanding 1920s

- **Model of *modern firm* brings data & model predictions closer – suggestive, work in progress**
- **Findings may shed light on why Great Depression was so immediately severe, and why investment fell so much**

How Did We Miss 1920s?
"Seduced by the Balanced Growth Path"

- **Cole and Ohanian (1999, 2000, 2002), Ohanian (2009) assume 1929 was on BGP**
- **Same (implicit) BGP assumption about 1920s in other studies:**
- **Friedman-Schwartz (1963), Lucas and Rapping (1969), Lucas (1977), Bernanke (1983)**
- **Implications of 1920s BGP perspective**
  - **1920s largely irrelevant for what happened in 1930s**
  - **Without late 1929/1930s shocks, 1930s economy would have remained on balanced growth path**

Chart 2-7. Real Per Capita GDP 1890-2010



Sources: Angus Maddison, The World Economy, Historical Statistics 1890-1929 and
Bureau of Economic Analyis, National Income and Product Accounts, 1929-2010.

How Did We Miss 1920s?
"Seduced by the Balanced Growth Path"

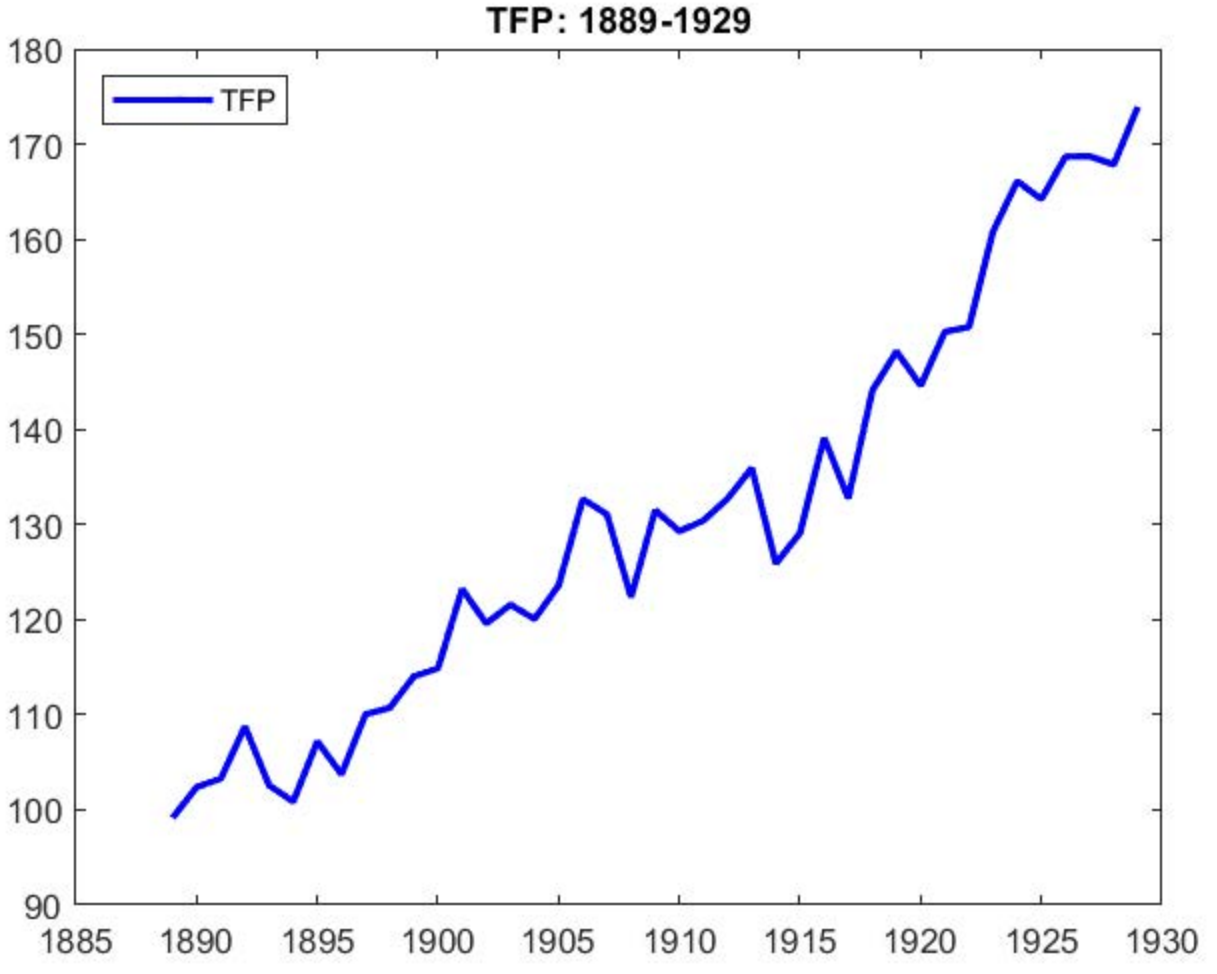
- **Output is on trend, but…**
- **Hours worked/working age population fell 5 percent**
- **Capital stock/working age population rose just 7 percent**
- **Record TFP growth exactly offsets factor inputs to keep output on BGP**

A Three-Sector Economy for the U.S. : 1889-1929

- **Study U.S. economy, beginning in 1889 using John Kendrick's (1961) U.S. national accounts data**
- **Includes BEA-definition constructions of real output and its components, hours worked, capital stock, various measures of productivity, sectoral detail**
- **Widely considered best pre-BEA U.S. data**
- **Supplement with data from *The Conference Board*, Census, Ag dept, *Historical Statistics of US***

A Three-Sector Economy for the U.S. : 1889-1929

- **Three-sector model - Ag, Manufacturing, Services**
- **Why three-sector?**
  - **U.S. was still transitioning out of Ag during period**
  - **1920s "One-off" features easier to see at sectoral level**
  - **Preferences will depart a bit from balanced growth**
  - **Technologies (for now) will be standard (balanced growth)**


TFP: 1889-1929
TFP
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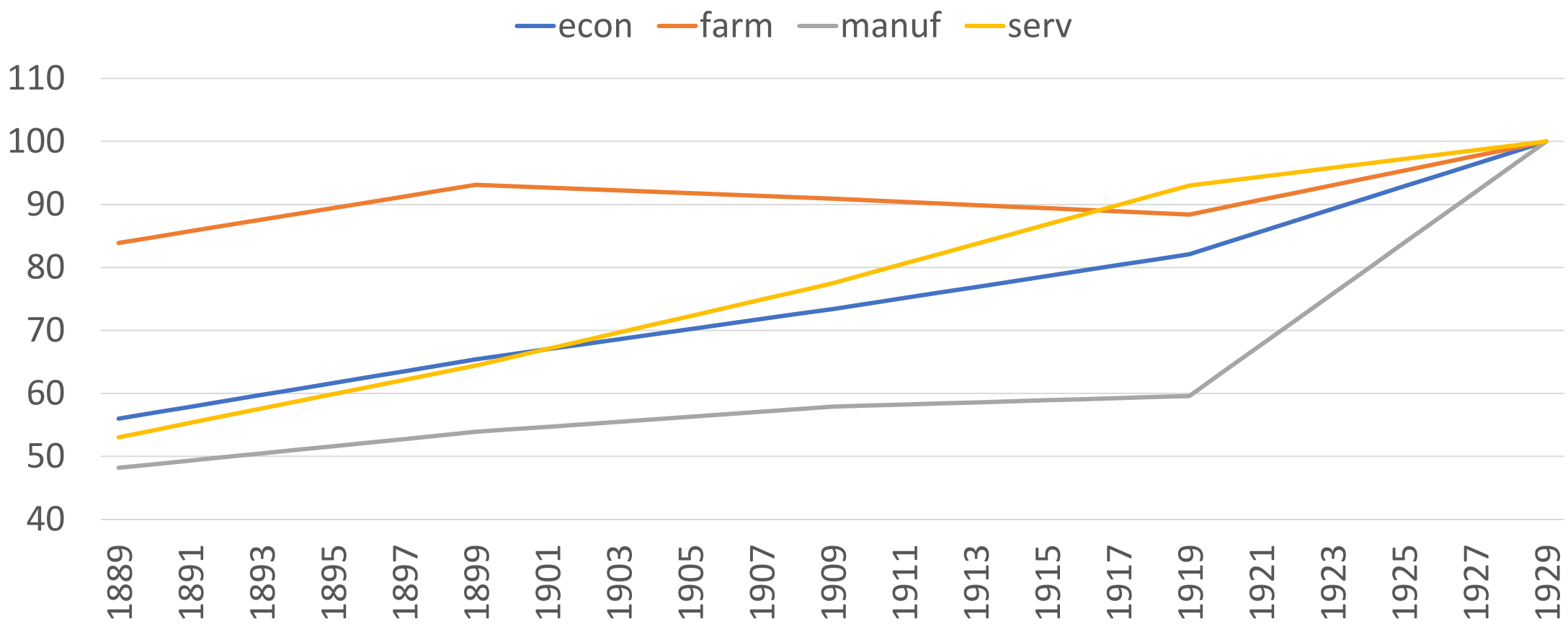
Aggregate and Sectoral TFP: 1889-1929



