ECON 3330 - U.S. Economic History

Industrial Transition

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Some unsolicited advice...

...on things I wish I had known as a 2nd/3rd year graduate student.

Go to conferences, workshops, and seminars

- as early as possible
- but def in the year before the job market

In my pre-job market year, I went to 14 conferences and workshops.

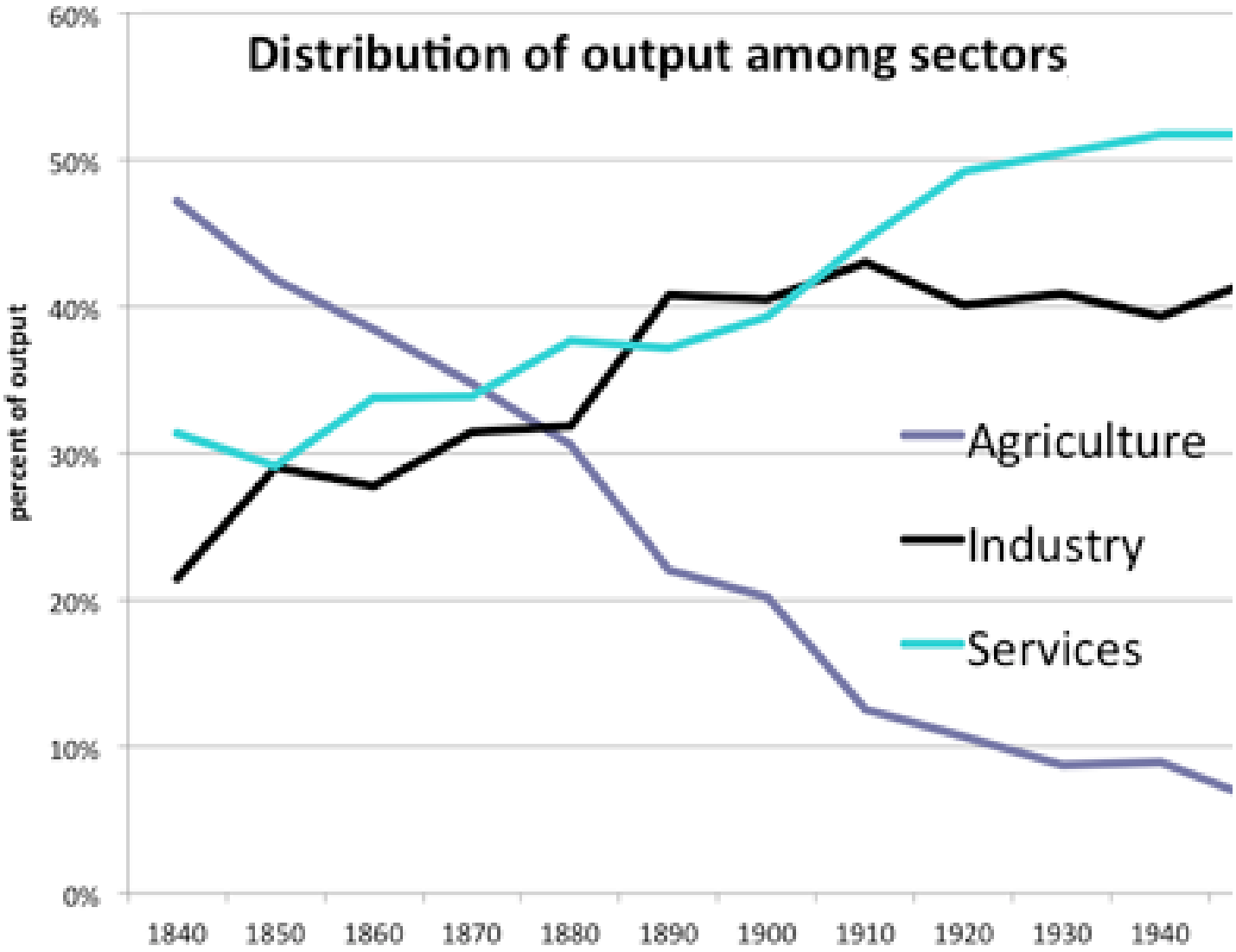
- 15 interviews
- in 9 of them I knew someone in the room
- 6 flyouts
- 5 of those from the set of those 9 interviews

Good research is a sufficient but not necessary condition. You also need to market your work and yourself!

Outline

- industrialization and its prerequisites
  - transport revolution
  - technology and processes
  - energy
- labor during the industrial transition
  - the Waltham and Rhode Island Systems
  - women, agriculture, and the north
- Methods: what if you don't have a perfect natural experiment
  - coefficient stability tests
  - selection on unobservables (Oster, 2019)

Output shares by sector and time



Source: Gallmann and Weiss (1969)

Production in the early 19th century

Quick recap:

- low population density
  - small and unintegrated markets
- firms are
  - small, usually family businesses
  - local monopolies
  - artisans
  - unincorporated
- rudimentary factories existed

