The Antebellum Tariff on Cotton Textiles 1816-1860: Consolidation

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Recent research on the importance of the antebellum tariff for the survival of the American cotton textile industry has come into highly conflicting conclusions. By examining both the British and American experiences throughout the period, we find that both extreme conclusions are potentially misleading. Our results suggest that both the quality composition of imports from Great Britain and the American cotton textile industry were both quite responsive to changes in the tariff. We find that elimination of the tariff at any point throughout the period would have cut back domestic production 20-40%, amount not necessarily crucial to the survival of the American industry, but potentially significant especially in the early stages of the industry.

19th century cotton textile industry has received considerable attention from economic historians. Not only did the mechanization of cotton spinning spearhead the Industrial Revolution in Britain, but it also brought Industrial Revolution to the United States. Although it can be said that cotton textile production in the America truly started in the 1790s, the 1807 Embargo, the Non-Intercourse Act of 1808 and then the formal commencement of hostilities in 1812 with Great Britain provided the protection and impetus which led to a period of rapid expansion. The ending of hostilities in 1815 threatened to wipe out much of the industry that had undergone a period of uncontrolled expansion through 1808-1815. Under duress it successfully lobbied for tariff protection, which it received in 1816 and was continued through the whole period under study.

For a long period commentators accepted Frank Taussig's view that "almost certainly by 1832" the cotton industry had reached a position of international competitiveness and hence the tariff was largely redundant for the remainder of the period¹, and much of the writing focused on more technical aspects of the industry. More recently the orthodox view regarding the importance of the tariff protection afforded to the industry throughout the period has become under more detailed scrutiny. Mark Bils finds using cost analysis

¹ Taussig, *Tariff History*, p.136

for 1833 that most of the American cotton textile manufacturing would have been wiped away should the tariff have been removed then². C. Knick Harley constructs detailed cost and price data for the American and British cotton textiles for period 1845-1860 as evidence that even through this period American textiles had not yet reached a point of international competitiveness³. On the other hand Peter Temin⁴ and later Peter Temin and Douglas A. Irwin⁵ have pointed out that the products produced by the British and American manufacturers occupied very different spaces in the quality spectrum and that although the quantity of British exports to the United States through 1826-1860 varied with changes in the effective tariff rate, the output of the American manufacturers was highly unresponsive to changes in this tariff, indicating a sufficient level of efficiency and providing evidence supportive of Taussig's earlier judgment.

This article briefly reviews the methods and findings of above authors and then provides a unified framework in which to analyze the question. The main sources of differences are seen to be both Bils and Harley focusing on absolute instead of comparative advantage, and Irwin and Temin neglecting the potential endogeneity of quality composition of British imports. Re-interpreting the data in a framework incorporating insights from both approaches used, we find that while the results of both Bils and Harley overestimate the importance of the tariff by not allowing for any adjustment processes, the results of Irwin and Temin are biased downward because of endogeneity bias in their regressions. We conclude that while the tariff was not necessarily crucial to the sole survival of the industry post-1820s, it would have come under considerably greater competitive pressure and the response in output could have been large throughout the whole period under analysis.

² M. Bils, "Tariff Protection"
³ Harley, "International Competitiveness"
⁴ Temin, "Product Quality"

⁵ Irwin and Temin, "Antebellum Tariff"

I: BRIEF HISTORY OF COTTON TEXTILE MANUFACTURE

The Revolution in cotton textile manufacture can be identified with the mechanization of the spinning process in England in 1770s, after which she quickly gained the position of world supplier of cotton manufactures. While spinning became rapidly mechanized, culminating in the mule spindle that came to dominate the British spinning well into the 20th century⁶, the weaving process remained a labor-intensive process, undertaken by handloom weavers.

Samuel Slater, 'father' of the American cotton textile industry, immigrated to the United States in 1789, and brought with him the direct knowledge of the water-frame technology developed by Arkwright. Although some copies of Hargreave's spinning jenny had been constructed already in 1770s, it was the water-frame, with minimal skill requirements and reliance on waterpower, abundant in New England, which was to revolutionize the American cotton manufacture⁷, leading it into a period of modest growth until 1807. The American manufacturers recognized from the start the intensity of competition by the British imports, and this, coupled with the fact that the water-frame was superior in producing only low-count yarn, led the industry on a path of producing solely low-count, low-quality textiles, as opposed to the British experience, based on the more versatile mule.

Throughout the early period the American industry remained very small. Although data is scarce, it has been estimated that there were roughly 5,000 spindles in operation in the United States by 1805^8 , nearly all water-frames, with a value of output totaling \$978,000, while imports from Britain valued at \$13,110,000⁹. Great Britain also maintained greater variety in processes with ratio of mule to waterframe spindles being roughly 7/3 in 1790^{10} .

The passing of the Embargo Act in December 1807, leading to the cessation of trade with Europe, gave the young market near-perfect protection, which continued until 1815 and the ending of hostilities with Britain. Although going through a period of relative distress

⁶ Improvements in the design culminated in Robert's 'self-acting' mule of 1825-30 (8)

⁷ Rosenbloom, "Path Dependence", pp. 7-8

⁸ ibid., p.31

⁹ Irwin and Temin, "Antebellum Tariff", p.794, from Zevin, "Growth", p.123

¹⁰ Rosenbloom, "Path Dependence", p.9

in 1807-1808 as the fortunes of New England merchants, who were the main market of many of the manufacturers, were diminished¹¹, it was quickly reversed to period of rapid expansion. The American cotton textile industry grew tenfold in capacity in the decade 1805-1815, producing output valued at \$47,160,000 by 1815¹².

