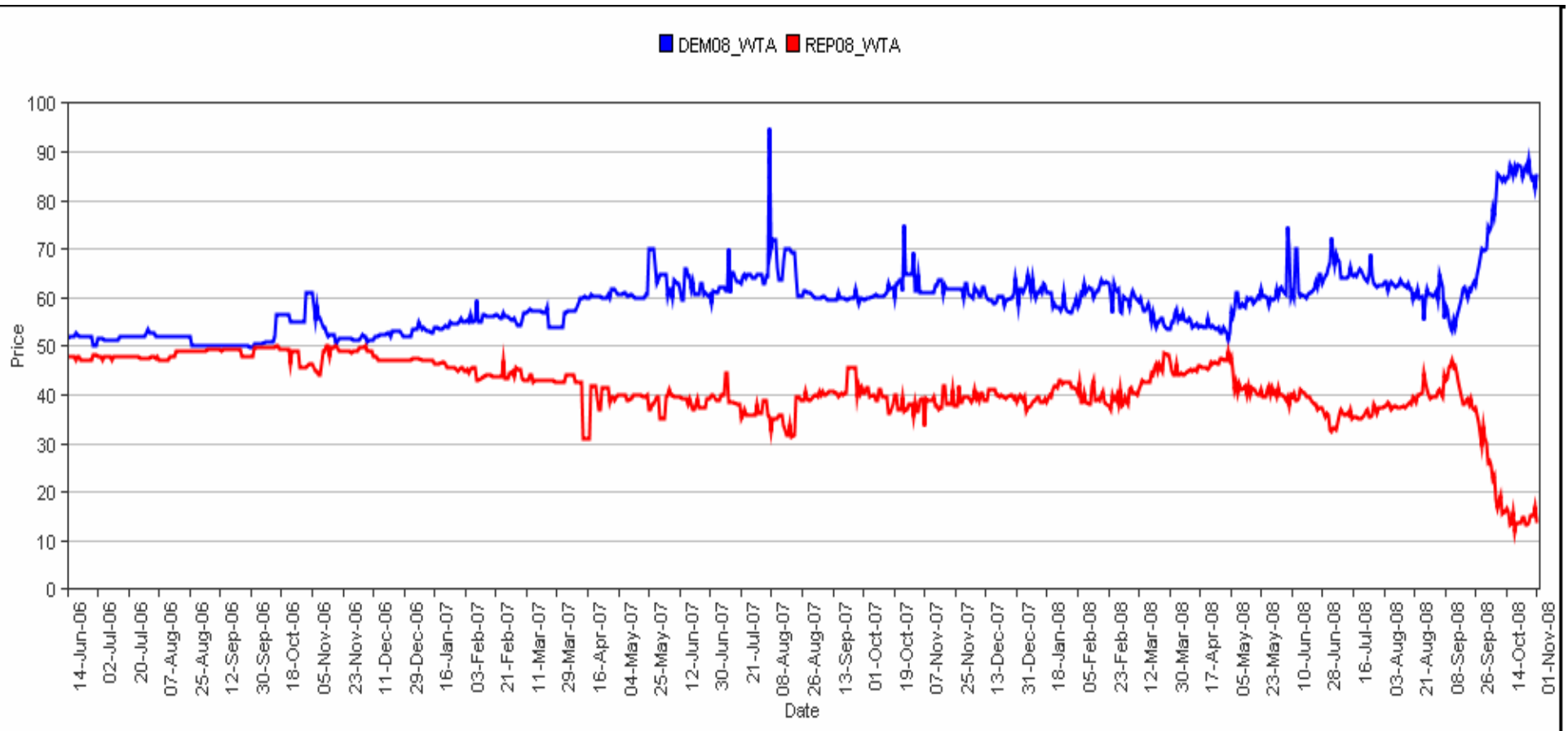


Lecture 17

AAE 374 Fall 2008



- Before 2:30 Announcement: IEM if interested today/tomorrow (google IEM)



Lecture 17

AAE 374 Fall 2008

- Overview:
- Beyond Exogenous “A” in the Solow Model
- Start with another quick look at the early American Industrial Success
- Move onto Increasing Returns to Scale (internal to firm and external in sectors)
- Learning-by-doing model (how technology can mitigate diminishing marginal returns)



