PRODUCTION, PRICES, PROTECTION, AND PRODUCTIVITY: LESSONS FROM CANADA'S COTTON MILLS

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August 14, 2012

2012 Cities, Open Economies, and Public Policy Conference
RCEA and the University of Toronto
August 16-19, Victoria College

Preliminary draft: comments, corrections, criticism welcomed.

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Is growth best encouraged by competition or protection? The modern theory of economic growth offers no firm conclusions, forcing policy makers to look to the empirical evidence. But the evidence is ambiguous: the 20th-century evidence favors competition; the 19th-century protection. The contrast has generated a vigorous and still-unresolved correlation-or-causation debate, particularly in the earlier period. This paper contributes to the conversation by providing new evidence: a case-study of the growth of Canada's pre-WWI cotton mills. In the late 19th century Canada was a rapidly growing, rich, high-tariff, small open economy. Canada's cotton mills grew extremely rapidly. Most of their growth, historians say, was stimulated by the National Policy tariff of 1879. We argue that historians have grossly exaggerated the importance of the NP and tariffs in general because: (1) The cotton mills trend growth rate did not accelerate after 1879; instead we find growth decelerated sharply from over15 per cent to 4 per cent; (2) A large number of other causal factors were at work; (3) In counterfactual exercises based on simple general equilibrium econometric models we find increased tariffs explain only about 2 per cent of the industry's growth 1850 to 1883. From 1884 to 1913 we find tariff increases would have actually decreased growth. The main lesson of this study is that a positive overall correlation between tariffs and growth for the economy as a whole may provide a distorted picture of the causal forces at work at the industry level. (JEL F11, F13, F14, N61, N71)

I found that however simple the plan on which a Protective policy started, it was drawn on irresistibly to become intricate, and to lend its chief aid to those industries which were already strong enough to do without it. - Alfred Marshall. *Industry and Trade*

Don't pay too much attention to the tariff! - John H. Dales. *Comment to one of the authors*

THE PROTECTION GROWTH PUZZLE

Economists have discovered (See Phelps 1966, Romer 1986, Baumol 1990, and Jones 1998) that in theory competition does not always and everywhere, even in very simple models, best support the economic growth of nations. In practice, however, economists have discovered in the twentieth century (See Aghion and Griffith 2005), based largely on large-scale, international, cross-sectional regression studies a strong positive correlation between freer trade and economic growth; in the nineteenth century, based on the seminal work of Bairoch (1989) and more recently by O'Rourke (2000), Reinhart (2007), and Chang (2002 and 2010) economic historians have found that tariff protection and economic growth go hand in hand.

Douglas Irwin (2001; 2002) has argued that the Bairoch Hypothesis, the assertion that the empirical finding of an association between tariffs and growth is evidence of a possible causal connection between tariff protection and growth is pure speculation. Correlation he reminds us is not causation. Taking a new political economy approach, he reasons, economic growth under conditions of abundant land and scarce labour can lead to the adoption of high tariffs, which is what he suggests actually happened in the late-19th century in the United States, Canada, Australia, Argentina, and elsewhere. As a result, he contends, the Bairoch hypothesis is a cracked conceptual foundation on which to establish economic policy.

In this paper we take a new approach to the 19th-century tariffs and growth puzzle and present a detailed case study of the relationship between tariff protection and the growth of Canada's pre-World War I cotton mills. Contrary to the conventional wisdom of Canadian historians, which supports the Bairoch hypothesis, we find that increases in tariff protection explains only a small part of the growth in output of Canadian cotton textiles in the second half of the 19th century. This said (see Hinton 2012) we cannot reject the idea that infant industry protection may have been important to the initial establishment of Canadian cotton textile in the 1850s and 1860s.

THE TARIFF AND THE GROWTH OF CANADA'S COTTON MILLS

THE INDISPENSIBILITY HYPOTHESIS

Canada's cotton mills grew extremely rapidly, 15 percent a year between 1870 and 1890 as measured by imports of raw cotton (the mills chief raw material input and single largest cost of production) the output of the industry doubling every five years. Looking around the world at cotton mills in the 16 other main countries in which modern factory-based cotton mills were to be found (see Table 1, below) only the Japanese mills growing at 19 percent grew faster. The Italian mills growing at 10 percent a year came a distant third.

The cotton mills of Britain and the United States, the oldest and the largest centers of modern cotton textile production, not surprisingly, trailed far behind at 2 and 5 percent.[1]

Despite the Canadian cotton mills rapid growth, Canadian economic historians have had little good to say about them: partly because little attention has been paid to the careful measurement of their growth and as a result most historians we suspect do not know how fast the industry actually grew; Partly, but the case has yet to be made persuasively, because of their reputation as harsh, monopolistic, and exploitive employers of labour. And partly, and probably most importantly as far as historians are concerned, because the deep-rooted idea that the National Policy tariff of 1879, or the NP as Victorian Canadians called it was indispensable to the rapid growth of the cotton mills.[2]

Table 1

ANNUALIZED RATES OF GROWTH OF IMPORTS OF RAW COTTON (OR COTTON CONSUMPTION) OF WORLD"S COTTON MILLS

Country	1870-1890	1890-1910	1870-1910
	Per cent		
UK	2.2	1.0	1.0
US	5.2	4.6	3.9
Germany	3.8	3.6	3.7
Russia	6.0	3.6	4.8
France	1.2	3.9	2.6
India	10.0*	3.5*	6.4*
Austro-Hungary	4.3	3.3	3.8
Italy	10.1	3.4	6.7
Japan	19.2*	12.8	14.5
Spain	4.6	1.6	3.0
Belgium	3.5	4.0	3.7
Switzerland	-1.8	-0.4	-1.1
Canada	15.0	4.2	9.5
Portugal	8.2	3.8	5.8
Netherlands	4.5	4.3	4.4
Finland	5.5	2.9	4.1

*Spindle growth

For example, tariff-historian O.J. McDiarmid, echoing both the language and the spirit of the findings of the influential Report of the Royal Commission on the Textile Industry of 1938, says"[cotton textiles] received a substantial impetus from the National Policy." Radical business historian and political economist R. T. Naylor says "[t]he process of domesticating the cotton industry climaxed with the National Policy." And regional and social historian Peter DeLottinville, expressing what most historians it would seem in their heart of hearts believe,[3] says, "[cotton textiles' growth] was due almost entirely to the [NP] tariff restrictions."[4]

Michael Bliss's (1987) treatment of the cotton mills growth under the NP from the 1880s to the 1900s in his highly respected business history *Northern Enterprise* is typical of the literature's position on the indispensability of protection.[5] In his narrative Bliss highlights three of a tariff's six possible effects.[6] (1) From 1879 to 1883, rising profits induce an increase in output and investment (the production or protection effect). (2) Increased domestic production drives out imports (the trade effect). And (3) after 1883, when the increased domestic production proved too much for the domestic market to absorb, resulting, first, in overproduction and falling prices, second, price-fixing cartels, 1883-1889 and the dumping of Canadian cloth in foreign markets, and third, and finally, mergers for monopoly power in 1890, 1892, and 1905 (the monopoly effect).