In 1850, only 5 cities had a total manufacturing workforce of over 5,000

Transportation

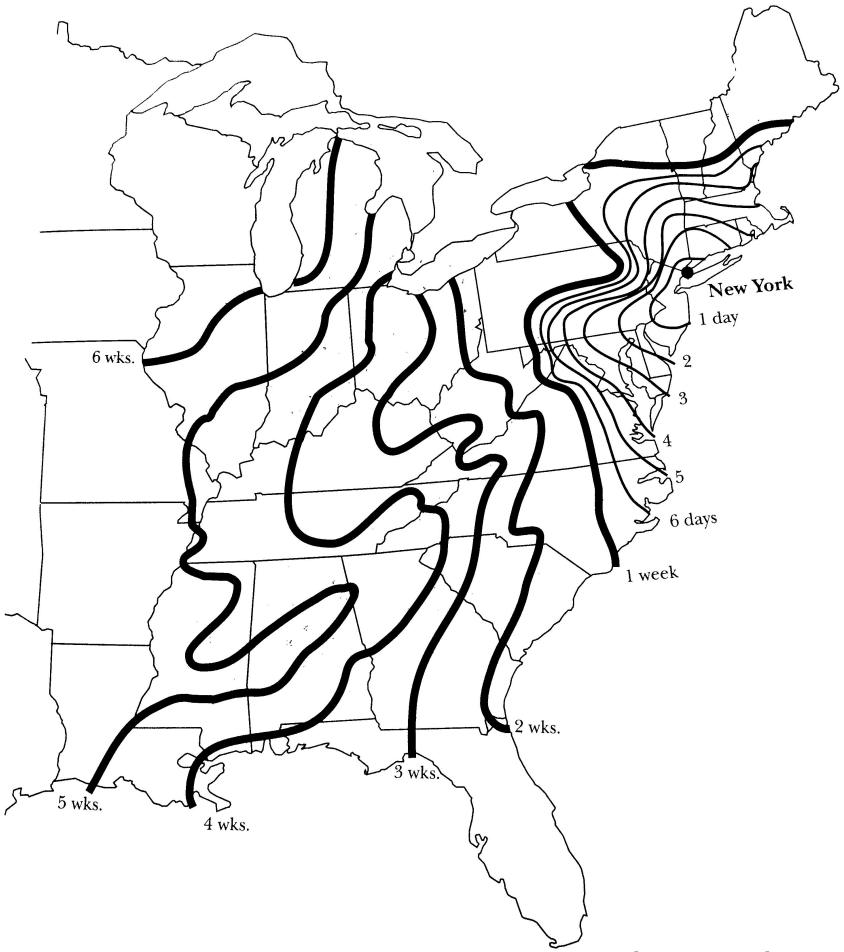
Transportation is important because

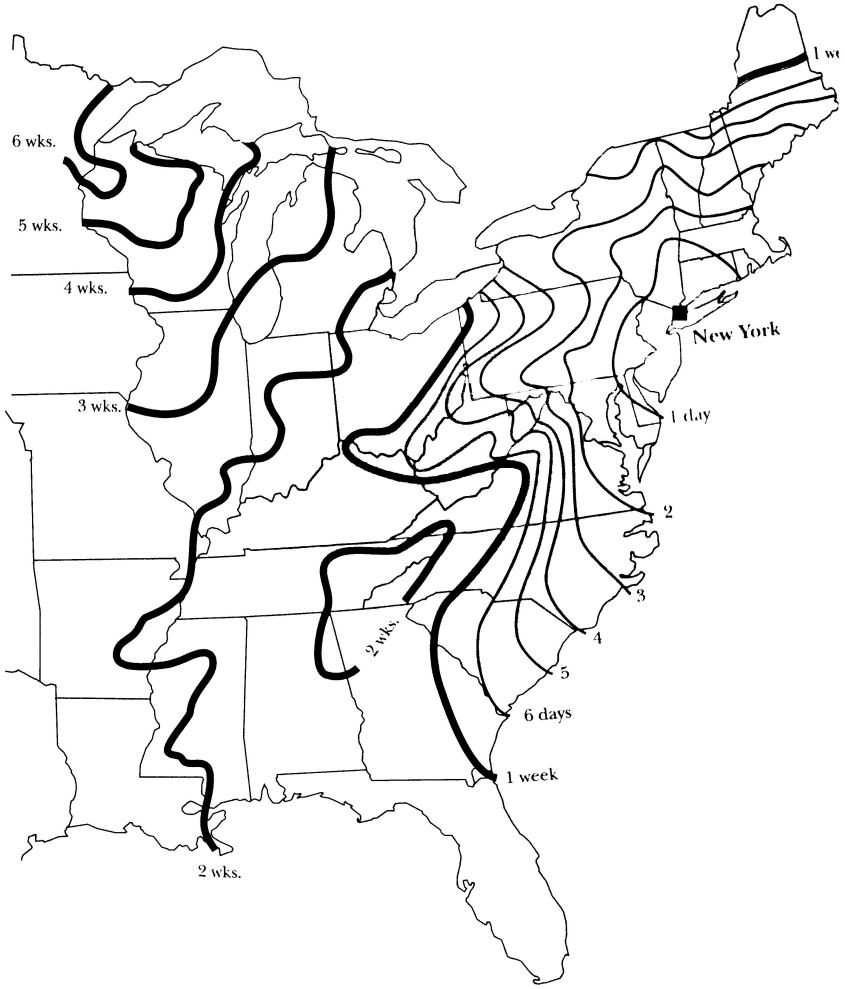
- it moves
  - goods
  - people
  - information
- more demand in the same location
- more competition

Incentives for up-scaling, specialization, and continuous production.

Travel Times in 1800 and 1830

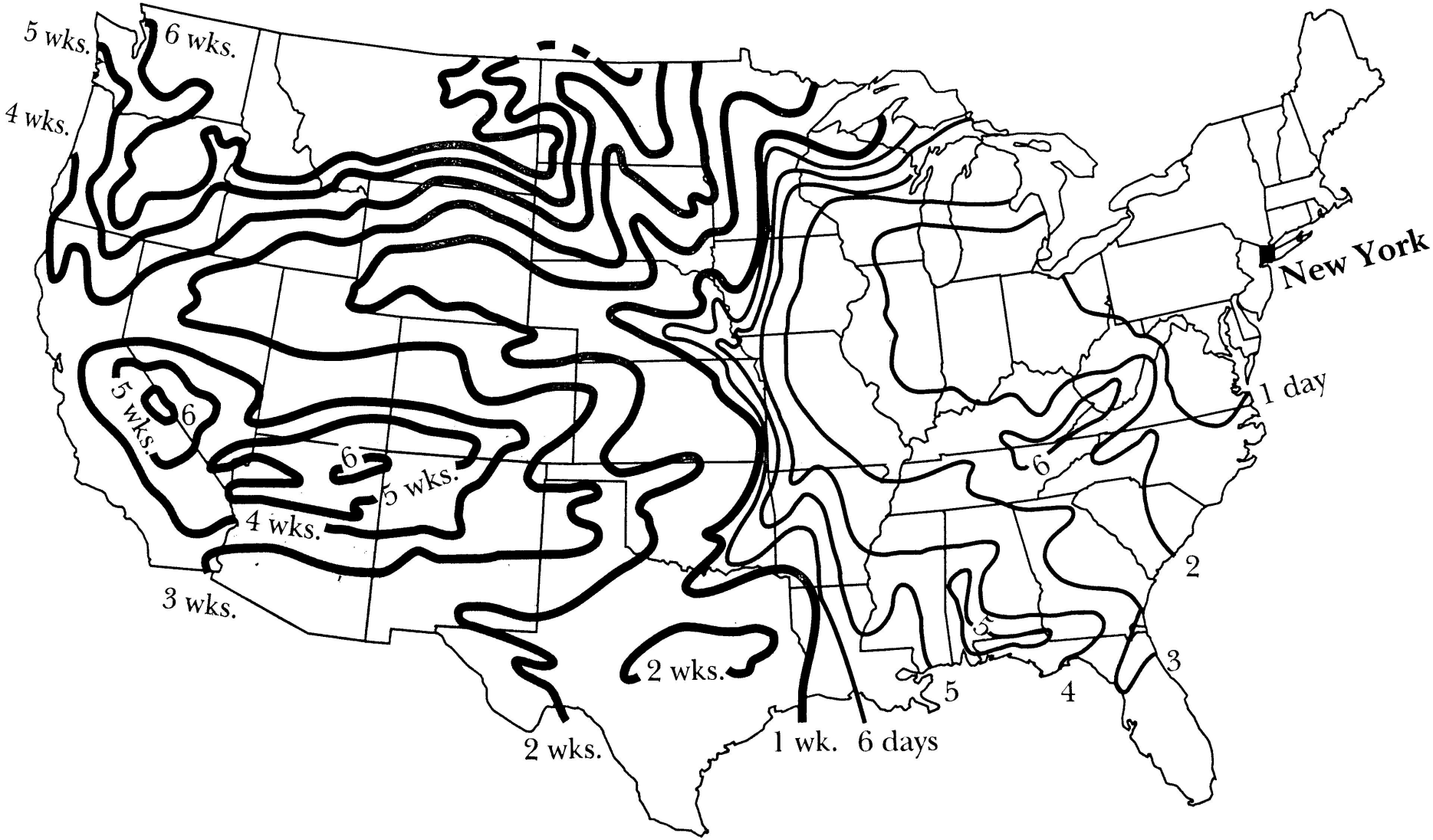
In 1800 (left) and 1830 (right):