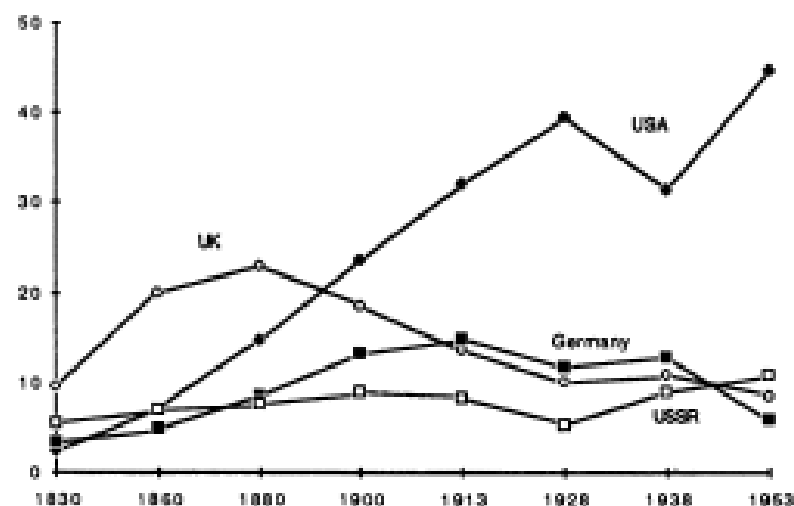
Origins of American Industrial Success Redux (Wright)

- *Revisiting of the 1879-1940 American manufacturing export “success”*
 - Congruence between US abundance in natural resources and advancing industries that were resource-intensive.
 - Leadership was not based on skill-intensive or capital-intensive exports.

Initial Evidence

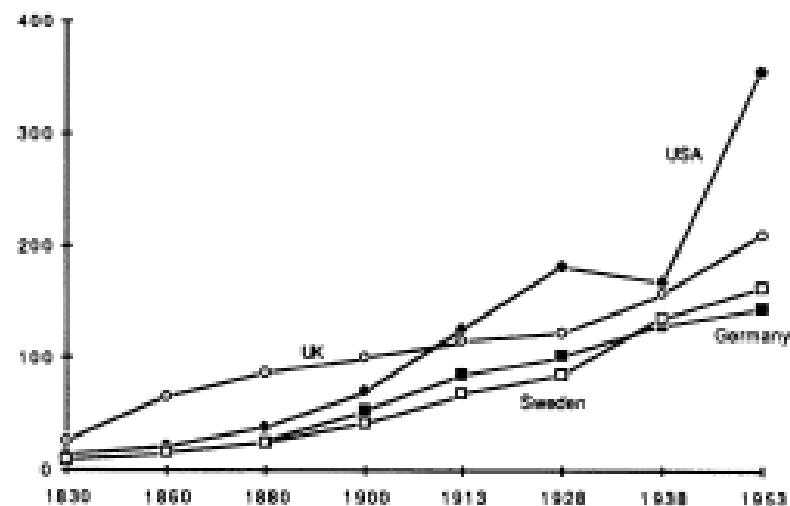
- Takeoff in US industrial performance after 1890.
- Leading exports in 1890s were US shoes, machine tools, and engineering
- Steel, machine tools, and cars in early 20th century.

CHART 1. SHARES OF WORLD INDUSTRIAL OUTPUT, 1830–1953



Source: Bairoch (1982, pp. 296, 304).

CHART 2. INDUSTRIAL OUTPUT PER CAPITA



Source: Bairoch (1982, pp. 294, 302).