Our interest in this paper is primarily with the production or protection effect. The conventional wisdom, it will be seen, rests its case for the power of the NP on a *post hoc ergo propter hoc* illusion. It is of course fallacious to argue as historians do that because

5

growth followed the advent of the NP the NP must have caused the industry's growth. But it will also be shown that in the case of the cotton mills growth did not increase after the coming of the NP it actually decreased. Moreover, testing the power of the NP econometrically in a simple, small-open-economy, general equilibrium model we find that increased tariff protection explains roughly only 2 per cent of the growth of Canada's cotton mills between 1850 and 1883 and the increases of the NP even less. By far the most important causal factor in the cotton mills growth between 1850 and 1883 was increased efficiency, the growth of total factor productivity, which was growing in these years at between 3 and 4 per cent a year. In the period 1883 to 1913 the most important causal factor, not surprisingly, was the growth of real income, this period being dominated by the Wheat Boom. More surprisingly, the positive contribution of the tariff in this period was the result of decreases in protection.

The implications of these findings are not trivial. At minimum, economic historians need to reconsider the importance of manufacturing industries such as cotton textiles in the received explanation of Canadian economic growth and the design Canadian economic policy.[7] Manufacturing may have caused Canadian economic growth, rather than as the old story goes economic growth in Canada caused domestic manufacturing to grow. For economists the lesson of the cotton mills is that crude high-level correlations between increased protection in economies as a whole and the growth of nations may tell us very little about how and why economies actually grew.

The remainder of the paper is divided into five sections each dealing with a specific question.

1. How big and how long-established was the industry on the eve of the NP?

2. How protective were the new NP tariffs on cottons?

3. How fast did the industry grow after the introduction of the NP?

4. How fast would the industry have grown without increases in tariff protection?

5. What lessons can we draw from the growth of Canada's cotton mills

HOW BIG? HOW LONG-ESTABLISHED?

On March 15, 1879, the day the NP went into force, the gross value of output of factory produced cotton textiles in Canada was probably in excess of $2.5 million,[8] making it a small, but not inconsequential, domestic manufacture. If other factory-based enterprises were the creation of the NP, "cutlery, clocks, felts, tableware,"[9] says P.B. Waite, for example, did not exist before the NP, the same cannot be said for cotton textiles. It was not new to Canada. In Quebec the factory production of cotton textiles had been taking place for 35 years, the first mill being built at Chambly, in 1844, closely followed by one at Sherbrooke. In Ontario cotton mills had been around for 32 years, the first mill being established at Thorold in 1847. In New Brunswick cotton textiles had been made in factories for 18 years, the first cotton mill opening at Saint John in 1862.[10]

It is not surprising that there were cotton mills in Canada in the nineteenth century. As is well known, see for example Clark (2007), Sandberg (1974) and W. Arthur Lewis (1978, p. 7-8), cotton textiles seemed to the Victorians the most obvious, most practical and indeed the inevitable path to industrialization. By 1910 cotton mills had

spread around the world from Britain to Canada and 18 other countries (Hinton 2012). What was it about cotton mills that made them such good travelers?

First, as Clark (2008) says, ""[t]here was a ready local market for textile products everywhere [in the nineteenth-century world.]" Canadians wanted cotton and cottons for everything from candle wicks to stuffing for quilts, bags to pack grain, belting and hose, and waste to wipe up spills to cloth for sturdy shirts, blouses, and trousers, and skirts, dress shirts, ball gowns, underwear, drapes and draperies. If ours is a world of synthetics, e-readers and virtual reality the nineteenth century was a world of cotton and woolen textiles, books, brick, and iron and steel. But above all it was a world that prized cotton textiles for its myriad uses in both tropical and temperate climates. Moreover, "[c]otton textiles were very cheap to transport," say Crafts, Leybourne, and Mills (1991), "at a time when most goods were not [referring to the first half of the nineteenth century]; as a result they were a large part of world trade."

Second, as Robson (1957) tells us, raw cotton after ginning is practically a "pure material" that loses very little weight in subsequent processing, and whose transport costs are extremely low. As a result the cotton mills are exceedingly footloose and are as easily established close to final markets (New England cotton textiles) as they are to sources of supply of the raw cotton (Southern cotton textiles). It would have been odd if cotton mills hadn't found their way to Canada.

Third, raw cotton, apart from the Civil War "cotton famine" years, was an easy-to-obtain global product with highly developed, sophisticated markets, both spot and forward. Canadian cotton mills, of course, were totally dependent on foreign sources of supply to

8

obtain raw cotton. Before Confederation 95 percent of it was imported from the U.S. South; after Confederation 99 percent was imported from the South. Canadian cotton mills benefitted from its small size, the highly developed export markets in raw cotton that grew and developed in the nineteenth century, as well as, the inexpensiveness of water over land transportation as the centers of Canadian production and consumption were all easily accessible by water. As a result, (see the appendix) gold prices for raw cotton in Montreal or Saint John differed very little from those obtaining in New York or Liverpool.

Fourth, contrary to popular thinking in both modern trade theory (Krugman 1987) and the treatment of manufacturing by Canadian economic historians (Eastman-Stykholt 1967), as Sandberg (1974) and Clark (1987 and 2010) tell us "the optimal mill size was small compared even to market sizes in the smallest countries." The nineteenth century world, especially the world of cotton textiles, is ideally suited to the application of the tools of neoclassical trade theory rather than the "new" trade theory. It is a world of inter-industry rather than intra-industry trade, competition rather than monopolistic competition or monopoly, constant returns to scale rather than increasing returns, "the industry" as the fundamental unit of analysis on the production side of the economy rather than "the firm," tariffs rather than a unwieldy bag of tariffs, subsidies, and quotas, and finally, a world of comparative advantage as the fundamental cause of trade rather than a combination of comparative advantage and increasing returns.

Fifth, cotton textiles fits a Hecksher-Ohlin-Samuelson world of a common technology available to be shared at a price, implicit or explicit, by all countries on highly competitive international markets, rather than a Ricardian world of different technologies.

9

This was true even in the first half of the nineteenth century, as Jeremy tells us, before the 1840s when British law forbade the export of machinery for the textile industry and the emigration of skilled workers. The technology travelled widely and rapidly wherever there was a demand for it.[11] In the second half of the century the only significant barriers to technology were the self-inflicted barriers owing to tariffs on imports of machinery, traditionally imposed by colonial and latter the Canadian governments.

Sixth, contrary to the stylized facts on Canadian manufacturing it was a largely Canadian owned domestic industry (see Acheson 1972) in which foreign direct investment played a very small, unimportant role in its establishment and development. This is not to say that American and British entrepreneurs did not play a role in its growth. They did; as they had to have done in every part of the new Canadian economy, which was with few exceptions predominantly a nation of recent immigrants. The branch plant, however, was not a characteristic feature of the nineteenth century cotton industry.

HOW PROTECTIVE WAS THE NP?

Fowke taught us that the NP marked "the historic milestone at which Canada abandoned the idea of tariffs for revenue only, discarded even the euphemism, 'incidental protection,' and deliberately set foot on the pathway marked 'Protection.' "[12] In the century it was to last,[13] almost every aspect of Macdonald's "judicious readjustment" of the tariff has been studied and debated, [14]and continues to be debated.[15] Nevertheless a unanimous consensus has long existed on the fundamental purposes and methods of the NP tariff which went into effect on March 15, 1879. The fundamental purpose was protection. The method or approach taken to implementing protection, as explained by McDonald, before

the election, in Parliament and on the picnic grounds of Ontario, and Tilley, his finance

minister, in the House of Commons in his budget speeches had four main features or

principles:

1. Select for high protective duties manufactured goods domestic firms could produce but
    did not now produce, or did not now produce in large quantities. And select for high
    revenue duties goods like wine, coffee, corn, rice, and tea that could not then be
    commercially produced in Canada.

