PURDUE UNIVERSITY

PURDUE AGRICULTURE

Emerging Agricultural Technology, Labor Markets, and Societal Impacts

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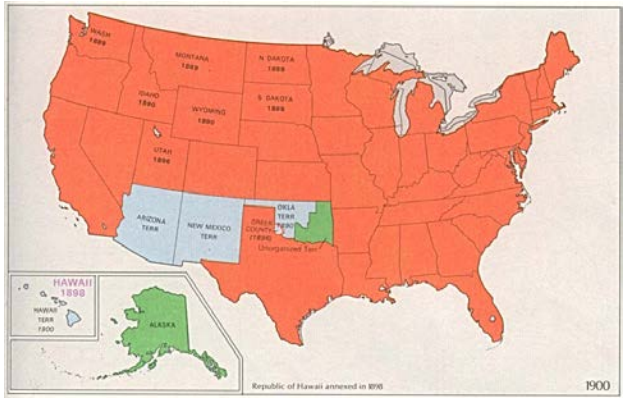
Beck Agricultural Center

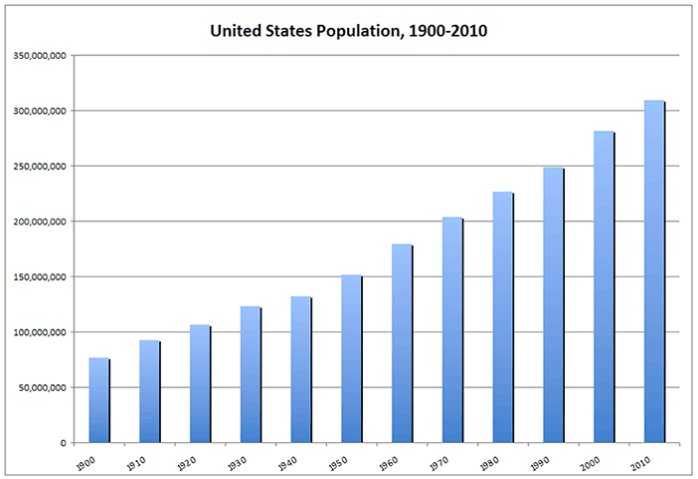
A Century of Change

- Population growth and geographic relocation
- Economic development and growth
- Emerging global society
- Public policy
- Investments in research and technology transfer