A Deeper Look (Factor intensity of trade and how it shifts)

TABLE 1—CAPITAL-LABOR RATIOS FOR MANUFACTURED GOODS, 1879–1940
(\$000 PER EMPLOYEE IN 1909 DOLLARS)

A. 1899 Coefficients						
	1879	1899	1909	1914	1928	1940
Exports	4.186	4.059	4.052	3.961	3.946	3.374
Imports	2.608	2.886	2.785	2.850	2.907	3.221
Exports/Imports	1.61	1.41	1.46	1.39	1.36	1.05
B. 1909 Coefficients						
	1879	1899	1909	1914	1928	1940
Exports	5.405	4.877	4.967	4.811	4.959	4.193
Imports	2.999	3.079	3.020	3.073	3.486	4.444
Exports/Imports	1.80	1.58	1.64	1.57	1.42	0.94
C. 1947 Coefficients						
	1879	1899	1909	1914	1928	1940
Exports	4.725	5.170	6.350	6.790	6.330	5.265
Imports	2.910	3.440	3.420	3.690	4.325	5.850
Exports/Imports	1.62	1.50	1.86	1.84	1.46	0.90

Sources: 1899 coefficients from Mary Locke Eysenbach, *American Manufactured Exports, 1897–1914*, New York: Arno Press, 1976, pp. 302–306; 1909 coefficients from U.S. Census of Manufactures; 1947 coefficients from Wassily Leontief, “Factor Proportions and the Structure of American Trade,” *Review of Economics and Statistics*, November 1956, 38, 403–407.

Trade Figures: for 1879, 1899, 1914 from Eysenbach, pp. 271–275; 1909, 1928, 1940 from U.S. Commerce Department, *Foreign Commerce and Navigation of the United States*. Exact industry groupings available on request.

- Exports more capital intensive from 1879-1928 but export surge in early 20th century is not marked by a shift toward capital intensive exports.
- Decline in food processing exports actually behind some of downward trend in K/L ratio in X/M.

A Deeper Look (Factor intensity of trade and how it shifts)

TABLE 2—MEASURES OF SKILL INTENSITY OF MANUFACTURED GOODS, 1879–1940

	A. Percentage Earning More than \$12/Week in 1890					
	1879	1899	1909	1914	1928	1940
Exports	52.3	48.7	48.2	45.9	46.6	42.9
Imports	48.5	45.7	47.1	44.1	42.3	41.3
Exports/Imports	1.08	1.07	1.02	1.04	1.10	1.04
	B. Average Wage (1909)					
	1879	1899	1909	1914	1928	1940
Exports	0.467	0.482	0.487	0.502	0.504	0.541
Imports	0.431	0.433	0.460	0.426	0.463	0.471
Exports/Imports	1.09	1.11	1.06	1.18	1.09	1.15
	C. Percentage Women and Child Labor (1909)					
	1879	1899	1909	1914	1928	1940
Exports	10.1	10.7	9.9	11.0	11.2	10.4
Imports	30.6	29.0	30.2	27.8	24.2	21.1
Exports/Imports	0.33	0.37	0.33	0.40	0.46	0.49

Sources: Percent \$/week from Eysenbach, pp. 307–311; average wage from 1909 Census of Manufactures (wage bill divided by labor force); women and child labor from 1909 Census of Manufactures (females aged 16 and over, under 16, and males under 16, divided by labor force).

- Again, no discernible upward trend in high wage L or average wage in X sector, suggesting that skill not behind X surge of first half of 20th century.
- Post WWII data probably would not look the same.



A Deeper Look

TABLE 3—NONRENEWABLE NATURAL RESOURCE COEFFICIENTS IN MANUFACTURING GOODS, 1879–1940 (1947 COEFFICIENTS)

	A. Direct Use					
	1879	1899	1909	1914	1928	1940
Exports	0.0742	0.0677	0.0918	0.0988	0.09984	0.0564
Imports	0.0131	0.0194	0.0170	0.0133	0.0290	0.0369
Exports/Imports	5.66	3.49	5.40	7.43	3.39	1.53
	B. Direct and Indirect Use					
	1879	1899	1909	1914	1928	1940
Exports	0.1107	0.1239	0.1647	0.1800	0.1635	0.1240
Imports	0.0565	0.0747	0.0766	0.0749	0.0934	0.1127
Exports/Imports	1.96	1.66	2.15	2.40	1.75	1.10

