

# 05. Agricultural Development

Econ 373: US Economic History

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# Agricultural development in the North and South

- In 19thC, American farmers rapidly moved frontier of settlement westward
- In two main regions of United States agricultural development preceded along different lines
  - North: “yeoman democracy” organized around family-owned and family-operated farms that produced a mix of crops for own and local consumption as well as international markets
  - South: plantations organized around planter autarky producing staple crops (especially cotton) for world markets using slave labor
- Aim to understand economic aspects of agricultural development

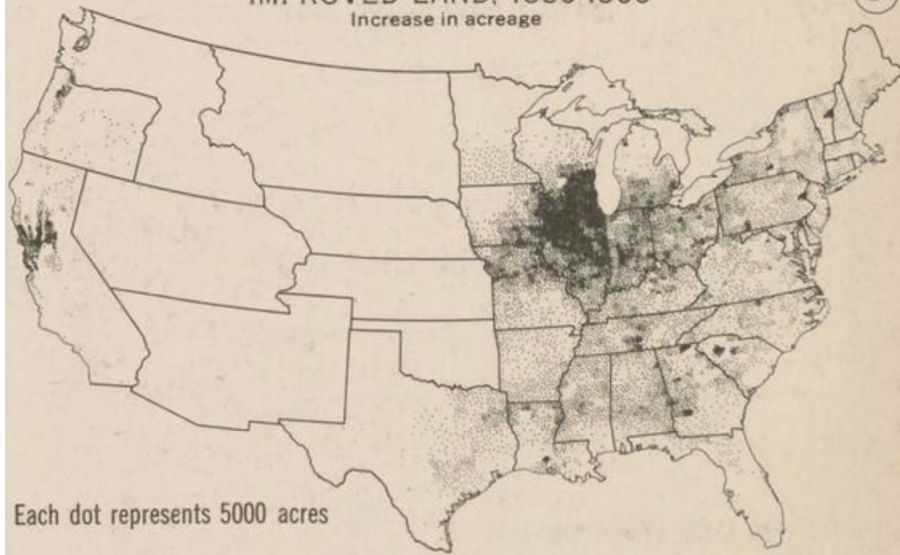
## A “typical” farm in the North

- Usual progression of development was for family to clear 5-10 acres per year and plant crops as land became available
  - Took 5-10 years to complete farm during which family was drawing down savings
  - Family could also hire outside labor as an alternative
- What is economic calculus governing these choices?
  - Savings on hand, availability of outside labor, time preference
- Cost was \$10-\$12 per acre for woodland and \$2-\$5 per acre for prairie

# IMPROVED LAND, 1850-1860

Increase in acreage

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## A “typical” farm in the North

- To “self-finance” cost of homestead with family labor required:
  - Mortgaging land, e.g., for \$200
  - Repaying balance in cash in 3-5 years, e.g., \$595
- Family farm required savings, difficult work at subsistence living standards
- Suggests farmer’s wealth could not fall below \$800-\$1,700
- Structure could also give rise to individuals or families with different “stakes” in farming, e.g., tenancy for cash or shares

**Table 1:** Capital Costs of Tenant and Owner-Occupied Farms

	Owner- Occupied	Tenant	Owner- Occupied	Tenant	Owner- Occupied	Tenant
<b>Midwest</b>						
Farm Value	738	969	1,363	1,460	2,490	2,151
Implement Value	46	38	67	57	96	87
Livestock Value	197	219	285	268	426	335
Total cost to						
O/T-occupier	981	257	1,715	325	3,002	422
<b>Northeast</b>						
Farm Value	1,599	2,967	2,621	2,772	3,966	3,636
Implement Value	65	58	116	80	162	124
Livestock Value	256	256	401	277	615	501
Total cost to						
O/T-occupier	1,920	314	3,138	357	4,743	625

# The process of growing wheat and other small grains

- Soil had to be loosened to bury seeds, provide drainage and space
  - Done with wooden or metal-sheathed wooden plow pulled by animals
- Seeds scattered by hand, buried under shallow soil by animal-drawn plow
- Mature plants cut with hand-swung scythe and bound together in shocks
- Shocks stored until grain separated from straw, chaff, dirt by screening

# Farming practices and productivity growth

- Labor productivity limited by:
  - Number of acres that could be plowed and harvested
  - Number of bushels of grain each acre could yield
  - Number of bushels each worker could thresh (or otherwise prepare for consumption)
- William Parker and Judith Klein estimated it took worker:
  - 1.45, 3.17, and 3.50 hours for oats, wheat, and corn in 1840-60
  - 0.40, 0.76, and 0.96 hours for oats, wheat, and corn in 1900-10
- Calculate change in labor productivity by crop