A Three-Sector Economy for the U.S. : 1889-1929

- **Household Preferences**
- $\sum_{t=0}^{\infty} \boldsymbol{\beta}^t \left\{ \left(\rho \boldsymbol{ln}(\boldsymbol{A_t} - \overline{\boldsymbol{A}}) \right) + \gamma \boldsymbol{ln}(\boldsymbol{M_t}) + \theta \boldsymbol{ln}(\boldsymbol{S_t} + \overline{\boldsymbol{S}}) + \psi \boldsymbol{ln}(\boldsymbol{1} - \boldsymbol{h_t}) \right\}$
- **Income elasticity of demand for agriculture (A) <1**
  - $\overline{A}$ **is Stone-Geary subsistence term (necessity good)**
- **Income elasticity of demand for services (S) >1**
  - $\overline{S}$ **is subsidy term (luxury good, Kongsamut et. al. 2001)**
- **M is consumption of manufactured goods**
- **Asymptotic expenditure shares given by** ρ, γ, θ

A Three-Sector Economy for the U.S. : 1889-1929

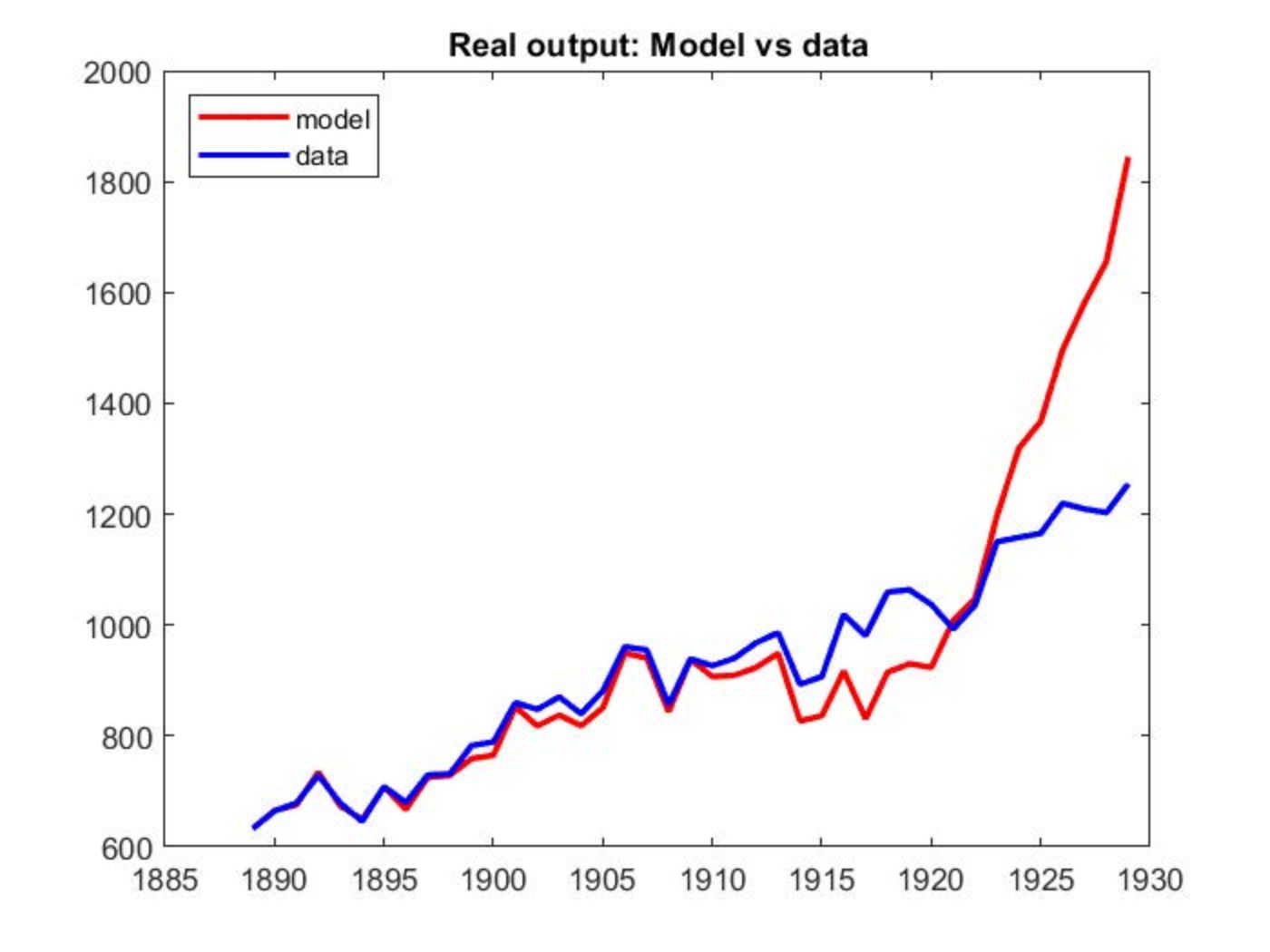
- **Technologies are standard**
- $Y_{A_t} = B_{A_t} X_t K_{A_t}^{\alpha} H_{A_t}^{1-\alpha} = A_t$
- $Y_{M_t} = B_{M_t} X_t K_{M_t}^{\alpha} H_{M_t}^{1-\alpha} = M_t + I_t$
- $Y_{S_t} = B_{S_t} X_t K_{S_t}^{\alpha} H_{S_t}^{1-\alpha} = S_t$
- X_t **is common technology component**
- B_{i_t} **is sector-specific technology component**

A Three-Sector Economy for the U.S. : 1889-1929

- Capital perfectly mobile across sectors
- $K_t = K_{A_t} + K_{M_t} + K_{S_t}$
- 4 uses of time, labor perfectly mobile across sectors
- $H_t = H_{A_t} + H_{M_t} + H_{S_t}$
- Standard capital accumulation:
- $K_{t+1} = I_t + (1 - \delta)K_t$
- **Focus of model on decade of 1920s, not so much on year-to-year changes**

Parameter Values and Solution

- Expenditure shares similar to Kongsamut et. al. (2000)
- Discounting, depreciation, leisure parameters use common values
- Subsistence & subsidy preferences terms chosen so initial labor allocations across sectors similar to data
- Productivities are from Kendrick (1961)
- Perfect foresight solution (terminal condition of BGP)