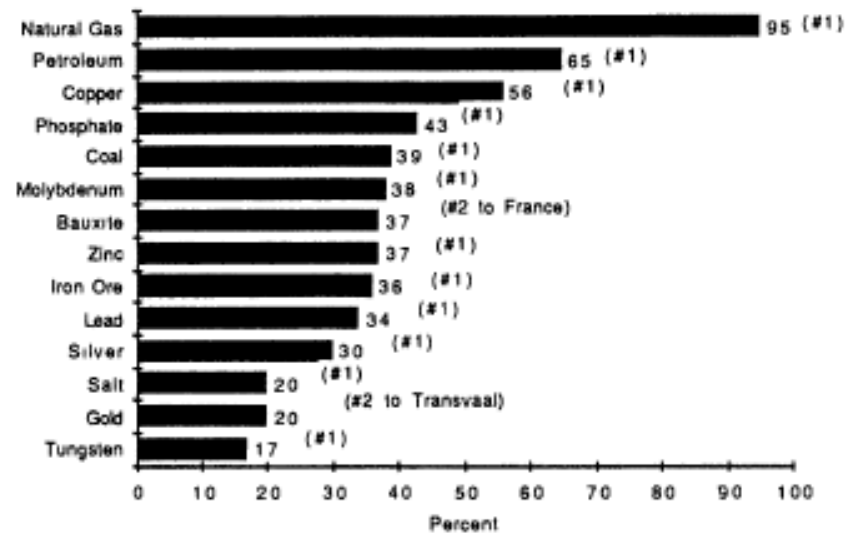
Sources: Coefficients from Eysenbach, pp. 297–301; trade figures, see Table 1.

- US exports had a higher nat. resource content than imports, “trend was growing both absolutely and relatively [during the period] the country was moving into a position of world industrial preeminence.”
- Resource intensity of imports growing. Reversed 1928, gone by 1943.
- Regression analysis confirms this evidence and illustrates complementary.

Natural Resources and American Industrial Success

- High transport cost era made US uniquely situated wrt major minerals.
- Ford UK paid 50% more for steel inputs than the parent company.
- Advantage of high throughput mass production where low-cost resources could be advantageous.

CHART 3. U.S. MINERAL OUTPUT, 1913:
PERCENTAGE OF WORLD TOTAL

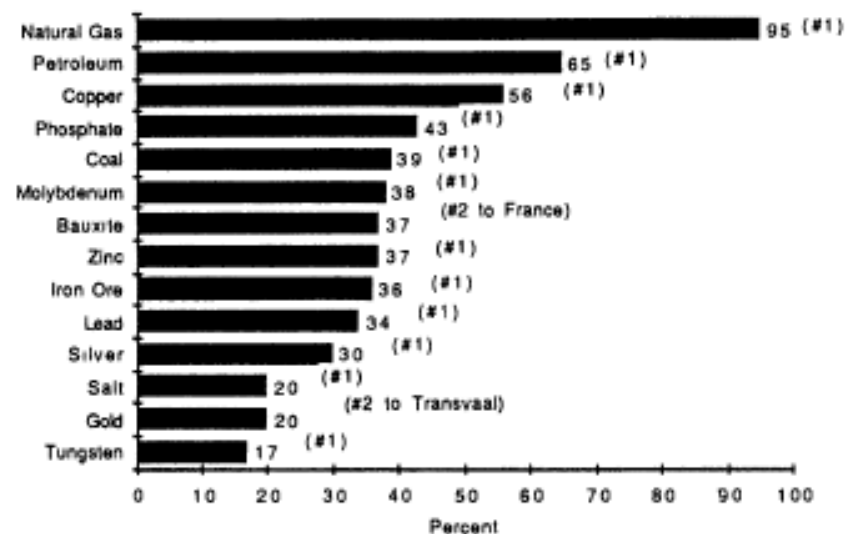


Source: Smith (1919), using data from U.S. Geological Survey (1913).

Natural Resources and American Industrial Success

- Exports led by Iron and Steel, Machinery, and Autos, add in oil and have 50% of US manufactured exports.
- High productivity/wages may have come from high throughput, low cost materials.
- Story not based on skill/technology but complementarity in input needs.