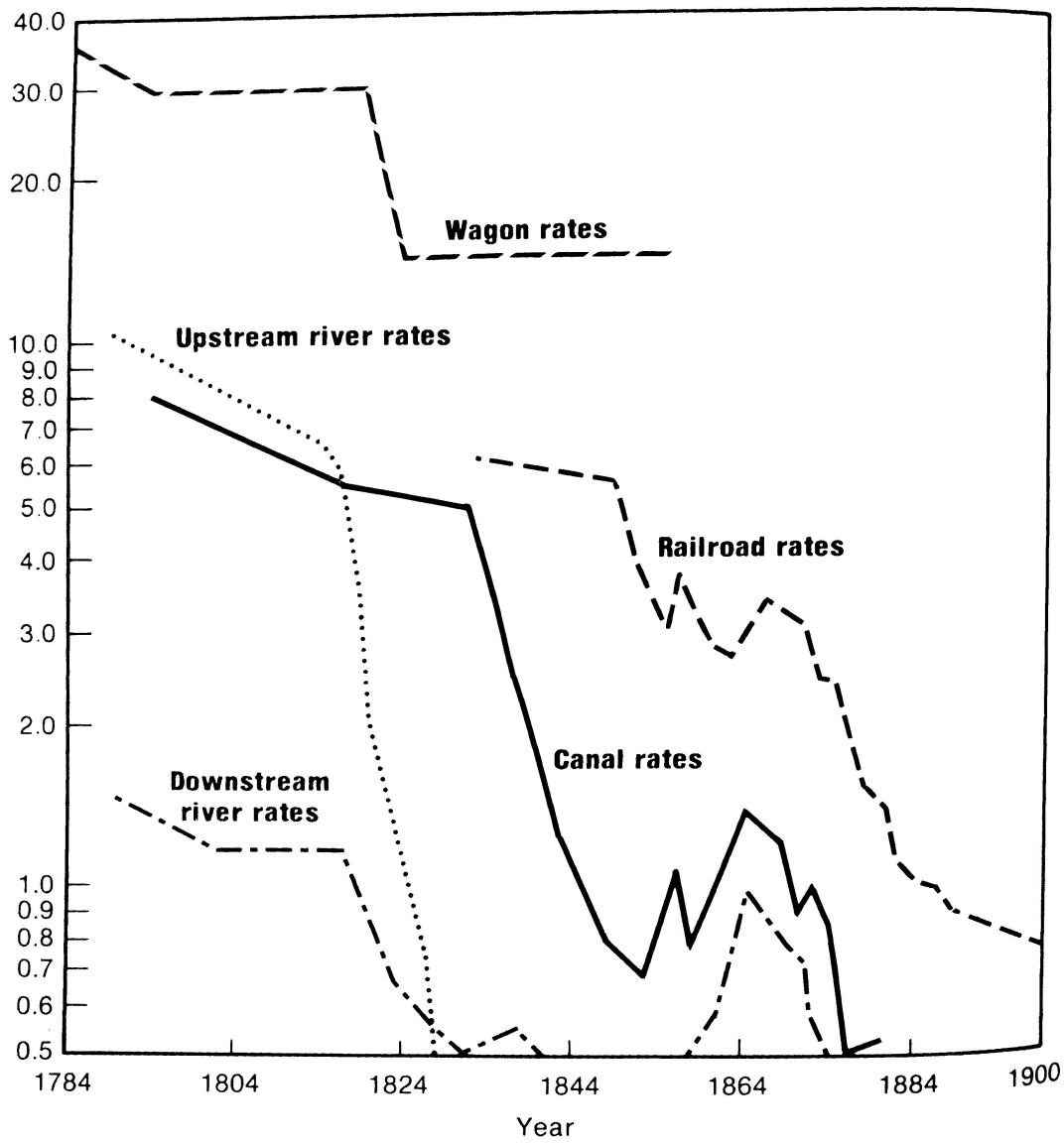
Source: Atack and Passell (1994)