Real output: Model vs data
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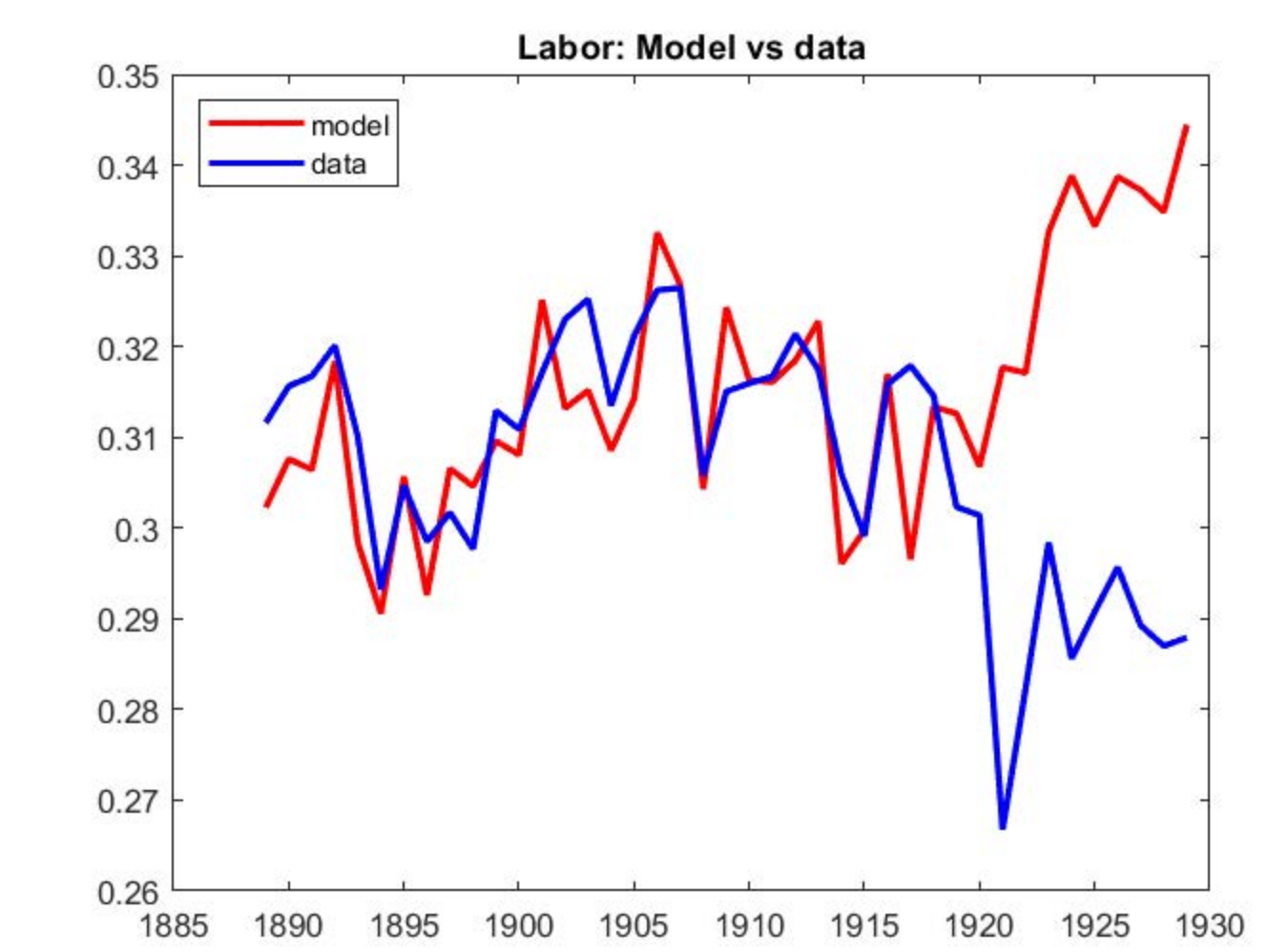
Labor: Model vs data
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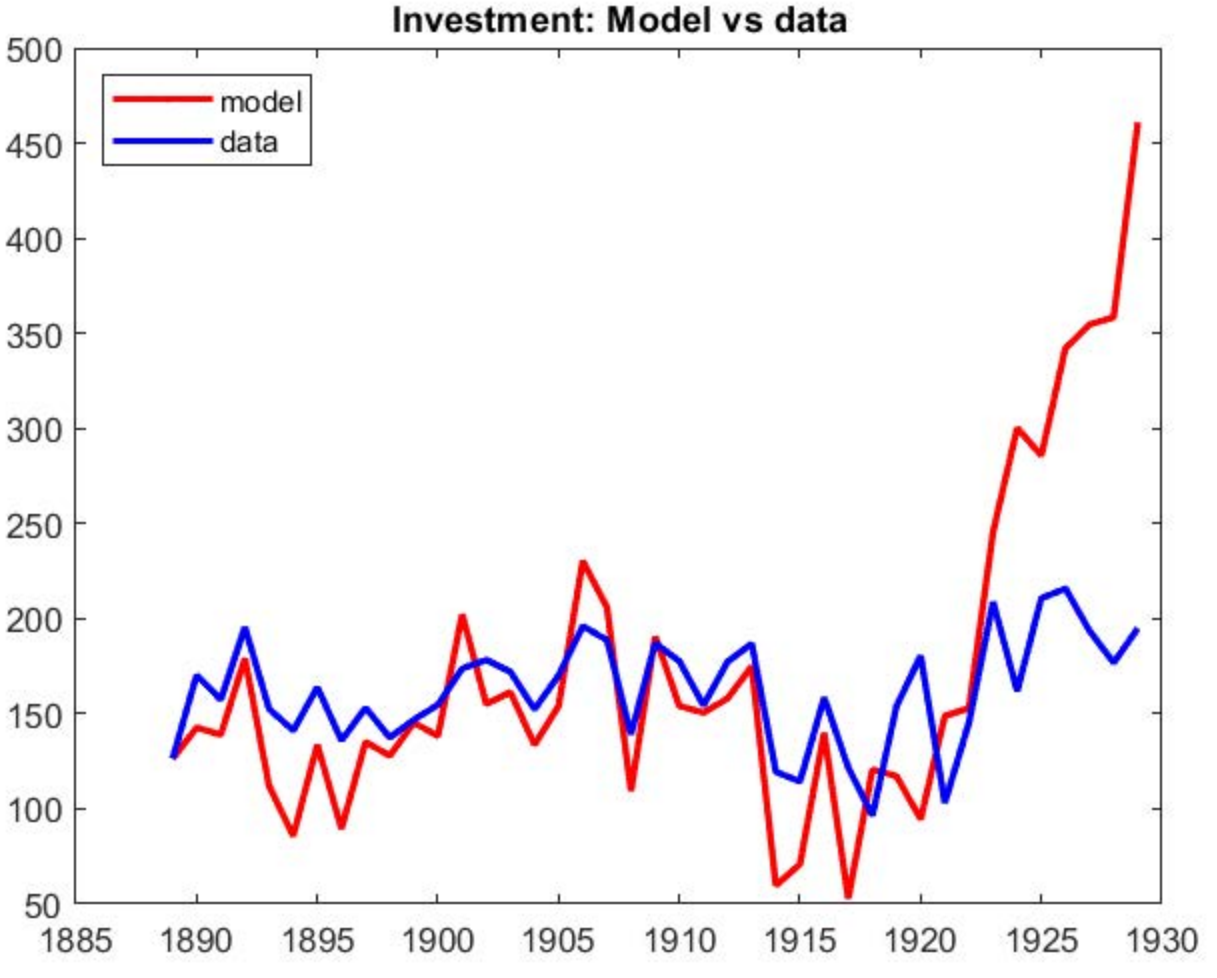
Investment: Model vs data
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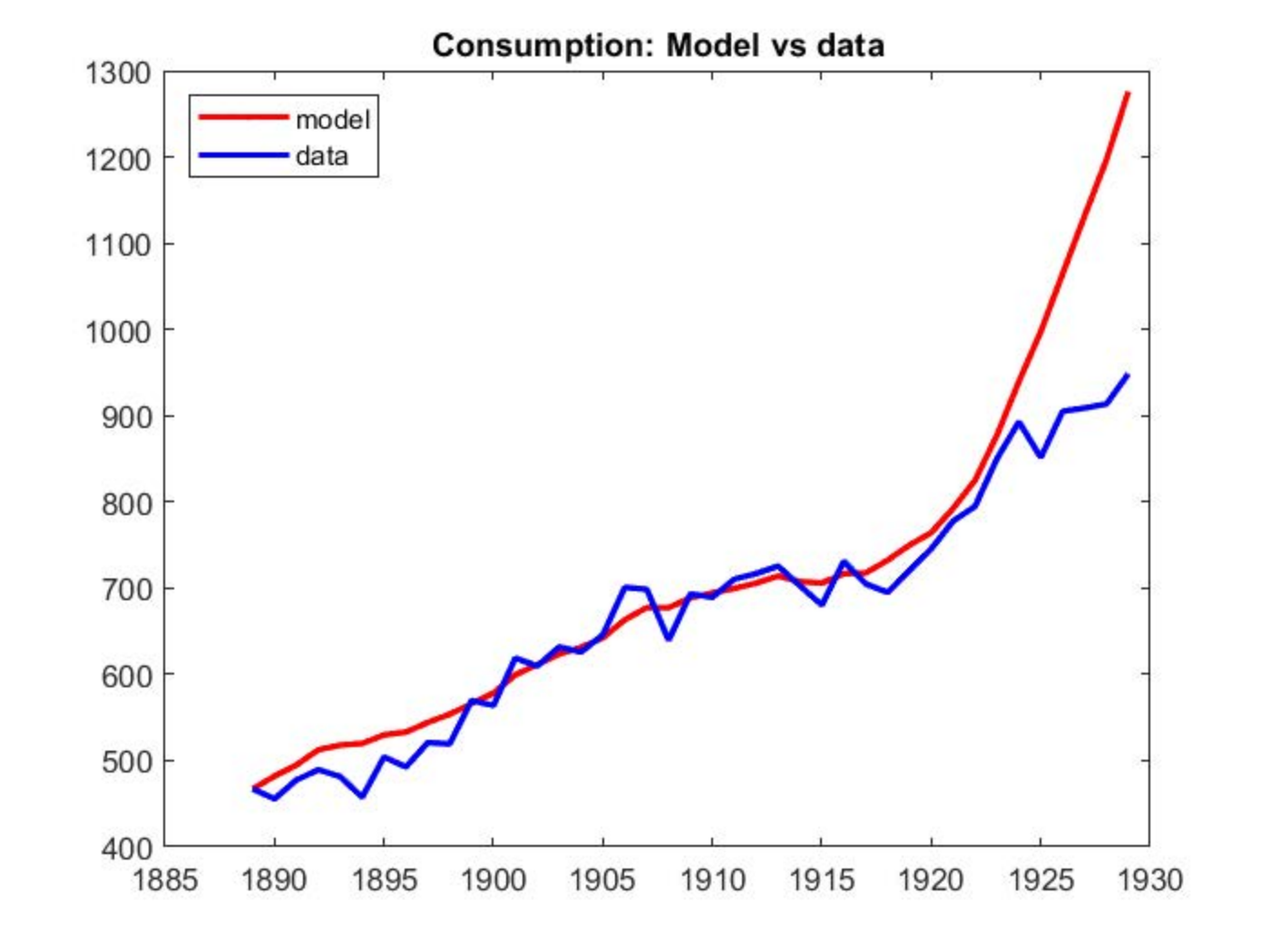
Consumption: Model vs data
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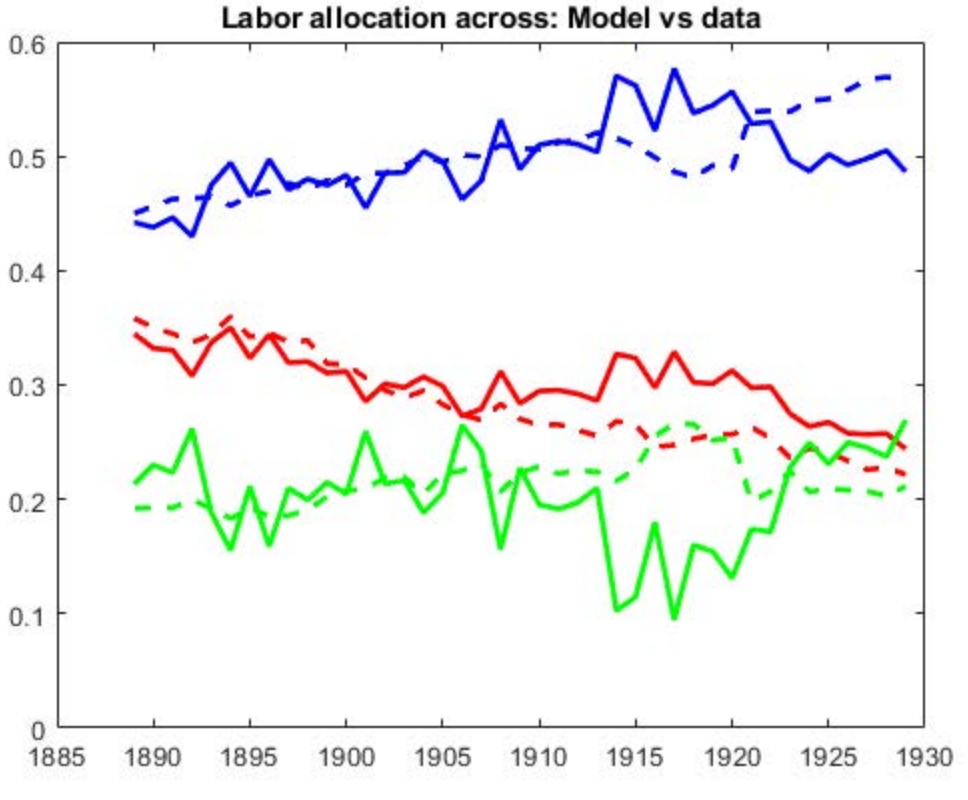
Labor allocation across: Model vs data
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Large Deviations from Standard Model Predictions