# Farming practices and productivity growth

- To understand “why” we use decomposition methodology
  - Mechanization: change in time spent plowing, planting, harvesting, preparing crop  
e.g., use of seeders, harrows, cultivators, reapers, and mechanical threshers
  - Westward movement: change in regional shares
  - Scientific farming: change in yields
- Can ask: if only one of these had changes how much of total gains in productivity would have been achieved?
  - Fixing “regional shares” and “yields” in 1840-60, changing only “mechanization” would have led to 186-246 percent increase in productivity
  - Represents 1/2 to 2/3 of the total increase, depending on crop

# Mechanization

- According to Parker and Klein labor productivity growth would have been less than half actual rate in absence of mechanization
- What factors determined adoption of mechanization?
- Many improvements came easily, e.g.,
  - 1820s wooden plows were displaced by cast-iron plows
  - 1840s spread of John Deere's 1837 invention (using steel)
  - Mechanical threshers cut time by 90 percent and cost by 50 percent
- Although threshing was hard it could be completed in winter, planting and harvesting had to be done at specific time and within certain period

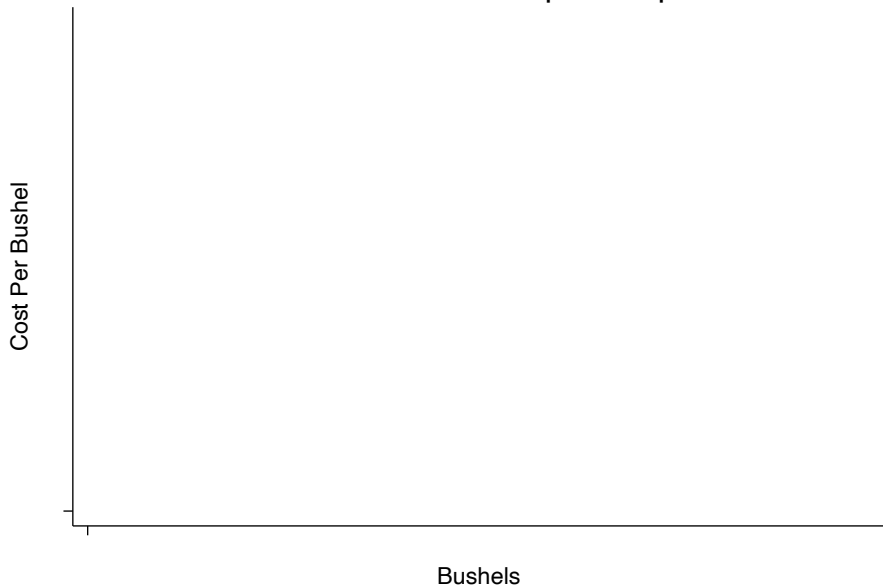
# Mechanization

- Small grain had two-week window of opportunity in which ripe grain could be harvested, imposing a binding labor constraint on farm output
- Individual farmers could use labor-for-hire to break constraint, but this was not solution for entire region for which labor supply was fixed
- What is solution to this problem?
- Obed Hussey (1833) and Cyrus McCormick (1834) patented first mechanical harvesters, but substantial adoption only occurred in 1850s

# The adoption of the reaper

- Why did widespread adoption of the reaper take so long?
- Conventional explanation is high price of wheat in 1850s raised wheat profitability, encouraged additional planting, and forced adoption
- What is economic model that describes this situation (and other instances of technological innovation in agriculture and industry)?
  - A model of supply (costs)
  - Relates costs (per bushel) to total quantity
  - Predicts the “threshold” (quantity) for adoption of the reaper