Travel Times in 1857



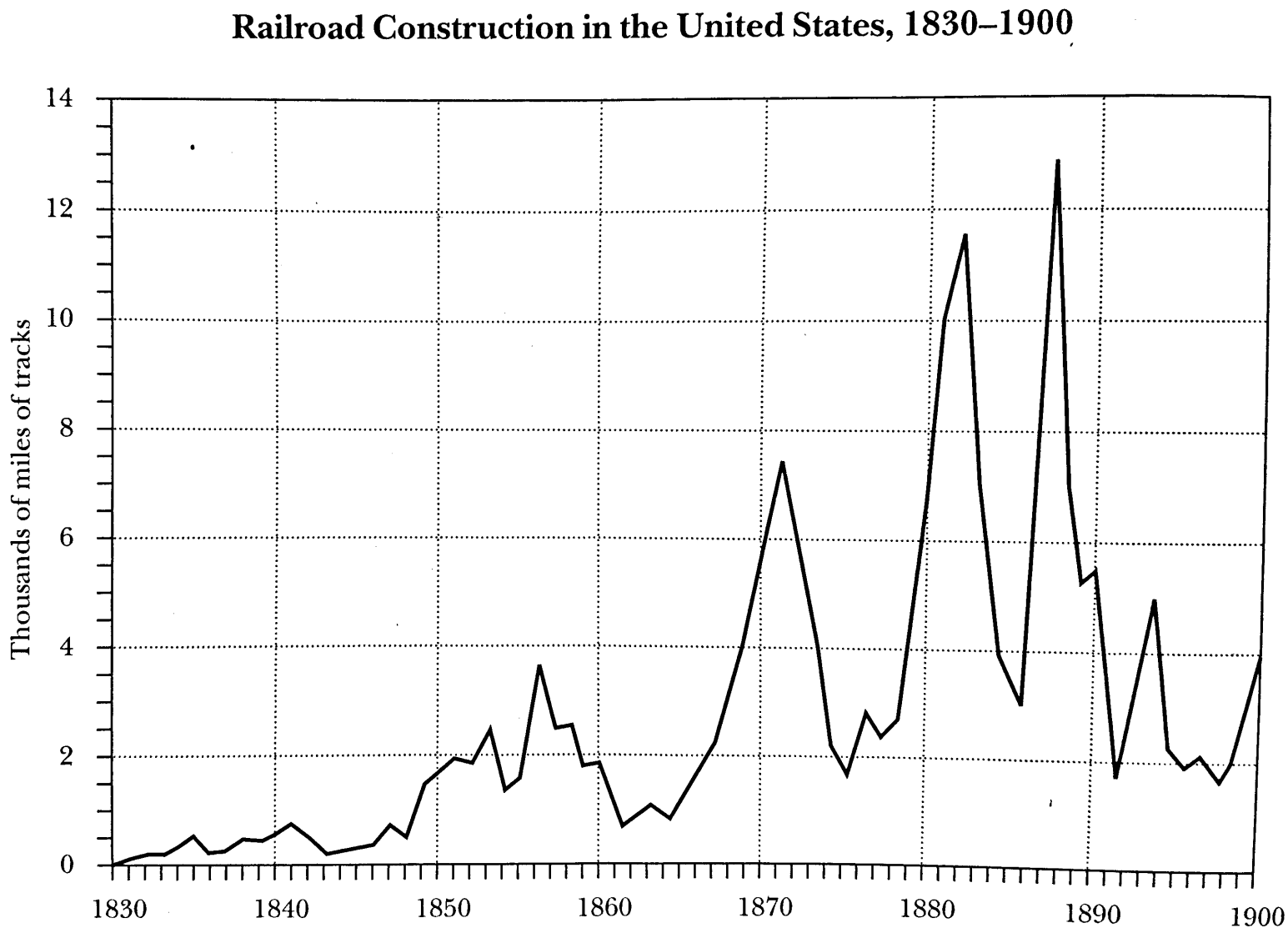
Source: Atack and Passell (1994)

Inland Freight Rates (Cents Per Ton Mile) 1784-1900



Source: Walton and Rockoff (2011)

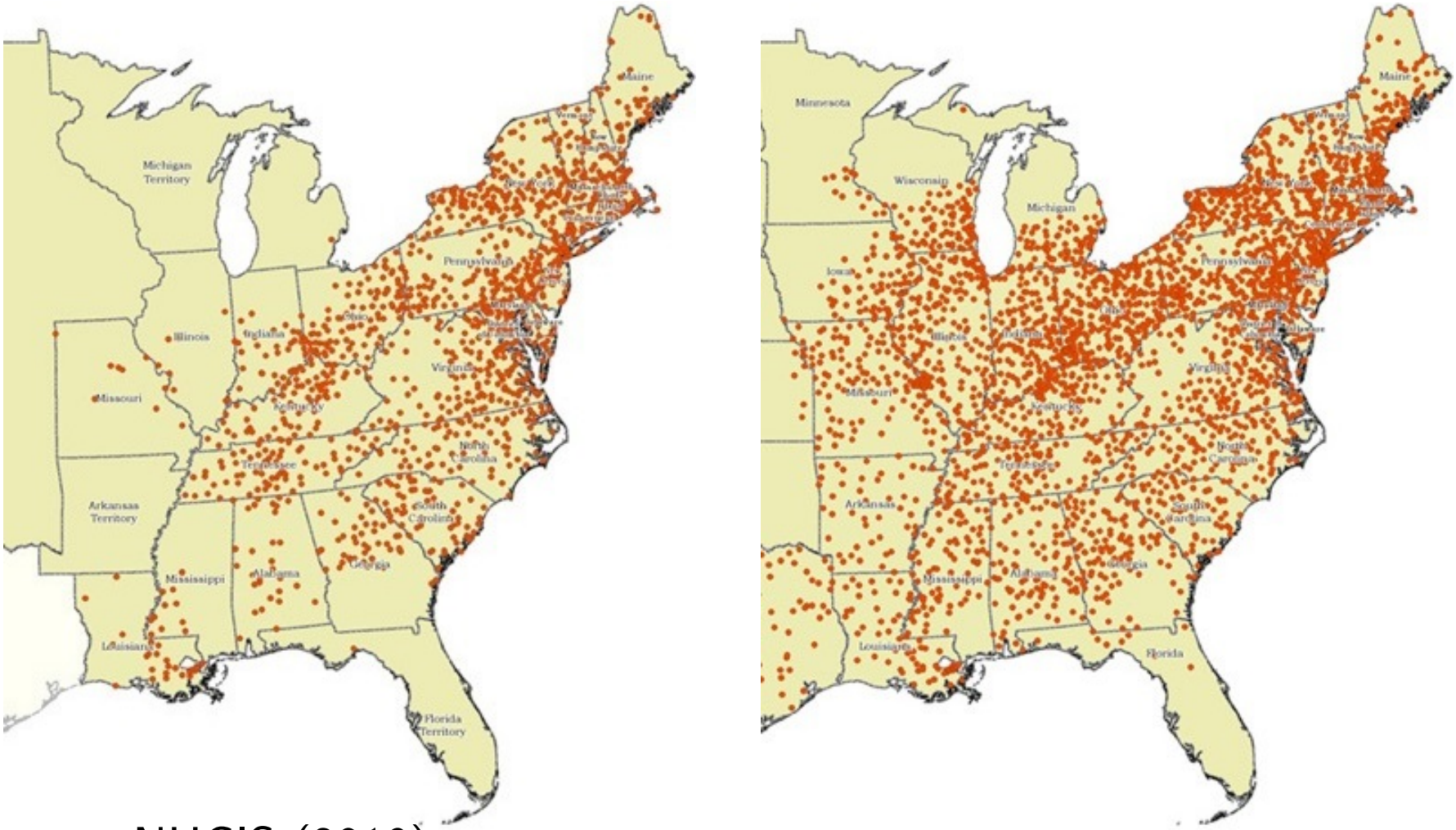
New Railroad Construction



Source: Atack and Passell (1994)