- (i) Quantities: Weak economic activity
  - Investment 60% below predicted level
  - Labor 20% below predicted level
- (iia) Prices: Real mfg wage rose 15% in 1920s, compared to 72% increase in mfg output per hour
- (iib) In contrast, real mfg wage rose 25% between 1900-1919, in 1920s, compared to 27% increase in mfg output per hour
- (iii) Income distribution: Large drop in labor share

Why Were Factor Inputs Depressed During Fastest Decade of US Productivity Growth?

- **Unlikely increase in market power or tax policies**
- ***"If monopolies were permitted, opportunity would be gone. The only remedy would be a revolution. We must have vigorous competition"*** **- Coolidge**
- ***"Too much competition is destructive, it wastes resources. A certain amount of industrial cooperation is in the nation's best interest."*** **- Hoover**
- **Hoover created industry associations that IO economists judged to have facilitate industry cartels**
- **1920s tax rates declined**
  - **Top rate fell from 73% to 25%**
  - **Average marginal rate dropped by about half**
  - **Corporate rate little changed, around 13%**

Labor-Saving Technological Change

- **Economic historians stress importance of electrification in manufacturing:**
- **Devine (1983), Jerome (1934), Lorant (1964), and Oshima (1984)**
- **(1) Continuous production methods, mass production techniques**
- **(2) New industry-specific capital equipment**

Capital-Biased Technological Change

- **Conceptually similar to *Capital-Skill Complementarity:* Rapid growth in capital-biased technological change and high substitution elasticity between capital and unskilled labor reduced demand for the unskilled labor**
- **Depressed labor & compensation in 1920s – real output per hour in mfg rose 70%, but real compensation rose 15%**
- **"Technological Unemployment" term coined in 1920s**
- ***"Electricity-Capital Complementarity"***

Electricity-Capital Complementarity

- **Idea: Electricity is complementary with capital, and is a substitute for labor**
- $y_t = \{\alpha(A_t k_t)^{\sigma} + (1-\alpha)(B_t h_t)^{\sigma}\}^{1/\sigma}$
- A_t, B_t **are capital-biased, labor-biased technologies, respectively**
- A_t **includes the impact of electrification**
- **Assess how factor demand conditions with reasonable parameter values match data**

Electricity-Capital Complementarity

- **Marginal products:**
- $F_h = \left(\frac{y}{h}\right)^{1-\sigma} (1-\alpha)(Bh)^{\sigma}$
- $F_k = \left(\frac{y}{k}\right)^{1-\sigma} \alpha(Ak)^{\sigma}$
- **Manufacturing wages from detailed surveys by Conference Board (Beney (1936))**
- **Average mfg wage rose 15% 1929 vs. 1919**
- **Output per hour rose 72%**

Electricity-Capital Complementarity

- $\%\Delta F_h = (1-\sigma)\,\%\Delta\left(\frac{y}{h}\right) + \sigma\,(\%\Delta B + \%\Delta h)$
- **Plugging in 1929/1919 percent changes in Y/H, real manufacturing wages, hours worked:**
- $15\% = (1-\sigma)\,72\% + \sigma\,(\%\Delta B - 5\%)$
- **Assuming B did not decline, this implies:**
- $\sigma = \frac{5}{6}, \rightarrow$ k/h substitution elasticity $= 6$
- Much higher than estimates in literature (0.6-2)

Electricity-Capital Complementarity

- **Another challenge for electrification hypothesis: electrification was spreading throughout economy for decades**
- 1899-1919, electrification rose from 4% of plant power generation to 59%
- But, real mfg compensation and output per hour grew by same amount between 1899-1919

Changes in Firm Management & Organization

- **Creation of the *modern firm: m*ajor changes in how firms were managed & organized in 1920s**
- **Created large efficiency gains, with firms economizing on capital and labor inputs**
- **Alfred Chander: *The Visible Hand: The Managerial Revolution in American Business***
  - ***Decentralization of decision making to managers released time of executives***

"Person of Interest Number 2: Modern Firm" Changes in Firm Management & Organization

- **Frederick Taylor, *Scientific Principles of Management***
- **Taylor, was U.S.'s original "McKinsey & Company"**

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- **"The country is suffering great losses in efficiency"**
- **"The remedy is *systematic management*, not searching for an extraordinary manager"**

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- **"The country is suffering great losses in efficiency"**
- **"The remedy is *systematic management*, not searching for an extraordinary manager"**
- **"Improving efficiency will reduce resources needed to produce output"**

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- **"The country is suffering great losses in efficiency"**
- **"The remedy is *systematic management*, not searching for an extraordinary manager"**
- **"We must apply science & mathematics to replace the 'rules-of-thumb' that waste resources"**
- **Peter Drucker: "Taylor provided most powerful & lasting American contribution to Western thought since Federalist Papers"**

Neoclassical Production Assessment of 1920s

- ***Technological advances that:***
- **(1) Depress demand for labor and its compensation**
- **(2) Depress demand for capital**
- **(3) In a nutshell, businesses didn't want more factor inputs, despite enormous growth in $\frac{Y}{H}$ and $\frac{Y}{K}$**

Neoclassical Production Assessment of 1920s

- ***Modified technology:***
- **Add third input to production function that is a substitute for capital and labor**
- **Third input has limited scalability (I assume it is fixed for simplicity, and that it is intangible)**
- **Increase its specific efficiency to match change in manufacturing sectoral productivity during 1920s**