The mechanization of spinning in both countries meant that weaving technology lagged behind. In Britain, the number of handloom weavers expanded rapidly, from 75,000 in 1795 to 225,000 by 1811¹³, while in the United States the availability of skilled handloom weavers, due to strict regulation of immigration by Britain until 1824¹⁴, proved to be the bottleneck for the expansion of the industry. A number of manufacturers were attempting to develop a power loom to overcome this obstacle in both countries. In the United States, Lowell aimed from the outset to develop a machine able to weave a single, uniform product, and so, "by dispensing with the need for flexibility, and concentrating on weaving a coarse varn, [he] was able to substantially simplify the mechanical problem of building his loom."¹⁵ Equally crucial for the further development of the American industry was the decision to integrate the spinning and weaving processes into a single textile factory¹⁶. First such cloth was produced by the Boston Manufacturing Company in 1815. The integrated nature of the Lowell-Waltham style of mill imposed a number of technical restraints on their operation. For example, finer goods needed more spindles per carding machine or loom, and switch from one quality to another would unbalance the machinery and labor force. Further, besides high fixed capital requirements, the industry initially needed to provide workers' housing, leading to falling average total costs¹⁷. In the meantime, the British aimed at maintaining greater flexibility in the production process to be able to take advantage of the changing world market conditions¹⁸.

The cessation of hostilities led to a great increase in imports of both cotton yarn and cloth to the United States. Having undergone a period of rapid expansion the nascent American

¹¹ Ware, Cotton Manufacture, p.39

¹² Irwin and Temin, "Antebellum Tariff", p.794

¹³ Leunig, "Cotton Industry: Technological Change"

¹⁴ Export of machinery was restricted until 1843.

¹⁵ Rosenbloom, "Path Dependence", p.13

¹⁶ ibid., p.14

¹⁷ McGouldrick, New England Textiles, pp.18-19

¹⁸ Further, it should be noted that while power looms gained foothold through 1810s in both countries, the weaving of finer textiles remained a labor-intensive process until the 1840s, when the design of the power loom became fine enough to be able to weave such fabrics.

industry found itself in trouble and in need of protection. The value of cloth production fell from \$47,160,000 estimated for 1815 to \$16,355,000 in 1816¹⁹. Under duress, the manufacturers lobbied for and received tariff protection. Among them was Francis Lowell, who was instrumental in devising the system that was put in place, with a minimum valuation structure combined with ad valorem rate that discriminated strongest against cheaper, low-quality textiles, leaving the higher-quality end less affected by the tariff. This was designed so as not to upset the British, who were a major market for the cotton farmers of the South, while keeping especially Indian textiles out of the market. This tariff was set in place 1816, and revised several times after that. Because of the minimum valuation system and falling cotton textile prices, the effective ad valorem rate faced by the British export basket varied throughout the period in the range of 24-60%. In 1846 the minimum valuation requirement was removed but the tariff was still maintained at 25% ad valorem.

The early period was marked by rapid technological progress as improvements and new innovations in both machinery and organization took place in both countries. In 1810 cotton textile mills were still confined to spinning, but by 1830 all but few minor processes in the whole cloth manufacturing process had been mechanized, and real cost of capital had fallen by roughly one third²⁰. While the technological advances took place in the United States, the British industry was also changing to power looms, enabling them to produce efficiently the coarse cloth types pioneered in the United States^{21} . Further, although the main technological innovations had taken place by the early 1830s, the productivity of especially labor continued to improve all the way to 1860, evidently through learning by doing and diffusion of best practices²². Britain also witnessed an additional wave of technological progress in the late 1830s, when the power loom became versatile enough to weave also high-count cloth, leading to a collapse in the earnings and employment of handloom weavers.

The Massachusetts-style integrated mills continued to strive, but the less integrated and smaller Rhode Island mills, producing finer goods, found it difficult to compete against

 ¹⁹ Irwin and Temin, "Antebellum Tariff", p.794
 ²⁰ McGouldrick, *New England Textiles*, pp.18-19

²¹ ibid., p.31

²² David, "Learning by Doing", Davis and Stettler, "Trends and Fluctuations", pp.227-232

the British imports even with the tariff in place, and largely vanished by the 1830s. This was also the experience of the Massachusetts-style Hamilton company that ventured into the production of finer, number 40 yarn in 1824, and by 1827 coming to the conclusion that "the fine goods which we make are found to be worth very little more than those of a coarser description; and, costing much more" not profitable. The whole mill was converted to producing only No. 22 yarn²³.

By 1830s, the American industry was highly vertically integrated, producing coarser fabrics, with average count in the low 20s, while the British industry remained more versatile, with counts ranging from 8 to 180 with mean around 50^{24} . While the American quality range is relatively well known, there is some disagreement on how British capacity was divided over the quality range. It is suggested that roughly 30% of employment in the British cotton textile industry was in counts 10-30 and 60-70% in 10- 50^{25} .

Both output and price movements are presented in figures 1.1 and 1.2 respectively, and these will work as the essential backdrop for the remainder of the article, so few preliminary comments are in place. Firstly, by 1826, the American market was not of inconsiderable size relative to total British exports. This indicates that considerable changes in the allocation of both final destination and type of output would have been required to fully wipe out the American producers. At the same token though, we can see that if roughly 30% of total British exports were in the count range of 10-30, post-1826 the British output was still sufficiently high to cause considerable replacement if directed at the American market. The British exports accounted for roughly two thirds of her output throughout the period in question and slowly climbing, totaling close to 80% by 1900²⁶. Secondly, we see that the price of British exports to the United States was considerably above the average export price over the high-tariff period of 1820-1845, after which it declined slowly towards the average.