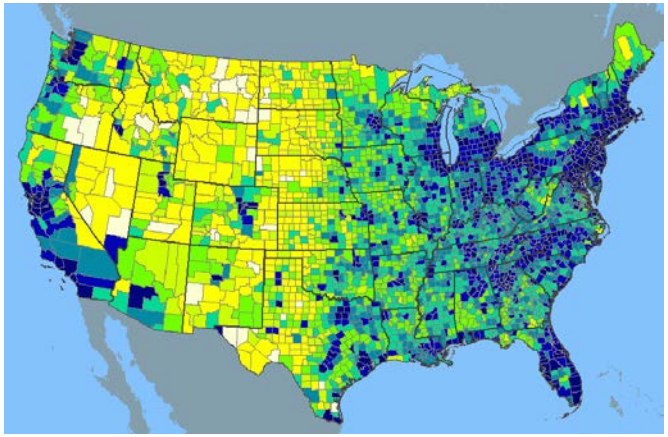
Let's set the stage

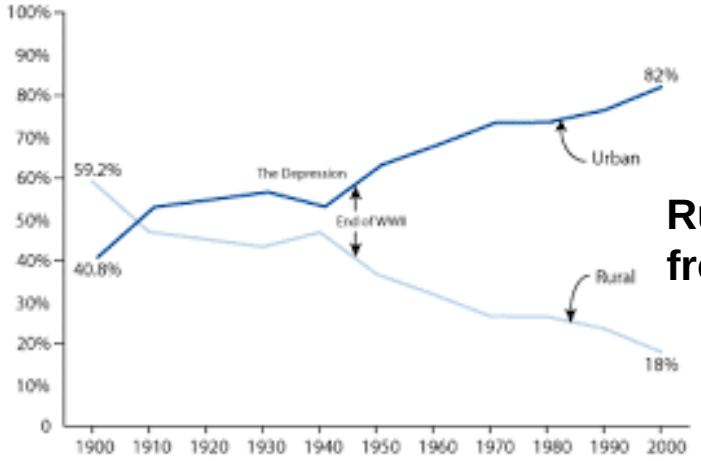
- The United States- 1900 to today





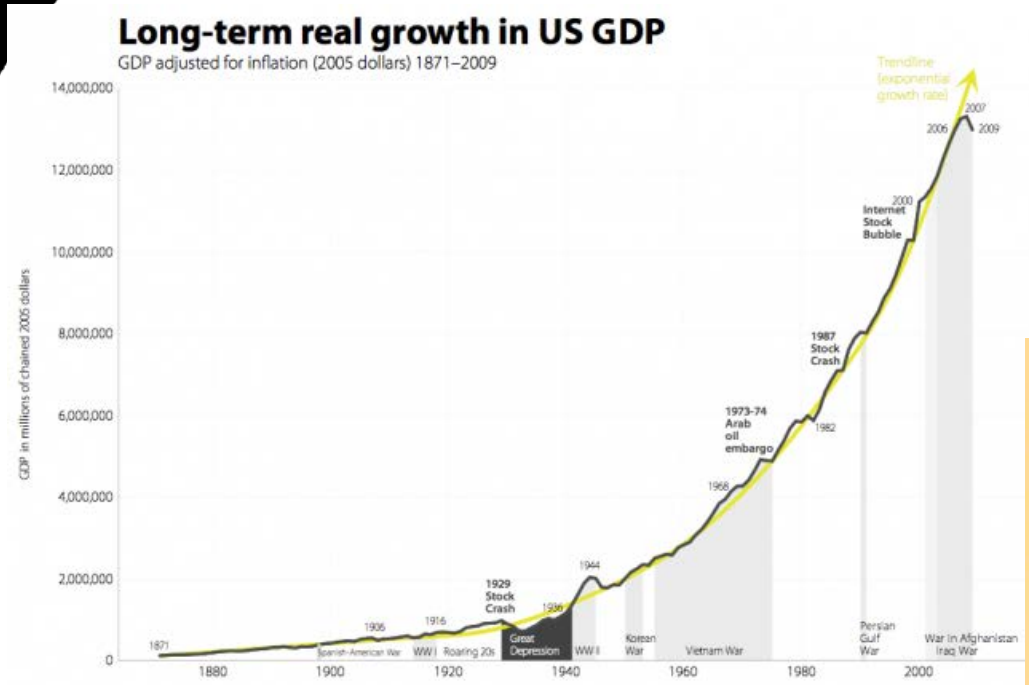
5-fold increase





Rural decline from 60 % to < 20%

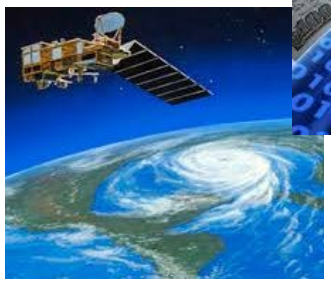
U.S. Economic Development



Globalization

- Increased trade
- Instantaneous communication
- Electronic transfer of money
- Weather satellites



- reallocation of resouces
- greater availability of good and services
- increased competition

Public Policy Environment

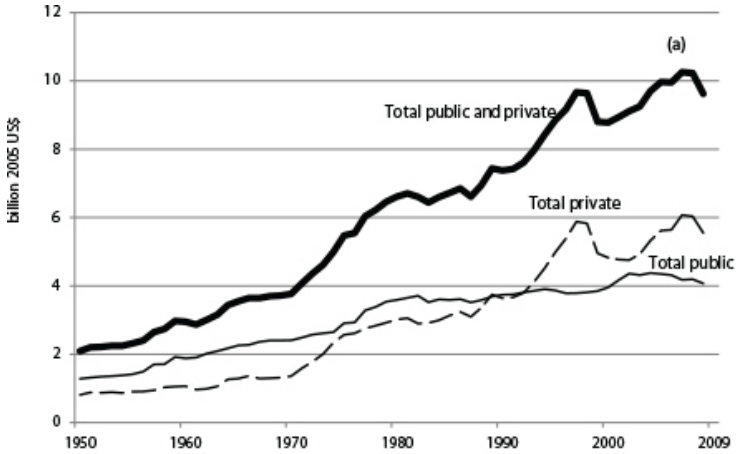
- Government legislation and regulations- more regulations

- Private sector decisions-consolidation

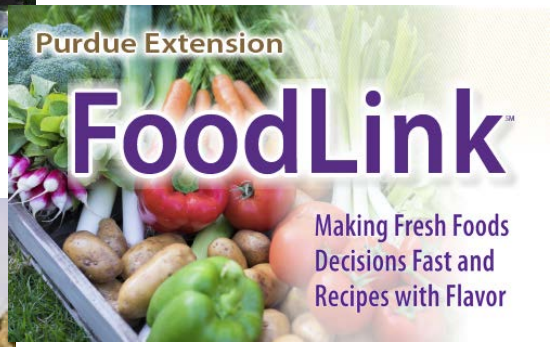
- Producer and consumer choices-more concerns about how food is produced

