# Protecting Infant Industries:

# Canadian Manufacturing and the National Policy, 1870-1913

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ABSTRACT

**Protecting Infant Industries:**
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In contrast to traditional neo-classical models of international trade, industrial organization and learning-by-doing trade models describe how protective tariffs can encourage output expansion, productivity improvement and falling prices. The 1879 National Policy substantially increased tariff protection to some, but not all, Canadian manufacturing industries. Treating the National Policy tariffs as a natural experiment, and using treatment intensity and difference-in-differences approaches, we find strong support for the predictions of the new trade models. After 1879, industries that received greater protection experienced faster growth in output and productivity, and larger price reductions. The industries targeted by the National Policy also exhibited larger increasing returns to scale and faster learning rates. In addition to addressing a central theme in Canadian economic history, our results shed light on the broader issue of infant-industry protection.

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## 1. Introduction

As part of the Dominion Government's 1879 budget, the Canadian parliament passed what has become known as the National Policy. The legislation had broad nation building objectives that were to be achieved by substantially increasing tariffs on a long list of manufactured goods and through measures to promote railway-building and immigration. Since its introduction, the role of the National Policy in Canadian economic development has been controversial. The debate, moreover, has important implications for our understanding of infant-industry protection that extend well beyond the Canadian historical context (Baldwin 1969; Melitz 2005). Empirical work on the impact of both protection (Irwin and Temin 2001; Irwin 2000; Bils 1984; Krueger and Tuncer 1982) and trade liberalization (Amiti and Konings 2007; Schor 2004; Tybout and Westbrook 1995) in the presence of infant industries gives a mixed picture. We would hardly claim to resolve the question, but our empirical findings shed light on a literature that has been mainly theoretical, while confronting directly a central theme in Canadian economic history.

W.T. Easterbrook and Hugh Aitken’s (1956) classic, *Canadian Economic History*, presents what is regarded as the traditional view, which reflects the claims made by John A. Macdonald in 1878 when, as leader of the opposition Conservative Party, he first proposed the National Policy. As Easterbrook and Aitken put it (1956: 394), the National Policy supported: "...a strong economic and political unity to 1930, a better balanced and diversified though vulnerable transcontinental economy, and a rise to 'middle nation' role in world affairs.” According to this interpretation, higher protective tariffs promoted economic and industrial development, and were a vital source of government revenue. This view of the National Policy is not without its critics. Dales (1966) and Easton et al. (1988), for example, use standard neoclassical trade models in support of their revisionist view that the National Policy reduced per-capita income growth and possibly extensive growth.

In light of the growing influence of the large, mainly theoretical, 'new' trade literature that describes how tariff protection for infant industries can increase productivity and the pace of industrial development, there is a need to revisit both the traditional and revisionist perspectives. The Canadian experience of increased tariff protection under the National Policy provides us with an opportunity to test the theoretical predictions of the neo-classical and new trade models, while investigating the impact of the policy on Canadian development.

We present versions of two models, prominent in the new trade literature. The first treats the manufacturing sector as a Cournot oligopoly, where a tariff can promote growth through internal scale economies. The second model focuses on external economies and the impact of tariff protection on learning by doing. These models describe mechanisms through which tariffs can trigger increases in output and productivity. We use Urquhart's (1993) data on fifteen Canadian manufacturing industries, spanning the years 1870-1913, to compare the performance of industries that were targeted by the National Policy with those that were not. Using treatment intensity and difference-in-differences estimation approaches, where industries receiving substantial tariff protection comprise the targeted group, we identify large, statistically significant impacts on output, productivity and price. We also find evidence of increasing returns to scale and learning-by-doing, with those industries most affected by the National Policy being particularly sensitive to output expansion through their scale economies and learning rates. Our findings support the two new trade models, and the traditional view that the National Policy fostered infant industries and promoted Canadian economic development.[1]

## 2. Tariffs and Canadian Economic Growth, 1870-1913

Prior to the work of Urquhart (1986, 1993), 1879 was not seen as a watershed year for the Canadian economy. According to earlier interpretations, the last thirty years of the nineteenth century was a period of generally sustained growth, albeit with a slowdown during the general recession of the early 1890s (Hartland 1955; Firestone 1960; Bertram 1963). Although Young (1955), McDougall (1971), Barnett (1966) and Altman (1987) point to faster growth in the decade following the introduction of the National Policy, they argue that the ‘wheat boom’, 1896-1914, was the true break point in Canadian development. Urquhart’s annual national income estimates have since allowed

[1] Supporting infant industries with tariff protection is not costless. Even where infant industry effects can be identified, the net contribution to welfare may be small or even negative (Head 1994; Inwood and Keay 2013; Irwin 2000). We do not consider the general equilibrium or broader welfare effects.

researchers to address the issue of timing more rigorously. Inwood and Stengos (1991), for example, test for structural breaks in gross national product and investment over the period 1870 to 1985, concluding that 1896 was an important discontinuity (see also Green and Urquhart 1987; Green and Sparks 1999). Certainly in terms of aggregate output and population, 1896-1914 was a period of remarkable growth unmatched in Canadian history. Nevertheless, the experience of the 1880s, both in manufacturing and in measures of per capita growth, is in some ways comparable to the wheat boom years.

INSERT TABLE 1 HERE

Population and GDP increased much more rapidly during the decade after 1900 than during the 1880s. Population grew at an average annual rate of 2.6 percent, as compared to 1.2 percent, and GDP grew by 5.8 percent rather than 3.6 percent (see Table 1). However, in per capita terms the differential in GDP growth was less than 1 percent, 3.2 percent as compared to 2.4 percent, and total manufacturing output grew just 0.5 percent faster during the 1900s. In fact, per capita manufacturing output grew more rapidly during the 1880s than during the first decade of the twentieth century. If we include the recession years of the early 1890s and the boom years of the late 1890s, with 1896 marking the start of the wheat boom, then the growth in manufacturing output from 1879-1895 differs from the post-1896 period by less than 2 percent, and growth in manufacturing output per capita differs by just 0.6 percent.

Not only was growth during the 1880s close to that experienced during the wheat boom years, it represented a sharp break from earlier years. Although population grew more slowly after 1879, GDP growth accelerated by 1.7 percentage points and manufacturing output by 3.7 percentage points. Per capita manufacturing output, which was stagnant through the 1870s, grew at an annual rate of 4.2 percent during the 1880s, ending the decade 50 percent higher than at the start.[2] Comparing the decade leading up to the National Policy to the last twenty years of the nineteenth century and the first decade of the twentieth confirms that 1880 (and to an even greater extent, 1879)

[2] There was no comparable acceleration in US growth during the 1880s. US manufacturing output grew more slowly from 1880-89 than 1870-79, and real GDP growth was flat (Carter et al. 2006: 3-24, 4-612).

represents a significant break in terms of GDP, manufacturing output, and the corresponding per capita measures.[3]

Even more revealing than the macroeconomic evidence is the expansion in industry-level output after 1879. Table 2 reports real value added growth rates for fifteen industries over the years 1870-79, 1880-89, and 1880-1913.[4] To better relate these growth rates to the differential effects of the National Policy, industries have been divided into three groups based on how directly they were affected. The first of these, the *target* group, are the four import-competing industries with the largest tariff increases. This group consists of Tobacco Products, Paper Products, Transport Equipment, and Petroleum and Coal Products. The second *broad* group adds Printing and Publishing, and Iron and Steel, industries that benefitted from large tariff increases, but were not as strongly import-competing.[5] What we call the *unaffected* group received much smaller tariff increases in 1879 or faced little import competition. This third group comprises Food and Beverages, Rubber Products, Textiles, Clothing, Wood Products, Non-Ferrous Metal Products, Non-Metallic Minerals, and Chemical Products.

INSERT TABLE 2 HERE

After 1879 the output of those industries receiving the largest increases in tariff protection under the National Policy accelerated more rapidly. Applying a GDP deflator, average growth among the nine industries in the *unaffected* group increased from 1.4 percent per year prior to the National Policy to 3.9 percent in the post-1879 period (1880-1913) - an acceleration of 2.5 percentage points. The corresponding increase among the industries in the *target* group was just 1.6 percent, while real output among the *broad* group accelerated by 3.8 percentage points. We note, however, that because industry output is derived from a single aggregate GDP deflator, these differences in real growth rates do not reflect changes in relative prices. Allowing for industry-specific price

[3] Tests for differences-in-means and trend breaks confirm significant differences in GDP, GDP per capita, manufacturing output and manufacturing output per capita growth rates before and after 1879.