²³ Nathan Appleton, "Introduction of the Power Loom and Origin of Lowell,", Kress Collection, Harvard Business School (Lowell, MA, 1858), quoted in Temin, "Product Quality"

²⁴ Temin, "Product Quality", pp.894-96

²⁵ Harley, "Reply", p.801 and Temin, "Product Quality", p.896

²⁶ Sandberg, "Movements in the Quality", pp.1-2



Source: British figures are from Great Britain, House of Commons, Sessional Papers 1847/48, 1851, 1856 and Helm, "Cotton Trade", and American output is from Zevin, "Growth", pp.123-24, years not reported were interpolated using output figures by Davis and Stettler, "New England Cotton Textile Industry"



Source: British export prices are from Great Britain, House of Commons, Sessional Papers 1847/48, 1851, 1856 and Helm, "Cotton Trade", US price is from Zevin, "growth", p.12, and tariff-inclusive price based on author's calculation

II: RECENT LITERATURE

Three recent articles have directly analyzed the role of the tariff, and since what follows is largely based on the insights contained in these articles, it is worth briefly reviewing the method used, results obtained and critiques faced by these articles.

Mark Bils²⁷ uses cost analysis as the basis for his article. Using the observation that labor was cheaper in Great Britain and that raw cotton cost less in the United States, with the technological fact that the production of higher quality cloth required relatively greater labor input and less raw cotton, he constructs a point estimate for 1833 of how the costs of production varied with the quality of the cloth, and hence how much protection did the tariff in place provide to the American industry, and how much of it was actually needed. He finds that should the tariff have been removed, "considerably more than half of the industry's revenue would have been eliminated. Furthermore, value added in the industry would have been reduced to an even greater extent because the cost of raw cotton constituted a higher share of total cost...for lower-priced cloth."²⁸. The main shortcoming of the analysis is, as pointed out by Harley²⁹, that much of the result relies on Bils' assumption that the total cost varied linearly with the quality, while actually considerable portion of the price differential was reflected by one-off finishing costs for the fabrics used.

C. Knick Harley³⁰ utilizes the increased availability of cloth price and other data from 1845 onwards to provide a series of evidence in support of the hypothesis that even at the end of the period, the American textile industry had not reached a position of international competitiveness. Firstly, he constructs direct price comparisons for comparable printing cloth and Waltham-style coarse cloth, and after subtracting the tariff, he finds that even in the late 1850s the price of British cloth plus shipping cost remained below the price recorded in the United States. However, as pointed out by Temin³¹, it can be questioned to what extent these goods were typical of the export basket of Great Britain in general.

²⁷ Bils, "Tariff Protection"
²⁸ Bils, "Tariff Protection", p.1043
²⁹ Harley, "International Competitiveness", p.564
³⁰ Harley, "International Competitiveness"

³¹ Irwin and Temin, "Antebellum Tariff", p.793

His second main source of evidence is the export performance of the two countries during this period, and by observing that the value of British exports to a number of countries demanding on aggregate lower-quality cloth was considerably greater than the corresponding American exports, the United States had not reached a position of international competitiveness.

The general shortcoming of both of the above papers is that while referring to comparative advantage, their argument on the impact of tariff removal relies on absolute advantage. It is fully possible that Great Britain had an absolute advantage in the production of all types of cotton textiles and found it profitable to supply a considerable quantity of low-quality cotton cloth to third markets, and still find it unprofitable to supply the American market, even in the absence of the tariff, to any large extent. For the equivalence to hold we need two additional assertions. Firstly, the British should be both able and willing to reallocate their production towards lower quality goods. With reference to figure 3, post-1826 this would have required a major upheaval in the industry, although not an impossibility over some period of time. Whether the removal of the tariff would have made it profitable to undertake such a reallocation remains to be determined. Secondly, the American supply curve should have been flat, so that any price reductions would have led to major reductions in quantity instead of only falling prices. Douglas Irwin and Peter Temin³² use data for 1826-1860 to directly estimate the responsiveness of domestic production to import price fluctuations resulting from both

changing prices and changes in the implied ad valorem tariff. They find that domestic production was highly insensitive to changes in the import price, hence supporting the orthodox view that the tariff was highly unnecessary after 1820s. They acknowledge that the 1846 Walker tariff reduction did lead to some domestic adjustments, with producers shifting their production towards lower-quality goods, but that full elimination of the tariff would in no way have threatened the survival of the industry in general³³. They conclude that the insensitivity was due to the fact that British and American product mixes were so different that changes in one had very little impact on the other. Further, as the United States constituted only about 10% of the total value of British exports, "British

 ³² Irwin and Temin, "Antebellum Tariff"
 ³³ ibid., p.792

producers did not shift away from specializing in finer products and begin producing coarser products simply because American market opened up³⁴. While briefly discussing the changes in quality and competition, they do not incorporate this directly into the empirical analysis performed.