Investments in Agricultural Research and Technology Transfer

- Public sector

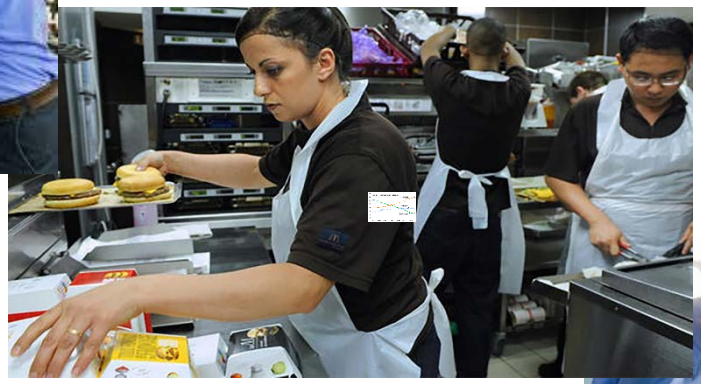


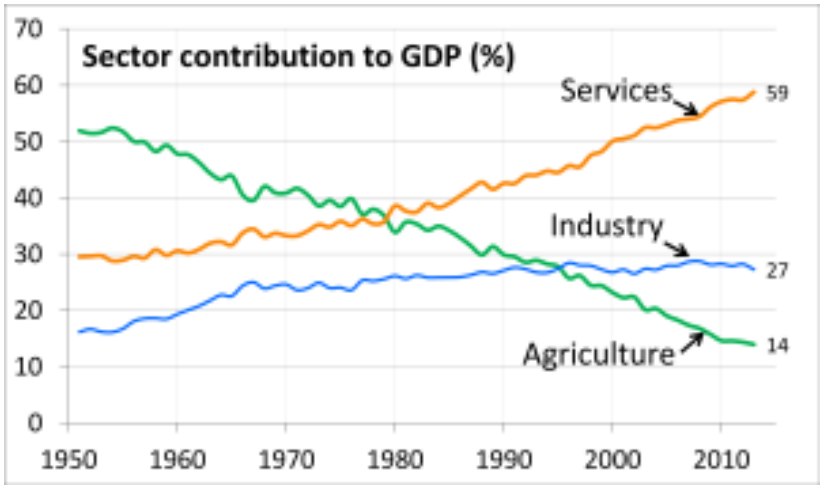
- Private sector



Increase in private relative to public investment in agricultural research

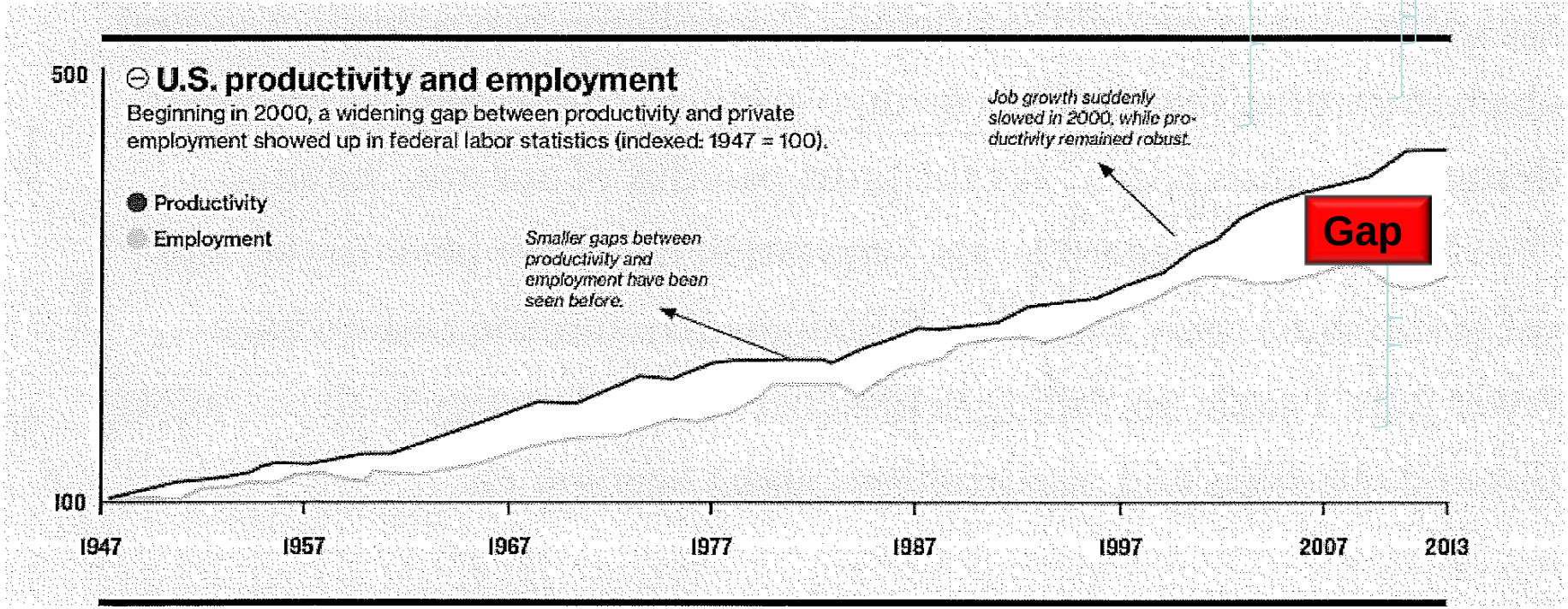
The Non-Farm Sector Performance



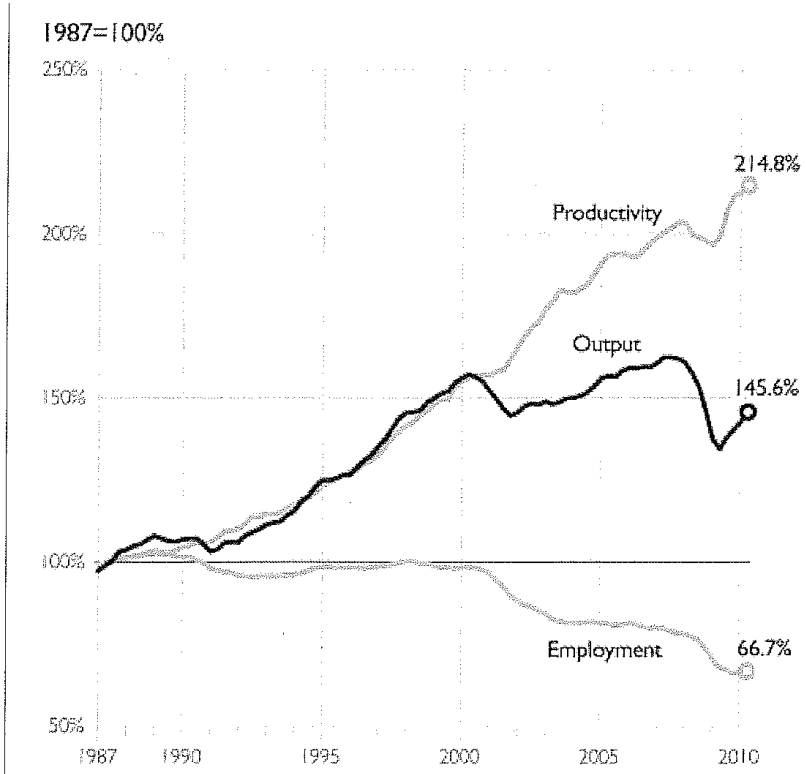