[4] Urquhart (1993: 39-43) identifies manufacturing industries at the two-digit SIC (1948) level. We omit two of Urquhart's industries: Electrical Apparatus (data is unavailable before 1890) and Miscellaneous Industries. Together, these industries produced less than 3% of manufacturing value added in 1913.

[5] Industries in the *target* group satisfy: (i) % increase in ad valorem tariff rates between 1875 and 1880 exceeds 37.5%, and (ii) import intensity in 1875 exceeds 30%. The two additional industries satisfy (i), but their 1875 import intensities were low (17% for Printing and Publishing, and 20% for Iron and Steel). See Appendix Table A1.

changes, we find considerably stronger evidence that output accelerated much faster among the industries that received greater tariff protection.[6] Deflating nominal value added by industry-specific wholesale price indexes reveals that growth in the *unaffected* group accelerated by just 0.8 percentage points after 1879, whereas growth rates among the *target* and *broad* groups increased by 12 percent and 9 percent, respectively.[7]

The aggregate evidence reported in Table 1 and the industry-specific evidence in Table 2 suggest a positive relationship between greater protection due to the National Policy and economic growth, but, of course, they do not imply causality. In the next section we present two models that describe mechanisms that can yield a potential *causal* connection between tariff protection and output growth, productivity improvement and falling prices. The first is an industrial organization model based on imperfect competition and internal scale economies. The second is based on learning by doing where the emphasis is on external economies.

## 3. Two Models of Tariff Protection and Growth

### 3.1 *Industrial Organization Model*

In the spirit of the 'new' theories of international trade, our first model describes one of the channels through which internal scale economies operate for firms within an oligopolistic framework. Following Harris (1984), Horstmann and Markusen (1987), and Melitz and Trefler (2012), we treat a manufacturing industry as a Cournot oligopoly with free entry. In this simple framework manufacturing uses only labour, while agriculture uses labour and land.[8] We apply the assumption made by Dales (1966) of a constant money wage, or equivalently, a constant real wage expressed in units of the agricultural good.

[6] Industry-specific output prices are based on benchmarks in Barnett (1966). Interpolation is based on prices reported in Michell (1931), Urquhart and Buckley (1965), *Trade and Navigation Reports*, various newspaper sources, and *Eaton's Fall Catalogues*. Information on data sources and how the series were constructed is provided in the Data Appendix.

[7] All of these comparisons apply to the period 1880-1913. Comparing instead the first decade following the National Policy (1879-1888) gives similar results, although, where the GDP deflator is applied, the acceleration in the *unaffected* group is greater, and the *target* group exhibits a slight decline in growth rates.

[8] Because late-nineteenth century Canada was open to unfettered capital flows, the absence of reproducible capital in this model does not affect the relevance of its predictions in our historical context.

Let $c$ denote the marginal cost of production within a manufacturing industry; $w$ the money wage; $v$ the variable input of labour per unit of output within a representative firm (assumed constant); and $f$ the fixed labour required to start up a representative firm. Prices are set in a free-entry Cournot model such that:

$$p_m = \text{mark-up} \times \text{marginal cost} = \theta wv \qquad (1)$$

and

$$p_m = \text{average cost} = wv + wf/q \;, \qquad (2)$$

where $q$ denotes output per firm, and $\theta$ the Cournot mark-up. The $N$ firms in the industry are assumed to sell a homogenous good. To keep matters simple we follow the standard practice of treating domestic demand for import-competing manufactures as a function of domestic prices, $p_m$, and world prices, $p_m*$. This Armington assumption of imperfectly substitutable domestic and foreign manufactures, which contrasts with the standard neo-classical demand assumption, is a necessary building block for any model of imperfect competition. Aggregate demand for domestic manufactures also depends on aggregate income and, hence, the total labour force, which, following standard practice, we identify as population. We simplify the analysis by assuming that the labour income elasticity of demand for domestic manufactured goods is one, and the land income elasticity of demand is zero. These assumptions imply the following linear demand function for the domestic manufacturing industry:

$$D(p_m, p_m*; w, L) = wL(\alpha - \beta p_m + \gamma p_m*) \;, \quad \beta, \gamma > 0 \qquad (3)$$

where $L$ is the total labour force. We restrict prices to the relevant range, so demand is positive. The demand function can be written in inverse form as:

$$p_m = a - b\,Q \;, \qquad (4)$$

where $Q$ is total domestic demand for manufactures; $a = \alpha / \beta + \gamma / \beta p_m*$ ; and $b = 1 / \beta wL$. With Cournot pricing, domestic firms take the output produced by other domestic firms as exogenous, which implies the following industry equilibrium condition between prices and output:

$$p_m = c + bq \;, \qquad (5)$$

where $q$ is the output of a representative firm (= $Q/N$). Substituting the marginal cost condition, $c = wv$, into (5) gives:

$$p_m = wv + q/\beta wL \;. \qquad (6)$$

Combining the Cournot pricing condition (6) with the zero profit condition (2) gives us the following relationship between output per firm, the wage rate, and population:

$$q = w(\beta f L)^{1/2} . \qquad (7)$$

Given the cost conditions and the assumption of unitary income elasticity of demand, output per firm is therefore proportional to the wage rate. More significant is the fact that output per firm depends on the square root of market size, as measured by population, $L$. We refer to the relationship between $q$ and $L$ defined in (7) as the market size schedule, depicted in Figure 1. This relationship works through the perceived elasticity of demand and the zero profit condition. Larger markets increase this elasticity and, therefore, reduce mark-ups, $\theta$. This means that for profits to remain at zero, an increase in market size must raise output per firm.[9]

INSERT FIGURE 1 HERE

To solve for equilibrium in the economy as a whole we need to introduce the agricultural sector, which produces a homogeneous good, 'food', for export at an exogenous world price, with labour and land. The labour market clearing condition, $L = L_f + L_m$ and (2) implies:

$$L = L_f + N(vq + f) , \qquad (8)$$

where $L_f$ is labour in agriculture; $L_m$ is labour in manufacturing; and $N$ is the number of firms in manufacturing. From (3), equilibrium in the manufactured goods output market is:

$$wL(\alpha - \beta p_m + \gamma p_m^*) = Nq . \qquad (9)$$

Defining the demand for manufactured goods per dollar of labour income as:

$$d(p_m, p_m^*) = \alpha - \beta p_m + \gamma p_m^* , \qquad (10)$$

we can derive the following relationship between the two endogenous variables $q$ and $L$, from (2), (8), (9) and (10):

$$w\, d[AC(q), p_m^*]AC(q) = 1 - L_f / L , \qquad (11)$$

where $AC(q)$ is average cost per firm. Note that $L_f$ is fixed if money wages are constant. We define:

$$\psi(q) = d\, [AC\,(w, q), p_m^*]AC(q) . \qquad (12)$$

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[9] In contrast to product differentiation models of trade (with constant elasticity of substitution between varieties), in which increased market size leads to an increase in variety, not larger firms, lower mark-ups with zero profits necessarily imply an increase in output per firm in this model.

Since prices equal average cost, this is the value of spending on manufactured goods per dollar of labour income. It is also the share of the labour force in manufacturing.[10] The slope of $\psi$ with respect to q can be derived as:

$$\psi'(y) = AC'(q)\, d\, (\varepsilon+1)\,, \qquad (13)$$

where $\varepsilon$ is the price elasticity of per capita demand. We assume that demand for domestic manufactures is price elastic, so $\varepsilon < -1$. In this case, the set of $(L, q)$ which satisfy (11), denoted by *LL* in Figure 1, clear both goods and labour markets. *LL* slopes upwards, meaning that larger populations, with fixed $L_f$, require a larger share of total spending on domestic manufactured goods to clear the goods market. So while average costs (and prices) fall as $q$ increases, demand must rise more than enough to allow total spending on manufactured goods to rise. In this case, the *LL* schedule cuts the market size schedule from below.[11]

Imposing a tariff on manufactured goods in this model raises foreign prices for domestic consumers. This has no effect on the market size schedule, but it affects the *LL* schedule through the shift argument, $p_m^*$, of the demand function. At initial per firm output levels and population sizes, $(q_0, L_0)$, the increase in the tariff raises per capita demand and hence total demand for manufactured goods, leading to a horizontal shift in the *LL* schedule to *LL'*. This induces the entry of new firms and the expansion of employment within domestic manufacturing. The latter effect is reinforcing, in the sense that demand for manufactured products increases even further due to the increase in population. Increased profitability, together with a larger market size via the entry effect, leads firms to expand output, cut mark-ups and lower prices. These effects will be measured as increasing returns to scale. In summary, the tariff:

a) increases market size through import substitution and increased population, raises total demand for import competing manufactures, and raises per firm output (and firm size);

b) reduces Cournot mark-ups, leading to lower average costs and prices, and higher productivity.

