Protecting Infant Industries:
Canadian Manufacturing and the National Policy, 1870-1913

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ABSTRACT

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In contrast to traditional neo-classical models of international trade, industrial organization and learning-by-doing trade models predict that protective tariffs can trigger output expansion, productivity improvement and falling prices. The 1879 National Policy substantially increased tariff protection to some, but not all, Canadian manufacturing industries. Using National Policy tariffs as a natural experiment, a difference-in-differences approach and the estimation of returns to scale and experience effects support the predictions of the new trade models. After 1879, industries "treated" by the National Policy experienced increased growth in output and productivity and more rapid reductions in price. The treated industries also exhibited larger increasing returns to scale and faster learning rates.

JEL Classification: N71; N61.

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1. Introduction

As part of the federal government's budget in 1879, the Canadian parliament passed what has become known as the National Policy. The legislation had broad nation building objectives that were to be achieved partly through substantially increased tariffs on a long list of manufactured goods, but also included were measures to promote, at least indirectly, railway-building and immigration. Since its introduction the National Policy has been at the centre of a debate about its effectiveness in promoting Canadian economic development. This debate has important implications for our understanding of infant-industry protection that extend well beyond the Canadian historical context.

W.T. Easterbrook and Hugh Aitken's (1956) classic, *Canadian Economic History*, presents a view in line with the claims made by John A. MacDonald when, as leader of the opposition Conservative Party, he first proposed the National Policy in 1878. As Easterbrook and Aitken put it (1956: 394), the National Policy led to: "...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 traditional interpretation, higher protective tariffs promoted economic and industrial development, and were a vital source of government revenue. In contrast, Dales (1966) and Easton, Gibson and Reed (1988) used standard neoclassical trade models in support of their argument that National Policy tariffs reduced per-capita income growth, and possibly extensive growth in Canada. 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.[1] The Canadian experience of increased tariff protection under the National Policy provides us with an opportunity to empirically test the theoretical predictions of the standard neo-classical and the 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

[1] Krueger and Tuncer (1982), Bils (1984), Irwin (2000), and Irwin and Temin (2001) study the impact of protection on infant industries.

growth through internal economies of scale. The second model focuses on external economies and the impact of tariff protection on learning by doing. We use Urquhart's (1993) data for fifteen manufacturing industries, spanning the years 1870-1913, to compare the performance of industries that were 'treated' by increased tariff protection in 1879 with those that were not. Using a difference-in-differences estimation approach, where industries receiving substantial National Policy tariff protection comprise the treatment group, and industries less directly affected are included in the control group, we identify a large and statistically significant impact of tariff protection 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 as well as the traditional view that the National Policy fostered infant industries and promoted economic development.[2]

2. Overview of 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 were 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 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

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

Canadian history. Nevertheless, the experience of the 1880s, both in manufacturing and in measures of per capita growth, was in some ways comparable to the wheat boom years.

INSERT TABLE 1 HERE

Population and GDP increased much more rapidly during the decade 1900-1909 than during the decade 1880-1889. Population grew at an average annual rate of 2.6 percent, as opposed 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 in our comparison, 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 the growth in manufacturing output per capita differs by just 0.6 percent.

Not only was growth during the 1880s comparable to the wheat boom years, it represented a sharp break. Although population grew more slowly, GDP growth accelerated by 1.6 percent and manufacturing output by 3.7 percent after 1879. 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.[3] Comparing the years leading up to the National Policy to the last 20 years of the nineteenth century and the first decade of the twentieth confirms that 1880 (and to an even greater extent, 1879) represents a significant break in terms of total output, manufacturing output, and the corresponding per capita measures.[4]

Even more revealing than the macroeconomic evidence is the expansion in industry-level output. Table 2 reports real value added growth rates for fifteen industries

[3] 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).
[4] Difference-in-means tests confirm that the differences in growth rates reported in Table 1 for GDP, and GDP/capita (1870-1878, 1879-1913) are statistically distinguishable from zero. Tests for linear trend breaks confirm statistically significant breaks for manufacturing output and manufacturing output per capita in 1879.

for the years 1870-79, 1880-89, and 1880-1913.[5] To better relate this growth to the National Policy, industries have been divided into 'treatment' and 'control' groups. The industries included in the treatment groups were import-competing prior to 1879 and their tariffs increased sharply under the National Policy.[6] The first of these groups - *narrow* – are the four import-competing industries with the largest increases in tariff rates. This group consists of Tobacco Products, Paper Products, Transport Equipment, and Petroleum and Coal. The second treatment group - *broad* – adds Printing and Publishing, and Iron and Steel, industries that also benefitted from large increases in tariffs but were not as strongly import-competing before 1879. Our *control* group includes industries that were less directly affected by National Policy either because their tariff increases were much smaller or they faced little import competition.[7]

INSERT TABLE 2 HERE

After 1879 output accelerated more among those industries that received greater tariff protection under the National Policy. Applying the GDP deflator, the average growth rate of the nine industries in the *control* 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 (see Table 2). Although the corresponding increase among the industries in the *narrow* group was just 1.6 percent, output among the *broad* group accelerated by 3.8 percentage points after 1879. Of course, these differences in real industry growth rates do not reflect changes in relative prices, since they are derived from a single aggregate GDP deflator. When we allow for industry-specific price changes, the evidence that output accelerated faster among the industries that received greater tariff protection is much stronger.[8] Deflating nominal output with industry

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[5] 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. These industries produced less than 3% of manufacturing value added in 1913.