Decline in agriculture, stagnant in industry, and growing in service sector

Labor Productivity and Employment



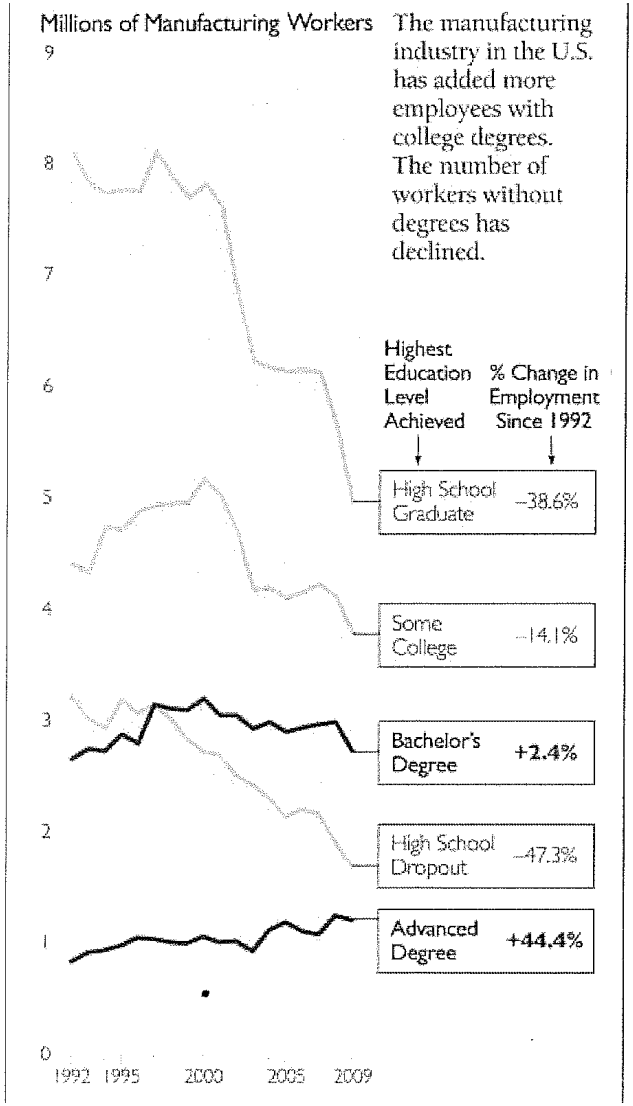
Trends in U.S. Manufacturing Productivity, Output, and Employment: 1987-2010



Source: U.S. Department of Labor, Bureau of Labor Statistics, "Productivity and Costs: Manufacturing Sector," 1987–2010, in Data Link Express, Haver Analytics.

