

The Invention and Diffusion of New Technology in the Global Cotton Industry, 1790s-1850

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Technology, the rules, forms and devices by which society and its members exploit matter and energy for their own purposes, is a complex phenomenon. So too are the processes by which technology undergoes change. Central to technological change are the two subordinate phenomena of invention and diffusion. Both have been studied extensively and from many perspectives including those of philosophy, psychology, sociology, economics, art, and science. This paper examines invention and the international diffusion of technology from an historical perspective and is confined to the cotton industry at a time (nearly 200 years ago) when cotton was the equivalent of computers today: at the cutting edge of technical and organizational change.

In attempting to relate invention and diffusion in global cotton manufacturing, this investigation uses four hypotheses as routes to inform, though not rigorously test, the invention-diffusion relationship. These hypotheses assume particular definitions of invention and diffusion. Invention is defined as the generation of new technical knowledge capable of achieving measurable factor savings. Such savings would be measured by absolute or relative reductions in the quantities and prices of the factors of production (land, labour, capital, entrepreneurship). International diffusion is defined as the importation into one society of new technical knowledge (capable of achieving factor savings) that has originated in a different society or societies.

The hypotheses informing the analysis are the following:

1. Invention may not be a rational response to international diffusion – rational in the sense of maximizing profit-making opportunities. This may be because the factor conditions and social institutions (rules) may not much differ between societies and therefore the imported technology may need little alignment.
2. Invention may occur without international diffusion. New technical knowledge may be derived from old technical knowledge that has been stored for decades or centuries in a given society.
3. Invention is an essential and rational response to international diffusion when new technical knowledge reaches a society possessing factor conditions and social institutions measurably different from those of the society originating and first

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implementing the new technical knowledge. Such necessity arises from those divergences in factor conditions and social institutions.

4. Both invention and international diffusion may be obstructed by pre-industrial values. This is likely because the pre-industrial value most responsible for hindering both was secretiveness, which is inimical to all processes that depend upon the sharing of new knowledge.

The paper is in five parts. The first identifies the period and the countries where the dramatic initial expansion of the cotton industry invites an examination of invention and diffusion. Britain, well ahead, France, and the USA emerged as global leaders during the years of most rapid expansion, 1790-1830.

The second part considers invention. Differentials in the patent institutions of the three countries are described and differences in the timing, magnitude, and direction of aggregated inventive effort in their respective cotton industries are presented. Major inventions are isolated and invention is cast in terms of combinative mental activity, following the neuroscientist Steven Pinker.

In the third part, international diffusion of new cotton manufacturing knowledge between Britain, France, and the USA during this vital period is shown to be heavily dependent upon migrant artisans. At the same time, their successes occurred within an institutional framework which favoured American inventors in Europe but disadvantaged European inventors in the USA. A stage model of international diffusion is proposed as the most appropriate for understanding global diffusion the early industrial period.

The fourth part examines the relationship between the generation of technological knowledge and its international diffusion. It is observed that the final stage in the international diffusion of new technology is its modification to suit the factor conditions and social institutions of the importing economy. This was most clearly demonstrable in the case of the USA. And modification equates to invention (though not all invention, of course). Those inventions developed in the importing economy (the USA) were selectively chosen by their inventors for offering to fresh hosts and markets (European competitors) and were then patented along an eastwards route beginning with the USA. The greatest barrier to the global spread of new technology in the cotton and machine making industries was secretiveness. While it persisted in the British cotton industry, this pre-industrial attitude vastly diminished in the American industry by the end of the 19th century.

The final part of the paper indicates several micro-level ways in which invention and international diffusion in the global cotton industry contributed to economic development in other global industries.