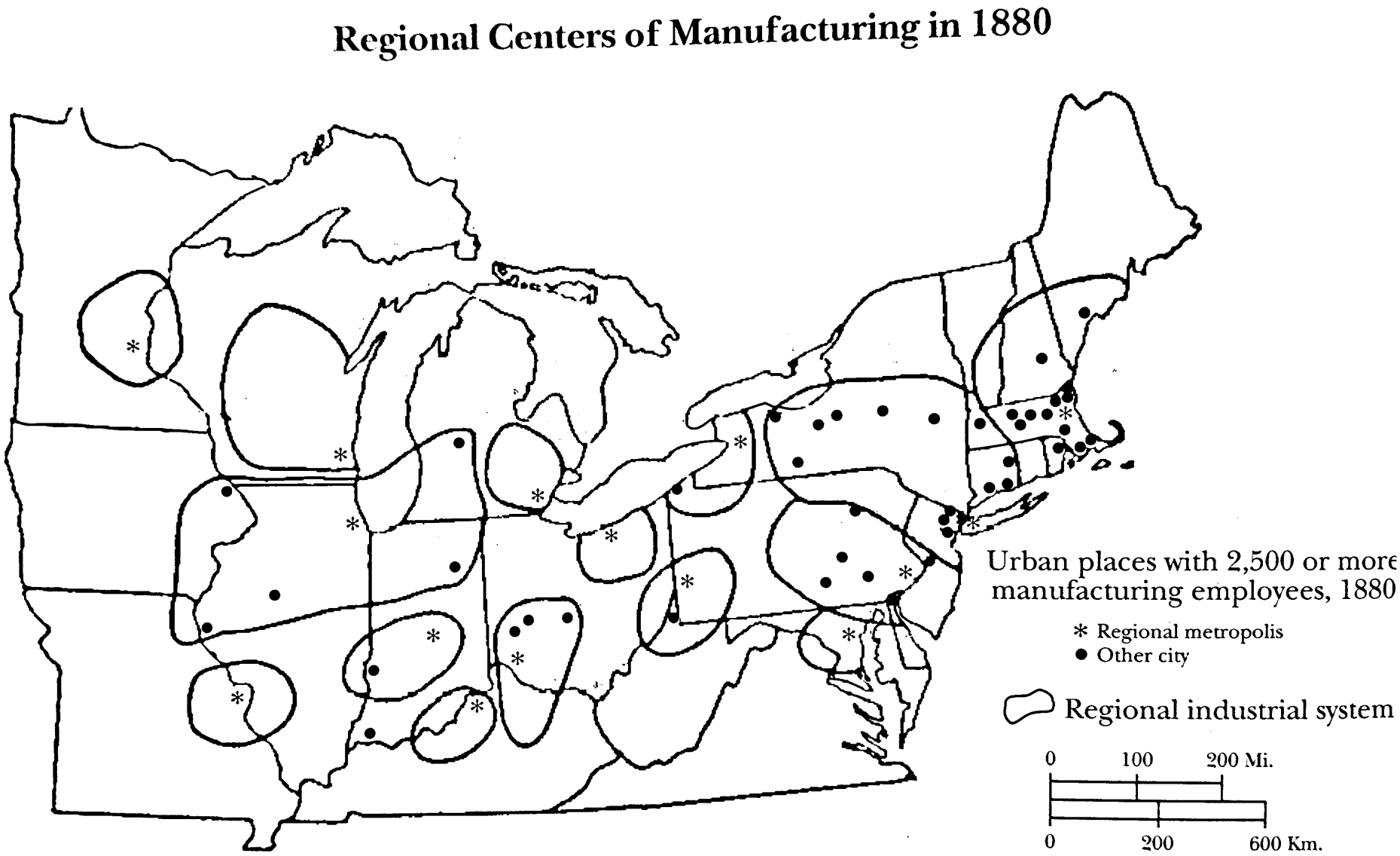
Population Density in 1830 and 1860

In 1830 (left) and 1860 (right):



Source: NHGIS (2019)

Regional Manufacturing Clusters



Source: Atack and Passell (1994)

% Value Added by Industry and Production Method

Industry	Artisan Shops 1850	Artisan Shops 1870	Other Nonmechanized 1850	Other Nonmechanized 1870	Mills 1850	Mills 1870	Factories 1850	Factories 1870
Boots and shoes	39	33	61	45	0	4	0	19
Brewing	41	21	24	0	35	49	0	30
Clothing	13	16	87	66	0	0	0	18
Cotton goods	0	0	4	3	16	1	79	96
Flour milling	7	5	0	0	91	95	2	0
Furniture	50	18	20	14	10	26	19	41
Iron	0	0	33	1	22	10	44	89
Leather	54	20	16	7	26	29	4	43
Liquor	9	4	18	4	73	82	0	10
Lumber milling	3	1	1	2	88	63	8	34
Meat-packing	34	31	29	0	11	69	25	0
Saddlery	62	71	38	28	0	1	0	0
Sheet metal	89	41	6	33	5	2	0	24
Tobacco	24	30	76	68	0	2	0	0
Wagon and carriages	32	33	63	47	3	3	3	18
Woolen goods	0	4	1	12	39	7	60	77

Source: Atack and Passell (1994)

What Else Spurred Industrialization?