2. Select for low duties that the raw materials imported to produce manufactured goods,
    and also product lines it was thought too expensive or complex for domestic firms to
    produce.

3. Substitute compound specific and *ad valorem* duties for *ad valorem* rates to insure
    price deflation did not reduce either the protective or revenue creating power of the
    tariff.

4. Promise to maintain protection for long periods of time to reduce uncertainty and
    assure investors that their investments would not go sour because a tariff was
    suddenly and unexpectedly reduced.

The method of the NP was more easily explained than executed. (Apart from goods such

as silk, bananas, coffee, and tea, it was impossible to grow in Canada, how could one tell

which goods to tax for revenue and which for protection? Clearly it was not easy to decide.

American experts on tariff making were hired to advise the minister, but the problems

were endless. Who were the long-term winners and who were the losers? What about

competing goods that were substitutes in consumption?   What about jointly demanded

goods in production such as machinery and coal? What about agriculture? Protecting

agricultural implement makers clearly hurt farmers. Protection to wheat farmers was clearly redundant. The story is so many manufacturers, merchants, and farmers wrote Tilley to ask for tariff protection, or ask that protection not be applied, the tee-totaling former druggist from New Brunswick went blind with exhaustion and was forced to retire, on doctors orders, to darkened rooms to recuperate. Not all the costs of rent seeking were pecuniary. But what the tariff makers were trying to achieve is easily grasped. Looking particularly at the duties that affected cotton textiles let us see what the tariff makers did and how different the NP tariff was from the tariffs that went before it.

The cotton industry the government said was to be particularly favoured (Principle 1) and historians have believed them. "Among the industries favoured by the National policy, said O.D. Skelton, "the cotton industry took first place."[16] That the government would select cotton textiles for protection is unsurprising. As we have suggested above cotton textiles in the nineteenth century was like plastics in the twentieth century, and computers in the twenty-first century. Naturally raw cotton (in accordance with Principle 2) was admitted free of duty. But raw cotton was admitted free under the revenue tariffs of the 1870s. Indeed in central Canada raw cotton had not been taxed since 1848 and in New Brunswick since 1855.[17] What was special about the NP in its treatment of imports of goods used by the cotton mills were the duties on textile machinery. For 5 days short of 19 months (March 15, 1879 to October 10, 1880) imports of textile machinery were admitted free of duty, a substantial saving. Under the old revenue tariffs the duty on machinery was 17.5 percent and under the NP after October 10 it was increased to 25 percent.

The tariffs on the goods the cotton mills specialized in were increased (in accordance with Principle 1). Before the NP imports of these largely low count yarns and plain weave

low count cloths, typically 20 count or less, greys, bleached, dyed ,or colored goods all paid

17.5 percent, 1874-1879, and 15 percent 1867-1874. After the NP greys and bleached

goods paid (in accordance with Principle 3) 15 percent plus 1 cent per square yard, and

dyed or coloured goods paid 15 percent plus 2 cents a square yard. Prints, which were not

then produced by the cotton mills (in accordance with Principle 1), were charged the not

elsewhere specified rate of 20 percent.[18]

The question is how protective were these duties and how much more protective were

they than the revenue tariffs of the 1870s or the incidentally protective tariffs of the 1850s

and 1860s?

One way to measure the effective protectiveness of the tariff is to calculate what we

will call its "Barber mark-up": the maximum potential mark-up on the costs of converting

raw cotton – purchased at world prices – into yarn and cloth. (According to the census of

1870 the tariff-distorted share of raw cotton costs in the gross value of production of

cottons was 59 percent.)[19]

Typically historians have seen the pre NP tariffs as being low. Firestone (1960, p. 218),

for example, says, tariffs "afforded only slight protection to industry" in the 1850s, 1860s,

and 1870s. The Barber Mark-up tells a very different story. In the early 1850s the 12.5 per

cent tariff of the day in central Canada delivered a markup of 25 per cent. The incidentally

protective 20 percent Cayley-Galt tariffs of 1858-59 delivered a mark-up of 68 percent. The

15 percent compromise revenue tariffs of the late 1860s and early 1870s brought the

mark-up down to 47 percent. Finally, the 17.5 percent additional protection given by the

Liberals last revenue tariff increased the mark up to 57 percent.

With rates of protection like these one well might expect Canadian cotton textiles to have taken off in a rapid growth spurt as early as the 1850s. And as we will see in the next section that is exactly what happened. And yet we have not yet provided a measure of the protectiveness of the NP. This is a more difficult task because the NP tariff was more complicated schedule but it is easy enough to get a clear idea of the possible range of protectiveness by measuring the Barber mark-up delivered by ad valorem equivalent tariffs of between 20, 25, 30, and 35 percent, which covers the full range of imported cottons goods competing with the goods produced by Canadian mills and, then, compare these markups to those delivered by the older so-called revenue or incidentally protective tariffs. The maximum potential Barber markup, assuming more conservatively the cost share of raw cotton to domestic firms was 0.50, comes 40 percent for goods paying 20 percent, 50 percent for goods paying 25 percent, 60 percent for goods paying 30 percent, and a whopping 70 percent for goods, like prints in 1884, paying 35 percent. With maximum potential rates of protection like these it is no wonder there was a rush to invest in cotton mills in the early 1880s. But it is also possible, or so we will argue, that the tariffs of even the late 1850s were so high as to be to a large extent redundant and by the 1870s almost entirely or completely so. That is, it is possible that the rate of protection remained unchanged despite the decreases in the tariff at Confederation and then the increases that climaxed with the NP. But before we go any further into causes let us examine the actual growth of the cotton mills more closely, for that is what we wish to explain.

HOW FAST DID THE INDUSTRY GROW?

If the NP was indispensable to the growth of domestic cotton textiles, as the historians suggest, one would expect to find a major growth spurt in or around 1879. And yet looking at Figure 1 showing the real input index of the cotton mills output and Figure 2 which plots an index of the money value of output 1850 to 1913 deflated by a Canadian cotton goods price index which we call a real value index that is not what we find.[20] Indeed if there is any break point in these measures of long term annualized growth it is not on or about 1879, but on or about 1883, four years later, when the so-called overproduction crisis struck, and the curve of growth tilts down.

