Lecture 7: Industrial Revolution

James R. Walker
U. of Wisconsin

Human Resources and Economic Growth
Since Tuesday

- Have updated my Lectures, posts for last three lectures. Posted lecture notes.
- Have placed Findlay’s (1990) article on the course web page.
- Have placed excerpt from Findlay and O’Rourke (2007) on the course web page. Provides another discussion of the model’s predictions.
- Will place a short write up on the GE model on the course web page.
Sketched model, comparative statics that an increase in population in Europe will

1. Increase the relative price of raw materials, $p^*$
2. Increase the relative price of slaves, $\pi^*$
3. Increases $M^*$, $R^*$, and $S^*$.
4. Because of (??) and (??) the Britain’s Terms of Trade shifts against Europe and in favor of Africa and New World.

Can show, IR has the same qualitative predictions.
How would you represent the Industrial Revolution in the model?
Technological Change

- Technical change: invention and innovation (what’s diff?)
- Produce more with same inputs, and/or produce higher quality products.
- Indeed, we’ve experienced the effect of technical change many times over in consumer electronic products.
Consider production function

\[ Y_t = A(t) \cdot F(L_t, K_t, R_t), \quad A(t) > 0 \]

So (total) cost function

\[ C(t) = C(w_t, r_t, p_t, Y_t/A(t)) \]

with \( w_t, r_t, p_t \) as input prices for \( L_t, K_t, R_t \).

\( A(t) \) is a scaling factor. \( A(t) \uparrow \iff C(t) \downarrow \) produce more with given inputs.
Technical Change

Neutral

\[ Y_t = A(t) \cdot F(L_t, K_t, R_t), \quad A(t) > 0 \]

Labor Biased

\[ Y_t = F(A(t) \cdot L_t, K_t, R_t), \quad A(t) > 0 \]

Capital Biased

\[ Y_t = F(L_t \cdot K_t, R_t), \quad A(t) > 0 \]
Key economic fact of the IR is the sustained technological change which produced sustained economic growth.
The lecture from Sept 19, 2013 presents several tables and some figures to show:

- Discussed differences between English and Chinese agriculture.
- Economic well-being (as measured by income per capita and life expectancy at birth) varied over time. Every country experienced good times and bad.
- The Great Divergence (between England and China).
Great Divergence

Evidence of Great Divergence:

1. Prior to 1750 there was little difference in income per capita and $e_o$ among countries.
2. Prior to 1750 there was at least as much variability of well–begin within a country over time as between countries at a point in time.
3. After 1750 (1760) (1800) Britain pulled away from other countries. Income per capita rose, as did population, and $e_o$.
4. Other Western European countries industrialized after G.B.
5. Asian countries, esp. India and China econ growth delayed into the 20th century.
Thinking about Industrial Revolution

- Greed, Ambition, Curiosity, Altruism. (Mokyr)
- What institutions had to change from a tributary mode (e.g., Feudalism and Mercantilism) to a market based system of voluntary exchanges and resources allocated by prices?
- N. Ferguson: What set of factors had to be in place for IR? Without any one factor IR would not have occurred in England 1760–1830.
- Sources of Growth?
Sources of Growth

1. **Solovian** Investment. Accumulation of capital.
2. **Smithian** Gains of trade from specialization and (Ricardo) comparative advantage.
3. **Boserupian** Scale or size effects. Population growth leads to per capita income increase (mixed).
4. **Schumpeterian** Increases in stock of knowledge — includes change in technology and change in institutions. Methods team in P&G.
Distinguishing feature of the Industrial Revolution is the sustained technological change. Produced sustained economic growth.

There were periods of innovation (e.g., in China in 1400–1500) that did not lead to IR.

The key is sustained technological change. The “pie” gets bigger every period.

Over 25 years, 3% growth doubles output $\implies$ Standard of living doubles between generations.
Explanations: Weber


Capitalism defined as a regular orientation to the achievement of profit through (usually) voluntary exchange. Disciplined labor force and regular investment of capital.

The continual accumulation of wealth for its own sake, rather than for the material rewards that it can serve to bring. “Man is dominated by the making of money, by acquisition as the ultimate purpose of life. Economic acquisition is no longer subordinated to man as the means for satisfactory of his material goods. (p. 53) This, according to Weber is the essence of the spirit of modern capitalism.

Protestants (and especially Calvinists) have this spirit (‘this–worldly asceticism’). Other religions, and other Christian sects (e.g., Catholics) do not possess this spirit.

Asceticism: Highest form of moral obligation of the individual is
Ferguson’s list of critical factors

1. Competition
2. Science
3. Property Rights
4. Medicine
5. The Consumer Society
6. The Work Ethic

- G.B. industrialized b/c its colonies (Canada, Caribbean, India, US), and lucky to have huge coal reserves to fuel industrialization.

- He argues that standard of living in China was comparable to GB at start of Industrial Revolution.

- China had well established markets (contracts over inheritance, sophisticated).

- China had a history of technological innovation: invented gun power, printing press, paper, ceramics (e.g., dinnerware called China), naval technology, hydrology and water management centuries ahead of the West.