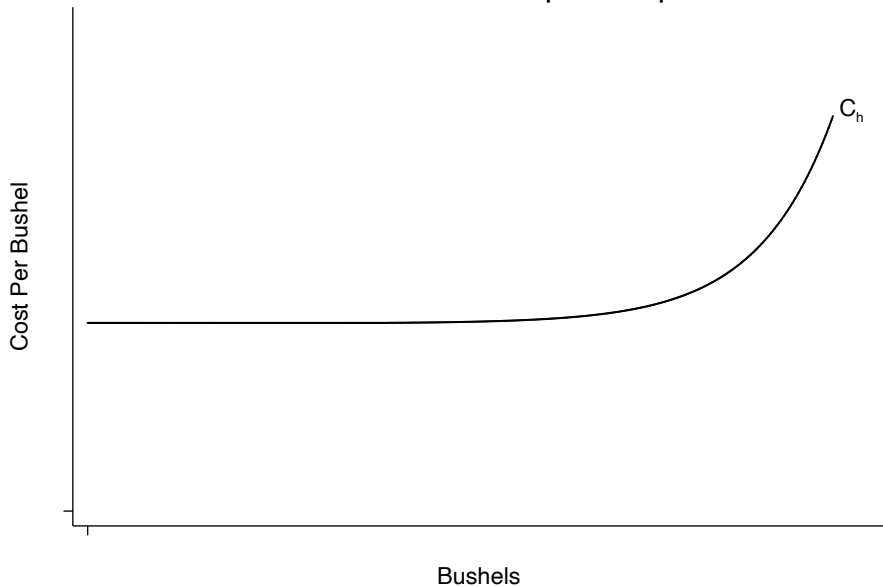
## The Threshold of Reaper Adoption



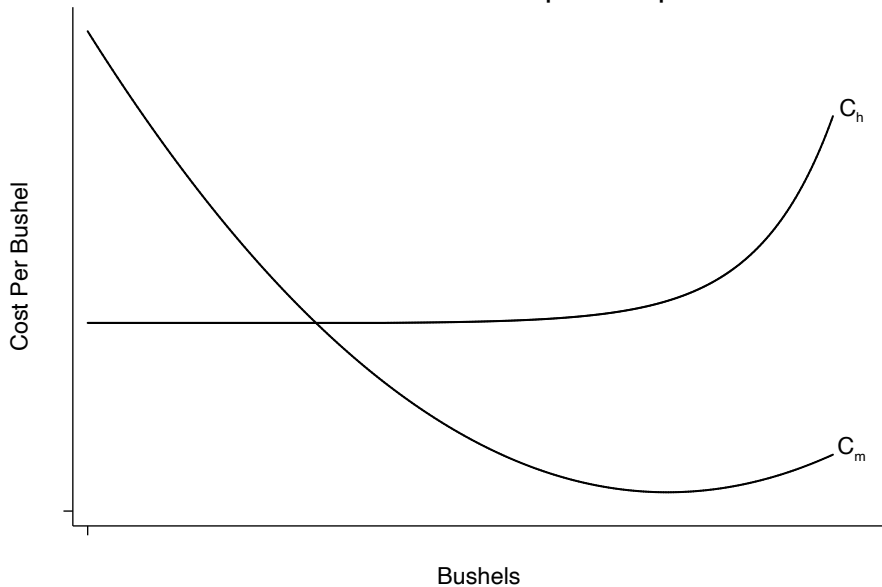
# The adoption of the reaper

- Represent relationship between cost per bushel, quantity
  - $C_h$ : cost curve for harvesting by hand,  $C_m$ : cost curve for mechanized harvesting

## The Threshold of Reaper Adoption



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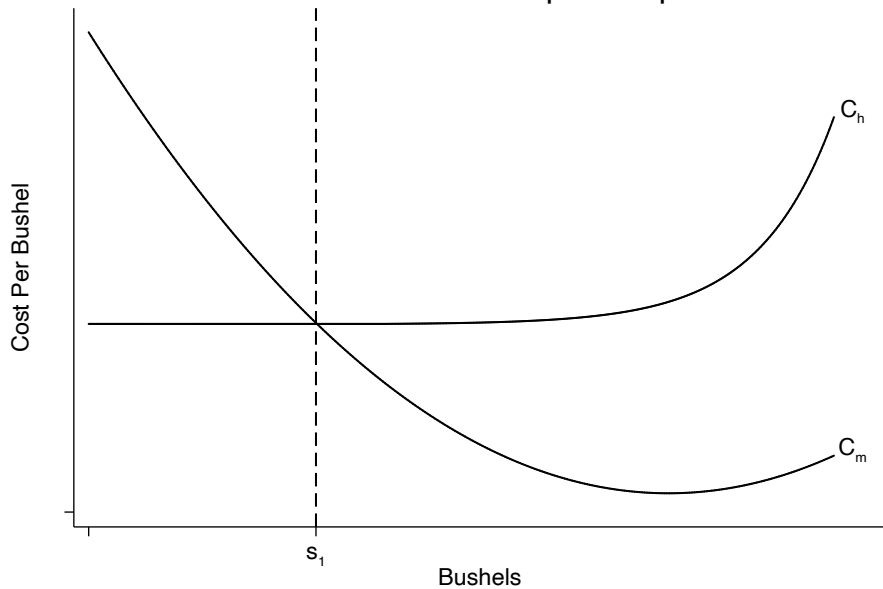




## The adoption of the reaper

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- To left of  $s_1$  costs of hand harvesting are less than mechanized harvesting, to right of  $s_1$  costs are greater ( $s_1$  is “threshold of adoption”)