Let us attempt a more rigorous, measure of the industry's growth before and after the NP. To examine and compare the trend long term annualized growth rate of the cotton mills before and after the NP we regressed the logarithm of our two output measures on a time trend variable for 3 time periods: 1850 to 1883, 1883 to 1913, and 1850 to 1913:

$$\text{Log Output} = \text{intercept} + \beta^* t$$

Our interest is in the β^* coefficients which are the estimated annualized trend rates of growth of the cotton mills over these time periods. The estimates (see Table 2) confirm the visual impression expressed in Figures 1 and 2; the industry grew rapidly at a rate of between 17.2 and 18.2 per cent a year in the period 1850-1883 and then decelerated sharply 4 years or so after the establishment of the NP to between 4.0 per cent and 4.4 percent a year in the period 1883-1913.[21]

Figure 1

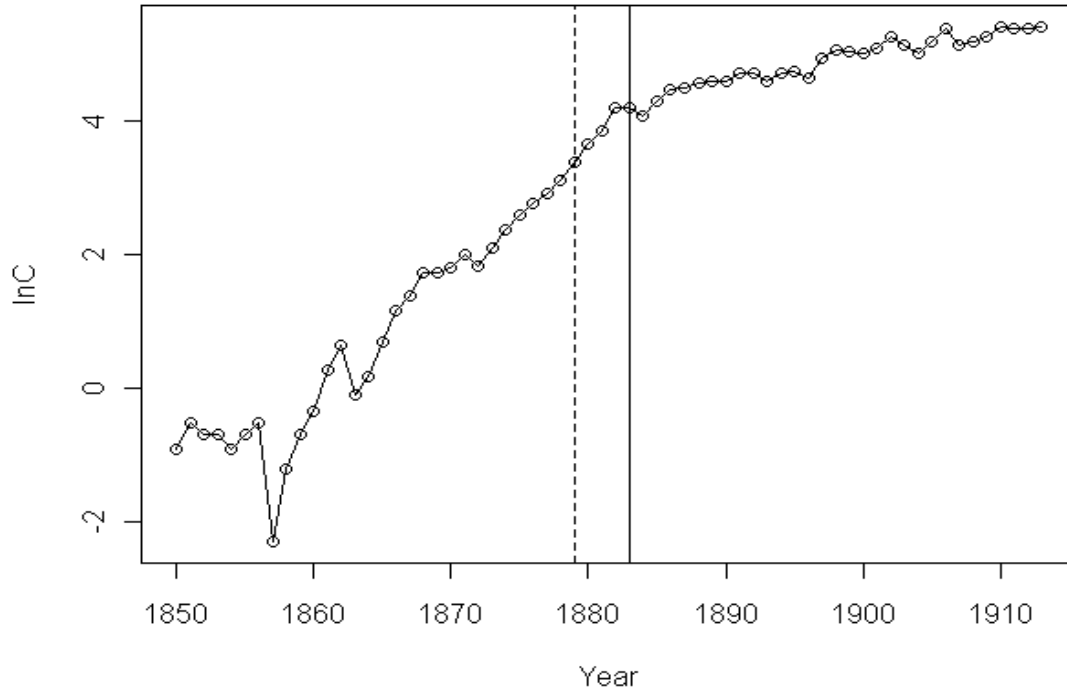GROWTH OF REAL INPUT INDEX OF COTTON MILLS OUTPUT, 1850-1913

Figure 2

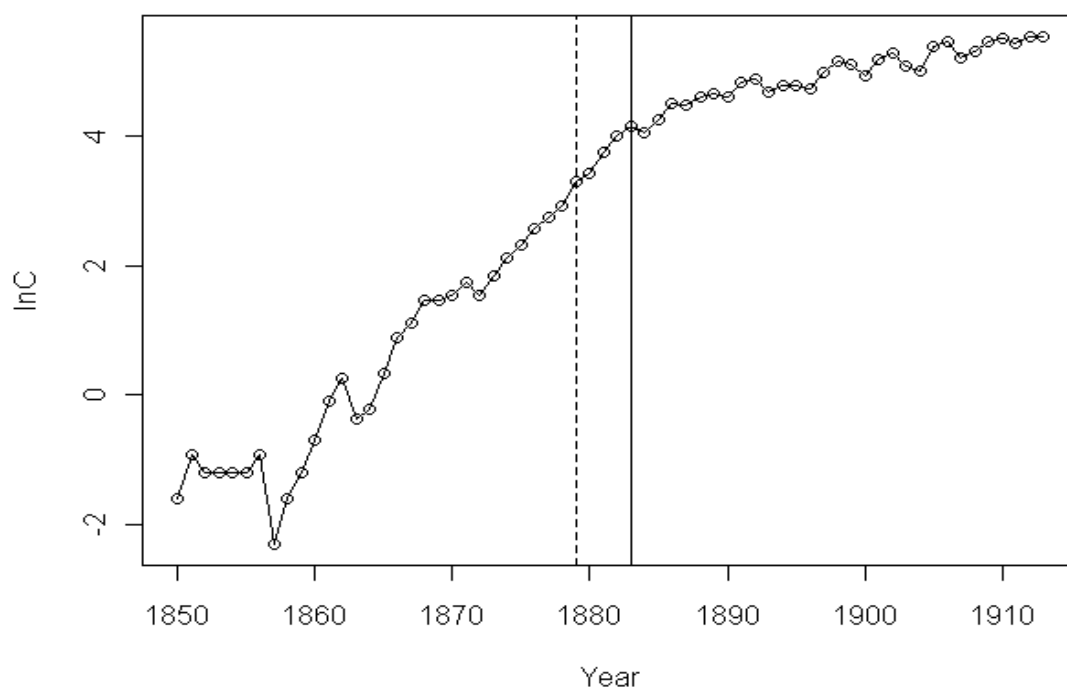GROWTH OF REAL VALUE INDEX OF COTTON MILLS OUTPUT, 1850-1913

Table 2

TREND GROWTH RATES IN REAL INPUT AND REAL OUTPUT OF THE COTTON MILLS,

1850-1883, 1883-1913, AND 1850-1913

Years	Intercept	B	R^2
Real Input			
1850-1883	-1.859679 (t = -10.44)	0.171800 (t = 19.34)	0.9212
1883-1913	4.261062 (t = 108.75)	0.039939 (t = 18.68)	0.9233
1850-1913	-0.917111 (t = -5.049)	0.117970 (t = 24.281)	0.9048
Real Output			
1850-1883	-2.34736 (t = -14.43)	0.18227 (t = 22.47)	0.9404
1883-1913	4.244420 (t = 89.22)	0.043813 (t = 16.88)	0.9076
1850-1913	-1.386713 (t = -7.476)	0.128155 (t = 25.830)	0.915

HOW FAST WOULD GROWTH HAVE BEEN WITHOUT THE NP?

How fast would the cotton mills have grown if tariffs had not increased beyond what they

were in 1850 and the NP never been introduced? Other causal factors were at work.

(See Table 3, below.) Tariffs, the historian's belief in the indispensability of protection

notwithstanding, were not the only forces at work. Over a dozen other factors are listed,

operating directly at the level of the industry alone. Among them: changing world prices

for cotton yarns and cloth and raw cotton, entrepreneurship, the development of markets

for labour, machinery and raw cotton, and yarn and cloth, and the invention and

improvement of new machinery, such as ring spinning and the automatic loom. Our goal,

here, is not to provide a detailed accounting of all possible sources of growth, but rather to