Not only the transport revolution but also

- Supply-side
  - the Jeffersonian embargo of British textiles in the early 19th century
  - tariffs that put foreign products at a disadvantage (1820/30s)
  - regional specialization allowed focus on comparative advantages

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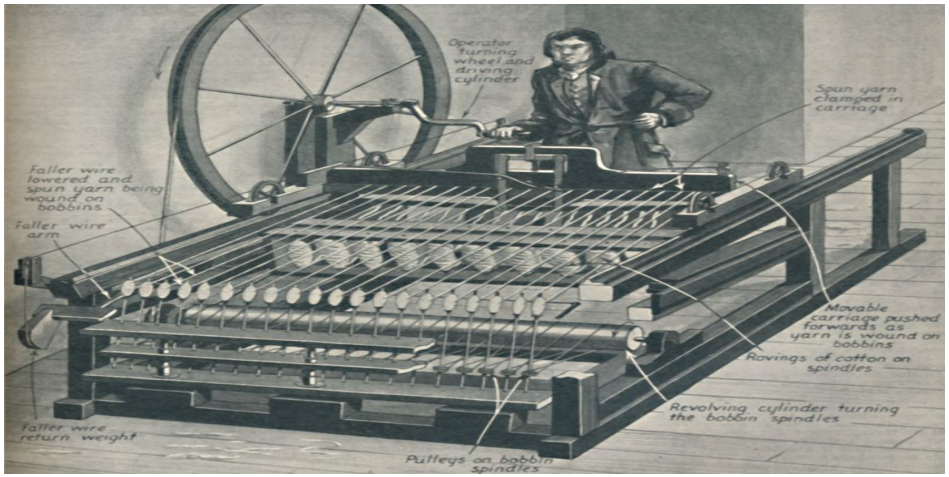
  - regional specialization allowed focus on comparative advantages
- Demand-side
  - rapid population growth: 3% p.a. from 1815-40
  - steadily rising income levels
  - westward movement (expansion of markets and resources)

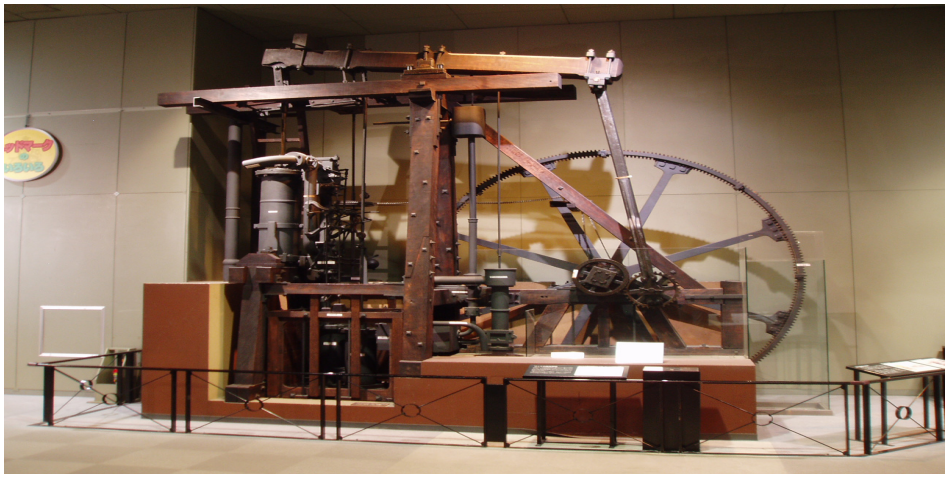
Another component is technological change

- more important for the second half of the century

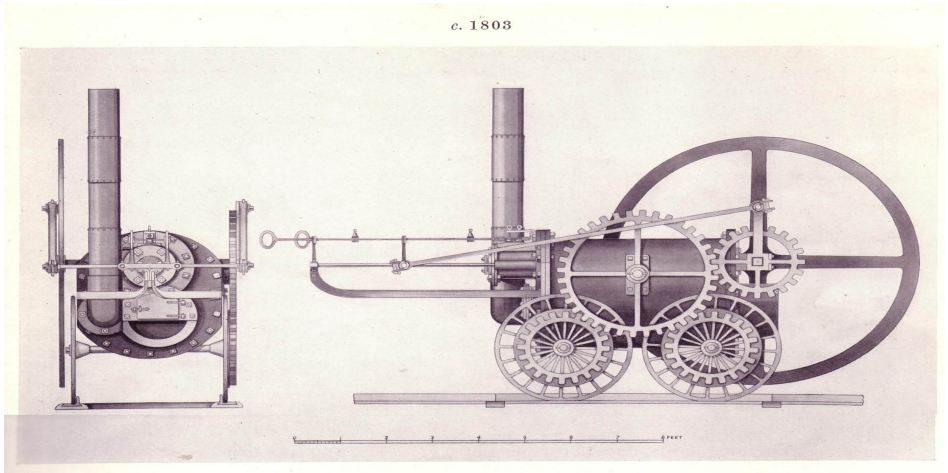
Machines and Technology



Spinning Jenny (1764)



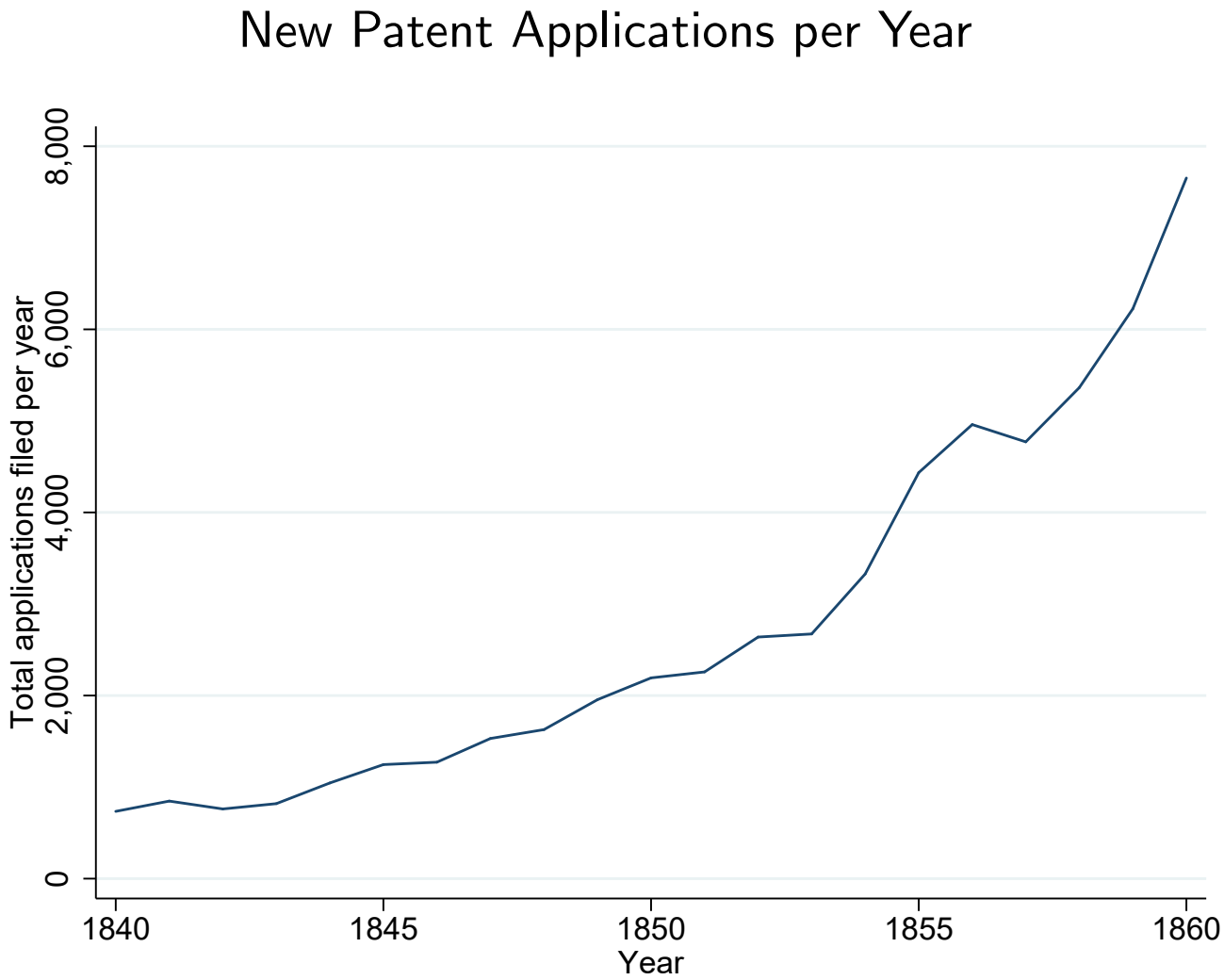
Steam Engine (1776)