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[10] With labour mobile between sectors, wages in agriculture and manufacturing will be equal. Also note that we are assuming all spending is from labour income.

[11] This will be true in the neighbourhood of a stable equilibrium. Note that for populations less than $L_f$ the $\psi$ schedule is undefined.

It is also useful to consider the quantitative impact of a tariff implied by this model. From the definition of $\psi$, it follows that if a tariff induces a 10 percent increase in per capita demand for manufactured goods, then the share of the total labour force in manufacturing, $(L\text{-}L_f) / L$, must also increase by 10 percent, *holding per firm output constant*. The increase in market size, however, means that per firm output will also rise and prices will fall, leading to further increases in the share of labour in manufacturing. The initial import substitution effect, therefore, provides a lower bound for the ultimate impact on the size of the domestic manufacturing sector.

This industrial organization-inspired model predicts output expansion, productivity improvement and falling prices in response to the introduction of a protective tariff. The key to the identification of these effects is the measurement of significant scale economies among those industries affected by the change in policy - the tariff triggers output expansion and a reduction in Cournot mark-ups, which are reflected in increasing returns to scale, productivity improvements and price reductions.

### 3.2 *Learning-by-Doing Model*

Our second model provides an infant industry justification for protection based on learning-by-doing (LBD). In this model, industry productivity is an increasing function of industry 'experience', proxied by cumulative output. When tariff protection facilitates increases in output, cumulative output rises more quickly, experience is gained, productivity increases, costs fall, and prices fall. Protection, therefore, is one means of increasing output to bring an infant industry to maturity sooner.[12]

As before, the manufacturing industry produces a close substitute for a competing foreign good, whose price, $p_m^*$, is fixed in world markets. Total domestic manufacturing output at time $v$ is denoted by $Q(v)$; and, setting the initial time at 0, cumulative output $Z(t)$ is:

$$Z(t) = \int_0^t Q(v)\, dv\ . \tag{14}$$

[12] Economic historians have long appealed to versions of the learning-by-doing model first formalized by Arrow (1962). For example see David (1970), Williamson (1972), and Irwin (2000).

The domestic manufactured good is produced under constant returns, with labour as the only input.[13] Productivity is denoted $a(Z)$, where $Z$ is a proxy for experience, and we assume that the productivity curve has a logistic S-shape which reaches an upper bound, $a^*$, at $a(Z^*)$.[14] In the present context $a^*$ can be thought of as reflecting best-practice technology available internationally. Thus, international diffusion of knowledge combined with experience jointly account for the shape of the learning curve. Perfect competition within manufacturing ensures that prices are set so that $p_m = w/a$. The per capita demand function is the same as in the first model, implying that total domestic manufacturing output is given by:[15]

$$Q = d(p_m, p_m^*)\, w\, [L_f + a(Z)^{-1} Q]\ . \tag{15}$$

Normalizing $w$ and noting that $p_m$ can be expressed as $a(Z)^{-1}$, (15) can be rewritten as:

$$Q = \frac{d[a(Z)^{-1}, p_m^*]\, L_f}{1 - d[a(Z)^{-1}, p_m^*]\, a(Z)^{-1}}\ . \tag{16}$$

From (16), the sign of the slope of $Q$ with respect to $Z$, for $Z < Z^*$, is $-sign(\varepsilon + s)$, where $\varepsilon$ is the price elasticity of per capita domestic demand and $s$ is the expenditure share for the domestic manufactured good. As before, $\varepsilon < -1$, implying $dQ / dZ$ is positive. From (14), the model's dynamics are given by $dZ/dt = Q$.

The evolution of per period output, $Q$, and cumulative output, $Z$ , is represented in Figure 2, where arrows indicate the dynamics. Initial output is $Q_0$ (where $Z$=0), and the economy moves along the $Q(Z)$ curve with $Q$ rising until cumulative output reaches the boundary value, $Z^*$. At this point the economy switches to the steady-state output level $Q^*$. Productivity grows along with $Z$, rising steadily until learning ceases. Thus the manufacturing sector grows, productivity rises, and domestic prices fall over the interval $[0,Z^*]$.[16]

[13] Since Canada was open to unfettered inflows of capital, the constant returns assumption is a reasonable approximation.

[14] Because output is produced with a single factor in this model, $a(Z)$ captures labour productivity alone. The model can easily be generalized to include multiple factors of production, in which case $a(Z)$ becomes a measure of TFP. In our empirical investigation we derive TFP based on a four factor, log-linear, Cobb-Douglas production function.

[15] The agricultural sector is also the same as in the first model. Note that labour market clearing implies that $L_m = a(Z)^{-1} Q$.

[16] It could be argued that this is not a 'true' infant industry model because the industry grows independent of any policy intervention. It would be possible to make the industry in this model a long run infant by amending the learning curve such that no learning takes place unless output achieves some critical level.

INSERT FIGURE 2 HERE

The introduction of a tariff increases the demand for domestic manufactures so that the impact on $Q$ for a given $Z$ is derived from (16) as:

$$\partial Q / \partial \tau = (\partial d / \partial \tau) [L_f / (1- da^{-1})^2] > 0 , \qquad (17)$$

where $\tau$ is the *ad valorem* tariff. Thus, an increase in the tariff shifts the $Q$ schedule up, and both initial output and permanent long run output are increased (see Figure 2). As well, the tariff speeds up the rate at which an industry proceeds up its experience curve, and therefore brings forward the date at which it matures. Note, however, that the tariff has only a transitional impact on productivity. In summary:

a) a protective tariff permanently increases the size of the manufacturing industry relative to the no-tariff situation, and output and cumulative output grow faster;

b) manufacturing productivity grows faster than it would without the tariff, and prices fall faster.

Similar to the industrial organization model, this model predicts that an increase in tariff protection can accelerate output expansion, improve productivity, and reduce prices. But here the channel is learning-by-doing.

## 4. Estimating the Impact of the National Policy Tariffs

### *4.1 Output, Productivity and Price*

The neo-classical trade model that underpins the revisionist view of the National Policy (Dales 1966, Easton et al. 1988), predicts slower growth in response to the National Policy tariffs. Perhaps the most important distinction between this model, and the industrial organization and learning-by-doing models, relates to prices and productivity. In the neo-classical framework, domestic and foreign manufactured goods are perfect substitutes which, in a small open economy, implies that the price of domestic manufactured goods increases by the tariff rate. The industrial organization model yields a very different prediction. In that model, domestic and foreign goods are imperfect substitutes, and industries are characterized as free-entry oligopolies. A tariff, through its effect on market demand and entry, increases firm size and lowers mark-ups, resulting in

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Another approach would be to introduce foreign productivity growth so $p_m$* is falling. In this case even with domestic productivity growth, the relative size of the domestic market might not change and there could be a permanent productivity gap. Krugman (1987) has a model with some of these characteristics.

higher productivity and lower prices. In the learning-by-doing model, the tariff increases the rate at which domestic production experience accumulates, which accelerates productivity growth and leads, for a time, to lower prices. Both models predict large output effects, due to a combination of more firms and increased output per firm.