Note: Increased productivity, stagnant output growth, and lower employment

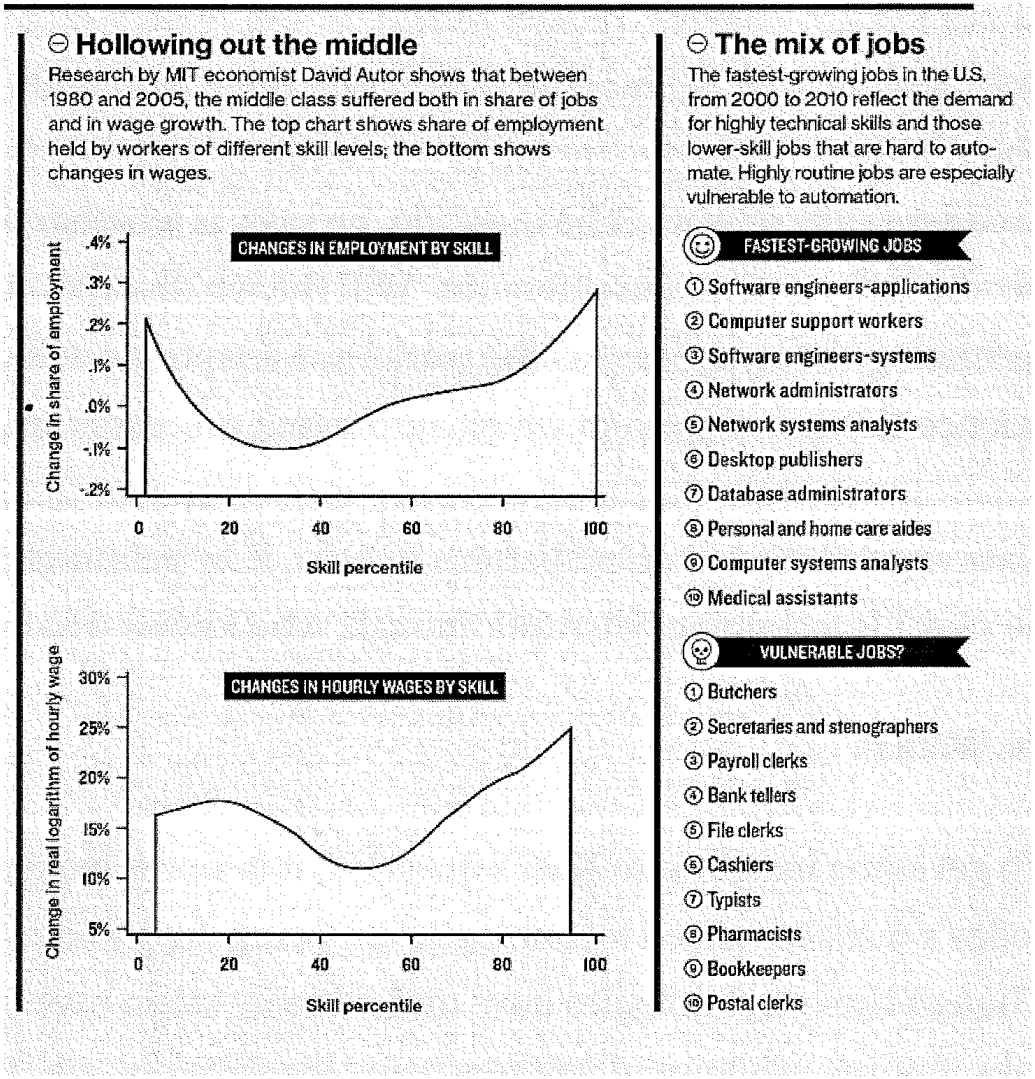
Manufacturing Jobs by Education Level



Shift to higher educated employees

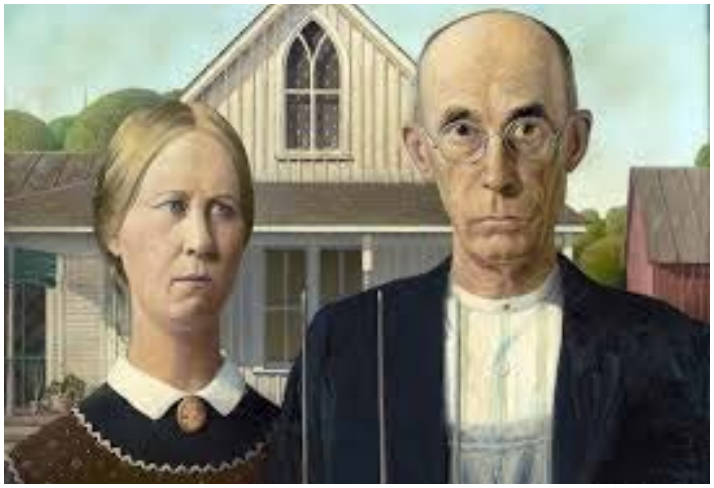
Employment by Skills

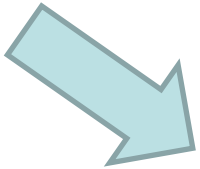
Middle class with lower skills
face jobs losses and stagnant wages



Not just factory workers!

A Century of Technological Change in U.S. Agriculture





Mechanization of Wheat Harvest

1900s

1950s

(2 A/Hr)

Today

(20 A/Hr)

Mechanization of Corn Harvest

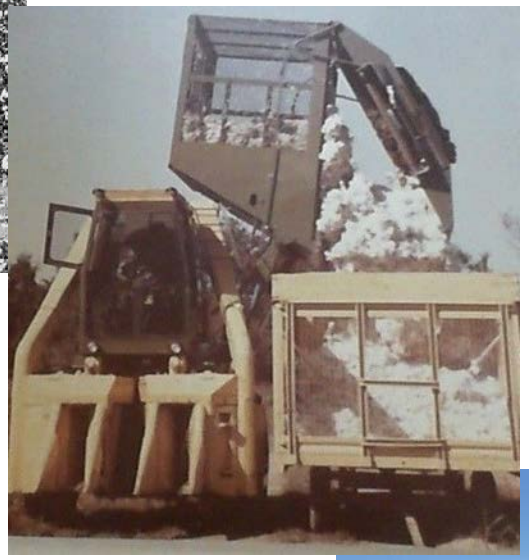
1900s

1950s
(1.5 A/Hr)

Today (15 A/Hr)

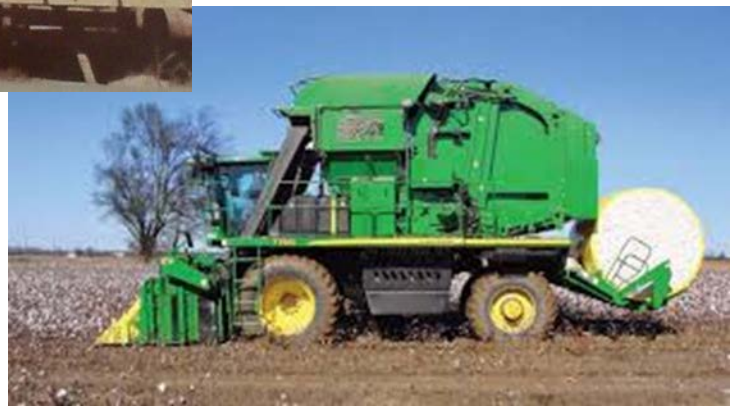
Cotton Harvesting

1900s



1950s

Today



Wage Rates, Man-Hours, Value of Production and Labor's Relative Share for U.S. Cotton Production: 1952-1969

