

SUMMARIES OF LECTURES in ECO 303Y1:
the Economic History of Modern Europe, to 1914
for the Academic Year: 2012 - 2013

X. Week no. 10: Lecture Topic no. 10, on 14 November 2012

The Industrial Revolution in Cotton- Textile Manufacturing: a Consumer Goods Industry (first part)

1. Importance of Textiles (Clothing) in Human History:

a) **textiles are consumed to meet one of the three basic human needs, as necessities:** food, clothing, and shelter

- i) protection against the elements: cold, heat, rain, snow, ice, sand storms, the sun (melanomas)
- ii) protection against physical abrasions
- iii) protection against a sense of shame: nudity as a social taboo in most (not all) societies

b) **luxury needs provided by textiles:** assertion of personal social status (social ranks) and social worth

c) **major types of textiles in human societies, past and present:**

- i) wool-based textiles: woollens (many costly) and worsteds (most relatively cheap): predominant in medieval and pre-Industrial Revolution Europe (now rare, in 21st century)
- ii) silks: the most luxurious of all fabrics (though rivalled by some luxury woollens)
- iii) linens: from cheap to costly luxury fabrics
- iv) fustians: a hybrid mixture of linen (warp) and cotton (weft): originating in 10th-century Egypt
- v) cottons: an industry in which Asians excelled, but in Europeans gained mastery (temporary) thanks only to the technology of the Industrial Revolution

d) **Contrast with the Iron Industry of the Industrial Revolution era:**

i) **Iron Industry:** a capital-goods industry

- (1) metamorphosis (transformation) from an artisan handicraft industry into a capitalist industry took place (in England) in the 16th century with the introduction of the Blast Furnace: no fundamental change in Industrial Revolution era except for very large scale increases
- (2) chiefly chemical processes of innovation in using coal fuels, in the form of coke throughout, for both smelting and refining
- (3) coal-fired steam power to operate machinery of smelting and refining: same as in cottons
- (4) Industrial concentration around coal fields, with both vertical and horizontal integration
- (5) Very large-scale production with oligopolistic competition: price-makers
- (6) only marginal role in English foreign trade before the 1830s

ii) **cotton industry:** a consumer-goods industry

- (1) capitalist metamorphosis took place in the Industrial Revolution era: from a rural, small-scale handicraft industry with production scattered across the countryside to an urban factory-based system of production using steam engines to power many and different machines
- (2) But still smaller scale than found in the iron industry, with spinning and weaving mills or factories often kept separate

(3) pure competition (only industrial example): firms were price-takers

(4) major role in British foreign trade, accounting for 46% of exports by 1820s (maximum share, with relative decline, but not absolute, thereafter)

2. **Origins of the British Cotton Industry of the Industrial Revolution era:**

a) **a fustians industry:** (Egyptian origins: 10th century) that had spread to Italy, Germany, and the Low Countries during the medieval and early modern eras

i) One of the New Draperies that Flemish Protestant Refugees fleeing Spanish conquest and Catholic persecutions brought into East Anglia (Norfolk, Suffolk) from the late 1560s (Revolt of the Netherlands)

ii) industry had migrated NE to Lancashire and Scotland: in search of cheaper labour

iii) nature of the fustian textiles

(1) warp (foundation yarn on the loom): made from linen fibres (extracted from flax): strong

(2) weft (the yarn woven between the separated warps): made from soft cotton fibres (weak – too weak to be used for warp yarns)

iv) South-Asian (Indian) supremacy in cotton textiles

(1) based on continued use of the millennia-old drop spindle and distaff: which had always produced the strongest and finest yarns, whether woollen or cotton: read the lecture notes

(2) but drop-spindle spinning was very labour-costly: 18th-century Indian hand spinners took over 50,000 hours to produce 100 lb of cotton compared to 135 hours for Robert's self-actor steam mule of 1825

(3) European spinning wheels: introduced (from Muslim cotton industries) in late 12th & 13th centuries

1. vastly increased labour productivity

2. but produced much weaker and lower quality yarns

3. originally used only for wefts in woollen industry

(4) Saxony Wheel: major improvement in 15th century, for spinning woollen/worsted warps – but not cotton.

b) **manufacture of fustian cloths:** processes

i) flax: retted and combed to produce linen fibres for spinning

ii) cotton: carded (brush-like multi-pronged instruments) the fibres for spinning

iii) spinning linen warps

iv) spinning cotton weft

v) weavers: used linen warp and cotton wefts to weave the cloth (see notes and diagrams)

c) **Industrial Production by the Putting-Out or Domestic System of Production:** a hybrid of mercantile capitalism and artisan handicraft manufacturing

i) **Merchant clothier:** the mercantile-financial capitalist entrepreneur who supplied the raw materials (linen and cotton), the working capital needs, and the marketing of the finished fustian cloths:

- ii) **The Master Weaver:** the industrial entrepreneur or sub-contractor employed by the clothier
- (1) he received or 'bought' the raw materials on credit from the clothier
 - (2) he 'put out' the raw materials to the various artisans, chiefly female, who worked in their own homes or cottages in the surrounding countryside: the flax retters and comber, the cotton carders, the flax spinners (warps) and the cotton spinners (wefts)
 - (3) the weaver and his family or hired employees then wove the warps and wefts into fustian cloths
 - (4) the finished product was sold to the clothier

iii) **incomes earned in this putting-out or domestic system:**

- (1) the weaver's income was in the form of profits, not wages,
- (2) those whom he employed received piece-work wages, thus according to their output, since they were unsupervised

iv) **note that the capital costs of production :** are largely born by the artisans themselves, working in their own homes

v) **this putting-out system, in cotton-fustian textiles, was almost entirely rural:** though 'putting out' systems can also be found in early-modern urban craft industries as well

vi) **the metamorphosis from a rural putting-out system:**, using no powered machinery, to an urban-based factory system of production using steam-engines as a central source of power: the product of the two, separate industrial revolutions in spinning and weaving, to be seen in the next lecture.

3. Domestic and Foreign Markets for the English Fustians Industry:

a) **Role of English Mercantilism: the Calicoes Act of 1721:**

i) British East India Company imports of South Asian calicoes and muslins provoked strongly hostile reaction from the established textile industries: woollens and worsteds (though calicoes were a substitute only for worsteds – not woollens – as a cheap and light fabric)

ii) clamours for protection led to increasing restrictions on Asian textile imports and finally the Calicoes Act of 1721, which banned not only the imports but also wearing of foreign calicoes (but did not affect the re-export trade in calicoes and muslins)

iii) chief beneficiary was the new English fustians industry, whose products were the closest substitute for imported calicoes: so it gained control over the domestic market

iv) but the fustians industry was not competitive abroad, in either quality or price: not unless it changed its technology to produce an all cotton cloth

b) **The role of India and Africa:** for foreign trade in textiles

i) Calicoes Act had not prohibited import of Indian yarn, which could have been used to weave substitute calico products within England

ii) But disintegration of the Muslim Mughal Empire after death of Emperor Aurangzeb in 1707 and ensuing civil wars with Hindus and Sikhs seriously disrupted trade in both calico textiles and cotton yarns

iii) **Royal African Company:**

- (1) had been re-exporting large quantities of calicoes to West African (in purchasing slaves)
- (2) with a lack of calicoes, had commissioned English fustian producers to produce all-cotton imitations of calicoes and muslins, but they were so inferior that they could not be sold

iv) hence incentive for technological change in the English fustians industry – all the more so when relative peace in India, by 1740s, restored re-export trade in calicoes and muslins

4. **The Revolution in Spinning**

a) **Wyatt and Paul: 1738:** the first attempts to mechanize spinning

i) after a decade of experimentation, developed the water-powered Spinning Roller to spin cotton yarn, and set up a factory

ii) proved to be a failure, but provided a key source for future successful innovation

iii) note that their experiments took place during the disruptions of trade in both calicoes and cotton yarns

b) **Hargreaves Spinning Jenny:** of 1764 to 1770 (when patented)

i) vast improvement on the traditional spinning wheel to operate not one but up to 100 spindles

ii) moving carriage, with the driving wheel: when moved further away from the spindles, it attenuated the cotton yarns, and thus made them finer

iii) produced a cotton yarn as fine as any made in South Asia, but a weak yarn suitable only for the weft

iv) quickly displaced traditional spinning wheels in making weft yarns

v) used no mechanical power and required little capital: fitted in well with the rural putting-out system, with female spinsters working in their own homes.

c) **Arkwright's Water Frame of 1769:**

i) Arkwright not the inventor: stole the idea from John Highes

ii) used the basis of the Wyatt-Paul spinning rollers to have water-powered rotating 'throstles' spin the yarn

iii) result a cotton warp yarn could now be spun, one with sufficient strength, but lacking fineness to compete with Indian yarns: so that all cotton textiles were made from Water-Frame warps and Jenny wefts

iv) Arkwright also established first successful water-powered factory in cotton textiles

v) He also invented a water-powered carding machine to prepare raw cotton for spinning

d) **Crompton's Mule of 1774-1779**

i) a hybrid of the Spinning Jenny and the Water Frame: using the multiple spindles and moving carriage of the Jenny (to provide fineness) and the water-powered throstles (to provide strength)

ii) England could now produce both warps and wefts of sufficient fineness and strength to be woven into all-cotton cloths rivalling the best South Asian textiles

iii) productivity gains: when Indian hand-spinners (drop spindles) took over 50,000 hours to produce 100 lb of spun cotton yarn, Crompton's original 1779 mule took only 2,000 hours, which he reduced to just 300 hours with his water-powered mule of 1800

e) Robert's Steam-Powered 'Self-Actor' Mule of 1825:

i) replaced water-power with effective, smooth running steam engines

ii) reduced time to spin 100 lb of cotton to 135 hours (40 hours today)

f) Thorp's Ring-Spinning of 1830:

i) an American innovation that superseded the mule everywhere but in Great Britain, before World War I (and in Britain after World War I).