INSERT TABLE 3 HERE

To explore how well these models conform to the Canadian experience, we analyse industry-specific output, productivity and price changes following the introduction of the National Policy tariffs. In Table 3 we report annual percentage changes in output, total factor productivity (TFP) and price for each industry and for our three industry groups - *target*, *broad* and *unaffected* – averaged over the pre- and post-National Policy periods. Although these performance indicators vary widely, producers in the *target* and *broad* groups had slower output and productivity growth before 1879, and faster output and productivity growth after, relative to the *unaffected* industries. As well, the output prices of industries in the *target* and *broad* groups rose faster before 1879 and fell faster after 1879. For example, annual output growth in the *target* industries was -2.2 percent from 1870 to 1879, and +7.4 percent from 1880 to 1913. TFP growth went from -8.3 percent to +4.8 percent, and price changes from +4.7 percent to -1.0 percent. In contrast, the *unaffected* industries experienced slower output and productivity growth after 1879, and prices, after falling from 1870 to 1879 by -2.2 percent per year, increased from 1880 to 1913 at 0.6 percent. To further explore the role of the National Policy in these differences, we adopt treatment intensity and difference-in-differences (DID) approaches that allow us to address the connections with more statistical rigour.

Before the implementation of the National Policy, the average *ad valorem* tariff on manufactured goods was 14.9%.[17] The average tariff in 1880 was 21.7%, and in 1890 it was 23.3%.[18] The increase in protection was both abrupt and uneven in its application

[17] Eugene Beaulieu and Jevan Cherniwchan generously provided data and documentation for the average *ad valorem* tariffs used in this paper; $\tau = \sum$ value all duties collected / $\sum$ value all manufactured imports (for home consumption). Values are derived from product-specific figures reported in the *Trade and Navigation Reports*. All products are assigned a six-digit Harmonized Description and Coding System (HS6) code, then aggregated up to two-digit 1948 Standardized Industrial Classification (SIC2) industries to match Urquhart (1993). See Beaulieu and Cherniwchan (2014) for a description of the aggregation.

[18] Between 1879 and the mid-1890s protection was periodically extended both across and within industries. These changes included a major revision of the tariff schedule in 1887, under Macdonald's finance minister, Charles Tupper (McDiarmid 1946).

across industries. Between 1875 and 1880, Tobacco Products, for example, received an increase in protection of 44 percentage points; the tariff on Transport Equipment increased from just 1% in 1875 to 26.7% in 1880; and protection for Petroleum and Coal Products tripled, from 6% to 18%. In contrast, tariffs on Non-ferrous Metal Products increased by only 0.5 percentage points; and protection for Wood Products *fell* by 5 percentage points. Even Textiles, an industry regarded as one of the main beneficiaries of the National Policy in much of the Canadian historiography, received only a 2.4 percentage point increase in tariff protection.

The uneven and abrupt implementation of Prime Minister John A. Macdonald's protectionist agenda allows us to treat the National Policy as a 'natural experiment'. In March 1879, in an environment where Canada's manufacturing industries were operating under common domestic and international macroeconomic conditions, some industries received substantially increased tariff protection while others did not. We first use a treatment intensity approach to identify the impact of industry-specific tariff increases on output, total factor productivity and prices, where we control for average growth before and after the policy change.

The estimated effects from our treatment intensity equations are elasticities that reflect the percentage change in output, productivity or price that occurred in response to a 1 percent increase in industry-specific *ad valorem* tariff rate in 1879. The estimating equations take the form:

$$\ln x_{it} - \ln x_{it-1} = \alpha_0 + \alpha_1\, policy_t + \alpha_2\, intensity_i + \alpha_3\, (policy_t \times intensity_i) + e_t\ , \qquad (18)$$

where $x$ represents output ($q$), total factor productivity ($TFP$), or output price ($p$);[19] *policy* is a regime variable that takes the value 0 before 1879 and 1 from 1879-1913; *intensity* is measured as the percentage change in *ad valorem* tariff rates between 1875 and 1880;[20] *i*

[19] Output is measured as industry-specific gross value of production (Urquhart 1993: Table 4.1) divided by an industry-specific output price index (Barnett 1966). TFP is measured as output relative to a Tornqvist index of raw materials, labour, capital and fuel, with cost shares as weights. Input values are from Urquhart (1993), and the industry-specific raw material price indexes are described in the Appendix. The unskilled manufacturing wage index and the user cost capital are from Inwood and Keay (2012). The Canadian coal price index is from Michell (1933).

[20] If we use the level change in tariff rates between 1875 and 1880, or the percentage change between 1875 and the maximum rate over the 1880 to 1910 period as our measure of treatment intensity, standard errors are affected, but our main qualitative conclusions hold. The ranking of our industries based on the percentage change in tariff rates and the level or maximum change are statistically indistinguishable (*Kendall's* $\tau$ = 0.676 (p-value=0.001) and 0.733 (p-value=0.000), respectively).

identifies industries, classified at the 2-digit,1948 SIC level; *t* identifies year; and *e* is an error term. The data form a panel of 660 observations (15 industries over 44 years).[21] The equations are estimated by generalized least squares (GLS), robust standard errors are clustered by industry, and because the dependent variables are measured as log-differences, random effects are included to control for unobserved, time-invariant industry characteristics that are uncorrelated with the independent variables.[22]

The dependent variable in (18) is the annual growth rate of one of three performance indicators; output, productivity or price. The constant term controls for average changes in the dependent variables before 1879. The *policy* variable controls for average changes in these indicators after 1879. The *intensity* variable controls for changes in performance before 1879 that are correlated with the tariff adjustments that occurred under the policy. Finally, the responsiveness of industry output, productivity and price to the tariff changes - the treatment effect - is captured by the coefficient on the interaction between the *policy* and *intensity* variables, $\alpha_3$ in (18). The sum of the *intensity* and *policy*×*intensity* interaction effects ($\alpha_2 + \alpha_3$) reflects the aggregate impact of a 1 percent increase in tariff protection on an industry's growth rates averaged over the full 1870-1913 period.

INSERT TABLE 4 HERE

In Table 4 we report parameter estimates and robust standard errors for the output, productivity and price treatment intensity equations. The elasticity of output growth with respect to *intensity* under the National Policy is +3.6%, the elasticity of TFP growth is +4.6%, and the elasticity of the price change is -4.6%. All these treatment effects are highly significant. Even after we control for average growth rates and differential pre-policy growth, industries that received greater tariff protection experienced faster output and productivity growth, and lower price changes after 1879 than those industries with smaller tariff changes.

In keeping with our comparisons in Table 3 and as further evidence of the impact of the National Policy tariff, we have also estimate difference-in-differences (DID)

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[21] When we take the first difference of the natural logarithm of the dependent variables we lose one observation for each industry, leaving us with 645 observations for estimation.

[22] The dependent variables are first-differenced to ensure parallel pre-treatment trends and stationarity. Log-differences minimize Akaike information criteria. First-differencing removes any unobserved, time-invariant industry fixed effects that are correlated with the independent variables.

equations that use categorical variables to distinguish between industry groups. The DID equations take the form:

$$\ln x_{it} - \ln x_{it-1} = \beta_0 + \beta_1\, policy_t + \beta_2\, group_i + \beta_3\, (policy_t \times group_i) + \varepsilon_t\ , \qquad (19)$$

where *group* takes the value 0 for the *unaffected* industries, and 1 for industries either in the *target* or *broad* groups, as defined earlier. Table 5 reports the estimated treatment effects and robust standard errors for output, productivity and price for both the *target* and *broad* groups.[23] The DID treatment effects are large and highly significant. The output effect is +6.7% for the *target* group and +5.2% for the *broad* group. The productivity effect is +10.6% for the *target* group and +8.0% *broad* group, and the price effects are -6.7% and -5.6%.[24] These results corroborate our treatment intensity estimates. So, whether we base the impact of the National Policy tariffs on treatment intensity or on industry groups, we obtain results consistent with the output, productivity and price effects implied by the industrial organization and learning-by-doing new trade models, but not by the neo-classical model.

INSERT TABLE 5 HERE

### 4.2 *Endogeneity, Parallel Trends and Structural Change*

Before accepting the treatment effects reported in Table 4 and 5 as identifying causal connections, some caution must be exercised. First, because tariff changes under the National Policy were determined politically, there is the question of endogenous treatment. Second, growth trends across industries prior to 1879 may not have been parallel, in which case our estimated treatment effects may be capturing pre-existing differential trends that were unrelated to the policy. Third, even if the tariff was not designed to pick ‘winners' based on industry performance prior to the policy, those industries that enjoyed relatively large increases in tariff protection may have been in a

[23] As a robustness check we also use an 'intent-to-treat' approach to industry categorization in which the target group is comprised of either: only those industries that were strongly import competing before the imposition of the National Policy; or *all* Canadian manufacturing industries (using matching US industries as a control group). Even these target groups, which include some industries that received very small changes in their tariffs after 1879, experienced relatively faster output and productivity growth, and falling prices after the imposition of the National Policy (see Appendix Table A4: Panel A and B).