Locomotive (1812)

Telegraph (1837)

Also Americans Started to Invent



Source: USPTO (2019)

Again Patenting Followed Factor Endowments

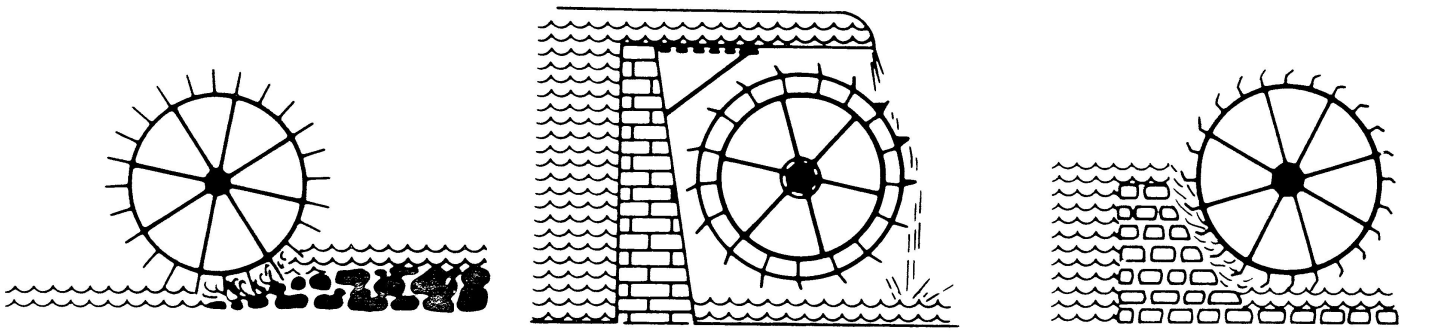
Frequency of words in patents in 1850

Source: Pearlman (2019)

Powering the Industrialization

Rich landscape of rivers and streams $\rightarrow$ water power

- stronger than humans or animals
- undershot wheel (left figure, $<$40% power transmission)
- breast wheel (right figure, 75% power transmission)



(a) Undershot wheel with straight blades

(b) Overshot wheel

(c) Crooked-blade undershot wheel (the "breast wheel")

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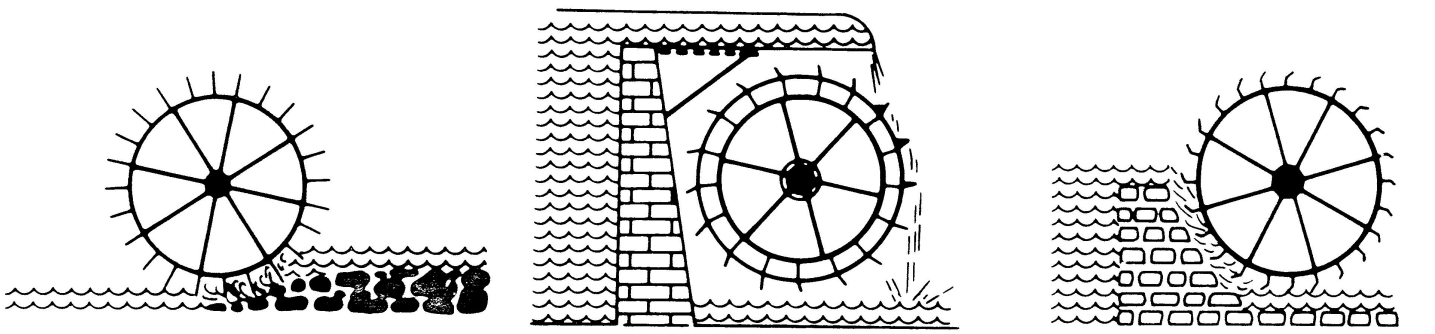

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The steam engine was more powerful and flexible

- but also more expensive (5-6x more than water in 1840)
- mostly used for steel and glass manufacture
- in 1820, waterwheels outnumbered steam engines 100:1
- by 1900, steam outnumbered waterwheels by 4:1

Labor During the Industrial Period

Remember that labor was the relatively more scarce input

How to attract workers to manufacturing?