There are at least four additional factors that could account towards this insensitivity towards the tariff. First is that the tariff actually was highly redundant for most of the period, as suggested by Harley³⁵. The imports that still flowed in the country were of so much higher quality that they indeed did occupy a very different market segment. This, however, doesn't mean that the quality imported would have remained so high if the tariff would have been eliminated. Second, interlinked to this aspect, is the technical fact that treating the import price as exogenous in the regressions will bias the estimated coefficient downwards, if indeed the quality of imports was responsive to the tariff level. Third is related to the high level of fixed costs involved in the running of integrated mills. This causes it to be optimal to keep on running the plant at full capacity even at a loss, as long as variable costs are covered. Therefore, the short-run sensitivity could be muted, while plant closure and diminished replacement investment could be observed in the long run. Finally, long-run reallocation of production in the quality spectrum to avoid competition can dampen the observed impact of the tariff, as plants closer to British competition close down and new ones are opened lower in the quality spectrum. The remainder of this article is devoted to the analysis of the impact changing quality composition of imports would have on the estimation of the importance of the tariff, while the analysis of the dynamic effects are left for future work.

³⁴ ibid., p.792 ³⁵ Harley, "Response"

III: THE MODEL:

Before proceeding with the empirical analysis I will briefly outline a theoretical framework that works as the backdrop for the interpretation of the empirical evidence. This is developed on the basis of the model of competition in differentiated products outlined by Harley³⁶, extended to illustrate resulting consumer choice. For ease of exposition, I will abstract from potential discontinuities in the supply function due to resource constraints, multidimensionality of quality and technological progress, and focus only on the equilibrium in the American market. Since the lack of data makes the full utilization of the model impossible even in its simplified form, the following leaves many finer details not analyzed, and should be taken only as an illustration of the qualitative predictions provided.

Both the United States and Great Britain can produce cotton textiles on a quality range $\left[\frac{\pi}{\pi}, \pi\right]$ according to a common production function:

$$Q_{\pi} = f(K, L^{skilled}, L^{unskilled}, C, \pi)$$
(3.1)

with the associated cost function:

$$C_{\pi} = C(w^{skilled}, w^{unskilled}, r, p^{raw}, \pi)$$
(3.2)

where π is used to index the quality of cotton produced.

While the total cost of production is an increasing function in quality for both countries, because of abundance of skilled labor in Great Britain and increasing labor intensity of production when moving up the quality spectrum, her slope is lower, reflecting comparative advantage in higher-quality products:

$$\frac{dC_{\pi}^{US}}{d\pi} > \frac{dC_{\pi}^{UK}}{d\pi} > 0$$
(3.3)

We can rationalize this by two ways – one is that the production functions actually differed between Great Britain and the United States because of US reliance on the waterframe, superior only in low-count cloth, while production in Britain was focused around the more versatile mule, or by following Hecksher-Ohlin framework for

³⁶ Harley, "International Competitiveness", p.563, figure 2

international trade, the relative resource endowments differed between the countries, giving rise to comparative advantage even in the face of same production technologies.

For an interior solution in the market we further assume that:

$$C^{US}(\underline{\pi}) < C^{UK}(\underline{\pi}) + tariff \text{ and } C^{US}(\overline{\pi}) > C^{UK}(\overline{\pi}) + tariff$$
 (3.4)

The supply function for the American market is then the lower envelope of the two cost functions.

On the demand side, we consider a continuum of consumers that have different preferences over the quality of cotton textiles they want to purchase. The utility consumer i derives from cotton of quality π is increasing in how close to the preferred quality it is. For illustrative purposes we can model this as:

$$U(\pi - \pi^*) = \alpha_i - \beta_i (\pi - \pi^*)^2$$
(3.5)

where α_i measures the utility derived from the preferred quality and $\beta_i(\pi - \pi^*)$ measures the disutility suffered from non-optimal quality.

Faced with a quality spectrum $[\underline{\pi}, \overline{\pi}]$, the consumer maximizes his or her utility, which, using the above equation, gives us the first-order condition for optimal choice of quality:

$$\pi = \pi^* - \frac{dp(\pi)/d\pi}{2\beta}$$
(3.6)

The supply equation, with the first-order condition integrated over the density of consumers gives us the equilibrium quantities and qualities demanded and supplied, and the division between domestic production and imports. In Figure 3.1 I have drawn the utility functions for three consumers, demanding low, medium and high quality cloths respectively, together with the cost functions for the United Kingdom and the United States, with the resulting supply function and qualities chosen by each consumer³⁷.

³⁷ The quality choices are characterized by the usual tangency condition, although in the case of a kink in the supply curve, the tangency alone is not sufficient for a global maximum, and utility at both points needs to be calculated.



FIGURE 3.1: DIFFERENTIATED PRODUCTS AND COMPARATIVE ADVANTAGE

The important insight of this framework is that the market equilibrium will depend on both the absolute cost level of the two countries and how the costs change over quality. Most importantly, the quality level of imports and domestic production becomes a function of the (tariff-inclusive) cost of production faced by the two countries.



FIGURE 3.2: COMPARATIVE STATICS OF A CHANGE IN THE TARIFF

In figure 3.2 I present a comparative statics exercise of changing the (binding) minimum valuation component of the tariff. This causes the British cost curve to shift down parallel to the original cost curve. Three observations follow. Firstly, the quality level at which British imports become competitive shifts to the left, leaving a smaller sector of the market to be supplied by the American producers. Further, even consumers whose initial choice of quality was on the quality range still dominated by the American producers after the tariff reduction, can swap to a higher-quality products that now have become relatively cheaper, as illustrated by the choice of consumer B. Finally, the magnitude of this substitution effect is likely depend on the size of the kink at the intersection of the two cost curves. At very high tariff levels, we might observe very little substitution, while considerable substitution could take place at lower levels. Following this, we would expect the aggregate quality of British exports to the United States to be positively correlated with the level of implied ad valorem tariff faced, with sensitivity potentially decreasing with the size of the tariff.