Modeling 'The Modern Firm'

- **Include a third (intangible) input in manufacturing**
- **Similar to *Organizational Capital* literature:**
- **Prescott & Visscher (1980, JPE), Hall (2001, AER), Atkeson & Kehoe (2005, JPE), McGrattan & Prescott (2005, ReStud)**
- **Key point of literature – most corporate value is not its physical capital, it is value of *intangible capital***

Modeling 'The Modern Firm'

- **Modify production technology in Manufacturing**
- $y_t = \left\{\mu E_t^{\sigma} + (1-\mu)\left(A_t K_t^{\alpha} H_t^{1-\alpha}\right)^{\sigma}\right\}^{1/\sigma}$
- **Third input, it is fixed, & is intangible**
- **It has specific efficiency E_t**
- **It has a KORV feel to it**
- **Treat payments accruing as capital income**

Modeling 'The Modern Firm'

- **Modify production technology in Manufacturing**
- $Y_{M_t} = \left\{ \mu E_t^{\sigma} + (1-\mu)\left(A_t K_{Mt}^{\alpha} H_{Mt}^{1-\alpha}\right)^{\sigma} \right\}^{1/\sigma}$
- **Exogenous efficiency, E_t, grows over time, similar to Atkeson-Kehoe (2005)**
- **Similar to McGrattan-Prescott but they restrict to Cobb-Douglas & unlimited accumulation of 3rd input**

'The Modern Firm' Experiments

- $Y_{M_t} = \left\{\mu E_t{}^{\sigma} + (1-\mu)\left(A_t K_{Mt}^{\alpha} H_{Mt}^{1-\alpha}\right)^{\sigma}\right\}^{1/\sigma}$
- **We want a labor and capital saving technology, so specify substitution elasticity $\left(\frac{1}{1-\sigma}\right)$ bigger than 1**

'The Modern Firm' Experiments

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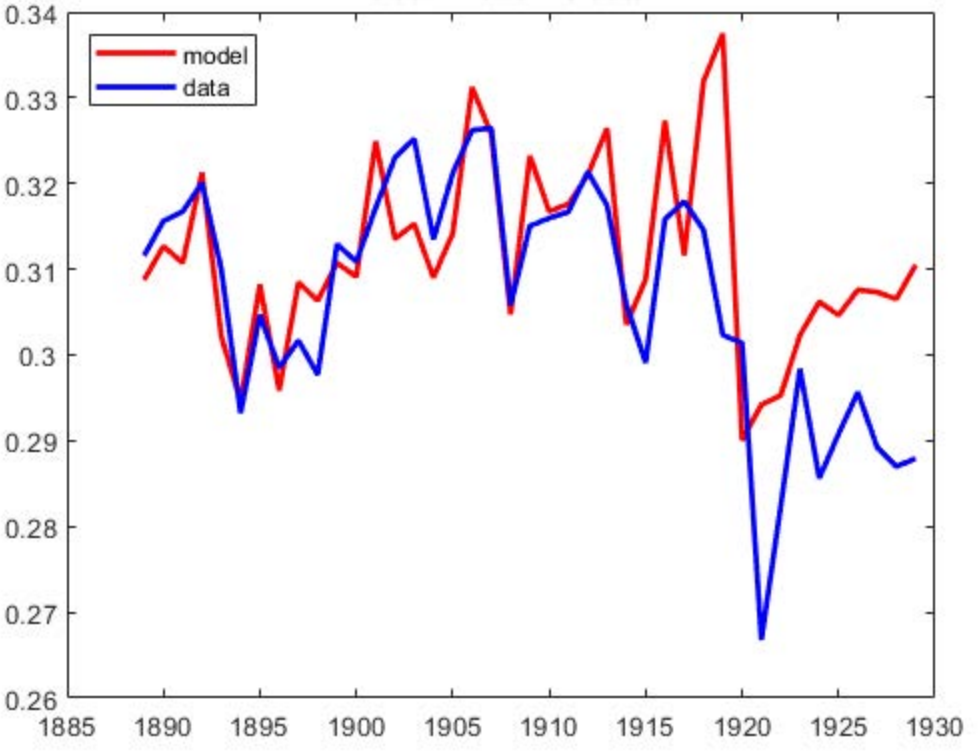
- **1889-1919: *"Old School Firm"***
  - **Parameter μ small, & growth rate of E_t same as long-run growth of X_t**

'The Modern Firm' Experiments

- $Y_{M_t} = \left\{\mu E_t^{\sigma} + (1-\mu)\left(A_t K_{Mt}^{\alpha} H_{Mt}^{1-\alpha}\right)^{\sigma}\right\}^{1/\sigma}$
- **We want a labor and capital saving technology, so specify substitution elasticity $\left(\frac{1}{1-\sigma}\right)$ bigger than 1**
- **1889-1919: *"Old School Firm"***
  - **Parameter μ small, & growth rate of E_t same as long-run growth of X_t**
- **1920-1929: *"Modern Firm"***
  - **Parameter μ & growth rate of E_t rise in 1920-1929**

'The Modern Firm' Experiments

- $Y_{M_t} = \left\{\mu {E_t}^{\sigma} + (1-\mu)\left(A_t K_{Mt}^{\alpha} H_{Mt}^{1-\alpha}\right)^{\sigma}\right\}^{1/\sigma}$
- **Experiment with 2 different substitution elasticities, 2 and 5**
- **Experiment with two different pairs of μ**
- $\mu = .05$**, then rises to** $.15$ **in 1919**
- $\mu = .02$**, then rises to** $.20$ **in 1919**
- **For both elasticities, and for both values of μ experiments, model predictions are closer to data**