Table 3

CHECKLIST OF CAUSAL FACTORS EXPLAINING GROWTH, 1867-1914

Economy-wide	Manufacturing-sector	The Cotton Mills
Noted by Literature		
Confederation creates BNA customs union	Tariff 67 set at 15% Patent Act 71 attracts direct foreign investment	World price cottons falls Price raw cotton falls
'Great Depression' Long down-swing 73-96 Steady out-migration to US	'Merchants versus Industry' Decline in old staples; Entrepreneurship, Savings abundant in Maritimes Labour abundant in Quebec Municipal bonusing and tax holidays common everywhere	Managers technically weak financially naïve, poor marketers , ignorant of trade Machines obsolete Local supplies of skilled labour and managers non-existent
Cyclical slump 73-78	Sacrifice markets Tariff reset at 17½% in 74	Dumping of U.S. cloth
IC RR completed 74, westbound fares low	Lachine Canal widened 1878	
Cyclical Boom 1879-83	NP raises duties to 20% for most manufactures	Tariffs 25%, 30% plus on cloth Machinery duty 25% waived Cotton orgy Rise in world prices cottons Fall in US Raw Cotton prices Overproduction crisis 83
Recession 83-89	Knights of Labour 9 hour day Price fixing schemes RC Capital and Labour Combines Act 89	Price-fixing 84-89 Mergers 90 and 92
Recovery 89-92	CPR Completed 85	Tariff on Prints 35% 84 Exports to China Mergers 05 and 10
Neglected by Literature		
Domestic product and factor markets continue to develop throughout period	Technical and pecuniary economies	Raw Cotton, machinery and cloth export markets continue to develop in UK and US
Trade expands under Classical gold standard	Rent seeking	Learning by doing and by observing
Wheat Boom	Second Industrial Revolution	Automatic Loom 95

Source: Bliss (1974), (1987), Furlong (1994), Marr and Patterson (1980), McCullough (1994), McDiarmid (1946), Naylor (1975), Norrie, Owram, and Emery (2008), Pomfret (1992), Shortt, Skelton (1914), and Williams (1983)

construct a simple counterfactual test of the importance of increases in tariff protection for the growth of the Canadian cotton textile industries in the second half of the 19th century. Imagine, if you will, to put some flesh on the bare bones of this counterfactual that in his budget speech of March 1879 Sir Leonard Tilley - as had, counterfactually, along with every other previous Canadian minister of finance, Grit or Tory - Hincks, Rose, Cayley, Galt, and Cartwright - before and after Confederation - announced that the "revenue" tariff of 12.5 per cent *ad valorem* of 1850 was to be maintained for cotton goods, yet again. Note, a 12.5 percent tariff would still have granted domestic cotton mills a Barber mark up of between 25.0 and 30.5 percent on the costs of converting raw cotton into yarn and cloth. Surely one might think this was adequate, indeed even overly adequate protection to an industry now over 20 years established. As counterfactuals go this one gives the NP a good chance of showing well relative to the imagined alternative and in contrast to most of the classic counterfactuals an easy one that is not very difficult to imagine happening. Easier to imagine, at least than some of the classic counterfactuals of economic history: such as, the asphalting of the prairies to prevent the Wheat Boom, an eighteenth century repeal of the British Navigation Acts, Europe's failure to discover the new world in the age of sail, or the overnight swapping of the American railroads for more canals and roads in either the 1850s or 1890s.

We pose two counterfactual questions: (1) How much of the industry's growth between 1850 and 1883 would have taken place if the tariff had been frozen at its 1850 level of 12.5 per cent; and (2) How fast would the industry have grown between 1884 and 1913 if the NP tariff had been gradually reduced, year by year from its 1884 level of 29.5 per cent to its former 1850 level of 12.5 per cent?

20

To answer these questions we divide the second half of the 19th century into two distinct periods, 1850-1883 and 1884-1913, and model each period separately.

In both periods, we assume, there are two countries Canada, a price-taking, small-open economy, with two domestic industries, Cotton goods and Agricultural goods, and the United States, a large country, which sets prices, the terms of trade, for both industry's goods . Both of Canada's two industries have well-behaved constant returns to scale production functions and firms in both industries maximize profits. The US stands ready to supply or demand both industry's goods in whatever amounts Canada wants at fixed prices. Domestic Canadian prices are distorted by a tariff on cottons but Canada has no tariff on Agricultural goods, for which it is assumed it has a comparative advantage and the US has no tariffs on imports from Canada.

In the first period, 1850-1883, it is assumed that at the equilibrium point, where the tariff distorted terms of trade is tangent to Canada's transformation curve between Agricultural and Cotton goods, the Canadian cotton good industry does not supply the whole domestic demand which is made up by imports from the United States.

Specifically, the Canadian Cotton goods supply curve is written as:

(1) $Q_s = S \cdot P_s{}^\varepsilon$

The law of one price holds, so the Canadian price of cotton goods P is fixed at world price *Pw* plus the tariff:

(2) $P_s = P_w (1 + T)$

The Cotton Goods production function is taken to be Cobb Douglas:

$$(3)\ Q = A_0 \cdot e^{gt} \cdot L^a \cdot C^b \cdot K^c$$

There are three factors of production, Labour, L, Raw Cotton, C, and Machinery, K. Total factor productivity is initially at level Ao and grows at a constant rate of g a year t and by definition the superscripts a, b, and c sum to 1.

The markets for L, C, and K are assumed to be competitive and therefore all are paid their marginal products. The wage, w, therefore, must equal a Q/L and the price of cotton, Pc, must equal b Q/C.   To get a rising supply curve we will treat K as fixed. Rearranging and substituting these expressions in (3) for L and C and with some further manipulation and taking logs throughout, we obtain the expression:

$$(4)\ Log\ Q = Constant - a/c\ Log\ w - b/c\ Log\ Pc + g/c\ t$$

Taking logs throughout in (1) and substituting the right hand side of (4) for S we obtain

$$(5)\ Log\ Q = Constant + \varepsilon\ Log\ P - a/c\ Log\ w - b/c\ Log\ Pc + g/c\ t$$

which is the equation we will estimate econometrically.

In the second period, 1884-1913, it is assumed that the equilibrium point, where the tariff distorted terms of trade is tangent to Canada's transformation curve between Agricultural and Cotton goods, the Canadian cotton good industry supplies exactly all of the Canadian demand for cotton goods. This is an Eastman-Stykholt type model. The Canadian cotton industry is assumed to be a monopoly whose marginal cost curve always cuts the demand curve to the right of the import point and to the left of the export point. As

22

a result we can model the growth of the industry by specifying the Canadian demand curve

for cotton goods:

(6) $Q_d = D \cdot Y^\sigma \cdot P^\eta$

Taking logs we obtain our estimating equation:

(7) $\text{Log } Q_d = \text{Constant} + \sigma\, Y + \eta\, P$

We used OLS regression models to explain the growth of the Canadian cotton mills'

production 1850-1884 and the demand for Canadian cotton goods 1884-1913. [22] Two

measures of the output of the mills are employed, as described earlier, real input and real

output. Our estimating equations, we should point out are not reduced forms but rather

structural equations. The two estimating equations for the industry's supply curve for the

period 1850-1883 are:

Log Real Input = Intercept + B1 Log Real Wage + B2* Log Real Price Cotton + B3* Log Real
Price Output + B4*Time Trend + B6 War Dummy + error

Log Real Output = Intercept + B1 Log Real Wage + B2* Log Real Price Cotton + B3* Log
Real Price Output + B4*Time Trend + B6 War Dummy + error

War Dummy is a dummy variable designed to capture the negative disturbances of the Civil

War and the Cotton Famine years 1861-1865.

In the estimation of the industry's supply curve, we are particularly interested in the

own price elasticity of supply, B3, the elasticity of output with respect to the wage, B1, the

elasticity of output with respect to the price of cotton, B2, and total factor productivity

change, B4.

In the period 1884-1913 we seek to estimate the demand curve for Canadian cotton goods: Specifically the own price elasticity of demand, B6, the income elasticity of demand, B7, and, B8, the dummy variable Crash Dummy is designed to pick up the negative shock of the recession of the 1884-1889.