CHART 3. U.S. MINERAL OUTPUT, 1913:
PERCENTAGE OF WORLD TOTAL

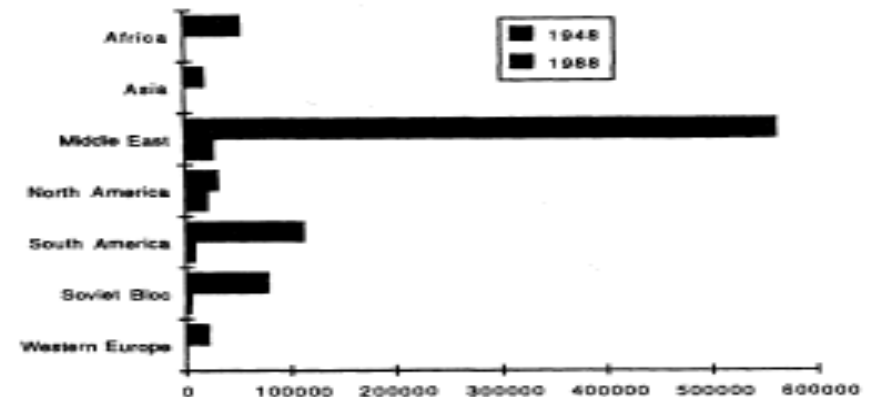


Source: Smith (1919), using data from U.S. Geological Survey (1913).

End of this era

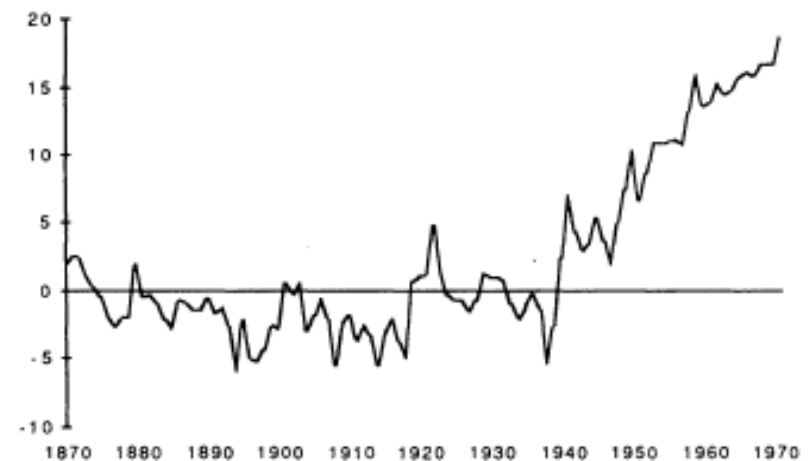
- 1920s, US becomes net importer of most minerals which means no longer in a preferred position.
- US had been heavily explored in late 19th century. Rest of world push in early 20th century.
- “Abundance” in US was related to large size and integrated transport system e.g. Mesabi ore in MN to PA coal.
- Globalization of resource industries has eroded nat'l adv. of natural resources as in US.

CHART 6. WORLD CRUDE OIL RESERVES, 1948 AND 1988



Source: American Petroleum Institute (1988, Section II, Table 1): “Estimated Proved Reserves of Crude Oil Annually as of January 1 (millions of barrels).”

CHART 4. U. S. NET MINERAL IMPORTS AS A PERCENTAGE OF CONSUMPTION



Source: Manthy (1978, Tables MC1 and MC2).



Value of this argument

- Solid historical example of an endogenous technology story that was crucial to long-term US success.
- Suggests how it can match up with other key resource endowments.
- Also, shows the ephemeral nature of “success” and leadership



Increasing Returns to SCALE (is bigger better?)

- *Dim Returns and Back again*
 - Diminishing returns – more capital, lower marginal return or productivity.
 - Crucial to convergence outcomes because justifies why capital would move to more productive and poorer places.
 - But, what if the returns are not diminishing?
- *Explore two types of increasing returns examples.*



Increasing Returns to SCALE (Fixed Costs)