Labor: Model vs data
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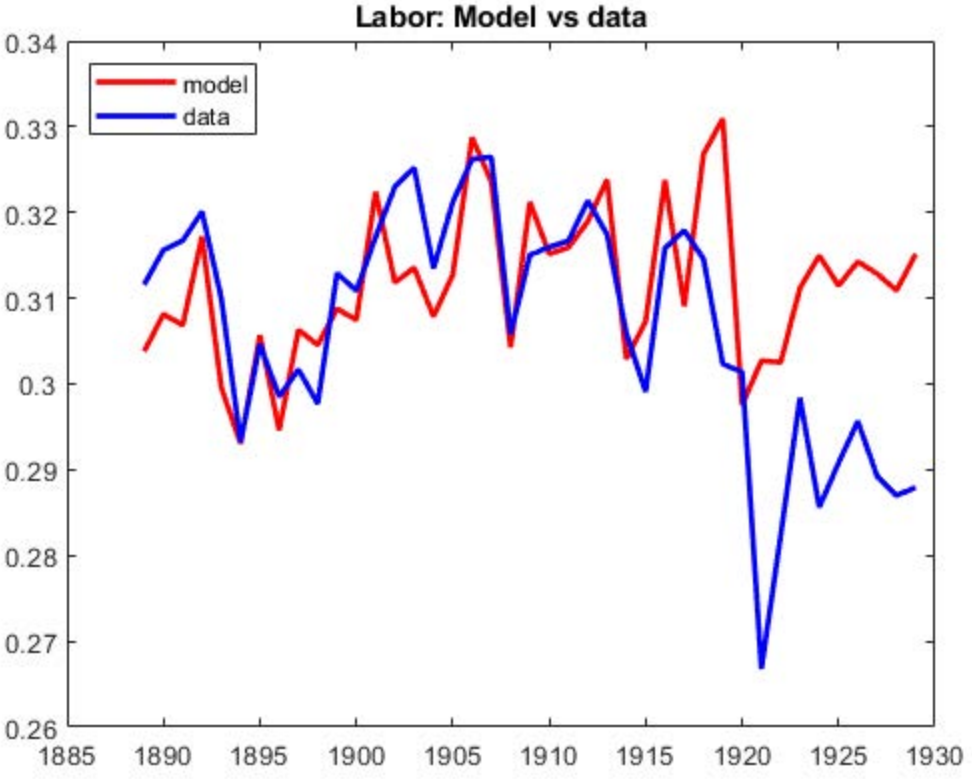
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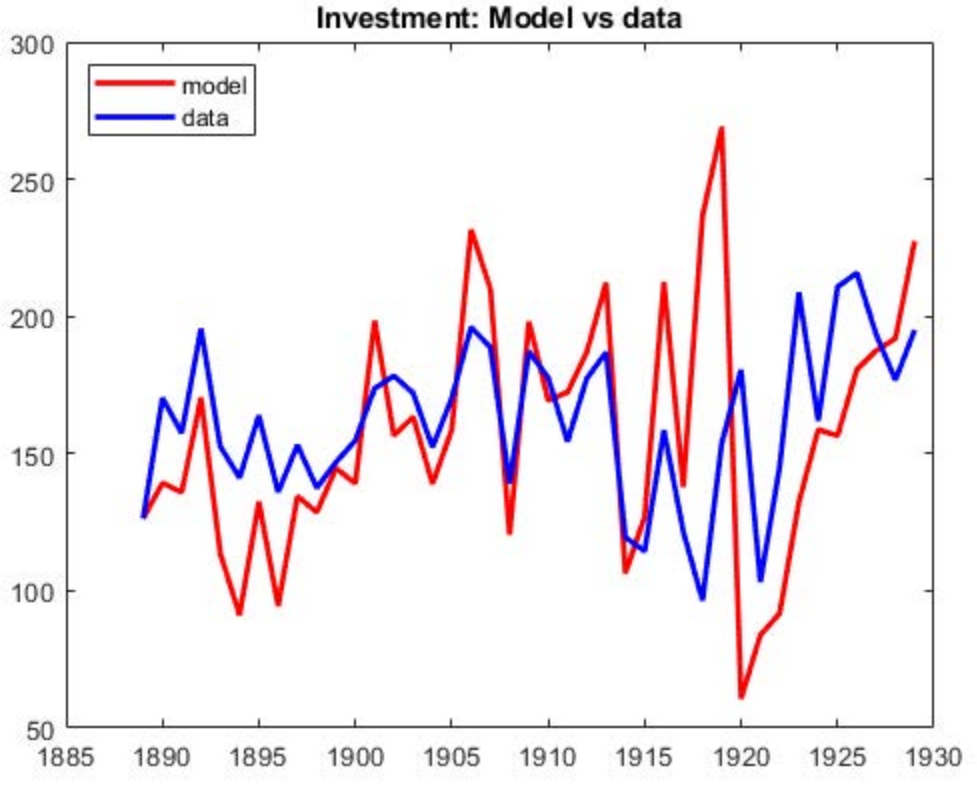
Investment: Model vs data
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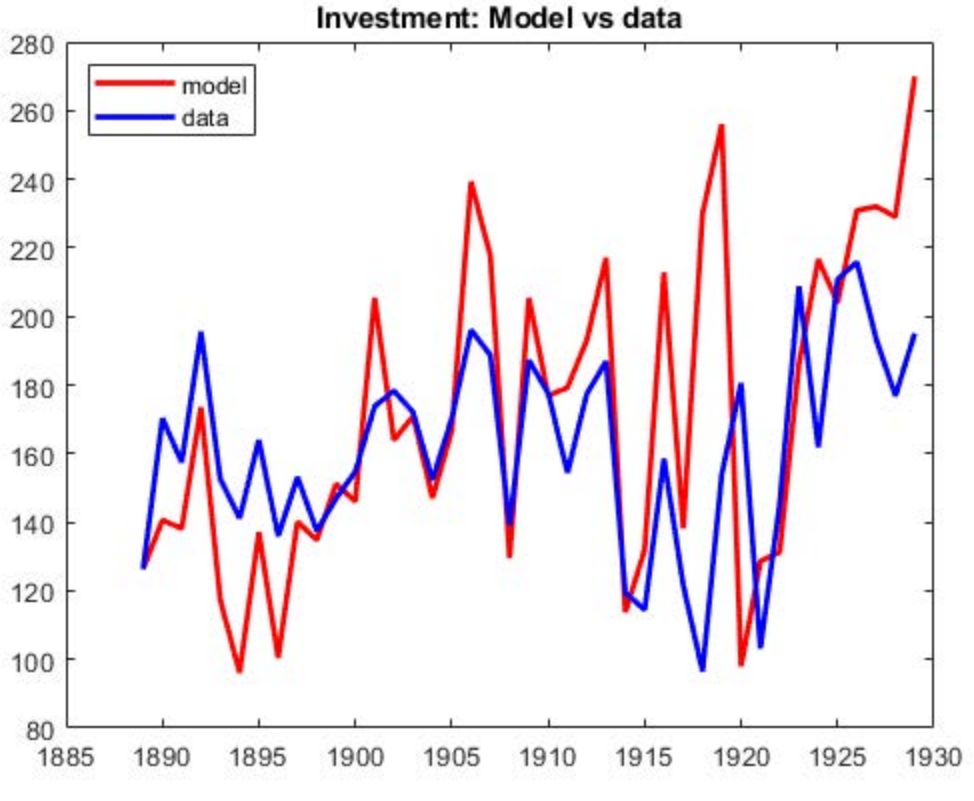
Investment: Model vs data
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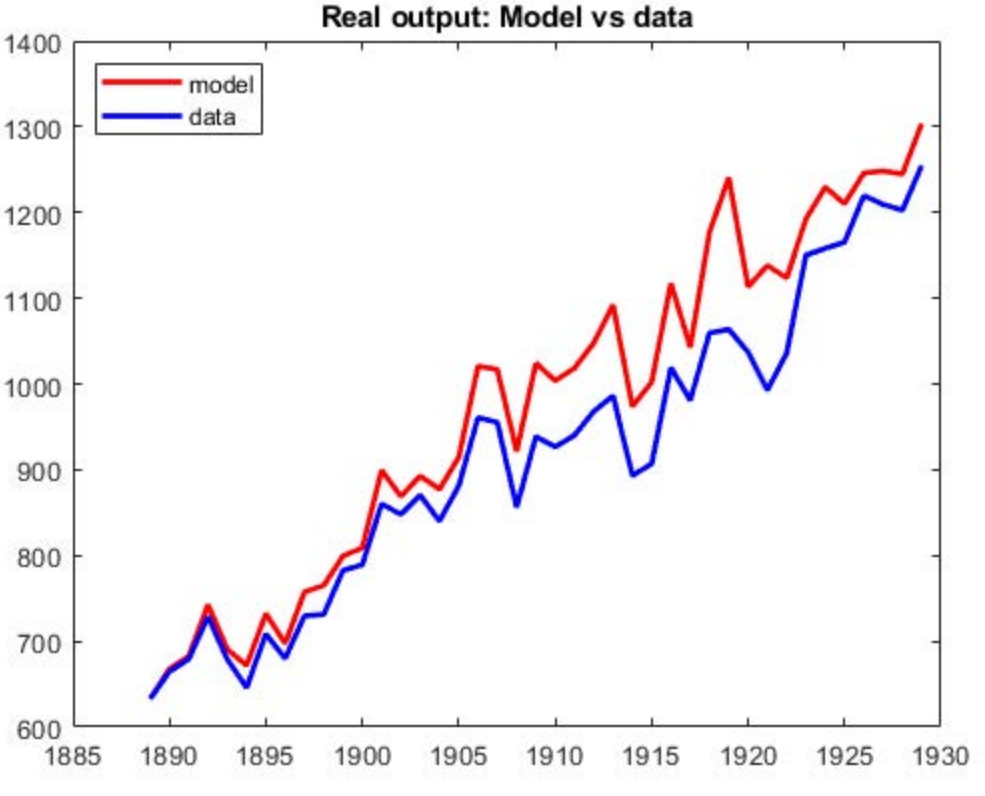
Real output: Model vs data
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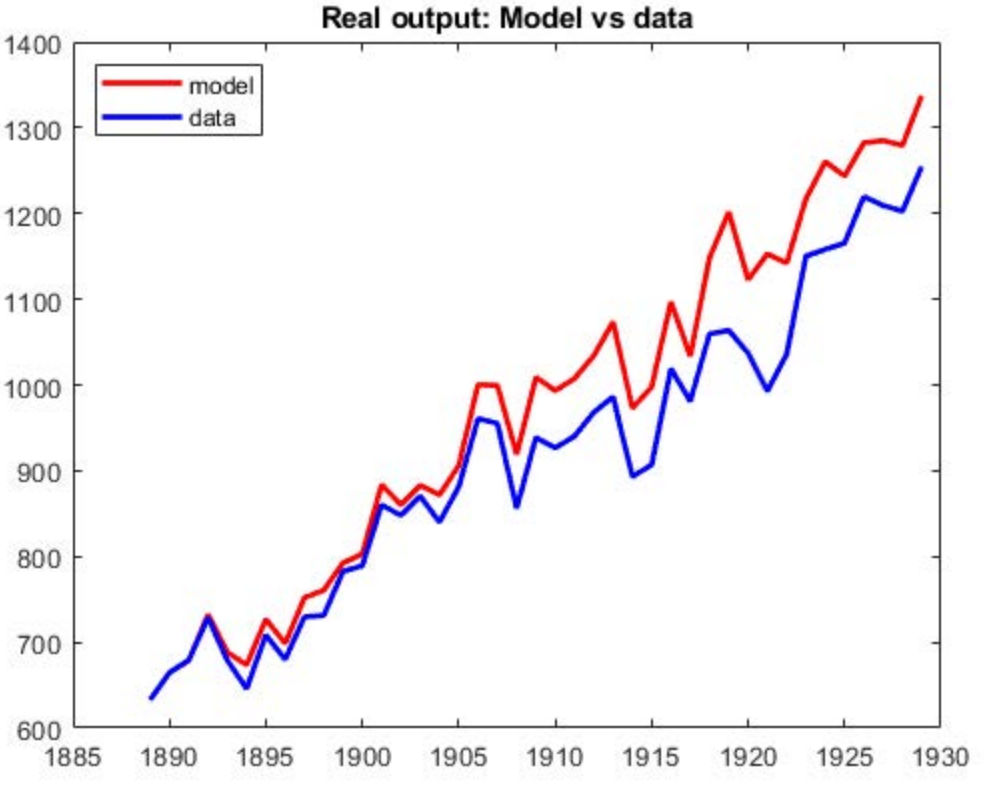