Year	Real Wage Rate/Hour[a]	Man-hours Cotton-Labor (millions)	Real Value Output Including Acreage Diversion Payments ($ millions)[b]	Labor Share[c] (S_L)
1952	0.5710	1655	2446.4	0.3863
1953	0.5978	1609	2736.8	0.3515
1954	0.5905	1269	2407.3	0.3113
1955	0.6043	1235	2655.2	0.2811
1956	0.6335	1074	2389.8	0.2847
1957	0.6253	818	1787.8	0.2861
1958	0.6220	769	2015.1	0.2374
1959	0.6330	911	2586.2	0.2230
1960	0.6433	831	2861.7	0.1868
1961	0.6540	772	2677.6	0.1886
1962	0.6603	679	2648.6	0.1693
1963	0.6720	647	2816.0	0.1544
1964	0.6958	573	2614.0	0.1525
1965	0.7155	483	2212.3	0.1562
1966	0.7405	309	1324.6	0.1727
1967	0.7935	242	1397.3	0.1374
1968	0.8308	275	1446.7	0.1579
1969	0.8615	279	1045.2	0.2230

Note: Real wages increased, but hours of labor and labor's share declined

Martin, Marshall A. and Joseph Havlicek, Jr., 1977. Technological Change and Labor's Relative Share: The Mechanization of U.S. Cotton Production, Southern Journal of Agricultural Economics, 9(2):137 141.

Fruit Harvest

1900s

1950s

Today

Weed Control

1990s

1950s

Today

Milking Cows

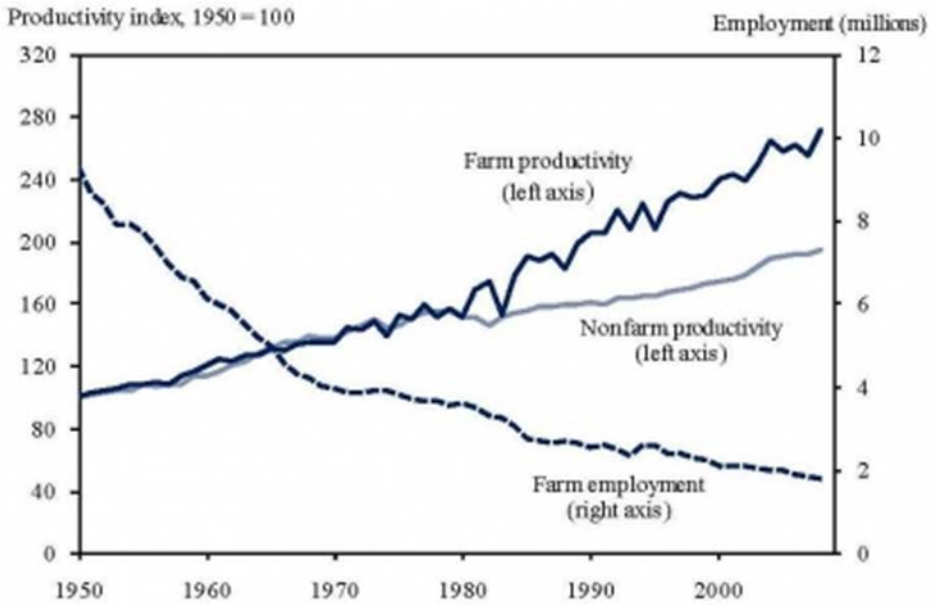
1900s

1950s

Today

U.S. Labor Productivity

Farm labor productivity growth faster than nonfarm



Relative Factor Endowments and Technological Change Theory

- The Hayami-Ruttan model of induced innovation

U.S. with 35 people per square mile vs Japan with 348 people per square mile

Historically, Japan has had a relative abundance of labor and U.S. has had a relative abundance of land

Induced Innovation over past Century

- Economic incentives for mechanization in U.S. due to relative labor scarcity
- Economic incentives for yield increasing technologies in Japan due to relative land scarcity

Labor Market Theories

Pull (economic perspective)