[6] Industries in the *narrow* group satisfy two criteria: (i) % increase in ad valorem tariffs between 1875-1880 exceeds 37.5% (ii) import intensity in 1875 exceeds 30%. Industries in the b*road* group satisfy (i), but their 1875 import intensities were low (17% for Printing and Publishing, and 20% for Iron and Steel). See Appendix Table A1.

[7] The control group includes Food and Beverages, Rubber Products, Textiles, Clothing, Wood Products, Non-Ferrous Metal Products, Non-Metallic Minerals, and Chemical Products.

[8] Industry-specific output price indexes 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 series construction is provided in the Data Appendix.

wholesale price indexes reveals that growth in the c*ontrol* group accelerated by less than 0.8 percentage points after 1879, whereas growth rates of the industries in the *narrow* and *broad* groups increased by 12 percent and 9 percent, respectively.[9]

The aggregate evidence in Table 1 and the industry-specific values in Table 2 indicate a positive relation between treatment by National Policy tariffs and growth in manufacturing output, but of course they do not imply causality. In the next section we present two models that suggest mechanisms through which tariff protection can *cause* output growth, productivity improvement and falling prices. The first is an industrial organization model based on imperfect competition and internal scale economies. The second model focuses on the external economies associated with learning by doing.

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.[10] We use the assumption made by Dales (1966) of a constant money wage, or equivalently, a constant real wage expressed in units of the agricultural good.

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

[9] 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 *control* group is greater, and the *narrow* group exhibits a slight decline in growth rates.

[10] 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.

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

where q denotes output per firm; and θ 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 contrasts with the standard neo-classical demand assumption, and it 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:

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

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 $b = 1 / \beta wL$. Cournot pricing among domestic firms, under which domestic firms take the output produced by other domestic firms as exogenous, 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:

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

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 (see 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, θ. This means that for profits to remain at zero, an increase in market size must raise output per firm.[11]

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 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:

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

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.[12] The slope of ψ with respect to q can be derived:

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

[11] 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.

[12] 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.

where ε 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.[13]

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 an 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 imposition of a tariff:

a) increases market size through import substitution and an 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.

It is also useful to consider the quantitative impact of a tariff implied by this model. From the definition of ψ, 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, $(L-L_f) / L$, 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

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

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 channel through which a tariff triggers these responses is the reduction in Cournot mark-ups, which are reflected in increasing returns to scale.

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 an increase in output, cumulative output rises more quickly, experience is gained, productivity increases, and costs and prices fall. Protection, therefore, is one means of increasing output to bring an infant industry to maturity sooner.[14]

As before, the domestic manufacturing industry produces a close substitute for a competing foreign good, whose price, p_m*, is fixed on 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:

$$Z(t) = \int_0^t Q(v)\, dv \qquad (14)$$

The domestic manufactured good is produced under constant returns, with labour as the only input.[15] Productivity is denoted $a(Z)$, and we assume that the productivity curve has a logistic S-shape which reaches an upper bound, a^*, at $a(Z^*)$.[16] In the present context a^* can be thought of as reflecting the 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

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

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

[16] 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.

prices are set so that $p_m = w/a$. The per capita demand function is the same as in the industrial organization model[17], implying that total domestic manufacturing output is given by:

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

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

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

From (16), the sign of the slope of Q with respect to Z, for $Z < Z^*$, is $-sign(\varepsilon + s)$, where ε is the price elasticity of per capita domestic demand and s is the expenditure share for the domestic manufactured good. Since, as before, $\varepsilon < -1$, dQ / dZ will be positive, and 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 at 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 $[0,Z^*]$.[18]

INSERT FIGURE 2 HERE

The introduction of a tariff in this model increases the demand for domestic manufactures so that the impact on Q for a given Z can be derived from (16) as:

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

where τ is an *ad valorem* tariff. Thus, the introduction of a tariff shifts the Q schedule up, and both initial output and permanent long run output are increased (see Figure 2). As well, a tariff speeds up the rate at which an industry proceeds up its experience curve,

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

[18] 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. 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.

and therefore brings forward the date at which it matures. Note, however, that a tariff has only a transitional impact on productivity in this model - once learning has ceased, removing the tariff will reduce domestic manufacturing output and increase real incomes. In summary, the imposition of a tariff in this LBD model:

a) increases the demand for domestic manufactured goods relative to the no-tariff situation; increases domestic output levels; and output experience accumulates more rapidly;

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 the introduction of tariff protection will accelerate output expansion, improve productivity, and reduce prices. But here the channel through which tariffs cause these effects is an acceleration in learning-by-doing.

4. The Impact of National Policy Tariffs

4.1 Treatment Effects: Baseline

The neo-classical trade model used by Dales (1966) in his assessment of the National Policy, predicts slower growth in response to protective tariffs. Perhaps the most important distinction between the neo-classical model and the new trade models we have described concerns the impact of tariffs on price and productivity. In the standard neo-classical framework, domestic and foreign manufactured goods are perfect substitutes, and in a small open economy a tariff raises the price of domestic manufactured goods by the tariff rate. Our industrial organization model yields a very different outcome. 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 higher productivity and lower prices. In the learning-by-doing model, a tariff, by increasing the rate at which domestic production accumulates, accelerates productivity growth and can also lead, for a time, to lower prices. Both of these models predict larger output effects, due to a combination of more firms and increased output per firm, relative to the neo-classical model. To probe the strength of these models' predictions, we begin with an assessment of the output, productivity and price changes that followed the imposition of protective tariffs under the National Policy.