ii) much lower cost, but not able to compete with mules in very fine (high count) yarns

f) consequences of the victory of steam-powered mules in Great Britain

i) reduced cost of cotton yarn by over 90% by 1830s

ii) principal factor in making the cotton textile industry an urban industry based on coal-fired steam powered factories

iii) democratic revolution: so reduced costs and prices of cotton textiles that they became cheaply available for mass consumption by even the lower strata of the working classes of Great Britain

iv) gender change: mule-spinners were exclusively male, who totally displaced female wheel and jenny spinners

v) also destroyed the cottage industry in spinning, at least

5. The Revolution in Weaving: a much longer process

a) **the revolution in spinning:** created a severe imbalance in the production process since cotton cloth manufacture obviously required the combination of spinning and weaving

b) Cartwright's Power Loom of 1785-87:

i) first attempt to resolve this problem: with a water-powered mechanized loom, and a weaving factory

ii) but the machinery was a failure: in causing damage to the yarns while weaving

iii) Cartwright went bankrupt when his factory failed: but provided the core solution

iv) the problems of mechanizing weaving were not fully resolved until the 1830s

v) Robert's Self-Actor Steam Power Loom of 1822-30: was the key break through (perfected by Kenworthy and Bullough in 1842)

c) Why did weaving take so long to mechanize?

i) very elastic supply of rural hand-loom weavers, because of Enclosures: number tripled from 1790s to the 1830s

ii) relative costs: weaving labour became cheaper while the machinery was far more expensive than in spinning factories

iii) trade cycles:

(1) meant that factories were often underemployed and not economic to run

(2) by 1840s, British exports and market power created sufficient stability to justify factories

iv) bitter opposition of male handloom weavers to factory employment and factory discipline

(1) burning factories to the ground was another disincentive to investing in power looms

(2) not a problem in spinning factories: because well-paid mule spinners had displaced females

6. The Cotton Gin:

a) **Eli Whitney:** a Connecticut Yankee: invented the cotton gin in 1792

i) machine to extract the short-fibred cotton from its boll, which had previously been prohibitively expensive

ii) but short-staple cotton was the only type that could grow in the US South (apart from some long-stapled Sea Cotton, grown in islands off the Carolina coasts)

iii) created a vast plantation economy and a vast expansion in African slave labour: as the major economic mainstay of the southern American states to the Civil War

b) American exports:

i) previously Great Britain had obtained its cotton from the eastern Mediterranean (Palestine-Syria) and India

ii) Now the U.S. became Britain's chief cotton supplier: exports rose from 0.5 million lb in 1793 to 120.0 million lb in 1820

iii) Note that Britain supported the South during the American civil war

7. Economics of the Factory System of Production in Cotton Textiles: potential gains

a) **technology: a central source of mechanical power**

- i) originally water-power (hence cotton 'mills') and then steam-power
 - ii) shift to steam power meant a shift from rural to urban locations
 - iii) steam power to drive many machines of the same kind and also different machines: in spinning, carding, and weaving (though not always)
- b) **increasing returns to scale:** economics of large-scale production, in comparing urban factories with the rural putting-out or 'cottage' system of production
- c) **savings in transaction costs:** by concentrating production in urban locations, near centres of finance and marketing
- d) **labour economies from factory supervision discipline:** impossible in rural putting-out system
- e) **substituting relatively cheap capital for expensive labour:**
- i) low wages do not mean low labour costs: have to be measured in terms of productivity
 - ii) rural putting out an inelastic system of production, in which costs rose sharply as clothiers ranged further afield to find carders, combers, and spinners
 - iii) enormous productivity gains from capital investment in steam-powered machinery
- f) **Questions of Industrial Integration and Industrial Scale:** pure competition
- i) unlike the iron industry, the cotton industry did not experience complete industrial integration
 - (1) 1856 statistics for Lancashire: 41% of factories were for spinning only, 24% were for weaving only and thus only 35% had integrated spinning and weaving within one factory
 - (2) reflects in part the long-delayed mechanization of weaving, before which many spinning factories had been established
 - (3) also reflects fact that many spinning factories specialized in very high-count fine yarns for export
 - ii) therefore, while the Industrial Revolution in cottons had created a metamorphosis from rural handicraft to urban capitalistic production, it did not produce the same scale changes as in the iron industry
 - iii) very large number of relatively smaller scale factories: with a total of 1,451 firms in Lancashire alone in 1856
 - iv) hence the essence of pure competition in the cotton industry
 - (1) producers selling homogenous, interchangeable products (at least in terms of fineness categories_)
 - (2) so many sellers and so many buyers that none could influence the price
 - (3) sales by weekly auctions.

8. Why did the Industrial Revolution take place first in cottons, before woollens? Read the lecture notes