Improved work and quality of life opportunities in urban areas

Rural urban migration

Better jobs and salaries

Health care

Education

Labor Market Theories

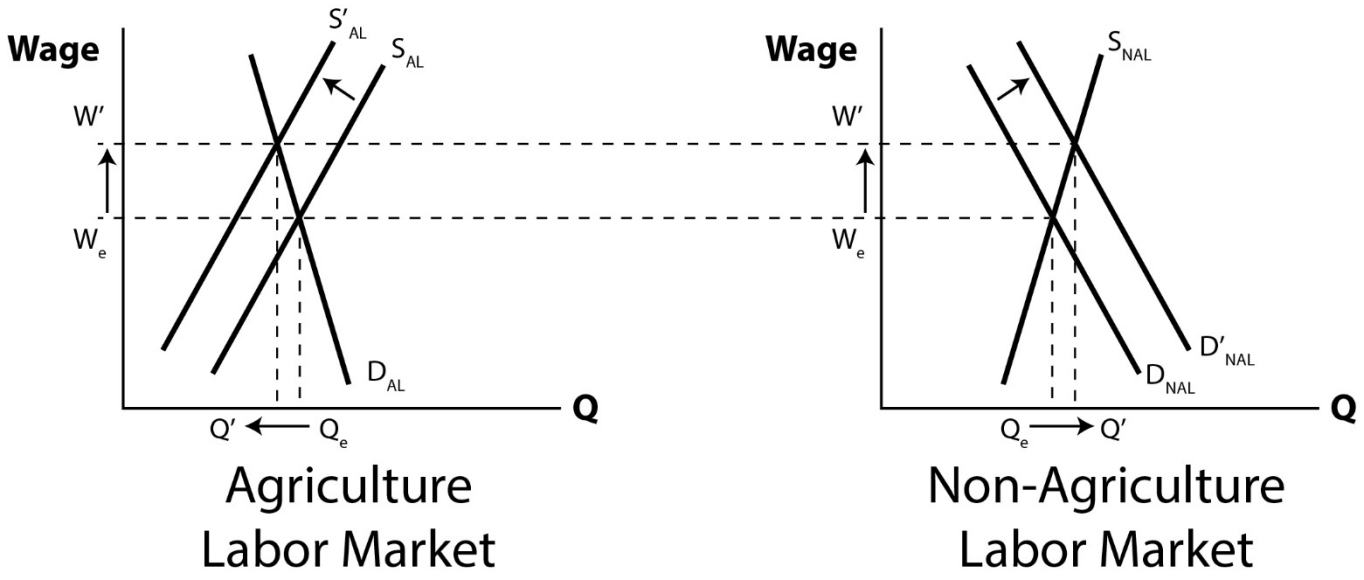
Push (Social perspective)

Social pressures and poor living conditions in rural areas

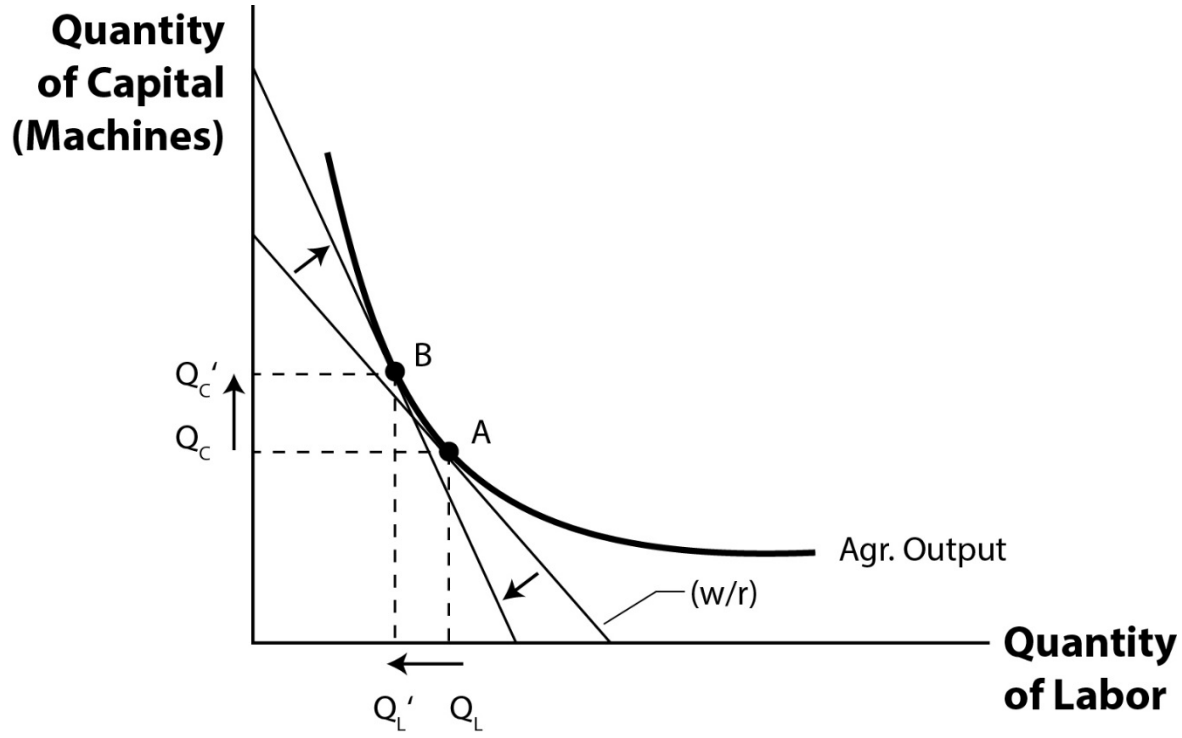
→ Rural urban migration

Substandard housing Lack of quality health services Limited educational opportunities