The OLS parameter estimates (and robust standard errors) are shown in Table 5. Our standard errors are probably too high because of multicollinearity, and we probably have a missing variables and an errors in variables problem. The missing variables are the cost of fuel and the cost of transporting inputs to the mills, and the cost of transporting cloth and yarn from the mills to the domestic market. All of these variables should be negatively correlated with the dependent variable. Note the intercept terms in both the real input and real value regressions are negative, as they are probably picking up the effects of the negatively correlated missing variables which are showing their influence via the error term. As a result the real wage elasticity, which should be negative, is the "wrong" sign and the real price of cotton may also be too low in absolute value..

Table 5

OLS REGRESSION ESTIMATES (ROBUST STANDARD ERRORS) OF THE DOMESTIC SUPPLY CURVE FOR CANADIAN COTTON TEXTILES, 1850-1883

Independent Variables	Dependent Variable	
	Real Input	Real Value
Intercept	-3.25077 (4.39919)	-3.91855 (4.15208)
Real Wage	1.23789 (0.90835)	1.18073 (0.85127)
Real Price Cotton	-0.86500 (0.55331)	-0.75679 (0.47401)
Real Price Output	1.82642* (1.08893)	1.65235* (0.98482)
Time trend	0.15741 **** (0.01896)	0.16761 **** (0.01685)
War dummy	-0.11830 (0.35484)	-0.08985 (0.32564)

Note:

(1) Robust standard errors are in brackets ("HC3"). Significance levels: * = >90%, ** = >95%, ***=>99%, ****=>99.9%.
(2) Regression on real input: Residual standard error: 0.4798 on 28 degrees of freedom
Multiple R-squared: 0.9385,   Adjusted R-squared: 0.9275
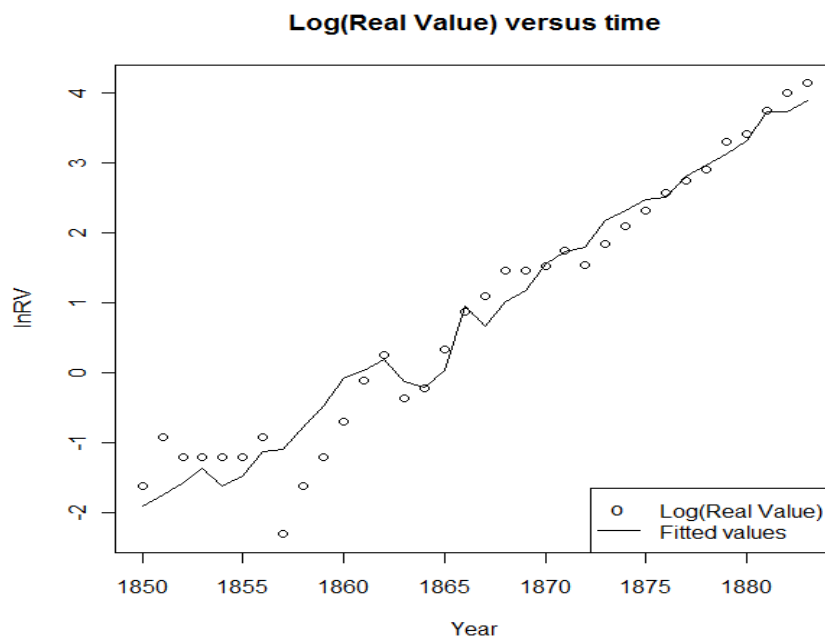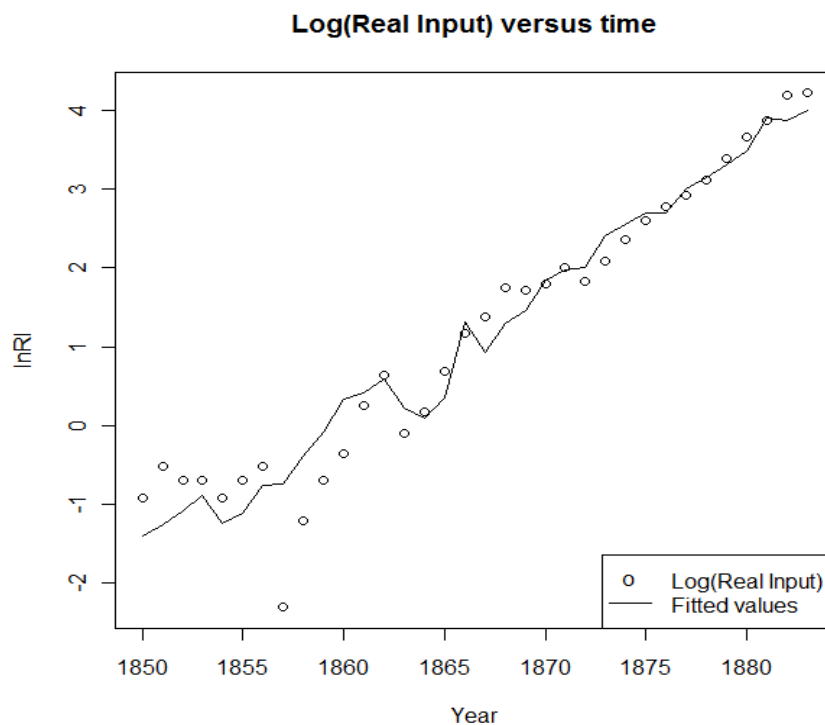F-statistic: 118.4 on 5 and 28 DF, p-value: < 2.2e-16
(3) Regression on real output: Residual standard error: 0.4379 on 28 degrees of freedom
Multiple R-squared: 0.9536,   Adjusted R-squared: 0.9453
F-statistic: 165.8 on 5 and 28 DF, p-value: < 2.2e-16

Figure 3

LOG OF REAL INPUT AND REAL VALUE, 1850-1883

Log(Real Input) versus time

Log(Real Value) versus time

Our estimating equations for the period 1884-1913 are:

Log Real Input = B0 + B1 Log Real Price + B2 Log Real GDP + B3 Crash Dummy + error

Log Real Output = B0 + B1 Log Real Price + B2 Log Real GDP + B3 Crash Dummy + error

The OLS elasticity estimates of these demand equations are shown in Table 6, below. Here we are probably in pretty good shape econometrically despite there being only 3 independent variables as this is a robust specification of the demand and the pattern of the residuals suggests little evidence of muticollinearity, as does the strong statistical significance of all the demand elasticity estimates. The own price elasticity of demand for domestic cotton goods is estimated to between -1.4 and -1.5 the income elasticity of demand to be 0.8. These are we believe the first empirical estimates of own price and income elasticities of demand for a Canadian manufactured good in the nineteenth century.

Table 6

OLS REGRESSION ESTIMATES (ROBUST STANDARD ERRORS) OF THE DOMESTIC
DEMAND CURVE FOR CANADIAN COTTON TEXTILES, 1884-1913

Independent Variables	Dependent Variable	
	Real Input	Real Value
Intercept	1.08499 *** (0.33934)	0.89849 ** (0.37953)
Real Output	-1.38635 ** (0.51739)	-1.46247 ** (0.62965)
Real Income	0.80031 **** (0.07017)	0.85075 **** (0.07943)
Crash Dummy	-0.25965 **** (0.06977)	-0.30867 **** (0.07996)

Notes:

(1) Robust standard errors in brackets ("HC3").