Before the implementation of the National Policy, the average *ad valorem* tariff on manufactured goods was 14.9%.[19] In 1880 the average rate had risen to 21.7%, and in 1890 it was 23.3%.[20] This increase in protection was both abrupt and uneven in its application 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 products nearly tripled, increasing by 12 percentage points. 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 typically regarded as one of the main beneficiaries of the National Policy, received only a 2.4 percentage point increase in tariff protection.

The narrow targeting and abrupt introduction of Prime Minister John A. MacDonald's protectionist agenda allows us to treat the National Policy as a 'natural experiment'. In an environment where Canada's manufacturing industries were operating under common domestic and international macroeconomic conditions, on March 14 1879 some industries were treated with protection, while others were not. We use a difference-in-differences (DID) approach to identify the impact of the policy on those industries that were clearly import competing and received large tariff increases. DID estimating equations identify changes in output, total factor productivity, and prices for those industries treated by the policy, controlling for growth in the treated and untreated industry groups before the policy, and for growth in the untreated industries after the policy.[21] For identification we must clearly distinguish treated from untreated industries,

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[19] Eugene Beaulieu and Jevan Cherniwchan generously provided data and documentation for the average *ad valorem* tariffs (τ) 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 detailed description of the data.

[20] 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).

[21] A detailed description of the differences-in-differences approach can be found in Card and Krueger (1994).

and we must adopt the 'parallel trends' assumption, which requires that other changes in the Canadian macroeconomy did not differentially affect the treated and untreated industries. Our DID estimating equations take the form:

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

where x = output (q), total factor productivity (TFP), or output price (p)[22]; *policy* is a regime variable that takes the value 0 before 1879 and 1 from 1879-1913; *group* is a variable that takes the value 0 for the untreated *control* industries and 1 for the *narrow* or *broad* treated industries; i identifies industries, classified at the 2-digit1948-SIC level; t identifies year; and ε is an error term. The data form a panel of 660 observations (15 industries over 44 years).[23] The DID equations are estimated by ordinary least squares (OLS), clustering standard errors by industry and correcting for heteroskedasticity across and within industries, and for autocorrelation.

The dependent variable in (18) is the annual growth rate of one of three performance indicators; output, productivity or price. The *policy* variable controls for changes in these indicators among the industries in the *control* group after 1879. The *group* variable controls for changes in performance among the treated industries before 1879. And the constant term controls for changes in the dependent variables for the industries in the omitted group, which in this case is the *control* group of industries before 1879. The effect of the tariff on the treated group of industries - the treatment effect - is captured by the coefficient on the interaction between the *policy* and *group* variables, α_3 in (18).

An important consideration when using a difference-in-differences approach is the grouping of industries. In a true experiment, industries would be randomly assigned to one of two groups before treatment, and treatment intensity would be identical within groups. In fact, the National Policy did not randomly treat industries with protection and

[22] 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), and industry-specific output price indexes are based on Barnett (1966).

[23] 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.

treatment intensity varied across industries. Still, among the fifteen manufacturing industries four stand out. Tobacco, Paper, Transport Equipment, and Petroleum and Coal all experienced tariff increases of more than 37.5 percent between 1875 and 1880, and all had import intensities of more than 30 percent in 1875.[24] These industries form our *narrow* treatment group. Our *control* or untreated group either had little increase in tariff protection or were not import-competing to a significant degree. The nine industries in this group are Food, Rubber, Leather, Textiles, Clothing, Wood, Non-Ferrous Metals, Non-Metallic Minerals, and Chemicals. The remaining two industries - Printing and Publishing, Iron and Steel - satisfy our tariff criteria for inclusion in the treated group of industries, but their import intensities in 1875 were only about 20%. These industries fall into a gray area between the obviously treated and obviously untreated industries. We estimate two sets of baseline treatment effects, one with Printing and Publishing and Iron and Steel included in a *broad* group of treated industries, and a second with these industries included in the untreated *control* group.

INSERT TABLE 3 HERE

In Table 3 we report annual percent changes in output, total factor productivity and price for each industry and for the three treatment groups, averaged over the pre and post-National Policy periods. Although these performance indicators vary widely across industries and time periods, the industries in the treated groups consistently had slower output and productivity growth before 1879, and much faster output and productivity growth after 1879, relative to the industries in the untreated group. The treated industries also had rising output prices before 1879 and falling output prices after 1879, in sharp contrast to the *control* group of industries. These measures suggest a change in the relative performance of these industry groups following the increase in tariff protection. Our difference-in-differences approach allows us test this casual empiricism.