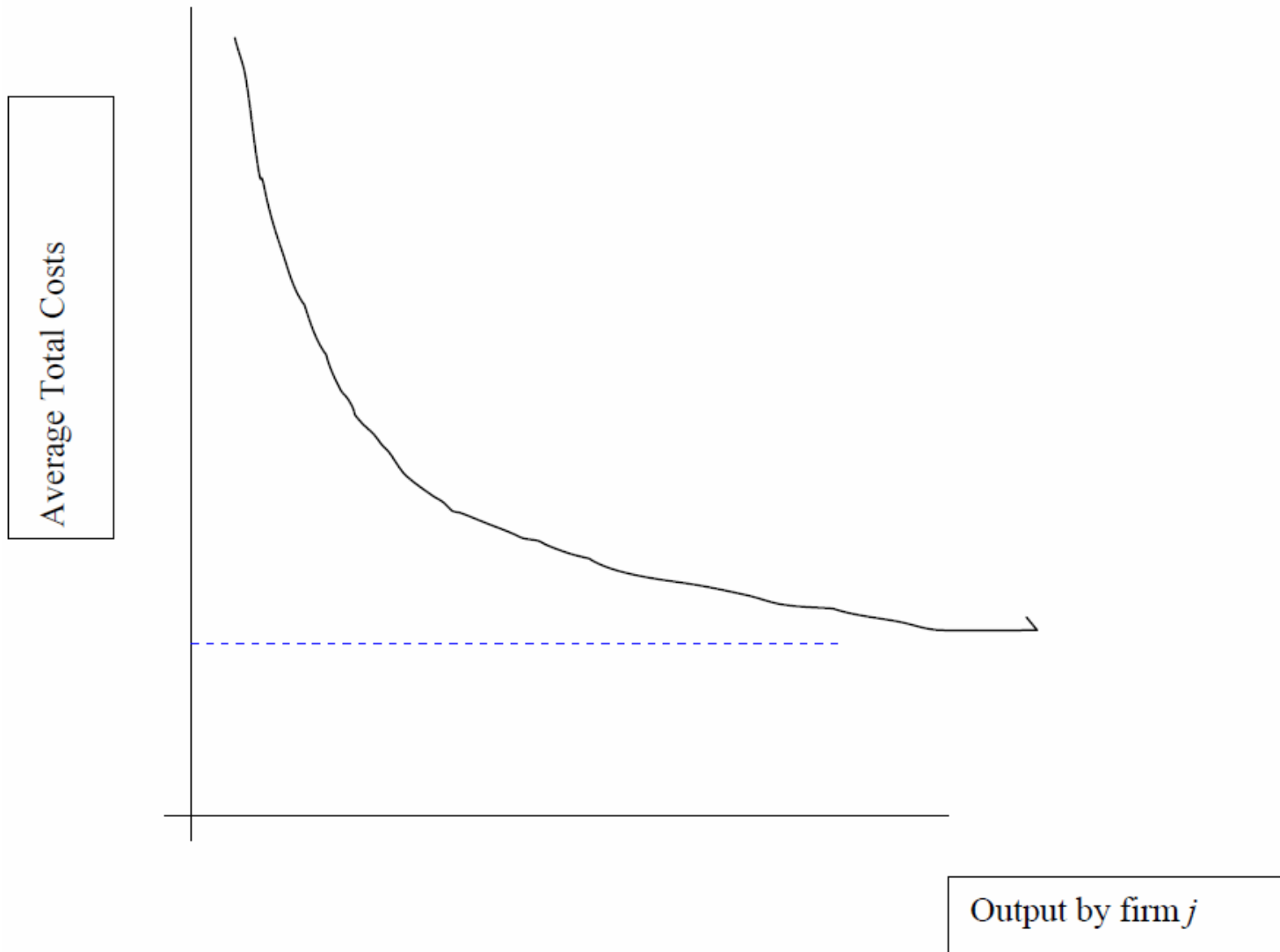
Fixed Costs	0	1000
Variable Unit Costs	10	10

Total Average Costs if produce:

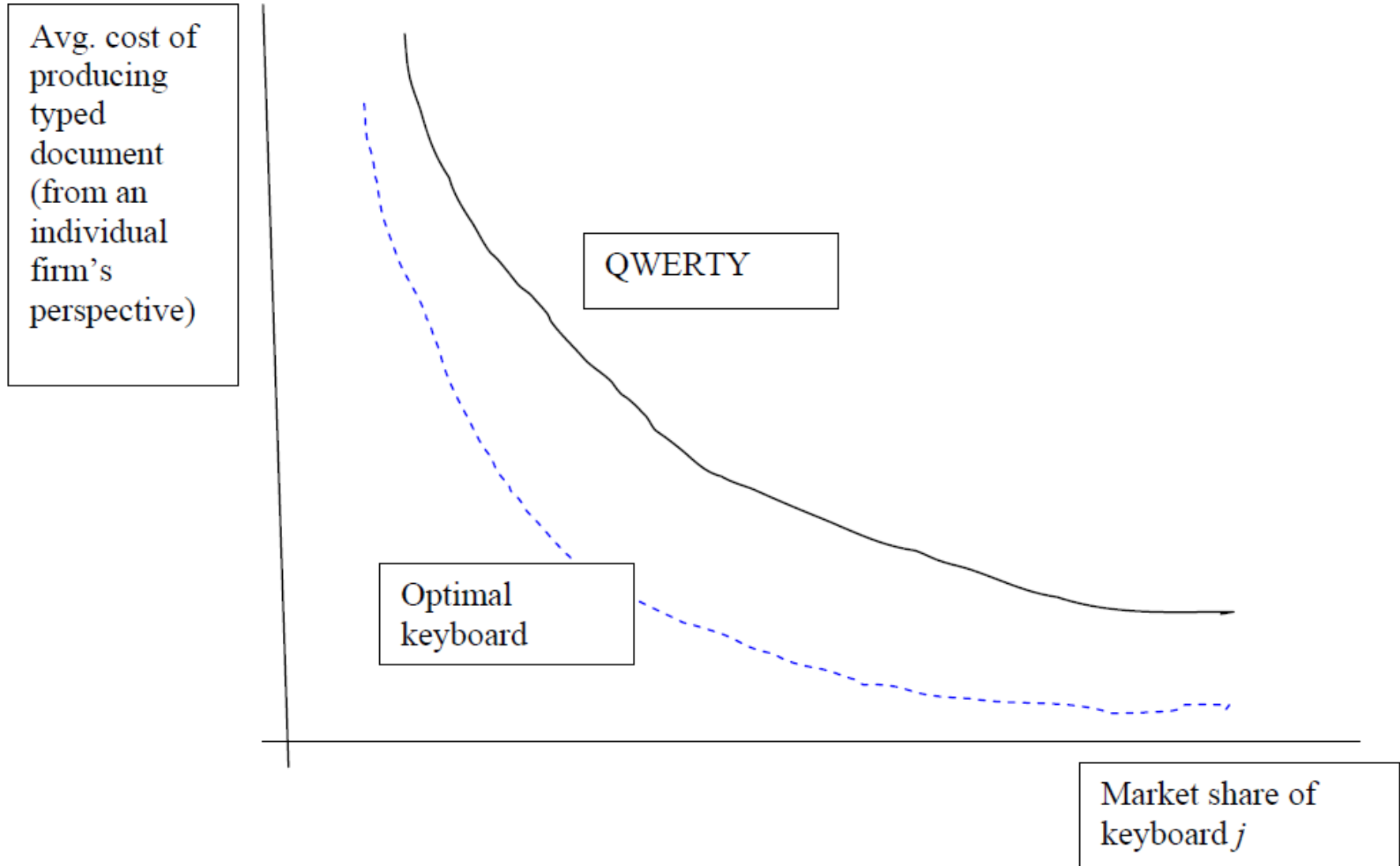
$$TAC = (VUC * N_units + FC) / (N_units)$$

10 units	10	110
100 units	10	20
1000 units	10	11
1,000,000 units	10	10.001

Increasing Returns to SCALE (Costs and Quantity)



Hypothetical QWERTY Example





Other examples of pecuniary externalities

- Supplier networks
- Labor markets
- Innovation (as in Nelson & Wright)
- More possibilities?



Leaks, Matches and Traps



Noorul Quader

- Dosh garments opens in Bangladesh, 1980 (43,000 shirts at \$1.28 each ~ \$55k)
- \$2b in short time (later as 54% of total exports)
- 130 workers trained by Daewoo in 1979 (& why did Daewoo do this in 1st place?)
- 6/30/81 Cancel agreement with Daewoo
- 115 of 130 exited Dosh to start own firms (over 700 by 1985)



Elements from Desh

- Knowledge non-rivalrous (Daewoo to Desh) & leaks
- Knowledge spills over/knowledge begets knowledge and know-how
 - Unstoppable growth after Daewoo left
 - Daewoo could not privately capture all returns (nor ultimately could Desh)
- Unanticipated 'public' returns to Daewoo investments made in the 1960s.