[24] If we use a cost function approach to TFP measurement, we find that the tariff's treatment effect on productivity remains large: +7.3% and +9.5% for the two treatment groups.

better position to exploit the structural changes that were transforming the Canadian economy after 1879.

Endogeneity in the choice of tariffs has been raised in other contexts. Feenstra and Lewis (1991), for example, develop a two-country model of negotiated trade restrictions that includes a role for political pressure, and Karacaovali (2011: 34) includes productivity differences in his study of tariff rate determination in Columbia, concluding that: "...more productive sectors have...more to gain from lobbying and can potentially generate more protection."[25] In the context of the National Policy, it seems clear that treatment intensity was not randomly assigned, but there is no evidence that Canadian policy makers structured tariffs to reward anticipated success. O.D. Skelton's (1914: 140) *General Economic History, 1867-1912* gives no indication of any intention or awareness that the tariffs were intended to promote 'winners'. On the contrary, Skelton reports that the tariff was seen as a defensive measure: "The home market must be preserved. Conviction grew of its importance and its peril." Prime Minister John A. Macdonald's addresses to Parliament make explicit the objectives of protection for threatened industries and industrial diversification, as in his presentation to the House of Commons in 1878 (Canada, House of Commons Debates 1878: 854): "(The National Policy tariffs) will restore prosperity to...struggling industries, now so sadly depressed, and will prevent Canada from being made a sacrifice market."

The estimates in Tables 4 and 5 are consistent with Macdonald's speeches and Skelton's assessment of how the National Policy tariffs were structured. In the 1870s, the industries targeted by the National Policy were doing poorly; our *intensity* measures are strongly negatively correlated with output and productivity growth and price reductions *before* 1879 ($\alpha_2 < 0$ for output and productivity growth, and $> 0$ for price changes). This suggests that any plausible endogeneity in treatment works against our finding that larger tariff increases promoted growth in the targeted industries.[26]

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[25] In the Canadian context, Beaulieu and Emery (2001) argue that pork packers' opposition to the removal of protectionist tariffs may have contributed to the defeat of Wilfred Laurier's Liberal Party in the 1911 federal election.

[26] Inwood and Keay (2012: Tables 2, 4, 5) report K/L ratios, TFP and returns to scale derived from the 1871 Canadian Industrial Census manuscripts for nine of the industries included in our study. Although treatment by National Policy tariffs may not have been random, it was uncorrelated with the industries' K/L ratios, TFP and RTS in 1871 (unconditional correlation = -0.010, 0.009 and -0.048, respectively).

We also address the question of endogeneity more formally by adopting an instrumental variables (IV) strategy that uses a two-stage control function.[27] In the first stage we instrument for *intensity* in (18) with a set of political outcome, location and market structure variables (Grossman and Helpman 1994).[28] We find that treatment intensity under the National Policy was high when an industry's value added (in 1871) was concentrated in electoral districts with close votes in the 1878 federal election (Conservatives' vote shares were near 50%), and in districts where voters strongly supported the Conservative Party (Conservative vote shares exceeded 60%).[29] An industry's treatment intensity was also high if its value added in 1871 was concentrated in Toronto or Montreal, or if the industry had a large, dominant firm.

Parameter estimates and robust standard errors from the second stage of our IV estimation of (18), as well as diagnostic test results for instrument strength (first stage partial F-test), instrument validity (Sargan's over-identification test), and the presence of endogeneity (Hausman's specification test), are reported in Table 4. Even after instrumenting for treatment intensity, we still find that output and productivity increased faster, and prices more slowly for those industries that received large tariff increases under the National Policy. In fact, the IV treatment effects are very similar to our baseline estimates: the output elasticity is the same (3.6%); the TFP elasticity is slightly higher, at 5.5%; and the price elasticity is slightly lower (-4.3%). This is further evidence that any endogeneity in the choice of the tariff schedule does not alter our conclusions.

A second concern is that differential pre-treatment trends may have an impact on our estimated treatment elasticities. We know that the *targeted* and *broad* industries were growing more slowly than the *unaffected* industries during the 1870s, but there is no evidence that growth rates among the industry groups were converging before the tariffs were imposed. We cannot statistically distinguish between linear time trends in the

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[27] We note that the DID approach should be less affected by potential endogeneity, because industries would have had more influence over the percentage change in their tariffs once they had been targeted for protection, than they would have had over the government's decision to protect or not.

[28] We use average Conservative vote share and average Conservative vote share squared in the ten largest electoral districts - in terms of 1871 industry value added - a Toronto-Montreal urban dummy, and industry-specific 1871 concentration ratios as excluded instruments in the first stage. See Appendix Table A2 for first stage and diagnostic test results.

[29] Holding all else constant, predicted treatment intensity is minimized in electoral districts where Conservative vote shares in 1878 were approximately 57%.

industry groups' output, TFP or price growth rates during the pre-policy period. A placebo test that imposes counterfactual treatment in 1875 reveals no statistically significant treatment effects associated with output, productivity or price before the policy. And a full set of year fixed effects interacted with treatment intensity also reveals no significant treatment effects before tariffs were imposed in 1879.[30] Growth rates among the *target* and *broad* industries were not converging towards the *unaffected* industries' growth rates prior to 1879.

A final identification issue to consider relates to the post-policy parallel trends assumption. Structural changes were taking place in the economy between 1870 and 1913, including shifts in the geographic distribution of production and changes in industry composition. Although all manufacturers were producing in a common macroeconomic environment, they were not equally exposed to the structural changes that were taking place. Using micro-data from the 1870-71 industrial census, Inwood and Keay (2012: Table 2) report that the industries in the *unaffected* group were larger, more capital intensive and more urban than industries in targeted groups. Moreover, according to Barnett's (1966: Table D.13) international trade shares, industries that experienced smaller tariff changes were more export oriented. These differences introduce the possibility that changes in the Canadian economic environment that were unrelated to National Policy tariffs, could have had differential effects on the targeted and unaffected industries.

Because the wheat boom (1896-1913) has long been identified as an era of dramatic economic transformation in Canada, one approach is to truncate the time series and re-estimate our treatment intensity equation over the pre-wheat boom years. Restricting our panel to the 1870-1895 period, we still find statistically significant differences in performance. The output and productivity of industries targeted by the National Policy increased faster, and prices more slowly. The estimated treatment effects from the truncated sample are all within +/- 1.5% of the full sample (see Table 4).[31]

[30] Minimum p-values for $\chi^2$ tests for common pre-treatment trends are 0.351 for output growth, 0.763 for productivity growth, and 0.955 for price growth. For output growth we find only one positive and significant treatment effect before 1879 (in 1871), for TFP we find no positive and significant pre-treatment effects, and for price growth we find no negative and significant effects.

[31] Results from the truncated sample estimates are reported in Appendix Table A3: Panel A.

Removing the wheat boom years deals with a particular concern about post-policy parallel trends.[32] To address the problem of structural change more generally, we re-estimate (18) including controls for raw material prices, urban population levels, net migration, and transport costs, where these variables are allowed to have differential effects on the targeted and unaffected industries.[33] The treated industries' performance indicators are sensitive to changes in transport costs and urban population levels but, even after controlling for these potentially confounding factors, the estimated treatment effects are still large and significant.[34]

The results from the alternate specifications and tests all point to the robustness of our empirical findings. As predicted by the industrial organization and learning-by-doing models, we find that the National Policy tariffs promoted faster output and productivity growth, and price declines among the industries that received larger increases in protection.[35]

## 5. Returns to Scale and Learning-by-Doing

The industrial organization model predicts that the exploitation of internal scale economies following the introduction of protective tariffs will trigger increases in output, improvements in productivity and reductions in price. To investigate the importance of internal returns to scale (RTS) for Canadian manufacturing industries, we estimate industry-specific four-factor Cobb-Douglas production functions:

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[32] 1879 was an unusual year in that it was the start of a recovery from a deep recession. If this recovery was not uniform across treated and untreated industries, then including 1879 in the treatment period could contribute to the violation of the parallel trends assumption. We find no changes in sign or significance when we estimate treatment effects assuming treatment began in 1880 rather than 1879 (see Appendix Table A3: Panel B).