INSERT TABLE 4 HERE

In Table 4 we report baseline parameter estimates, robust standard errors and an indicator of statistical significance for the output, productivity and price DID equations. The treatment effects are consistently large and strongly statistically significant. The

[24] Import intensity is equal to the value of imports for home consumption divided by the value of domestic production.

output effect is +6.7% for the *narrow* group and +5.2% for the *broad* group. The productivity effects are even larger, +11.1% for the *narrow* group and +8.9% *broad* group, and the price effects are -7.8% and -6.9% for the *narrow* and *broad* groups, respectively.[25] These results reveal that, even after controlling for relative growth rates before 1879, tariff protection under the National Policy was associated with increased output and productivity, and lower prices for those industries most directly affected. These are the effects predicted by the industrial organization and learning-by-doing new trade models.

4.2 Treatment Effects: Threats and Extensions

Some caution must be exercised before accepting these treatment effects as evidence consistent with causal relationships. Identification of the treatment effects reported in Table 4 is conditional on two key assumptions. First, we assume that we have correctly distinguished between treated and untreated industries, and second, we assume that any changes in the post-National Policy macro-economy affected the treated and untreated industries equally.

The validity of the first assumption may be called into question because we have based our categorization of industries on just two criteria - the presence of significant import competition, and large increases in tariff rates.[26] In a standard DID framework, treatment intensity is assumed to be uniform within industry groups - all or nothing. In fact, changes in average *ad valorem* tariffs after 1879 ranged from +3.7% for Non-Ferrous Metal Products to +345% for Transport Equipment, with a coefficient of variation across the 15 Canadian manufacturing industries of 0.983. If we accept that tariff rates are an appropriate treatment criteria in our context, then the large variation in

[25] If we use input and output prices in a cost function approach to TFP measurement, rather than our production function approach, we find that the tariff's treatment effect on productivity remains large: +7.3*** for the *broad* group and +9.5*** for the *narrow* group.

[26] Because the National Policy was not exclusively protectionist, its broader objectives may have differentially affected industries in ways unrelated to tariff rates or import competition. As a robustness check we use an 'intent-to-treat' approach to industry categorization in which the treatment 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 treatment 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 A2: Panel A and B).

these rates suggests that a [0,1] variable may be a very blunt instrument for the identification the effects of treatment.

Concern about the validity of the second key assumption arises from the structural changes that were taking place in the Canadian economy between 1870 and 1913, including shifts in the geographic distribution of production and demand, domestic and foreign market access, industrial structure, and technology. Although all manufacturers were exposed to the general patterns, they were not equally affected. Using micro-data from the manuscripts of the 1870-71 Canadian industrial census, Inwood and Keay (2012: Table 2) report that the industries in our *control* group were comprised of larger, more capital intensive and more urban firms than the industries in either treatment group. International trade shares reported by Barnett (1966: Table D.13) indicate that the *control* industries were also more export oriented and, therefore, likely to be more sensitive to changes in trade costs.

An alternative to the standard DID all-or-nothing categorization of industries is to use industry-specific treatment intensity - based on the percentage change in the tariff after 1875 - for identification. The estimating equations retain the difference-in-differences structure, but the treatment effects are now elasticities reflecting the percent change in output, productivity or price in response to a 1% increase in the industry-specific *ad valorem* tariff rate.[27]

$$\ln x_{it} - \ln x_{it-1} = \beta_0 + \beta_1\, policy_t + \beta_2\, treatment\ intensity_i + \beta_3\, (policy_t \times treatment\ intensity_i) + e_t \quad (19)$$

Treatment intensity in (19) is either the change in the *ad valorem* tariff between 1875 and 1880, or the difference between the 1875 tariff rate and the maximum rate over the 1880 to 1910 period. The first measure of treatment intensity reflects the impact of the initial round of National Policy tariffs, while the second captures the maximum change in tariffs to 1910.

INSERT TABLE 5 HERE

The impact of treatment intensity under the National Policy is again large and strongly statistically significant (see Table 5). The elasticity of output with respect to

[27] Similar to our baseline DID results, we estimate (19) by OLS, clustering standard errors by industry and correcting for heteroskedasticity across and within industries, and correcting for autocorrelation.

treatment intensity ranges from +3.6% to +4.8%, while the productivity elasticity is +5.7% with respect to the initial tariff increase and +4.0% with respect to the maximum tariff increase, and the price elasticity with respect to tariff changes falls between -4.9% and -4.6%. These results provide more evidence that protection under the National Policy did in fact lead to large increases in output and productivity, and lower prices.

The second potential threat to our identification of the National Policy's treatment effects is the failure of the parallel trends assumption. Changes in the macroeconomy unrelated to National Policy tariffs may have had differential effects on the treated and untreated industries, and these effects could pollute our DID estimates. Canada underwent a major economic and social transformation between 1896-1913 during the wheat boom. To mitigate the possible impact of this boom our results, we truncate the time series and re-estimate the DID equations over only the pre-wheat boom years. When we restrict our panel to the 1870-1895 period, we still find that the industries treated by the National Policy experienced substantial and statistically significant increases in output and productivity, and reductions in price, relative to the untreated industries. The treatment effects are all within +/- 1.5% of the full sample effects reported in Tables 4 and 5.[28]

Removing the wheat boom years addresses concerns about the parallel trends assumption to a degree, but the same issue could apply to less transformative changes during pre-1896 period.[29] To address more general skepticism about the validity of the parallel trends assumption throughout our period of study, we re-estimate our DID equations 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 treated and untreated industries. Although the treated industries' performance indicators are significantly more sensitive to changes in transport costs and urban population levels, even after controlling for these potentially confounding factors,

[28] Results from the truncated DID estimates are reported in Appendix Table A2: Panel C.