IV: EMPIRICAL RESULTS

This article extends the work presented in section II in two parts. Section A is fully devoted to analysis of the British experience in the dynamic comparative advantage framework illustrated above. While the British might not have changed their total output mix with changes in the tariff, both the quality composition and the British market share in the United States seem highly correlated with the implicit ad valorem tariff rate, as evidenced by figure 4.1, in support of the main prediction of the model. The quality index was constructed simply by dividing the average British export prices to the United States with that of non-US exports. The data was complied from House of Commons Sessional Papers and Helm³⁸. I will return to the appropriateness of using this as average quality later.

Similarly the British share of the American market³⁹ varied highly throughout the period, fluctuating between 10-16% until 1830s, plummeting to 4% by 1846, and climbing back above 10% by 1850⁴⁰. Although of interest in its own right as a study of functioning of the comparative advantage in international trade, it also provides evidence for the endogeneity of quality of British exports to the United States. Section B takes on this observation of endogeneity and analyzes the responsiveness of the domestic production in the United States following roughly the framework presented by Irwin and Temin, estimating the demand equation for American cotton textiles in the domestic market.

³⁸ Great Britain, House of Commons, Sessional Papers 1847/48, 1851, 1856 and Helm, "Cotton Trade"

³⁹ I ignore the existence of imports from other countries for two reasons. Firstly, no detailed data is available, and secondly, the quantities remained small relative to imports from Britain and domestic production. ⁴⁰ Sessional Papers 1847/8, 1851, 1856, Helm, "Cotton Trade", and Zevin, "Growth"



Source: Author's calculation, based on Sessional Papers, Helm, Ellison, Zevin and Tariff Structure reported in Irwin and Temin

A: The British Experience and Comparative Advantage: 1816-1860

Any estimation of the quality of British exports to the United States is complicated by two facts. Firstly, The model presented in section III suggests that the quality of British exports should be a function of both the tariff, exchange rate and the relative cost of inputs in both countries. Unfortunately, no sufficient data is available for either wage/yard or capital cost/yard for either country⁴¹. Secondly, the rapid technological progress, expansion of the market and other changes that took place throughout the period complicate the estimation further.

Various functional forms and sets of variables were tested, but it is suggested that the most reliable estimate of the importance of the tariff is obtained by using the form:

⁴¹ Some data exists for capital cost/spindle in the US by McGouldrick, and annual wages in the US and the UK by Layer and Wood respectively. These, however, include changes in productivity, and make them inappropriate series for present purposes where the key determinant is cost/yard.

$$\log\left(\frac{P_{US}^{UK}}{P_{non-US}^{UK}}\right) = \alpha_1 + \alpha_2 * tariff + \alpha_3 * \log\left(\frac{P_{domestic}^{US}}{P_{domestic}^{UK}}\right)$$
(4.1)

This form circumvents the issue of technological progress and changes in the composition of exports by measuring only the deviation of the average quality of exports to the United States from the average non-US export quality. Linear relation to the tariff is suggested by the fact that the plot of the quality series, after purging it from the effect of the tariff, provided a smooth series with no considerable jump at 1845-46, present in the residual plots of all other functional forms. Finally, above circumvents the lack of cost/yard data by using the ratio of British and American price series for specific products as a proxy for the varying cost differential between the two countries. The prices are both in US dollars. The exchange rate used is that of 60-day bills of exchange compiled by Laurence Officer, The US domestic price is by Zevin and the British domestic price is the gray cloth price index by Sandberg⁴², for 1815-1845 coinciding with 7/8-72 Reed Printer series by Neild⁴³. Both price series are considered as representative of the products the two countries produced, the British product being of higher quality than the American. This method will be accurate as long as the price movements in these two series were representative of the general experience of the countries, and there is no a priori reason to assume otherwise⁴⁴. Finally, the results are roughly representative in the magnitude to most of the other estimates constructed.

Estimation Results:

Equation 4.1 is estimated using annual data from 1816-1860. Implied ad valorem tariff rate is based on author's calculation. The series is slightly different from that of Irwin and Temin, for two reasons. When tariff was changed in the middle of the year, I am using a weighted average of the two tariff rates to get at a yearly average tariff. Secondly, instead of assuming that all British exports to the United States were of printed cloth, I am using the breakdown of total British exports in printed and plain by Ellison as a proxy for the

 ⁴² Sandberg, "Movements in Quality", pp.8-10
 ⁴³ Neild, "An Account of Prices", pp.496-97

⁴⁴ Since the method of production was relatively standardized across the qualities, one would expect that shocks would occur more at the level of industry than a specific product category.

composition of exports to the United States, when the tariff in place discriminated between the two. The resulting difference is that the estimated maximum average tariff is not quite as high as their estimate, but the general movements are the same.

The estimation results are presented in Table 4.1. Because there appeared to be some sensitivity as regards to for what period the regression was run, time-period dummies were introduced to account for this sensitivity. Also, standard OLS regressions suffered from serial correlation, so the results reported allow for first-order autocorrelation in error terms. Finally, because of the potential endogeneity of the ad valorem tariff⁴⁵, Instrumental Variables was used instead of Generalized Least Squares.