[33] If we estimate (18), dropping the *policy x intensity* interaction term and including our pre and post-policy controls, the post-1879 regression residuals for the targeted groups and the unaffected group are statistically indistinguishable from zero and each other. This is evidence that the targeted and unaffected groups' *conditional* trends are parallel.

[34] All industries appear only weakly affected by changes in raw material prices and net migration (see Appendix Table A3: Panel C). Because Canadian manufacturing output (and productivity and price) could have affected labour demand, and hence the incentive to move to Canada and the incentive to move into urban centres, the OLS estimates of (18) and (19) with controls for urban population and net migration may be biased due to endogeneity. Using an IV estimation approach the treatment effects (with controls) still remain large and significant (see Appendix Table A3: Panel D).

[35] These results, of course, do not include the general equilibrium or welfare effects of tariff protection. Irwin (2000) finds that the protection of the tinplate industry in the US had negative welfare effects from 1870-1913. Head (1994) concludes that during the same period the protection of the U.S. steel rail industry had, at best, as small positive welfare effect.

$$ln\ q_{it} = \gamma_0 + \gamma_1\ ln\ L_{it} + \gamma_2\ ln\ K_{it} + \gamma_3\ ln\ M_{it} + \gamma_4\ ln\ F_{it} + \nu_t\ , \qquad (20)$$

where the factors of production are labour ($L$), capital ($K$), raw materials ($M$) and fuel ($F$); $v$ is an error term; and $t$ spans the post-policy period, 1880-1913.[36] We derive industry-specific RTS (= $\sum_{b=1}^{4} \beta_b$) from the estimated parameters in (20).

INSERT TABLE 6 HERE

Eight industries exhibit increasing returns to scale after 1879, two have decreasing returns, and five constant returns (see Table 6). The median RTS is 1.057 (Chemical Products), the minimum is 0.865 (Food and Beverages), and the maximum is 1.383 (Transport Equipment). All industry groups exhibit strongly increasing returns, but the *target* and *broad* groups have significantly larger returns to scale than the *unaffected* industries.[37] This pattern in internal scale economies is consistent with the predictions of the industrial organization model, where a higher protective tariff triggers increases in output, thereby shifting industries' *LL* schedules, driving down mark-ups, reducing average costs, and fostering larger returns to scale (see Figure 1).[38]

In the learning-by-doing model, productivity improvements and price reductions result from more rapid accumulation of production experience following the imposition of a tariff. To estimate the logistic experience curves (or learning rates) described by the LBD model, we assume that cumulative output, $Z$, can proxy for production experience.[39]

$$ln\ TFP_{it} = \lambda_0 + \lambda_1\ ln\ Z_{it} + \mu_t\ , \qquad (21)$$

where output is accumulated from 1880 to period $t$ ($Z_{it} = \sum_{j=1880}^{t} Q_{ij}$); $\mu$ is an error term; and the elasticity of TFP with respect to cumulative output, $\lambda_1$, can be used to calculate

[36] Because we consider the imposition of protective tariffs under the National Policy a regime change, from revenue-based tariffs to protection-based tariffs, our estimation period begins in 1880. Sensitivity tests (reported in Appendix Table A5: *Test 1*) confirm that our qualitative conclusions are not affected by the estimation of *RTS* over the full 1870-1913 period. We have insufficient degrees of freedom to reliably estimate our production functions over the pre-policy period. Group and aggregate production functions include industry fixed effects to control for time-invariant, industry-specific technological differences.

[37] Our qualitative conclusions hold across three additional robustness tests: in *Test 2* we move to a three-factor log-linear Cobb-Douglas production function by dropping *Fuel*; in *Test 3* we use a *Value Added* output measure, which allows us to move to a two-factor production function by dropping both *Fuel* and *Raw Materials*; in *Test 4* we include a linear time trend to allow for neutral technological change (see Appendix Table A5).

[38] The unconditional correlation between Canadian manufacturing industries' RTS and treatment intensity is 0.671***.

[39] Using industry data to estimate experience curves requires that we assume perfect knowledge spillovers across firms within an industry, and no spillovers across industries or national borders. Head (1994: 149-50) discusses the validity of these assumptions for late nineteenth and early twentieth century US steel rail producers.

the learning rate ($1\text{-}2^{-\lambda 1}$), which measures the productivity gain from a doubling of output experience.[40] The learning rate also reflects the rate at which industries are approaching maturity, *[a*, T*]*.

Twelve of the industries exhibit statistically significant learning-by-doing. The median learning rate is 18 percent, and learning rates for those industries with significant output elasticities range from 8.9 percent for Tobacco to 56.9 percent for Paper.[41] All three industry groups have large and significant cumulative output elasticities, but the *target* and *broad* treatment groups have higher learning rates than the *unaffected* group.[42] The more rapid learning rates among the industries most affected by the National Policy are consistent with the learning-by-doing model's prediction that tariffs trigger increases in output, causing industries to move further along their learning curves, leading to accelerating productivity improvement and lower prices.[43]

The returns to scale and learning rates reveal the presence of both internal and external scale economies following the introduction of the National Policy. Recognizing that the mechanisms were not mutually exclusive, we can compare their effects with a simple 'back-of-the-envelope' calculation. Among the *target* industries, the DID treatment effect on output growth is +6.7% (Table 5) and our estimate of this group's internal scale economies is 1.3 (Table 6). The implied contribution of RTS to productivity is +1.5% ($.067\times\frac{RTS-1}{RTS}$), or 14.2 percent of the total DID treatment effect of the tariff on TFP (+10.6% from Table 5). Similarly, we can use the learning rates reported in Table 6 and the output treatment effects reported in Table 5 to derive a productivity contribution that can be attributed to the more rapid accumulation of production experience. Among the

[40] We accumulate output in our experience curves over the post-National Policy period because we are implicitly assuming that the imposition of protective tariffs in 1879 marked the start of a new regime in the process of learning-by-doing. Group and aggregate learning curves include industry fixed effects to control for time-invariant, industry-specific differences in learning by doing.

[41] Dutton, Thomas and Butler (1984: Figure 3) report learning rates from 162 US industries that range from -7% to +50%, with a median learning rate of approximately 20%.

[42] Learning rates may differ across industries due to forces unrelated to cumulative output experience, such as neutral technological change (Adler 1990) or capital accumulation (Thompson 2001). Our qualitative conclusions hold across three robustness tests: in *Test 4* we use a cost function approach to measure TFP as our dependent variable; in *Test 5* we include the natural logarithm of fixed capital as an additional control variable; and in *Test 6* we include a linear time trend to control for neutral technological change (see Appendix Table A6).

[43] The unconditional correlation between Canadian manufacturing industries' learning rates and treatment intensity is 0.286.

*target* group, 24.5 percent of the tariff's impact on productivity can be attributed to learning-by-doing, and the corresponding impact for the *broad* group is 20.2 percent.[44] These calculations suggest that, if we assume Canadian manufacturers' internal and external scale economies were technologically separable, nearly 40 percent of the total impact of the tariff on productivity can be attributed to the combined effect of internal returns to scale and learning-by-doing.[45]

## 6. Conclusions

Since protective tariffs were introduced as part of the National Policy there has been a debate over their impact on Canadian industrial development. The traditional view is that increased tariff protection was a key element in Canadian industrialization. In contrast, those relying on neo-classical trade models argue that protective tariffs slowed intensive, and possibly extensive growth. New trade models, however, hark back to the traditional view, focusing on the advantages provided by protection for infant industries. Industrial organization models predict an increase in market size following the imposition of protective tariffs, triggering output expansion, lower average costs, improved productivity, and lower prices. These effects operate through internal returns to scale. Relying on external returns, learning-by-doing models predict output expansion, productivity improvement and lower prices, as producers accumulate experience more rapidly.

Using treatment intensity and difference-in-differences approaches we find large and statistically significant output, total factor productivity and price treatment effects following the introduction of the 1879 National Policy tariffs. These effects hold across a range of specifications designed to deal with potential problems of endogeneity, and differential pre- and post-treatment trends. We also find large and statistically significant increasing returns to scale among the industries most affected by National Policy tariffs, as well as large and significant learning-by-doing effects. The size and pattern of these

[44] For the *target* treatment group the output treatment effect of 0.067, multiplied by the cumulative output elasticity of 0.39, implies a productivity treatment effect of 0.026, or 24.5% of the estimated total productivity effect of the tariff.