[29] The National Policy tariffs were introduced in March of 1879. 1879 was an unusual year in that it was the start of a sharp recovery from recession. If this recovery was not uniform across treated and untreated industries, then including 1879 in the treatment period could lead to another potential violation of the parallel trends assumption. When we estimate treatment effects assuming treatment began in 1880 rather than 1879, there are no changes sign or significance. Results for the 1880-1913 treatment period are reported in Appendix Table A2: Panel D.

the National Policy treatment effect on output, productivity and prices, and the treatment elasticities, continue to be large and significant.[30]

After addressing these concerns about the identification of National Policy treatment effects, and after extending the standard DID estimation approach to include treatment intensity, we are confident in the robustness of our empirical findings. As predicted by the industrial organization and learning-by-doing models, Canadian manufacturing industries that received the largest increases in protection under the National Policy experienced faster output growth, faster productivity growth and larger reductions in their output prices than the industries that were less affected by the policy.[31]

5. Returns to Scale and Learning-by-Doing

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

$$\ln q_{it} = \beta_0 + \beta_1 \ln L_{it} + \beta_2 \ln K_{it} + \beta_3 \ln M_{it} + \beta_4 \ln F_{it} + v_t \qquad (20)$$

where the factors of production include labour (*L*), capital (*K*), raw materials (*M*) and fuel (*F*); *v* is an error term; and *t* spans 1880-1913.[32] RTS (= $\sum_{b=1}^{4} \beta_b$) are derived from the estimated parameters in (20).

[30] All industries appear only weakly affected by changes in raw material prices and net migration. Results with additional controls are reported in Appendix Table A2: Panel E. Because Canadian manufacturing output (and productivity and price) could have affected labour demand, and hence the incentive to move to Canada and/or the incentive to move into urban centres, the OLS estimates of the DID equations with controls for urban population and net migration may be biased due to endogeneity. Using an IV estimation approach - with Australian population and the population of Sydney and Melbourne as excluded instruments for urban population, and net Australian migration as an excluded instrument for net Canadian migration - the treatment effects (with controls) remain large and significant. See Appendix Table A2: Panel F.

[31] 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.

[32] 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 A3: *Test 1*) confirm that our qualitative conclusions are not affected by

INSERT TABLE 6 HERE

Eight of the industries exhibited increasing returns to scale, two experienced decreasing returns to scale, and five had constant returns (see Table 6). The median RTS was 1.057 for Chemical Products, the minimum was 0.865 for Food and Beverages, and the maximum was 1.383 for Transport Equipment. All industry groups enjoyed strongly increasing returns, but the *narrow* group of treated industries had larger returns to scale than either the *broad* group or the *control* group, although the difference between the *narrow* and *broad* groups was not statistically significant.[33] This pattern in internal scale economies is consistent with the industrial organization model's predictions, where higher protective tariffs trigger increases in output, thereby shifting industries' *LL* schedules (see Figure 1), driving down mark-ups, reducing average costs, and fostering larger returns to scale. In other words, the model correctly predicts that we should observe the strongest returns to scale among the most treated industries – those in the *narrow* group.[34]

In the learning-by-doing model, productivity improvements and price reductions result from a more rapid accumulation of production experience following the imposition of a tariff. To estimate the LBD model's logistic experience curves (or learning rates), *a(Z)*, we assume that cumulative output can proxy for production experience, and we estimate a log-linear cumulative output function for each industry.[35]

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

where output is accumulated from 1880 to period t ($Z_{it} = \sum_{j=1880}^{t} Q_{ij}$); μ is an error term; and the elasticity of TFP with respect to cumulative output, λ_1, can be used to calculate

the estimation of *RTS* over the full 1870-1913 period. Group and aggregate production functions include industry fixed effects to control for time-invariant, industry-specific technological differences.

[33] 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. The *RTS* estimates from these tests are reported in Appendix Table A3.

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

[35] 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 productivity gain from a doubling of output experience - the learning rate ($1\text{-}2^{-\lambda 1}$).[36] The learning rate also reflects the rate at which the industries are approaching maturity, *[a*, T*]*.

Twelve of the industries exhibited statistically significant learning-by-doing, the median learning rate was 18 percent, and learning rates for those industries with significant output elasticities ranged from a low of 8.9 percent for Tobacco, to 56.9 percent for Paper (see Table 6).[37] All three industry groups had large and significant cumulative output elasticities, but the *narrow* treatment group had a higher learning rate than either the *broad* group or the *control* group (38.8 percent vs. 31.8 percent and 14.3 percent, respectively).[38] The more rapid learning rates among the industries most affected by the National Policy are consistent with the learning-by-doing model's predictions, where higher protective tariffs trigger increases in output, moving industries further along their learning curves, accelerating productivity improvement and reducing prices.[39]

These returns to scale and learning rates reveal the presence of both internal and external scale economies among Canadian manufacturing industries following the imposition of the National Policy. We can compare their effects with a simple 'back-of-the-envelope' calculation. Among the *narrow* group of industries, the tariff's treatment effect on output was +6.7% (Table 4) 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% ($.0667 \times \frac{RTS-1}{RTS}$), or 13.5 percent of the total treatment effect of the tariff on TFP (+11.1% from Table 4). Among the *broad* group of industries, 12.4 percent of the tariff's effect on

[36] 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.