- Rhode Island System
  - hire entire families
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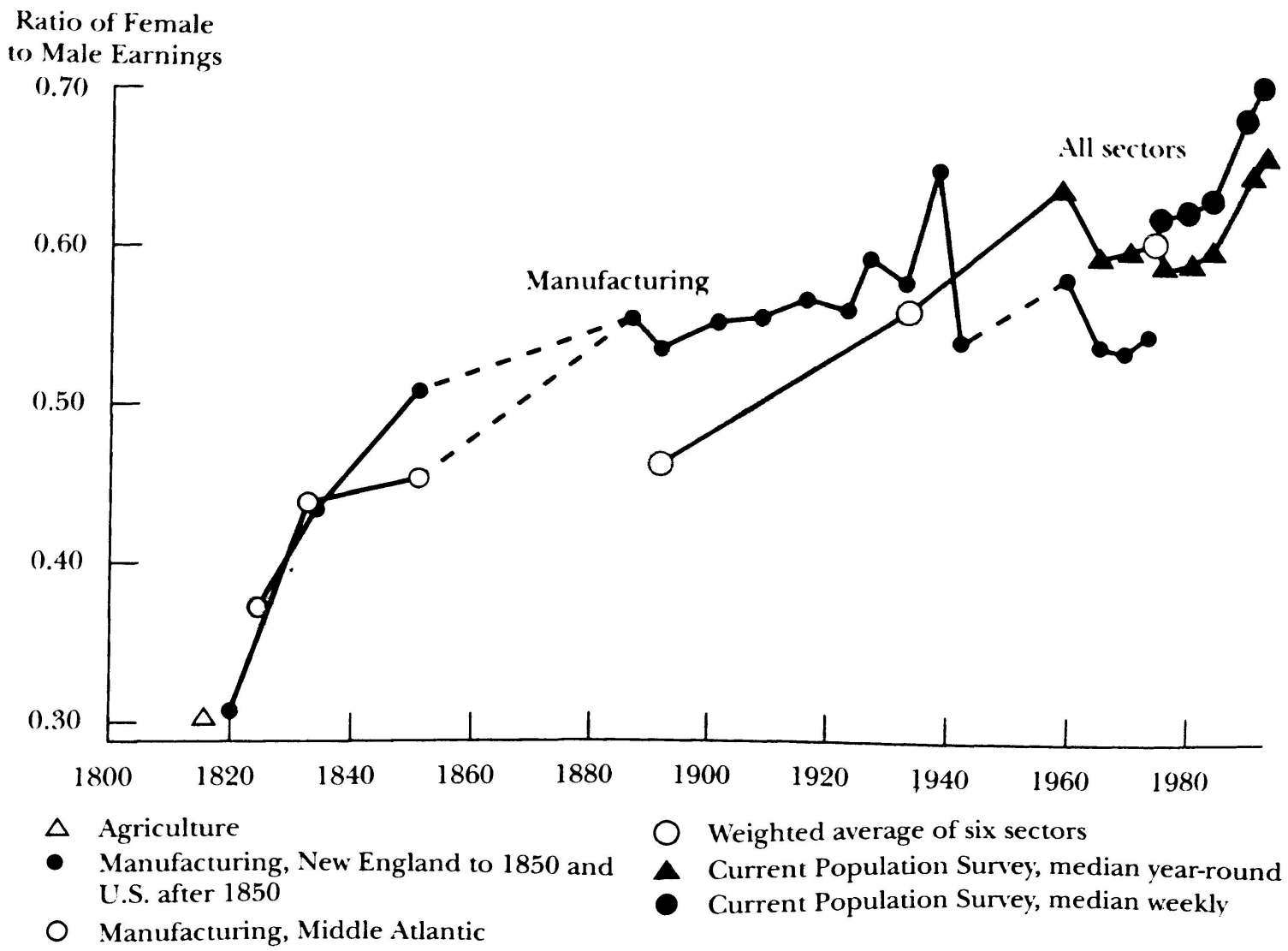
  - each member assigned a suitable task by age
  - provide housing to the family
- Waltham System
  - employ young women
  - provide housing with a **matron** overseeing them
  - working w/o marriage carried a strong social stigma

Female labor force participation: 0% in 1810 $\rightarrow$ ca. 25% in 1830

Why did this work in the North East but not elsewhere?

Female-to-Male Wage Ratios



Source: Atack and Passell (1994)

Relative Productivity Hypothesis of Industrialization

Goldin and Sokoloff (1984) observe that

- wages and LF participation of women low in the pre-industrial Northeast
- low productivity of women and children in agriculture

Industrialization arrives,

- new job opportunities for women and children

What should happen to their wages? And what region should industrialize first?

Testing the Hypothesis Empirically

Suppose you ran the regression

$$\frac{w_f}{w_m} = \beta \text{Manufacturing Firms} + X'\Gamma + \epsilon \tag{1}$$

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The identification popo arrives and says:
"manufacturing firms do not appear randomly"

It's kind of hard to find a natural experiment.

What do you do?

Coefficient Stability Test

[insert whiteboard action here]

Selection on Unobservables

Oster (2019) relaxes the correlation assumption between observables and unobservables. Let the regression of interest be

$$Y = \beta X + W_o + W_u + \epsilon \tag{2}$$

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For the following, we need to pick a max R^2 for (2). Usually $R^2_{\text{max}} = 1.3$

- Why not 1?

Selection on Unobservables

Next, run eq. (2) as short (s) regression (w/o controls) and long (l) regression (w controls) to get

- the uncontrolled β_s and R_s^2
- the controlled β_l and R_l^2

Oster (2019) proposes a bias corrected estimator

$$\beta_l - \delta \left[\beta_s - \beta_l\right] \frac{R_{\text{max}}^2 - R_l^2}{R_l^2 - R_s^2} \xrightarrow{p} \beta$$

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where the bias is

- the difference in the short and long reg coeffs
- scaled by the R^2 movement
- and related back to the unobservables via δ

Stata Implementation

Title

psacalc — Calculate treatment effects and relative degree of selection under proportional selection of observables and unobservables

Syntax

psacalc *estimate varname* [,*options*]

estimate	Description
beta	Calculate treatment effect
delta	Calculate relative degree of selection

options	Description
Main	
mcontrols(*varlist***)**	unrelated controls to be included in all regressions
rmax(#)	maximum R-squared; default is rmax=1
model(*command***)**	command for model to be estimated when used as stand-alone command
Beta	
delta(#)	value of delta if requesting calculation of treatment effect beta; default is delta=1
Delta	
beta(#)	value of beta if requesting a value of delta to match given beta; default is beta=0

What beta and delta do

The beta option asks:
"Pick an R^2_{max} and a value for δ, what would be my bias adjusted β be?"

The delta option asks:
"Pick an R^2_{max} and assume a true value for β, then what δ value would be consistent my estimated β"

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The delta option asks:
"Pick an R^2_{max} and assume a true value for β, then what δ value would be consistent my estimated β"

The second option is more useful. Especially

- if you assume $\beta = 0$ (i.e. all of the effect is driven by the unobservables)
- then the question becomes: what value of δ produces $\beta = 0$?
- typically $\delta \geq 1$ is considered robust

This is useful for testing **first stage** regressions