(dependent variable $\log(P_{US}^{UK} / P_{non-US}^{UK})$)										
Variable	(4.1/1) TSLS	(4.1/2) TSLS	(4.1/3) TSLS	(4.1/4) TSLS	(4.1/5) TSLS					
Constant	4.72*** (0.12)	4.70*** (0.12)	4.71*** (0.12)	4.69*** (0.12)	4.66*** (0.12)					
Tariff(%)	0.0062*** (0.0010)	0.0065*** (0.00087)	0.0060*** (0.0009)	0.0073*** (0.0012)	0.0078*** (0.0011)					
Tariff(%)*year1815-24	-	-	-0.0010 (0.0012)	-						
Tariff(%)*year1815-34	-	-	-	-0.00067 (0.0010)	-0.00087 (0.0011)					
Tariff(%)*year1845-60	-	0.00094 (0.00069)	-	-	0.00076 (0.00062)					
$Log(P^{US}/E^*P^{UK})$	-0.052 (0.068)	-0.060 (0.39)	-0.033 (0.078)	-0.055 (0.071)	-0.064 (0.073)					
Rho	0.91*** (0.051)	0.90*** (0.056)	0.90*** (0.049)	0.90*** (0.054)	0.89*** (0.061)					
$Adj. R^2$	0.89	0.89	0.89	0.89	0.88					
Standard Error	0.058	0.059	0.058	0.059	0.060					
D-W statistic	1.89	1.86	1.94	1.90	1.87					

TABLE 4.1	
ESTIMATES OF THE IMPACT OF TARIFF ON IMPORT Q	UALITY
$(\text{dependent variable } \log(P^{UK} / P^{UK}))$	

*** indicates significance at 1%, ** at 5% and * at 10% confidence level

Note: Newey-West HAC Standard Errors & Covariance, yearx-y is a dummy variable taking the value 1 for the period from x to y and 0 otherwise.

Tariff instrumented with implied tariff on British domestic price series. Results were roughly the same when instrumenting with implied tariff on British non-US exports.

⁴⁵ Because the ad valorem tariff is calculated on the basis of the price of imports, if import price (quality) truly was responsive to the tariff, this causes a feedback mechanism from the RHS back to LHS and hence the tariff needs to be instrumented.

The regression results tell us a fairly convincing story about the endogeneity of the quality of British exports to the United States. Before continuing with the interpretation, it is worth noting that the fact that the ratio between British and American domestic prices fails to turn out significant is not evidence against the validity of the form of regression chosen. Firstly, as the dependent variable measures deviations form the mean, any general developments within the British industry, affecting all exports equally, would show up as no effect in the dependent variable. Secondly, the ratio itself is very stable, fluctuating around a constant mean, indicating that the technological development on both sides of the Atlantic was roughly uniform.

The predictions provided by the regression 4.1/5 are summarized in figures 4.2 and 4.3. Figure 4.2 is constructed by dividing the appropriately scaled average export prices (implied and realized) by the British domestic price index of gray cloth. The appropriateness of this measure depends highly on whether the prices of specific types of cloth moved in unison throughout the period. Although data is scarce, the gray printing cloth series moves very closely with that provided by Ellison for an unspecified calico printing cloth⁴⁶ and other fragmentary series. There is some divergence between the behavior of prices of gray and printed cloth, indicating the slower initial decline in finishing costs relative to technological progress in production, catching up later in the period in question⁴⁷. The general movements, however, are the same, and it is believed that the method used is a reasonable first approximation to an actual quality index.

Figure 4.2 suggests that the quality of British exports to the United States would have been considerably closer to the average quality of British exports to other parts of the world in the absence of the tariff. The interesting observation is that while until about 1825, the average quality of exports to the United States would have been below the increasing overall average quality, after 1825 it remained above, although slowly declining with the overall average quality of exports. The declining average quality of exports is in agreement with evidence of continual shift of production in Great Britain towards lower-quality cloth. While in mid-1830s, 10-20% of firms in Britain were producing sub-20 counts and 70% sub-40 counts (see above), 1909 the output figures

⁴⁶ Ellison, "Cotton Trade", p.61
⁴⁷ Sandberg, "Movements in Quality", pp.24-27

were 34% and 87% respectively⁴⁸. Finally, the anomalous behavior of the series around mid-1830s can potentially be explained by the large price fluctuations of raw cotton that were more pronounced in the United States, giving Great Britain a temporary competitive edge.

Figure 4.3 translates these quality index results into implied price series and contrasts them with the actual experience. One cannot be without noticing both the considerable margin of protection provided for domestic cloth by the tariff, and the closeness of the implied price series to the realized domestic price throughout the whole period. The price series per se are no longer comparable because of potentially different costs of production in the two countries and hence we lose the price-quality interpretation, but some conclusions can be drawn.

Firstly, the initial period of protection appears to have been crucial to the survival of the industry, at least until about 1823. This is supported by three facts. First is the actual experience of the industry in 1816, as suggested earlier. Although some of the massive decline in output definitely was the results of closing down of inefficient production after a period of uncontrolled expansion, it seems unlikely that such a massive downturn would have occurred unless even the more efficient firms would have been facing trouble. Secondly, if high profit margins would not have been guaranteed, it is unlikely that the capital would have been made available in sufficient quantities to make such fast technological progress possible as was actually witnessed. Thirdly, in addition to the predicted average price, even the realized average price without the tariff closely traced the price of domestically produced cloth. Noting that this average includes also finer cloth, the price of equivalent goods must have been at least at par.