[37] 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%.

[38] The difference between the *narrow* and *broad* groups was not statistically significant. 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. The LBD estimates from these tests are reported in Appendix Table A4.

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

TFP can be attributed to internal returns to scale. Similarly, we can use the learning rates reported in Table 6 and the output treatment effects reported in Table 4 to derive the productivity effect that can be attributed to the more rapid accumulation of production experience following the increase in National Policy tariffs. Among the *narrow* group, 23.4 percent of the tariff's impact on productivity can be attributed to learning-by-doing, and the corresponding impact for the *broad* group is 18.6 percent.[40] These calculations suggest that roughly 35 percent of the total impact of the tariff on productivity (36.9 percent for the *narrow* group and 31 percent for the *broad* group) can be attributed to internal returns to scale and learning-by-doing.

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 and development. 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. An industrial organization model predicts an increase in market size following the imposition of protective tariffs, which triggers output expansion, lower average costs, productivity improvements and lower prices. These effects operate through internal returns to scale. A learning-by-doing model predicts output expansion, productivity improvement and lower prices, as producers accumulate experience more rapidly - effects that are reflected in producers' learning rates.

Using a difference-in-differences approach we find large and statistically significant output, total factor productivity and price treatment effects following the imposition of the National Policy tariffs. 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 in these internal and external scale economies are consistent with the predictions of the new trade

[40] For the *narrow* 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 23.4% of the estimated total productivity effect of the tariff.

models. The empirical evidence does not prove causation, nor can it clearly distinguish between the relative importance of the two mechanisms. Nevertheless, the models highlight channels through which tariff protection may have contributed to Canadian industrial development and economic growth.

7. References

Adler, P.S. (1990), "Shared Learning," *Management Science* 36, 938-57.

Altman, M. (1987), "A Revision of Canadian Economic Growth: 1870-1910," *Canadian Journal of Economics* 20, 86-113.

Arrow, K. J. (1962), "The Economic Implications of Learning by Doing," *Review of Economic Studies* 29, 155-73.

Baldwin, J.R. and A.G. Green (2008), "The Productivity Differential Between the Canadian and US Manufacturing Sectors: A Perspective Drawn from the Early Twentieth Century," *Canadian Productivity Review* 22, 1-35.

Barnett, R.F.J. (1966), "Canada's Manufacturing Development and Foreign Trade, 1870-1915," Department of Economics, Bishops University, mimeograph.

Bertram. G. W. (1963), "Historical Statistics on Growth and Structure in Manufacturing in Canada, 1870-1957," in J. Henripin and A. Asimakopolous, eds., *Canadian Political Science Association Conference on Statistics*, 1962 and 1963 (Toronto), 93-146.

Beaulieu, E. and J. Cherniwchan (2014), "Tariff Structure, Trade Expansion and Canadian Protectionism from 1870-1910," *Canadian Journal of Economics* 47, 144-72.

Bils, M. (1984), "Tariff Protection and Production in the Early U.S. Cotton Textile Industry," *Journal of Economic History* 44, 1033-45.

Canada (1883), *Census of Canada*, 1880-81, Vol. 2 (Ottawa).

Canada (1894), *Census of Canada*, 1890-91, Vol. 3 (Ottawa).

Canada (Various Years), "Trade and Navigation Reports," *Sessional Papers, Parliament of Canada* (Ottawa).

Card, D. and A.B. Krueger (1994), "Minimum Wages and Employment: A Case Study of the Fast Food Industry in New Jersey and Pennsylvania," *American Economic Review* 84, 772-93.

Carter S., S. Gartner, M. Haines, A. Olmstead, R. Sutch and G. Wright, eds. (2006), *Historical Statistics of the United States:Millennial Edition* (New York: Cambridge University Press).

Dales, J.H. (1966), *The Protective Tariff in Canada's Development* (Toronto: University of Toronto Press).

David, P.A. (1970), "Learning by Doing and Tariff Protection: A Reconsideration of the Case of the Ante-Bellum United States Cotton Textile Industry," *Journal of Economic History* 30, 521-601.

Dutton, J.M., A. Thomas and J.E. Butler (1984), "The History of Progress Functions as a Managerial Technology," *Business History Review* 58, 204-33.

Easterbrook, W.T., and Aitken, H.G.J. (1956), *Canadian Economic History* (Toronto: Macmillan).

Easton, S. T., Gibson, W. A., and Reed. C. G. (1988), "Tariffs and Growth: The Dales Hypothesis," *Explorations in* Economic *History* 25, 147-63.

Firestone, O.J. (1960), "Development of Canada's Economy," in Conference on Research in Income and Wealth, *Trends in the American Economy in the Nineteenth* Century, Studies in Income and Wealth, vol. 24 (Princeton: N.B.E.R. and Princeton University Press).

Green, A.G. and G.R. Sparks (1999), “Population Growth and the Dynamics of Canadian Development: A Multivariate Time Series Approach,” *Explorations in* Economic *History* 36, 56-71.

Green, A.G. and M.C. Urquhart (1987), "New Estimates of Output Growth in Canada," *Perspectives on Canadian Economic History*, D. McCalla (ed), Toronto: Copp, Clark, Pitman.