Real output: Model vs data
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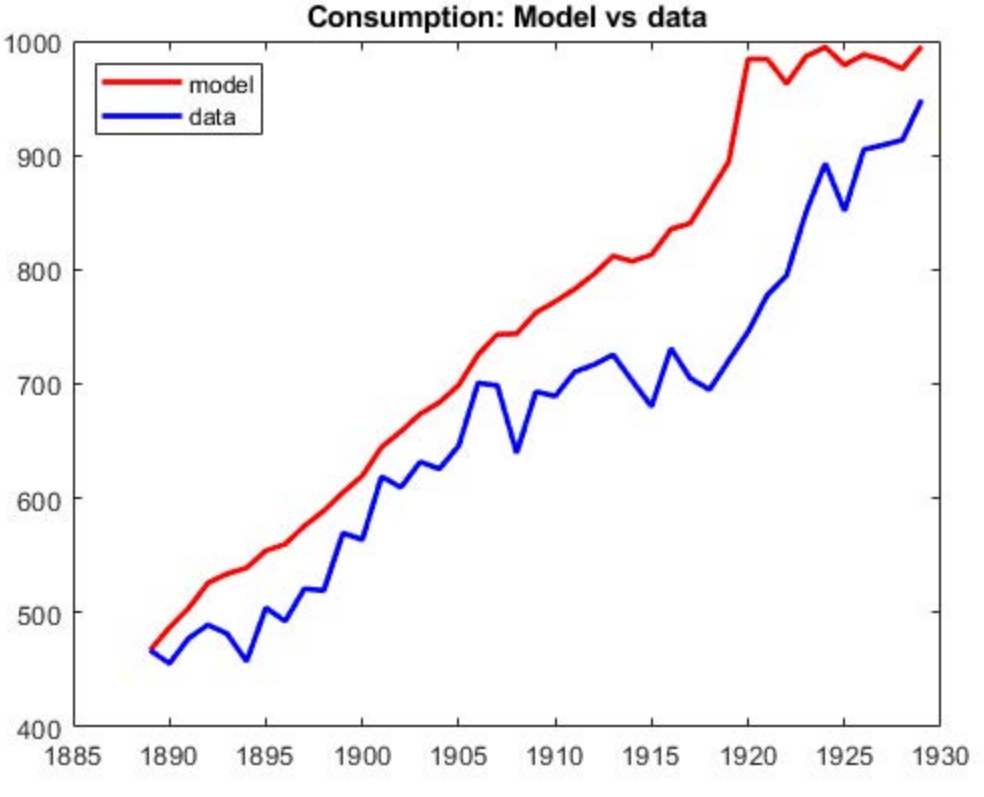
Consumption: Model vs data
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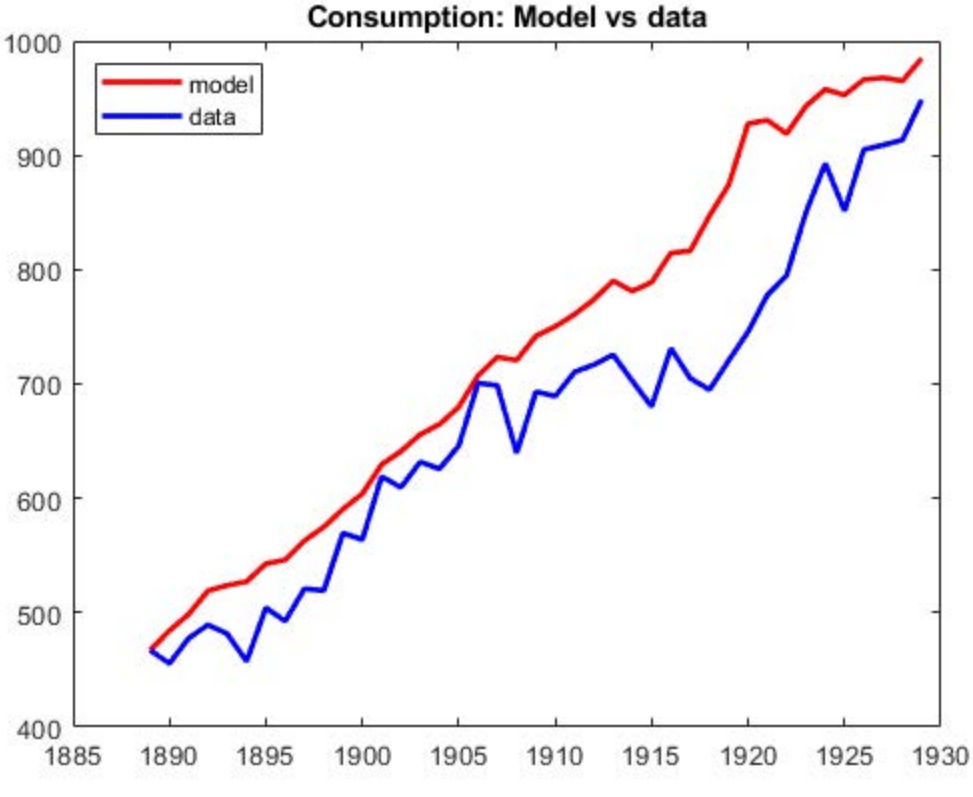
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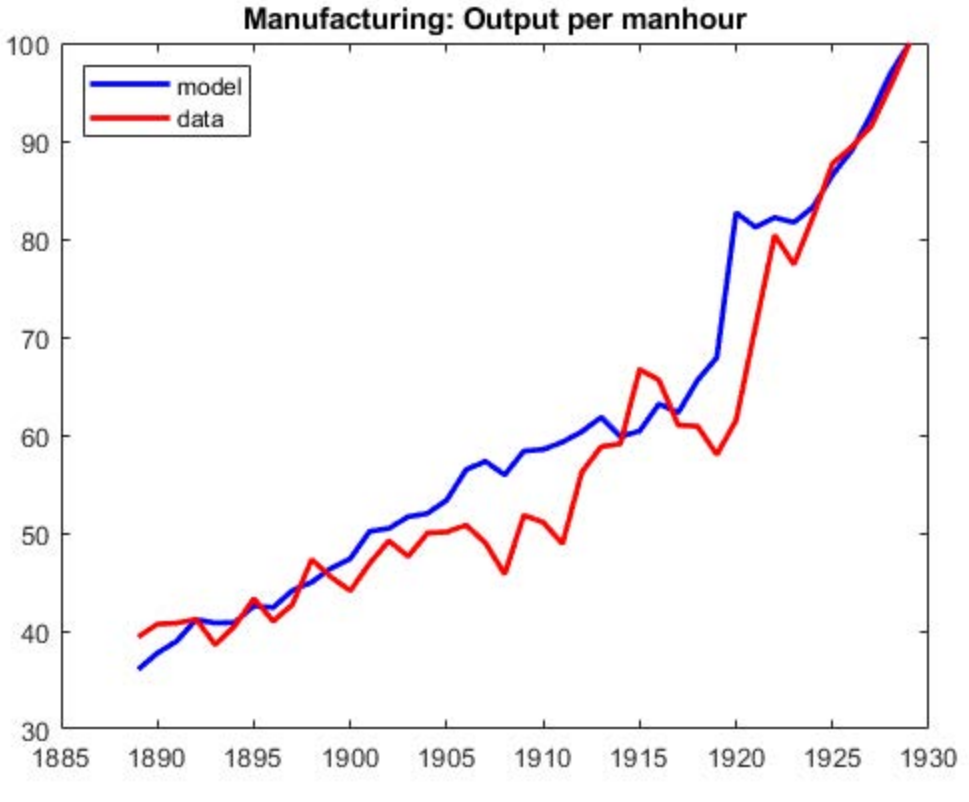
Manufacturing: Output per manhour
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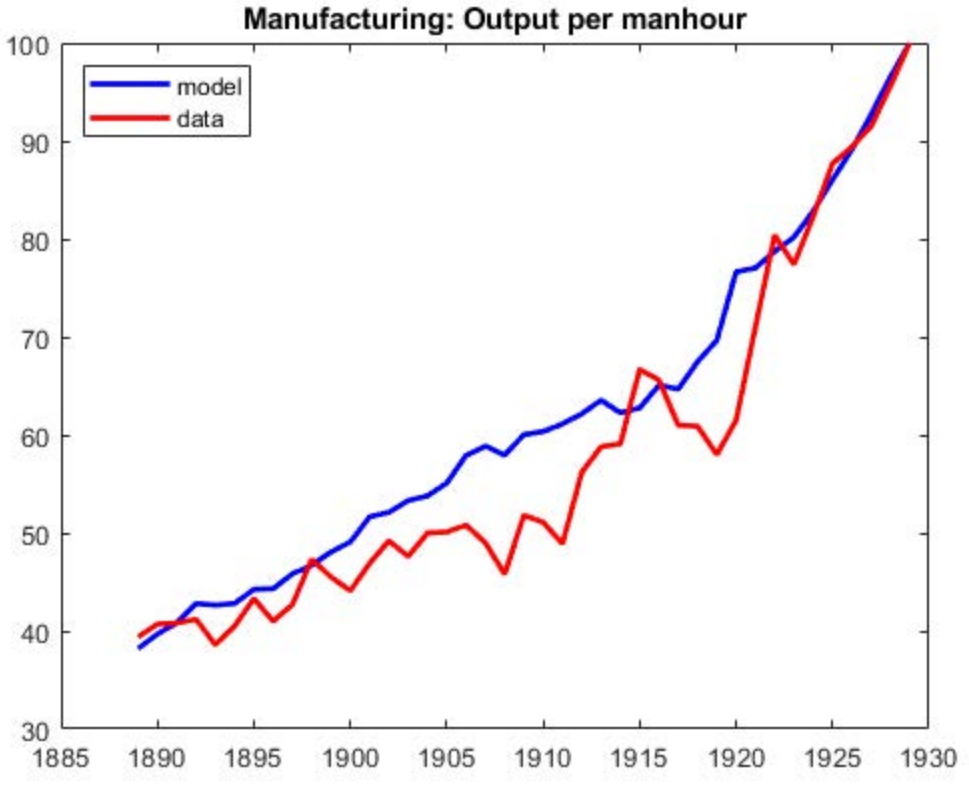
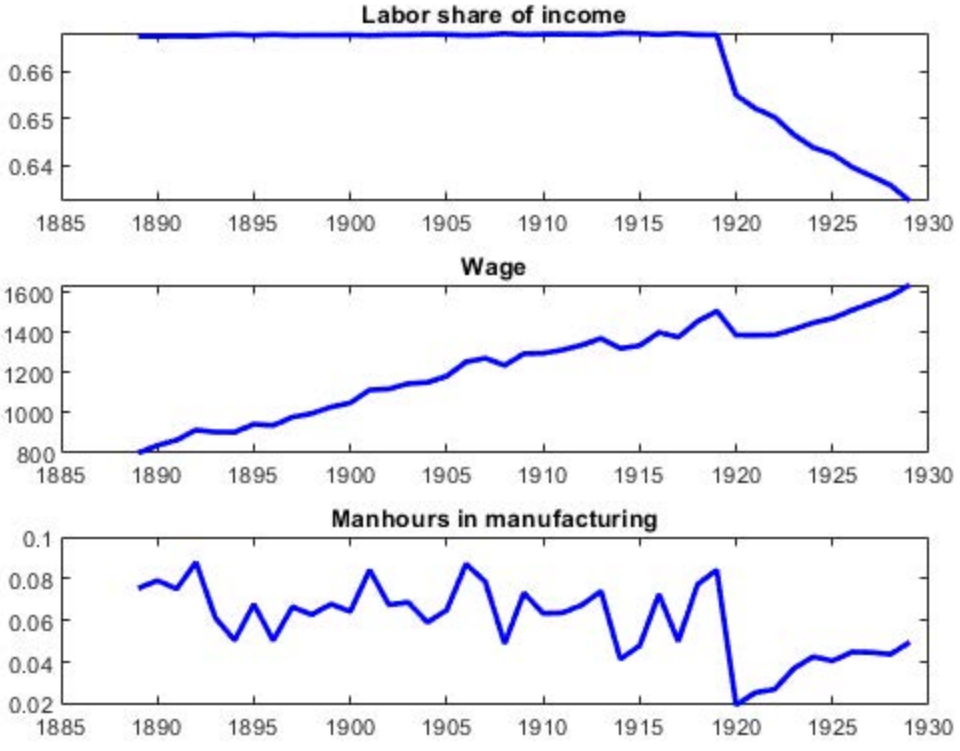
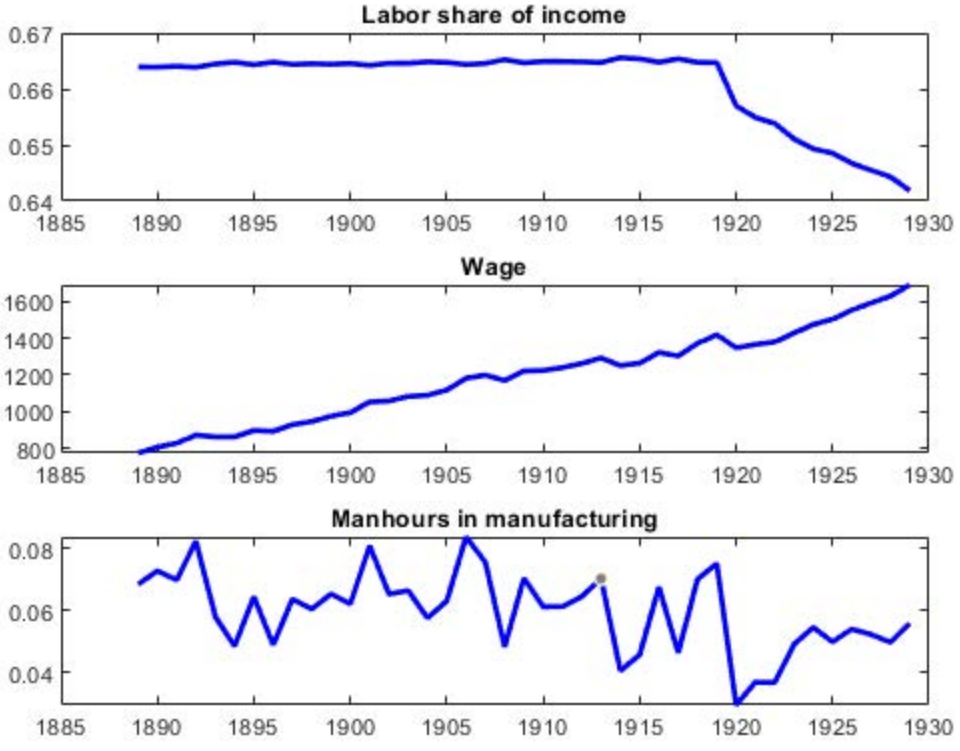
1930