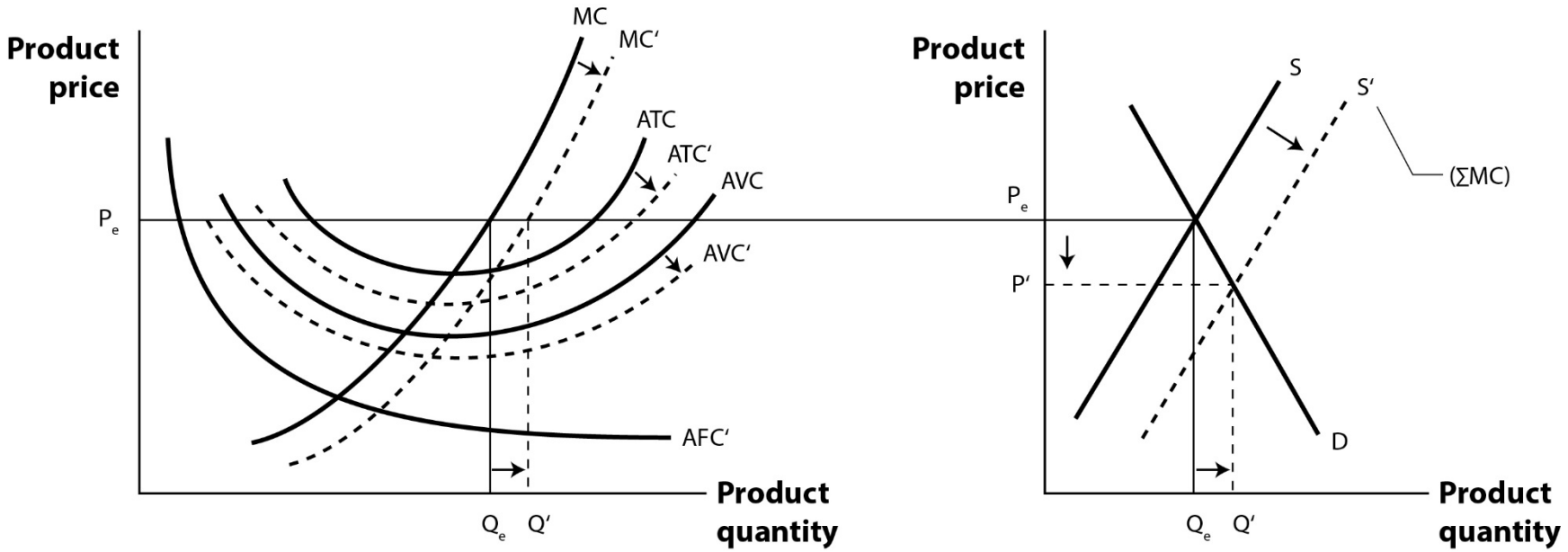
Labor Market Theory



Substituion of Capital for Labor



Agricultural Technology Adoption: The Treadmill Theory



Farm

AFC - Average Fixed Costs
AVC - Average Variable Costs
ATC - Average Total Costs
MC - Marginal Costs

Market

S - Market Supply
D - Market Demand

Agricultural Technology of Tomorrow

Genomics

Phenotyping

Bioinformatics

Agricultural Technology of Tomorrow

Precision Agriculture

Big Data

Driver-less tractors

Job Loss: Trade Vs Technology

- International trade both expands and reduces employment depending on the sector
  - Fewer low skilled Jobs, but demand for some higher skilled employees

Automotive sector

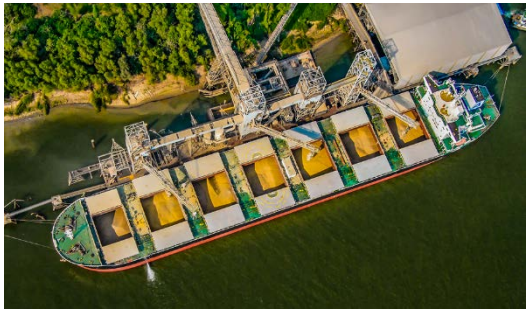
Job Loss: Trade Vs Technology

- International trade increases competition and offers large choice of cheaper goods
  - Imported consumer goods and intermediary inputs

Imported goods

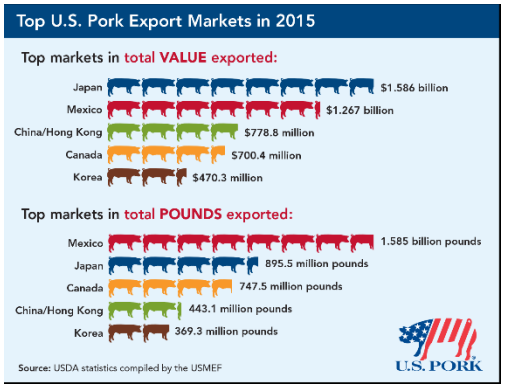
Job Loss: Trade Vs Technology

- International trade increases U.S. exports
  - Export of U.S. agricultural products



Soybean exports 45% U.S. production

Agricultural exports



Pork exports 24% U.S. production

Job Loss: Trade Vs Technology

- Technological change increases labor productivity, but requires new skills for many and may increase flow/quantity of product
  - more knowledge based than physical labor based
  - increased volume

Mail and package shipping

Job Loss: Trade Vs Technology

- Challenge is motivating, funding, and providing opportunities for retraining

PURDUE POLYTECHNIC

IVY TECH COMMUNITY COLLEGE

Breakout Discussion

- What new skill sets will you need on your farm in next 5-10 years?

- How can society best prepare people for these future job opportunities in agriculture?

Breakout Discussion

- What jobs and skill sets do you expect to need in your community/county in next 5-10 years?

- How can society best prepare people for these careers in your county/community?

Questions

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CASE IH