(2) Significance levels: * = >90%, ** = >95%, ***=>99%, ****=>99.9%.

(3) For regression on the Real Input dependent variable: Residual standard error: 0.09834 on 26 degrees of freedom; Multiple R-squared: 0.9338, Adjusted R-squared: 0.9261; F-statistic: 107.3 on 3 and 26 DF, p-value: 9.201e-15.

(4) For regression on the Real Value dependent variable: Residual standard error: 0.1149 on 26 degrees of freedom; Multiple R-squared: 0.9248; Adjusted R-squared: 0.9161; F-statistic: 107.3 on 3 and 26 DF, p-value: 9.167e-15.
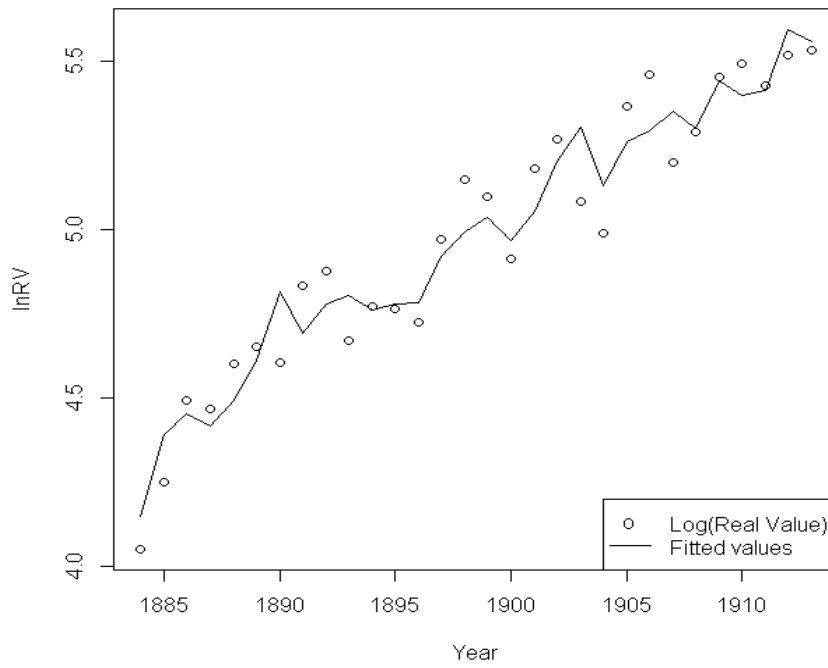
Figure 4

LOG OF REAL INPUT AND REAL OUTPUT,1884-1913

Log(Real Input) versus time
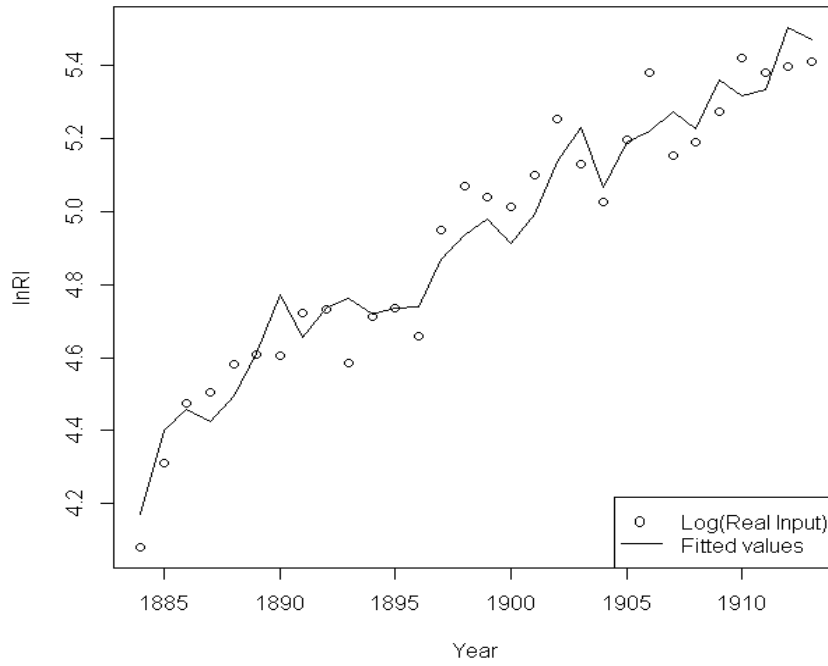
Log(Real Value) versus time

On the supply side while multicollinearity might be inflating our standard errors it is doubtful that missing variables are biasing upwards our estimates of the own price elasticity of supply, which is statistically significant and we estimate to be between 1.7 and 1.8 and the coefficient on our time trend variable provided it is interpreted properly (to be not only the growth of total factor productivity but also the benefits of increasing economies external to the cotton mills TFP measure) which we estimate to be growing at between 3.7 and 4.0 percent. Our estimate of the own price elasticity of supply of domestic cottons is the only example we know of in the literature for the estimation of such an elasticity.

What would the growth of the cotton mills if the tariff had stayed unchanged since 1850 and the NP had never taken place. Let us focus on the real value measure of output in the period 1850-1883. The actual growth of the cotton mills (see Table 7) was 18.2 per cent a year. The regressions tell us that out of this total TFP growth explains 15.8 per cent , all other factors 0.8 per cent, and the tariff o.5 per cent. The residual contribution of all other factors was 1.8 per cent a year.

Table 7

ACCOUNTING FOR GROWTH, 1850-1883 AND 1884-1913

Growth Rates, Elasticities and Rates of Change	1850 - 1883		1884 – 1913	
	Real input	Real Output	Real input	Real Output
1. Growth of output [%]	17.2	18.2	4.0	4.4
2. Price elasticity of supply	1.8	1.7	. .	. .
3. Price elasticity of demand	. .	. .	-1.4	-1.5
4. Income elasticity of demand	. .	. .	0.8	0.9
5. Growth of income [%]	3.2	3.2	4.3	4.3
6. Price of cotton goods [%]	-1.3	-1.3	-0.2	-0.2
7. Tariff [%]	0.3	0.3	-0.1	-0.1
8. Contribution to growth:				
a. Tariff [%]	0.5	0.5	0.2	0.2
b. Productivity [%]	15.7	16.8	..	..
c. Income [%]	0.0	0.0	3.4	3.9
d. All other [%]	1.0	0.9	0.4	0.3

Sources: See text

Note, the contribution of the tariff is based o n the estimates in Table 4. The annualized increase in output of the cotton mills stimulated by increased tariffs between 1850 and 1883 was at most:

$$\mathbf{T\cdot}\,T/(1 + T) \cdot \varepsilon\cdot$$

where **T** is the annualized rate of change of the tariff in1850, T, and 1883, T.' The tariff in 1850 is 12.5 per cent and the tariff in 1883 is 28.3 per cent, and ε, recall, is the own price elasticity of supply which we have estimated at 1.7. Substituting we estimate the NP at most contributed:

0.28 per cent x 1.7 = 0.5 per cent

to the industry's total actual growth rate of 18.2 per cent. Therefore, as a percentage of the cotton mills actual growth rate, tariff increases, including the NP increases, at most, contributed 2. 8 per cent of the total (0.5 percentage points divided by 18.2 percentage points). By contrast TFP growth contributed 92.3 per cent to the growth of the cotton mills. Granted our measure of the impact of the NP does not include the effect of the 16 month elimination of the tariff on machinery, but even so it seems doubtful that the NP played any more than a minor role in the growth of the Canadian cotton mills in the time of the heyday of cotton textiles growth.