Harris, R.G. (1984), "Applied General Equilibrium Analysis of Small Open Economies with Scale Economies and Imperfect Competition," *American Economic Review* 74, 1016-33.

Hartland, P. (1955), "Factors in Economic Growth in Canada," *Journal of Economic History* 15, 13-22.

Head, K. (1994), "Infant Industry Protection in the Steel Rail Industry, " *Journal of International Economics* 37, 141-65.

Horstmann, I. and J. Markusen (1986), "Up the Average Cost Curve: Inefficient Entry and the New Protectionism," *Journal of International Economics* 20, 225-247.

Inwood, K. and I. Keay (2012), "Diverse Paths to Industrial Development: Evidence from Late Nineteenth Century Canada," *European Review of Economic History* 16, 311-33.

Inwood, K. and I. Keay (2013), "Trade Policy and Industrial Development: Iron and Steel in a Small Open Economy, 1870-1913," *Canadian Journal of Economics* 46, 1265-94.

Irwin, D. (2000), "Did Late-Nineteenth Century US Tariffs Promote Infant Industries? Evidence from the Tinplate Industry," *Journal of Economic History* 60, 335-60.

Irwin, D. and P. Temin (2001), “The Antebellum Tariff on Cotton Textiles Revisited,” J*ournal of Economic History* 61, 777-98.

Isserlis, L. (1938), "Tramp Shipping Cargoes and Freights," *Journal of the Royal Statistical Society* 101, 53-146.

Krueger, A. and B. Tuncer (1982), “An Empirical Test of the Infant Industry Argument,” *American Economic Review* 72, 1142-52.

Krugman, P. (1987), "The Narrow Moving Band, the Dutch Disease, and the Competitive Consequences of Mrs. Thatcher," *Journal of Development Economics* 27, 41-55.

McDiarmid, O.J. (1946), *Commercial Policy in the Canadian Economy* (Cambridge MA: Harvard University Press).

McDougall, D.M. (1971), "Canadian Manufacturing Commodity Output, 1870-1915," *Canadian Journal of Economics* 4, 21-36.

Melitz, M.J. and D. Trefler (2012), "Gains from Trade when Firms Matter," *The Journal of Economic Perspectives* 26, 91-118.

Michell, H. (1931), *Statistical Contributions to Canadian Economic History, Volume 2* (Toronto: MacMillan).

Thompson, P. (2001), "How Much did the Liberty Shipbuilders Learn? New Evidence for an Old Case Study," *Journal of Political Economy* 109, 103-37.

Urquhart, M. C. (1986), "New Estimates of Gross National Product, Canada, 1870-1926," in S.L. Engerman and R.E. Gallman, eds., *Long-Term Factors in American Economic Growth* (Chicago: N.B. E.R. and University of Chicago Press).

Urquhart, M.C. (1993), *Gross National Product of Canada, 1870-1926: Derivation of the Estimates* (Montreal: Queen's McGill Press).

Urquhart, M.C. and K.A.H. Buckley (1965), *Historical Statistics of Canada* (Toronto: MacMillan).

Williamson, J.G. (1972), "Embodiment, Disembodiment, Learning by Doing, and Returns to Scale in Nineteenth Century Cotton Textiles," *Journal of Economic History* 32, 691-705.

Young, J.H. (1955), "Comparative Economic Development: Canada and the United States," *American Economic Review: Papers* and *Proceedings* 45, 80-93.

8. Tables and Figures

Table 1. Population, Manufacturing Value Added and GDP, 1870-1913 (average of 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. Manufacturing Output by Industry, 1870-1913 (average of annual percentage changes)

	GDP Deflator			Industry Deflators		
	1870-79	1880-89	1880-1913	1870-79	1880-89	1880-1913
Food [C]	1.6	6.0	4.1	3.7	4.1	3.6
Tobacco [N]	0	7.8	5.9	-2.8	7.4	5.0
Rubber [C]	3.8	11.5	9.9	1.6	12.9	11.1
Leather [C]	-3.7	2.0	2.3	-4.7	2.3	1.7
Textiles [C]	5.6	7.1	2.9	5.6	7.7	3.0
Clothing [C]	5.4	7.2	4.4	6.8	8.3	6.0
Wood [C]	0.7	6.2	3.1	4.8	0.5	1.2
Paper [N]	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 [N]	3.5	2.1	4.8	-5.1	1.5	7.3
Non-Ferrous Metals [C]	9.4	5.0	7.2	10.2	5.3	8.3
Non-Metallic Minerals [C]	4.3	0.6	4.8	8.4	-0.1	5.4
Petroleum - Coal [N]	4.0	-5.1	2.9	3.9	1.3	5.4
Chemicals [C]	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
Narrow	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
Control	1.4	5.5	3.9	3.3	3.9	4.1

Note: See Note to Table 1. N = *narrow* treatment group (Tobacco, Paper, Transport, Petroleum), B = *broad* treatment group (also includes Printing and Publishing, and Iron and Steel), C = *control* group (Food, Rubber, Leather, Textiles, Clothing, Wood, Non-Ferrous, Non-Metallic, Chemicals). For a discussion of the grouping of industries see Appendix Table A1 and text. Output is value added in production; GDP deflator is from Urquhart (1993: Table 1.6); industry deflators are based on the gross value of production. Details on the industry deflators are given in the Data Appendix.