⁴⁸ Leunig, "British Industrial Success", p.23



FIGURE 4.2: QUALITY INDICES OF BRITISH EXPORTS

Source: British export prices are from Great Britain, House of Commons, Sessional Papers 1847/48, 1851, 1856 and Helm, "Cotton Trade", base price series used is from Sandberg, "Movements in Quality", p.12, and implied series is based on above data and author's calculation



Source: see above

However, the view that the United States gained absolute advantage in low-count textiles after this period does not as such stand on a strong ground. Although the technological advances in the United States were large in magnitude and led to fast growth in productivity, similar progress was taking place in the United Kingdom. While initially focusing on higher-count cloth, after 1830s she started producing more and more lower-quality cloth, and catching up with the American price level. The results clearly support the contention of Harley that even through 1845-1860 the United States had not yet reached a position of international competitiveness. However, these results only show that given that the tariff would have been eliminated, the American textile industry would have come under a considerable amount of pressure. The remainder of the article is devoted to the examination how the industry would have responded to such a pressure.

B: The American Experience: Output and Beyond – 1826-1860

As indicated above, the period was one of rapid technological progress, with changing productivities, capital/labor ratios and beyond, so of considerable interest would be to attempt to provide a valid functional representation of the technology of production. In the limitations of this paper, it is unfortunately not possible to pursue this path and obtain a reduced-form equation for the equilibrium in the market. Instead, we will satisfy ourselves with attempting to infer the demand equation in the market.

The problem with any such estimation is that we are attempting to infer what would have happened in the absence of the tariff from the behavior of the market with high tariffs. This is much like attempting to guess the mean or overall shape of a distribution by observing tail events – the final outcome will be strongly driven by functional assumptions made. This is mind, there are some logical limits to the response predicted.

As a minimum, it is logical to assume that the response in relative terms will be at least as great in relative terms for low tariffs than for high tariffs, since we would expect the competition to intensify as the products come closer together in the quality spectrum. This guides us to the first specification of the demand equation:

 $\log Q = \alpha_0 + \alpha_1 \log \left[E * P_{US}^{UK} (1+\tau) \right] + \alpha_2 \log P_{US}^{US} + \alpha_3 \log CPI + \alpha_4 \log GDP + \varepsilon$ (4.2)

To allow for the response to be larger for lower tariffs than large tariffs, as an alternative we will consider equation:

 $\log Q = \alpha_0 + \alpha_1 \log \left[\log \left[E * P_{US}^{UK} \left(1 + \tau \right) \right] \right] + \alpha_2 \log P_{US}^{US} + \alpha_3 \log CPI + \alpha_4 \log GDP + \varepsilon$ (4.3) By allowing the double-log for both price and tariff, we amplify the predicted effect for tariff removal. With the chosen functional form this amplification still remains fairly conservative.

Empirical Results:

Several combinations of equations 4.2 and 4.3 were estimated, and a representative sample of these regressions is shown in table 4.2. The domestic output series is the inflated New England output series by Stettler. Price Index is Paul David and Peter Solar's consumer price index⁴⁹. As GDP estimate I am using Joseph Davis' index of industrial output since neither the Berry or Gallman series are regarded being of sufficient quality⁵⁰. Because of the illustrated endogeneity of import quality and hence import price, and potential endogeneity of domestic price, instrumental variables regression was utilized, again allowing for first-order autocorrelation. Instruments for the domestic price were price of raw cotton from U.S. Bureau of Census (E-126) and wage/yard index, compiled form data presented in Zevin⁵¹, McGouldrick⁵² and Ware⁵³. I chose to use wage/yard measure, even if less complete than Layer's hourly and annual earnings index, because we need an instrument that is independent of the technological progress made throughout the period to make it as accurate as possible. The results were roughly the same using the tariff series used by Irwin and Temin, and the output series by Berry.

⁴⁹ David and Solar, "Bicentenary Contribution"
⁵⁰ Davis, "Industrial Production",
⁵¹ Zevin, "Growth", p.134

⁵² McGouldrick, New England Textiles, p.147

⁵³ Ware, New England Cotton Manufacture, p.114

(dependent variable log of output)										
Variable	(2.1) TSLS	(2.2) TSLS	(2.3) TSLS	(3.1) TSLS	(3.2) TSLS	(3.3) TSLS				
Constant	8.38**	7.76**	9.03***	8.31***	7.61***	9.15***				
	(3.06)	(2.91)	(1.19)	(3.21)	(3.00)	(1.02)				
Log(FP(1+t))	0.53**	0.59**	0.52**							
Log(EI(1+i))	(0.23)	(0.24)	(0.21)							
Log(log((EP(1+t)))				1.43**	1.59**	1.33**				
				(0.63)	(0.62)	(0.49)				
Log(PUS)	-0.48**	-0.55**	-0.43**	-0.46**	-0.54**	-0.41**				
	(0.21)	(0.23)	(0.18)	(0.22)	(0.24)	(0.18)				
$L_{\alpha\alpha}(CDI)$	0.17	0.24	. ,	0.19	0.28					
Log(CII)	(0.60)	(0.59)		(0.62)	(0.61)					
Log(GDP)	0.77***	0.87**	0.82***	0.75**	0.87***	0.81***				
	(0.25)	(0.16)	(0.15)	(0.25)	(0.13)	(0.12)				
Time	0.006			0.007						
	(0.016)			(0.017)						
Rho	0 74***	0 74***	0 75***	0 74***	0 73***	0 75***				
	(0.04)	(0.04)	(0.03)	(0.04)	(0.04)	(0.04)				
$Adj. R^2$	0.98	0.98	0.98	0.98	0.98	0.98				
Standard Frror	0.11	0.11	0.10	0.10	0.11	0.10				
Sunuuru Error	2.22	2.22	2.10	2.24	2.20	2.20				
D-W statistic	2.33	2.33	2.28	2.34	2.29	2.29				