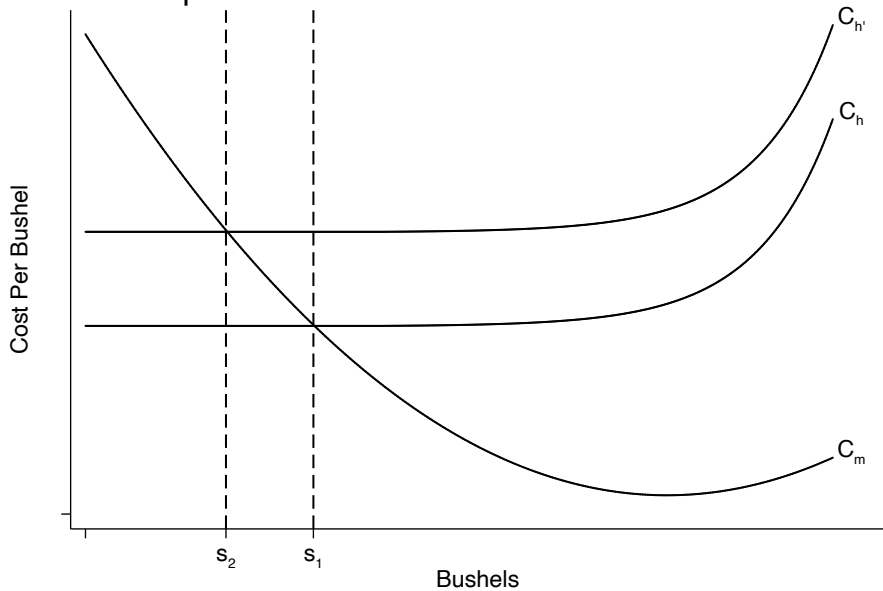
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- What economic factors explain shape of cost curves?
  - Labor constraint  $\rightarrow C_h$ , Fixed costs  $\rightarrow C_m$
- Finally, what happens if there is region-wide increase in labor demand?

# The Impact of Increased Labor Costs on the Threshold



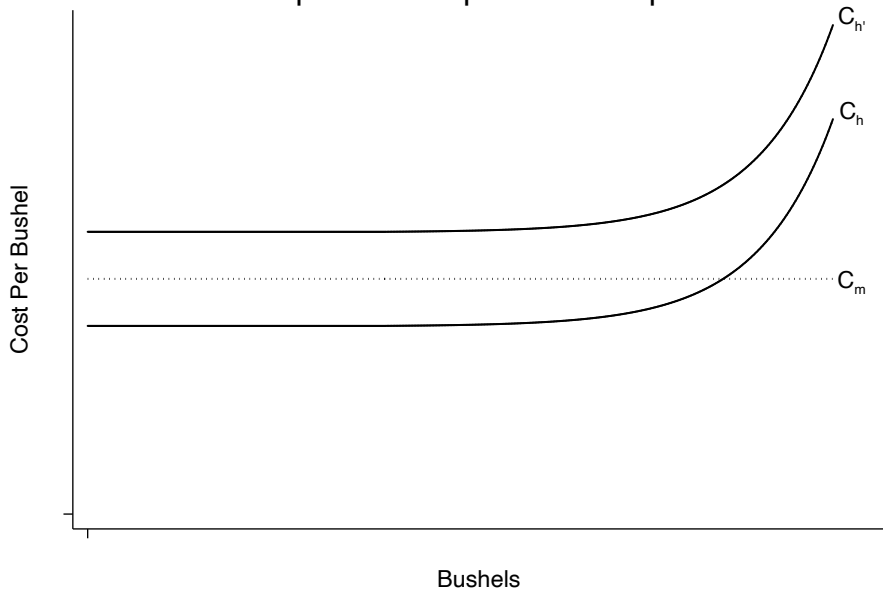
# The adoption of the reaper

- So explanations of reaper adoption here are twofold:
  - Increase in planting induced by higher prices
  - Increase in labor costs across the entire region
- What does evidence suggest about plausibility of these explanations?
  - 1849-53: McCormick reaper was 97.6 laborer-day wages  $\rightarrow$  threshold = 46.5
  - Typical farm in Illinois between 15-40 acres
  - By 1859-60, threshold decreased and average farm size increased
- Note: changes reflect changing conditions at home *and* change conditions abroad, e.g., interruption of European wheat trade by Crimean War

## The adoption of the reaper

- So far, discussion assumed reapers are “indivisible,” i.e., to gain services of reaper farmer must purchase a whole reaper
  - How does adding rental market change shape of cost curve?

## The Impact of Cooperative Reaper Use



# The adoption of the reaper

- So far, discussion assumed reapers are “indivisible,” i.e., to gain services of reaper farmer must purchase whole reaper
  - How does adding rental market change shape of cost curve?
- Indeed, Olmstead found evidence of cooperative ownership with neighboring farmers and related farmers pooled resources to buy reapers jointly
- How have technology choices (reaper and other forms of mechanization) shaped subsequent history of American agriculture?
  - Once farmer adopted expensive equipment reluctant to make changes even if incentives changed
  - Called “lock-in” and arises because of complementarity of technology, inputs