*Industrial Revolution is the result of a complex interaction of cultural mores and historical circumstance.*

“If we learn anything from the history of economic development, it is that culture makes all the difference. (Here Max Weber was right on.)” (p. 516)

Culture is the inner values and attitudes that guide a population. . . “One could have foreseen the postwar economic success of Japan and Germany by taking account of culture. The same with S. Korea vs. Turkey, Indonesia vs. Nigeria.” (pp. 516–517)

*Culture does not stand alone. Culture and economic performance are interrelated . . . changes in one will work back on the other.’ (p. 517)*
“In this world, the optimists have it, not b/c they are always right, but because they are positive. Even when wrong, they are positive, and that is the way of achievement, correction, improvement, and success. Educated eyes–open optimism pays, pessimism can only offer the empty consolation of being right.” (p. 524)
Explanations for GD: Goody I

Jack Goody (2010) *The Eurasian Miracle*
“The book is about the relative unity of the European and Asian continents rather than their differences, a relative unity that began with the Bronze Age Revolution.”

Bronze Age: 3,000 B.C.E.

“The Bronze Age did not result in a bifurcation between the dynamic west, passing through antiquity, feudalism, to capitalism, and the east that produced a static, hydraulic, bureaucratic, despotism, which was not about to modernize. This was the nineteenth century theory of Marx, Weber who saw the world from the standpoint of Europe’s predominance and presumed it had always had an advantage.”
Argues for “alternation” where East and West alternate which society is more advanced, sometimes East sometimes West, neither had a permanent advantage over the other. The roots of the IR lay in the development of techniques that had been borrowed over the Eurasian landmass, transmitted by the constant trading back and forth, so that the birth of ‘capitalism’ occurred in the east and the west and was but one part of an alternation.” (p. 111)

“essentially that of the nineteenth century the west had seized the high ground in the economy, in military matters, as in the knowledge society more generally.” (p. 114)

“NW Europe was a minor region that generated economic growth when other, larger societies did not. Rare moves in that direction by the great empires of the ancient and oriental world all lapsed. By fruitful economic change in Europe pre–dated the industrial revolution, which, rather than being the start of growth, emerged from the long past. The continent’s advantages and achievements were varied and cumulative. . . Perhaps the most significant process of all was competition among political units, especially the emergent nation–states. But no single factor can be picked out as decisive.” (p. 239)
IR roughly 1760–1850: turning point in human history sustained economic growth.

1. Not an abrupt change, but the result of a series of transformative changes in the fifteenth through seventeenth centuries.
   - Age of discovery. (land route closed) decades prior to 1760.
   - Growth of trade and commerce. Europe sought many Asian and Arabic products.
   - Expansion out of Europe; colonies. GB holdings did not offer immediate riches, over LR produced cotton, furs, lumber, and demand for GB products.
   - Technological change. Substituted inanimate energy for animate (fossil fuel versus animal and human energy.
   - Technology gains that affected many industries (steam engine, steel and iron making). And gains to smaller industries (e.g., Smith’s pin factor and division of labor).
   - New products from East (China) and South (India) Asia.
2. Favorable governmental and cultural context.
   - English Constitution.
   - Parliament could take people’s property. Property in France too secure?
   - IR sustained by emerging scientific culture. natural rules govern the universe and the world; we can discover those rules and apply the knowledge for the betterment of people.
   - Social change urbanization and growth of commerce. Fostered spread of literacy.

3. Yet, scientific culture, urbanization, and secularization of society happened not just in England (GB). IR in England
   - Labor expensive relative to capital $\Rightarrow$ invest in labor saving machines.
   - Labor expensive relative to energy (coal). $\Rightarrow$ invest in labor saving machines.
With capital investment and cheap energy, worker productivity in England high and growing, translate into high labor earnings.

High labor earnings increased demand for industrial products; luxuries became necessities (e.g., tea, linens).

4. Diffusion to Western Europe. R&D expenditures adapted machines designed for GB context to local contact.
Labor to Capital Costs

Fig 3.7, page 31 Allen (2011)
Fig 6.1, age 139 Allen (2009)
Labor to Energy Costs

Fig 2.1, Allen (2009)
Fig 4.1, p. 83, Allen (2009)
Fig 6.2, p. 140, Allen (2009)
What does it mean? I

- Importance of Political Structure and Economy. Who determines who produces what for whom?
- Interconnected nature of economic sectors. Division of labor is limited by the extent of the market. (A. Smith [1776]).
- Complementarities between economy and society. Industrialization and factory system gave rise to measurement of time and of literacy.
- Importance of individual freedoms, and especially spatial and occupational mobility.
- England unusual in that it was able to finance its development without sophisticated credit market and financial market in general. Had basic (emergent) forms of insurance (insure against pirates, lost ships, fires).
What does it mean? II

General story: labor saving technology in agriculture released labor from farms. Opportunities initially in the “putting out” system (small rural textile producers). Then eventually to migration from farm to city (rural to urban). Became urban worker in factory. Organization of factory, division of labor, regularization of work force increase productivity and eventually earnings. Increased demand for urban produced products.
The key to economic growth is continual invention and innovation. Innovation may be production process or in organizational structure or in financial and insurance services and products. The relentless pursuit of profit to survive in a competitive environment. Today’s comparative advantage can easily be tomorrow’s forgotten memory. (e.g., Blackberries), Universities? vs MOOC

How does a society organize itself to permit competition, and technical change? Aka Progress?

Unfettered markets may be efficient (use minimal resources to produce output) but are heartless, cold, impersonal but can wrought massive devastation to a society. Blind to personal situation and any notion of justice.