TABLE 4.2 ESTIMATES OF MARKET RESPONSE TO CHANGES IN TARIFF (dependent variable log of output)

*** indicates significance at 1%, ** at 5% and * at 1% confidence level

Note: Newey-West HAC Standard Errors & Covariance. Both PUS and Pimport instrumented instruments: Price of raw cotton, wage/yard and non-US export prices

The regression results suggest that the responsiveness of domestic production to changes in the tariff were considerably greater than suggested by Irwin and Temin. The sole source for this difference is allowing for the endogeneity of the import quality. Before proceeding, it should be noted that the results are only suggestive, in the sense that the results are clearly driven by the functional form, which requires the sensitivity to remain the same throughout the period. However, unlike Irwin and Temin, I fail to find timevarying sensitivity by using time-period dummies. This result is likely to arise because, recalling table 4.1, there is some suggestion that the import quality was less sensitive to the level of tariff early in the period. This would increase their estimates for the early period by decreasing the endogeneity-bias present in their regressions.

The results in table 4.2 suggest that elimination of the tariff at its peak would have cut back domestic demand by 30-40% (in both specifications) - not necessarily threatening the survival of the industry, but a considerably larger amount than previously suggested. In evaluating the validity of this estimate it is worth looking at the transition 1846-47. 1847 witnessed a sharp rise in the price of raw cotton, which should make the production of higher-quality cloth more profitable, but reduce the overall profitability of cloth production. Indeed, the f.o.b. price of British non-US exports jumped up in 1847, whereas the f.o.b. price to the US jumped downwards, and continued on a downward trend after that.

The results are both encouraging and disappointing. The model overpredicts the response to the realized tariff reduction – suggesting 4% fall in output instead of 1% rise that was actually observed. However, part of this is likely to be explained by the supply-side shock experienced at the time. British total exports were considerably below trend for 1846-48, so American industry could have had less pressure from competition than predicted by the model, and following this, output growth could have been above trend. This is partly supported by estimating responses for 1847-48 and 1848-49, both of which again underpredict the expansion of domestic output by roughly 4% - this is encouraging because no changes in the tariff took place throughout the period, so the misprediction could be due to a systemic shock to the system, instead of misestimation of the coefficient for the import price. However, this also highlights that the model as it stands at the moment is far from complete.

CONCLUSION AND FURTHER AVENUES:

This article has presented a brief synopsis of the debate over the antebellum cotton textile tariff and explored some further avenues in an attempt to shed more light on the importance of the tariff. Although I tend to agree with Rosenbloom that, "given the limitations of the data, this question is unlikely ever to be resolved to the full satisfaction of all participants,"⁵⁴ I believe some additional headway has been made.

Starting with the British experience, as argued earlier, it would appear that the tariff was highly important for the early period of roughly 1816-25. Also the comparison of price trends would suggest that Great Britain most probably maintained an absolute advantage in the production of most types of cotton textiles, including most, if not all, of those manufactured by American producers. This result is in full agreement with the results of Harley, and also supported by the result that even in the early 20th century, Great Britain was absolutely more productive in nearly all types of cotton cloth, and had shifted more and more of her productive capacity towards lower-quality cloth⁵⁵.

But, as argued, this does not imply that the British would have chosen to exploit this advantage in the US market in the absence of the tariff. For this, it would have had to been that the production of low-quality cotton cloth to the US market would have been more profitable than any other type of production, and that the American industry would have been unable to cut costs to any significant degree.

This in mind, the predicted 30-40% response of the American industry to complete tariff does seem neither an implausibly large nor small figure. As such, however, it remains only suggestive. Both the quality estimation and the quantity response estimation were forced into functional forms that allowed for obtaining single coefficient estimates over time, to circumvent the fact of extremely rapid productivity growth, expanding outputs and falling prices. Some preliminary tests were made using time-period dummies and no significant differences were found for the quantity responsiveness.

⁵⁴ Rosenbloom, "Path Dependence", p.5

⁵⁵ Leunig, "???"

Where can we go from here? As suggested above, the framework used here is one for a static industry, not one undergoing such massive changes as the cotton textile industry was in the 19th century, and as a result, the natural equations to estimate were massaged to fit the environment. Of considerable interest would be formulating a framework which would allow for dynamic dependencies inherent in such an environment. As suggested earlier, the availability of funding for research was potentially crucial to the rapid early development of the industry. Similarly, learning by doing appears to have played a role throughout the period. Finally, on another front, the response of the domestic industry to changes in the tariff could have been muted because of the high fixed costs involved in the production of cotton textiles, and also the possibility of reallocation of production within the quality spectrum into a space less pressured by British competition would bias downwards the above estimates. A suggestive fact of the former is that while the American industry averaged 9% growth through 1830-45, it grew only at 3% for 1846-60, with no slowing down of GDP growth, while the British exports grew at slightly over 5% through the whole period 1830-60. To the extent that any of the dynamic dependencies indicated above will be possible to examine within the limitations of the data is still open.

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