[45] Because learning is not controlled for in our production functions, the assumption of separable internal and external economies is unlikely to hold, and this estimate of the aggregate productivity impact must be viewed as an upper bound.

internal and external scale economies are consistent with the predictions of the new trade models. The empirical evidence does not prove causation, nor can it clearly distinguish the relative importance of the different mechanisms. Nevertheless, the models highlight channels through which the tariffs may have contributed to Canadian industrial development.

More generally, our findings support the traditional view of the National Policy, which dates back to the National Policy itself. In the early 1880s, the House of Commons formed a select committee (Canada, House of Commons 1883) to, "...inquire into the operation of the tariff." As part of the inquiry, the committee commissioned Alfred H. Blackeby to look into the state of manufacturing in Ontario and Quebec, and Edward Willis to do the same for the Maritime provinces. Each surveyed hundreds of firms, writing detailed reports for the committee. Their conclusions are remarkably in line with our statistical analysis. Blackeby and Willis report significant increases in output, as well as productivity improvements and price declines. Blackeby (1883: 4, 6), for example, reports:

> The value of the product in money does not represent the whole of the increase which has taken place...Prices are so much lower now in most cases that a like production in value would mean a 10 to 15 percent difference in bulk...Production has increased in a greater ratio than the number of hands, showing by means of better appliances and facilities brought into use, by reason of the larger trade to be done, each man produces more now than six years ago... That the general result of that change [the 1879 tariff] has proved decidedly beneficial to manufacturing industries there is now no dispute, and is fully borne out by the figures herewith submitted.

Blackeby and Willis' findings are in stark contrast to the revisionist view articulated by Dales (1966: 109-10): "[the tariff] is the price we pay for our protected manufacturing industry...protection fosters inefficient, oligopolistic forms of market organization in Canada...Canadian growth has been distorted by the National Policy."

The traditional view of the National Policy, as reflected in Blackeby's and Willis' findings, is very much in line with our results. Perhaps equally important, our conclusion, that infant industry protection promoted Canadian industrial development, has potentially broad implications for other countries and time periods.

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## 8. Tables and Figures

Table 1. Canadian population, manufacturing value added and GDP
(average annual percentage changes)

| | Population | GDP | Manufacturing value added | GDP per capita | Manufacturing value added per capita |
|---|---|---|---|---|---|
| 1870-79 | 1.6 | 1.9 | 1.7 | 0.3 | 0.1 |
| 1880-89 | 1.2 | 3.6 | 5.4 | 2.4 | 4.2 |
| 1890-99 | 1.0 | 3.2 | 2.3 | 2.2 | 1.3 |
| 1900-09 | 2.6 | 5.8 | 5.9 | 3.2 | 3.3 |
| | | | | | |
| 1870-78 | 1.6 | 1.0 | 1.3 | -0.6 | -0.3 |
| 1879-95 | 1.2 | 3.4 | 3.6 | 2.2 | 2.4 |
| 1896-1913 | 2.3 | 5.8 | 5.3 | 3.5 | 3.0 |
| | | | | | |
| 1870-1913 | 1.7 | 4.0 | 3.9 | 2.3 | 2.2 |

*Note*: Annual percentage change = log difference × 100. Values are in 1900 prices. All series are from Urquhart (1993: Tables 1.1 and 1.6).

Table 2. Canadian manufacturing output by industry
(average annual percentage changes)

| | GDP deflator | | | Industry deflators | | |
|---|---|---|---|---|---|---|
| | 1870-79 | 1880-89 | 1880-1913 | 1870-79 | 1880-89 | 1880-1913 |
| Food[U] | 1.6 | 6.0 | 4.1 | 3.7 | 4.1 | 3.6 |
| Tobacco[T] | 0.0 | 7.8 | 5.9 | -2.8 | 7.4 | 5.0 |
| Rubber[U] | 3.8 | 11.5 | 9.9 | 1.6 | 12.9 | 11.1 |
| Leather[U] | -3.7 | 2.0 | 2.3 | -4.7 | 2.3 | 1.7 |
| Textiles[U] | 5.6 | 7.1 | 2.9 | 5.6 | 7.7 | 3.0 |
| Clothing[U] | 5.4 | 7.2 | 4.4 | 6.8 | 8.3 | 6.0 |
| Wood[U] | 0.7 | 6.2 | 3.1 | 4.8 | 0.5 | 1.2 |
| Paper[T] | 4.2 | 8.1 | 6.8 | -4.3 | 13.7 | 10.0 |
| Printing[B] | 5.9 | 4.9 | 4.2 | 5.6 | 6.3 | 4.8 |
| Iron - Steel[B] | -1.4 | 7.6 | 5.8 | -2.4 | 8.4 | 7.5 |
| Transportation[T] | 3.5 | 2.1 | 4.8 | -5.1 | 1.5 | 7.3 |
| Non-Ferrous Metals[U] | 9.4 | 5.0 | 7.2 | 10.2 | 5.3 | 8.3 |
| Non-Metallic Minerals[U] | 4.3 | 0.6 | 4.8 | 8.4 | -0.1 | 5.4 |
| Petroleum - Coal[T] | 4.0 | -5.1 | 2.9 | 3.9 | 1.3 | 5.4 |
| Chemicals[U] | 4.3 | 3.9 | 5.3 | 5.8 | 4.0 | 5.7 |
| All industries | 1.4 | 5.4 | 4.4 | 1.5 | 4.5 | 4.7 |
| *Target* | 3.3 | 2.7 | 4.9 | -6.3 | 5.0 | 5.8 |
| *Broad* | 1.4 | 5.4 | 5.2 | -3.1 | 6.0 | 5.8 |
| *Unaffected* | 1.4 | 5.5 | 3.9 | 3.3 | 3.9 | 4.1 |

*Note*: See Table 1 notes, Appendix Table A1, and discussion in text. T is *target*; B is *broad*; U is *unaffected*. Output = value added in production; GDP deflator is from Urquhart (1993: Table 1.6); industry deflators are based on wholesale prices for industry-specific output goods, weighted by gross value of production. Details on the industry deflators are given in the data appendix.

Table 3. Manufacturing performance indicators
(average annual percentage changes)

| | Output | | TFP | | Price | |
|---|---|---|---|---|---|---|
| | 1870-79 | 1880-1913 | 1870-79 | 1880-1913 | 1870-79 | 1880-1913 |
| Food[U] | 4.3 | 3.1 | -1.5 | -0.4 | -2.4 | 1.3 |
| Tobacco[T] | -2.2 | 4.7 | -7.8 | 0.3 | 2.4 | 1.7 |
| Rubber[U] | -1.9 | 10.2 | -6.4 | 1.0 | 1.9 | -0.3 |
| Leather[U] | -2.1 | 1.8 | -0.4 | -0.3 | 0.7 | 1.4 |
| Textiles[U] | 3.8 | 3.0 | -9.3 | 0.6 | -0.3 | 0.8 |
| Clothing[U] | 7.0 | 5.6 | 1.8 | 2.6 | -1.7 | -0.7 |
| Wood[U] | 4.6 | 1.1 | 3.1 | -1.3 | -4.4 | 2.7 |
| Paper[T] | -3.2 | 9.9 | -13.6 | 6.6 | 8.2 | -2.4 |
| Printing[B] | 6.0 | 4.4 | -2.1 | 1.4 | 0.0 | 0.2 |
| Iron-Steel[B] | -1.1 | 7.6 | -3.8 | 2.3 | 0.6 | -0.9 |
| Transport[T] | -3.3 | 7.9 | -11.1 | 3.2 | 8.3 | -1.7 |
| Non-Ferrous[U] | 10.6 | 8.9 | -1.0 | 2.4 | -1.1 | -0.3 |
| Non-Metallic[U] | 9.2 | 5.5 | 2.2 | 1.9 | -4.5 | 0.2 |
| Petroleum[T] | 5.1 | 6.2 | -11.7 | 2.7 | -0.2 | -1.6 |
| Chemicals[U] | 5.2 | 5.2 | -0.7 | 0.4 | -1.9 | 0.4 |
| All industries | 2.3 | 4.5 | -2.0 | 1.0 | -0.5 | 0.5 |
| *Target* | -2.2 | 7.4 | -8.3 | 4.8 | 4.7 | -1.0 |
| *Broad* | -1.5 | 7.3 | -7.1 | 4.1 | 4.2 | 0.2 |
| *Unaffected* | 3.7 | 3.4 | 0.1 | -0.4 | -2.2 | 0.6 |

*Note*: See Table 1 and 2 notes. Output = gross value of production deflated by industry wholesale price indexes; total factor productivity = Tornqvist index using output, labour, capital, raw materials and fuel, with cost shares as input weights.