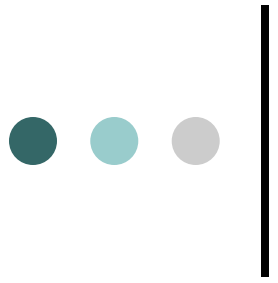
Elements from Desh

- Agglomeration (Desh versus Mohammadi Apparel)
 - Pre-Desh, would have been unprofitable to invest
 - After Desh, investment became profitable:
Knowledge + one dozen trained workers from Desh
- ‘Traps’ of History: vicious or virtuous circles?
 - Why not do it everywhere? Incentive issues
 - Ironies in Desh story (more contemporary Africa Growth with Opportunity Act, maybe Daewoo story again).
- Domestic examples of vicious/virtuous circles?




Complementarities & Expectations

- Are skills substitutes (diminishing returns) or complements (increasing returns with more skilled)?
- Easterly's examples of star chefs in Morocco (goes to France) and Indian surgeons (go to the West)
- More serious examples
 - Brain Drain (54% of World gdp on 10% of land area)
 - Urban pull (2% of US land produces 50% of GDP)
- Traps of Expectations



Public policy?

- Educated Indian 14 times more likely to emigrate than uneducated
- Gunsham and Bhutibai at Donutland: Why not more Gunshams?
- What are some implications for policy?



Learning-by-doing Model of Endogenous Growth

$$Y_j(t) = A(t)K(t)_j^\alpha L(t)_j^{1-\alpha}$$

- Usual production setup
- j indexes a firm so if firms are small relative to economy size, no effect on $A(t)$



Learning-by-doing Model of Endogenous Growth

$$A(t) = ak(t)^{(1-\alpha)} = a(K(t) / L(t))^{1-\alpha}$$

- Assume technology grows as capital per worker
- Akin to “complementarity” story

- ● ● | Let's put it all together

$$Y(t) = [ak(t)^{(1-\alpha)}]K(t)^\alpha L(t)^{1-\alpha}$$

$$= aK(t) \left(\frac{L(t)}{L(t)} \right)^{1-\alpha} = aK(t)$$

- Ignore j now and look at Output country-wide
- What is the story with diminishing returns?
- Looking familiar yet?

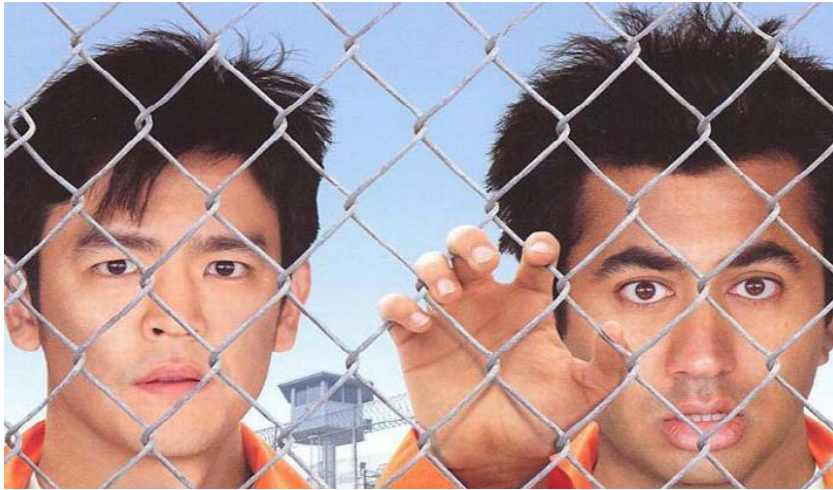
● ● ● | Let's put it all together

$$y(t) = ak(t)$$

- Output per worker grows as in Harrod-Domar
- a is analogous to $1/\theta$
- Endogenous growth and Convergence?



So Endogenous growth can make:



=





Next Time

- Weil 9.3
- Pack and Saggi