Manufacturing: Output per manhour
model
data
100
90
80
70
60
50
40
30
1885
1890
1895
1900
1905
1910
1915
1920
1925
1930


Labor share of income
0.66
0.65
0.64
1885
1890
1895
1900
1905
1910
1915
1920
1925
1930
Wage
1600
1400
1200
1000
800
1885
1890
1895
1900
1905
1910
1915
1920
1925
1930
Manhours in manufacturing
0.1
0.08
0.06
0.04
0.02
1885
1890
1895
1900
1905
1910
1915
1920
1925
1930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Measuring the Impact of the Modern Firm

- $Y_{M_t} = \left\{\mu {E_t}^{\sigma} + (1-\mu)\left(A_t K_{Mt}^{\alpha} H_{Mt}^{1-\alpha}\right)^{\sigma}\right\}^{1/\sigma}$
- **Hall (2001) and McGrattan-Prescott (2005) use stock market valuation to infer the importance of μE_t**
- **Rising stock values indicate greater importance of intangibles**
- **Stock values increased 500% in 1920s (22% per year)**

What This Could Mean for Great Depression

- **This change in technology depresses demand for factor inputs**
- **Implies that the impact of Hoover's nominal wage fixing program will have larger effects than in a standard technology**
- **How much larger? About three times larger.**

Conclusions

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- **1920s Low wage growth and drop in labor’s share provide explanation for why Hoover implemented policies raising wages and work-sharing**

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- **Reconciling 1920s anomalies requires reducing mfg demand for both capital & labor**
- **Simple model of intangible input whose importance grows at time of "modern firm" is promising direction**
- **To do list:**
  - **Analyze how Hoover program - above-market wages and work sharing – impact economy with the 3-input technology**
  - **Use stock values to quantify importance of intangibles in 1920s**