In the years 1884-1913 which we will not go into in detail here, the tariff did make a positive contribution to the industries growth because the tariff was reduced from 29.5 per cent to 25 percent which increased domestic demand. This is not what historians have in mind by the role of protection in the growth of industries, but perhaps that is why the actual economic history of an industry is often different from the way historians imagine that it.

WHAT ARE THE LESSONS?

In the second half of the nineteenth century, it grew extremely rapidly in Canada, growing at first at 17-18 per cent a year from 1850 to 1883 and then at a more moderate rate of 4.0-4.4 per cent a year 1884 to 1914.

Canadian historians have long believed the cotton industry's growth depended largely on the NP, that the tariff was indispensable to the growth of the industry. We have shown:

1. The Canadian cotton textile industry's growth was significantly faster before the NP than after.

2. Other causal factors were far more important than the literature would lead one to believe.

3. Counterfactually, and conservatively, if the NP had not been introduced, and the tariff not increased after 1850, most of the industry's growth, over 97 per cent, would still have taken place.

The main lesson of this study is that a positive overall correlation between tariffs and growth for the economy as a whole may indeed provide a distorted picture of the causal forces at work at the industry level. Contrary to the conventional wisdom, the case of the Canadian cotton textile industry provides no support for the Bairoch hypothesis.

APPENDIX I

A BRIEF NOTE ON STATISTICAL SOURCES

A more detailed note on statistical sources is available upon request.

Y is a real GNP index (1890=100) obtained by linking Maddison's annual estimates (1850-1870), which in turn are based on Firestone's estimates, and Urquhart's estimates (1870-1913).

Pa is a Canadian wholesale price index, 1890=100, which links Paterson and Shearer's estimates 1850-1870 with the price index used by Urquhart to deflate his current dollar GDP estimates (1870-1913).

W is a gold dollar wage index, (1890=100) based on Layer's data on the wages of loom fixers in the US.

Pc is a gold dollar Bureau of Labor Statistics, price of raw cotton in New York index (1890=100) taken from the Historical Statistics of the United States.

P is a Canadian price of cotton goods which links a tariff-adjusted gold money price of U S brown sheeting (1850-1861), a William Parks and Son, Saint John, NB, factory price index for cotton yarn and cloth (1861-1892), and a Coats DBS price index for cotton yarn and cloth (1892-1913).

Pw is a gold price BLS of US Brown Sheeting price index, taken from Historical Statistics of the United States.

Tus is the Canadian tariff on cotton goods from US, (per cent) from Canada's Tables of Trade and Navigation.

Tuk is the Canadian tariff on cotton goods from UK, (per cent) Canada, Tables of Trade and Navigation

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END NOTES

[1] Studying the growth of industries in 5 major industrial countries, Kuznets 1930, p.324-325)found that "the simple logistic and the simple Gompertz curves ..., chiefly the logistic, yielded suitable descriptions of the long-time movements in production," and over periods of 30 to 40 years "the tendency of industries to exhibit a declining rate of growth." According to Rostow 1975, p. 160, the British cotton mills in the Industrial Revolution, grew "explosively" at 9.2 percent a year between 1775 and 1800, less than half of the rate achieved by the Canadian and Japanese industries a century later, "This," he says, " is what a case of increasing returns ... looks like in real life." This is less than the rate the Italian mills were growing at in the 1870s and 1880s.

[2] See McCullough 1991 for a survey of the literature.

[3] Glen Williams 1979, for example, writes: "While it would be difficult to isolate the tariff as the only, or even the principle, cause of early Canadian industrial growth, it clearly played a central role."

[4] McDiarmid 1946, p. 190; Naylor 1975, vol 1, p. 49; DeLottinville 1980, p. 102.

[5] Bliss 1987, pp. 301, 304, and 305. For comparable accounts see McCullough 1994, Naylor 1975, Pomfret 1993, and Taylor and Baskervile 1994.

[6] Kindleberger 1974 recall lists 10 effects. But only 6 apply to the growth of an industry. The other four are macroeconomic and are quite rightly ignored by Bliss: the terms of trade effect, internal income distribution effect, balance of payments effect, and employment effect. The two he does not talk about but might are the consumption and revenue effects which we will deal briefly with later in the paper. There are of course also the innumerable non-economic effects of a tariff. For example Stigler (1947) organizes these effects under three major headings: political and diplomatic relations, administrative enforcement and military self-sufficiency, to which we could add a fourth heading, morals public and private. In this paper we will have nothing to say about the noneconomic effects of the NP. But it should be noted that the debate over protection in nineteenth century Canada centered largely on the non-economic effects of protection.

[7] There is now a fairly large and growing body of work on productivity change that supports this idea. For an overview see Inwood and Keay 2005, Baldwin and Green 2008, and Hinton 2010.

[8] Estimated as the average of Urquhart's (1993, p. 389) estimates for "cotton textiles" gross value of product 1878 ($2.1 million) and 1879 ($2.9 million). Other manufacturing industries of roughly the same size ($2 to $3 million) included distilleries, paper, and railway equipment.

[9] For example McInnis 2000 labels the industry a "laggard" and describes its growth as "meagre"

[9] Bliss 1987, pp. 301, 304, and 305. For similar stories see McCullough 1994, Naylor 1975, Pomfret 1993, and Taylor and Baskervile 1994.

[10] Mills would not appear in Nova Scotia until after the NP, the first mill opening at Windsor in 1882. This marked the geographic limits of Canadian cotton textiles in the nineteenth century industry.

[11] See Jeremy

[12] Fowke 1952.

[13] Hart 2002.

[14] See the Fall, 1979 issue of the *Journal of Canadian Studies*, marking the 100th anniversary of the introduction of the NP.

[15] See Beaulieu and Cherniwcchan 2011, who argue that the NP restricted trade significantly more than historians have typically believed at a much lower static welfare cost than economists and economic historians have typically believed was the case.

[16] Skelton 1913, p.187.

[17] Hinton 1994.

[18] McDiarmid 1946, pp. 136-142, 161-165, 174-177, 200, and 252 and Canada *Tables of Trade and Navigation*, 1868-1897

[19] See, Barber 1952, Dales 1964, and Mackintosh 1937. We are indebted to a paper by Harley (2001) for reminding us of this simple and elegant approach to measuring protectiveness. The mark up, it is easy to show, is equal to the ad valorem or ad valorem equivalent tariff, t ,divided by *1 - Sc (1 + t)*, where *Sc* is the Canadian industry's cost share of raw cotton,.

[20] The real input index is based on estimates of annual imports of raw cotton into Canada 1850-1913. See Appendix 1: A Note on Statistical Sources, which will make available at the meetings in June to thise who are interested.

[21] A Chow test was employed to test for structural breaks, or more properly the absence of a structural break, in the year 1879 and the presence of one in 1883. The p-values for a structural break in the time-trend coefficient were 0 for both dates, indicating that the null hypothesis of no structural break can be rejected. That is we can say with a very high degree of confidence the coefficient on the time trend is different before and after the interval 1879-1883 but we cannot say precisely where in this interval the break occurs.

[22] A detailed description of the sources of our data is provided in Appendix II.