Table 4. National Policy treatment effects: treatment intensity, 1870 - 1913

| | GLS | | | IV | | |
|---|---|---|---|---|---|---|
| | Output | TFP | Price | Output | TFP | Price |
| Control - pre-NP (*constant*) | 0.042*** (0.015) | -0.003 (0.016) | -0.015 (0.012) | 0.039*** (0.015) | 0.003 (0.014) | -0.012 (0.015) |
| Treatment - pre-NP (*intensity*) | -0.027*** (0.007) | -0.042*** (0.008) | 0.037*** (0.007) | -0.023*** (0.009) | -0.050*** (0.0010) | 0.033** (0.013) |
| Control - post-NP (*policy*) | 0.009 (0.018) | 0.015 (0.019) | 0.021 (0.014) | 0.009 (0.019) | 0.009 (0.017) | 0.019 (0.018) |
| Treatment effect (*intensity x policy*) | 0.036*** (0.008) | 0.046*** (0.010) | -0.046*** (0.010) | 0.036*** (0.011) | 0.055*** (0.011) | -0.043*** (0.017) |
| N | 645 | 645 | 645 | 645 | 645 | 645 |
| First stage partial F-test | | | | | 10.63 (0.000) | |
| Hausman specification test | | | | 2.71 (0.258) | 3.27 (0.195) | 3.27 (0.195) |
| Sargan over-ID test | | | | 2.53 (0.470) | 0.941 (0815) | 0.769 (0.857) |
| $R^2$ | 0.010 | 0.022 | 0.018 | 0.011 | 0.023 | 0.019 |

*Note*: See Table 2 notes, estimating equations described in text, and Appendix Table A2. Log-differenced dependent variables; random effects GLS and IV estimation; robust standard errors (clustered by industry) reported in parentheses; treatment intensity = % Δ tariff (τ ) between 1875 and 1880. Excluded instruments for treatment intensity include: average Conservative Party vote share in 10 largest census districts (district choice based on 1871 industry value added); Conservative vote share squared; urban fixed effect (=1 for Toronto and Montreal districts); concentration ratio (= value added for largest establishment / value added for district). First stage weak instrument partial *F-Test* identifies statistically significant excluded instruments in first stage ($H_0$ = jointly significant first stage excluded instruments); Hausman specification test ($\chi^2$ with 2 degrees of freedom) identifies the presence of endogeneity ($H_0$ = exogenous second stage explanatory variables); Sargan over-identification test ($\chi^2$ with 2 degrees of freedom) identifies instrument validity ($H_0$ = exogenous first stage excluded instruments). *, **, *** indicate statistical significance with 90%, 95%, 99% confidence.

Table 5. National Policy treatment effects: difference-in-differences, 1870-1913

| | *Target* treatment group | | | *Broad* treatment group | | |
|---|---|---|---|---|---|---|
| | Output | TFP | Price | Output | TFP | Price |
| Control - pre-NP (*constant*) | 0.038** (0.016) | -0.004 (0.013) | -0.006 (0.011) | 0.040** (0.019) | -0.001 (0.016) | -0.008 (0.013) |
| Treatment - pre-NP (*group*) | -0.049** (0.019) | -0.091*** (0.022) | 0.054* (0.029) | -0.036 (0.023) | -0.068*** (0.025) | 0.043* (0.024) |
| Control - post-NP (*policy*) | 0.013 (0.018) | 0.016 (0.014) | 0.010 (0.013) | 0.011 (0.021) | 0.012 (0.017) | 0.015 (0.015) |
| Treatment effect (*group x policy*) | 0.067*** (0.024) | 0.106*** (0.030) | -0.067* (0.035) | 0.052* (0.019) | 0.080*** (0.031) | -0.056** (0.028) |
| N | 645 | 645 | 645 | 645 | 645 | 645 |
| $R^2$ | 0.009 | 0.026 | 0.011 | 0.010 | 0.022 | 0.010 |

*Note*: See Table 4 notes and estimating equations described in text. *, **, *** indicate statistical significance with 90%, 95%, 99% confidence.

Table 6. Returns to scale and learning-by-doing, 1879-1913

| | Returns to scale | Learning-by-doing | |
|---|---|---|---|
| | | Z elasticity | Learning rate |
| Food[U] | 0.865** | 0.051 | 0.035 |
| Tobacco[T] | 1.007 | 0. 089** | 0.060 |
| Rubber[U] | 0.958 | 0.121** | 0.080 |
| Leather[U] | 1.097 | 0.079 | 0.054 |
| Textiles[U] | 0.895* | 0.128*** | 0.085 |
| Clothing[U] | 1.271** | 0.223*** | 0.143 |
| Wood[U] | 1.010 | 0.141*** | 0.093 |
| Paper[T] | 1.327*** | 0.569*** | 0.326 |
| Printing[B] | 1.001 | 0.119*** | 0.079 |
| Iron-Steel[B] | 1.257*** | 0.185*** | 0.120 |
| Transport[T] | 1.383** | 0.187*** | 0.122 |
| Non-Ferrous[U] | 1.135** | 0.235*** | 0.151 |
| Non-Metallic[U] | 1.054** | 0.184*** | 0.120 |
| Petroleum[T] | 1.128** | 0.327*** | 0.203 |
| Chemicals[U] | 1.057*** | - 0.018 | -0.013 |
| All industries | 1.212*** | 0.209*** | 0.135 |
| *Target* | 1.297*** | 0.388*** | 0.236 |
| *Broad* | 1.282*** | 0.318*** | 0.198 |
| *Unaffected* | 1.158** | 0.143*** | 0.095 |

*Note*: Estimating equations described in text. *, **, *** indicate statistical significance with at least 90%, 95%, 99% confidence.

Figure 1: Industrial organization model: the effect of a tariff

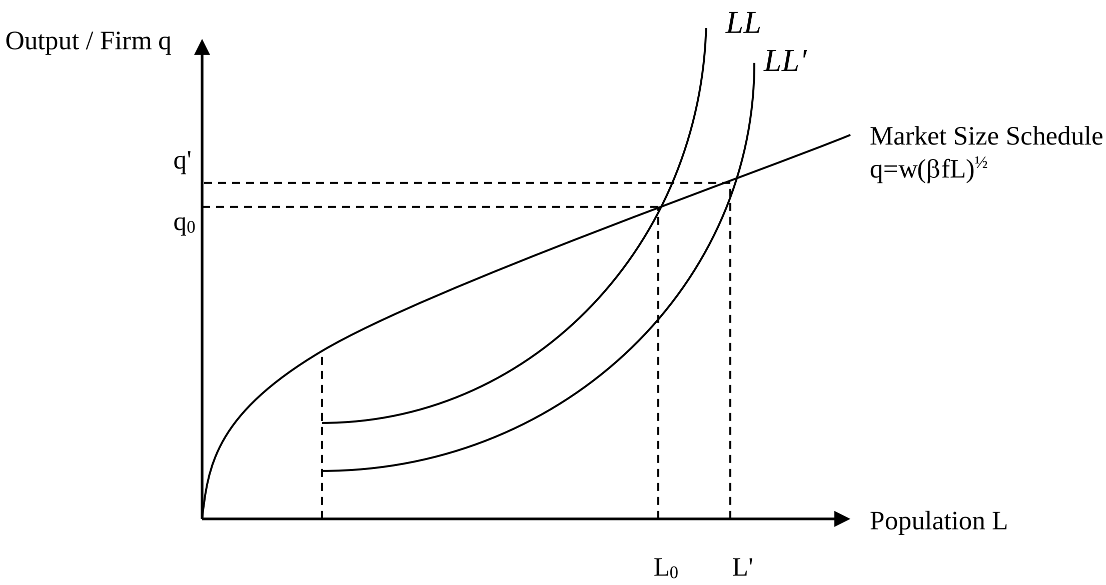

Figure 2: Learning-by-doing model: the effect of a tariff