Table 3. Manufacturing Performance Indicators, 1870-1913 (average of annual percentage changes)

	Output		TFP		Price	
	1870-79	1880-1913	1870-79	1880-1913	1870-79	1880-1913
Food[C]	4.3	3.1	-1.5	-0.4	-2.4	1.3
Tobacco[N]	-2.2	4.7	-7.8	0.3	2.4	1.7
Rubber[B]	-1.9	10.2	-6.4	1.0	1.9	-0.3
Leather[B]	-2.1	1.8	-0.4	-0.3	0.7	1.4
Textiles[C]	3.8	3.0	-9.3	0.6	-0.3	0.8
Clothing[C]	7.0	5.6	1.8	2.6	-1.7	-0.7
Wood[C]	4.6	1.1	3.1	-1.3	-4.4	2.7
Paper[N]	-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[N]	-3.3	7.9	-11.1	3.2	8.3	-1.7
Non-Ferrous[C]	10.6	8.9	-1.0	2.4	-1.1	-0.3
Non-Metallic[C]	9.2	5.5	2.2	1.9	-4.5	0.2
Petroleum[N]	5.1	6.2	-11.7	2.7	-0.2	-1.6
Chemicals[B]	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
Narrow	-2.2	7.4	-8.3	4.8	9.3	-0.1
Broad	-1.5	7.3	-7.1	4.1	4.2	0.2
Control	3.7	3.4	0.1	-0.4	-2.2	0.6

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

Table 4. *Difference-in-Differences* National Policy Treatment Effects, 1870-1913

	Narrow Treatment Group			*Broad* Treatment Group		
	Output	TFP	Price	Output	TFP	Price
Control - Pre-NP	0.038**	-0.011	-0.016*	0.040**	-0.008	-0.021**
(Constant)	(0.016)	(0.019)	(0.009)	(0.019)	(0.023)	(0.011)
Treatment - Pre-NP	-0.049**	-0.092***	0.065**	-0.036	-0.071**	0.055**
(Group Dummy)	(0.019)	(0.028)	(0.029)	(0.023)	(0.030)	(0.022)
Control - Post-NP	0.013	0.019	0.021*	0.011	0.013	0.028**
(Policy Dummy)	(0.018)	(0.021)	(0.012)	(0.021)	(0.025)	(0.014)
Treatment Effect	0.067***	0.111***	-0.078**	0.052*	0.089**	-0.069**
(Group x Policy)	(0.024)	(0.037)	(0.035)	(0.019)	(0.036)	(0.027)
N	645	645	645	645	645	645
i	15	15	15	15	15	15
t	43	43	43	43	43	43
R^2	0.010	0.016	0.011	0.010	0.014	0.011

Note: See Note to Table 2 and estimating equations described in text. Random effects GLS estimation; robust standard errors reported in parentheses; standard errors clustered by industry; *, **, *** indicate statistical significance with 90%, 95%, 99% confidence.

Table 5. *Treatment Intensity* National Policy Treatment Effects, 1870 - 1913

	% Δ τ in 1879			Maximum % Δ τ		
	Output	TFP	Price	Output	TFP	Price
Control - Pre-NP	0.042***	-0.006	-0.024**	0.048**	0.002	0.033***
(Constant)	(0.015)	(0.020)	(0.011)	(0.019)	(0.019)	(0.013)
Treatment - Pre-NP	-0.027***	0.048***	0.041***	0.027***	0.035***	0.039***
(Group Dummy)	(0.007)	(0.010)	(0.006)	(0.009)	(0.008)	(0.007)
Control - Post-NP	0.009	0.013	0.031**	0.003	0.010	0.040**
(Policy Dummy)	(0.018)	(0.023)	(0.014)	(0.020)	(0.021)	(0.016)
Treatment Effect	0.036***	0.057***	-0.049***	0.048**	0.040***	-0.046***
(Treatment Intensity x Policy)	(0.008)	(0.013)	(0.008)	(0.019)	(0.009)	(0.009)
N	645	645	645	645	645	645
i	15	15	15	15	15	15
t	43	43	43	43	43	43
R^2	0.010	0.015	0.016	0.008	0.019	0.013

Note: See Note to Table 4. Treatment intensity = % Δ average tariff (τ) between 1875 and 1880, or the maximum % Δ average tariff after 1875; *, **, *** 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[C]	0.865**	0.051	0.035
Tobacco[N]	1.007	0. 089**	0.060
Rubber[C]	0.958	0.121**	0.080
Leather[C]	1.097	0.079	0.054
Textiles[C]	0.895*	0.128***	0.085
Clothing[C]	1.271**	0.223***	0.143
Wood[C]	1.010	0.141***	0.093
Paper[N]	1.327***	0.569***	0.326
Printing[B]	1.001	0.119***	0.079
Iron-Steel[B]	1.257***	0.185***	0.120
Transport[N]	1.383**	0.187***	0.122
Non-Ferrous[C]	1.135**	0.235***	0.151
Non-Metallic[C]	1.054**	0.184***	0.120
Petroleum[N]	1.128**	0.327***	0.203
Chemicals[C]	1.057***	- 0.018	-0.013
All Industries	1.212***	0.209***	0.135
Narrow	1.297***	0.388***	0.236
Broad	1.282***	0.318***	0.198
Control	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

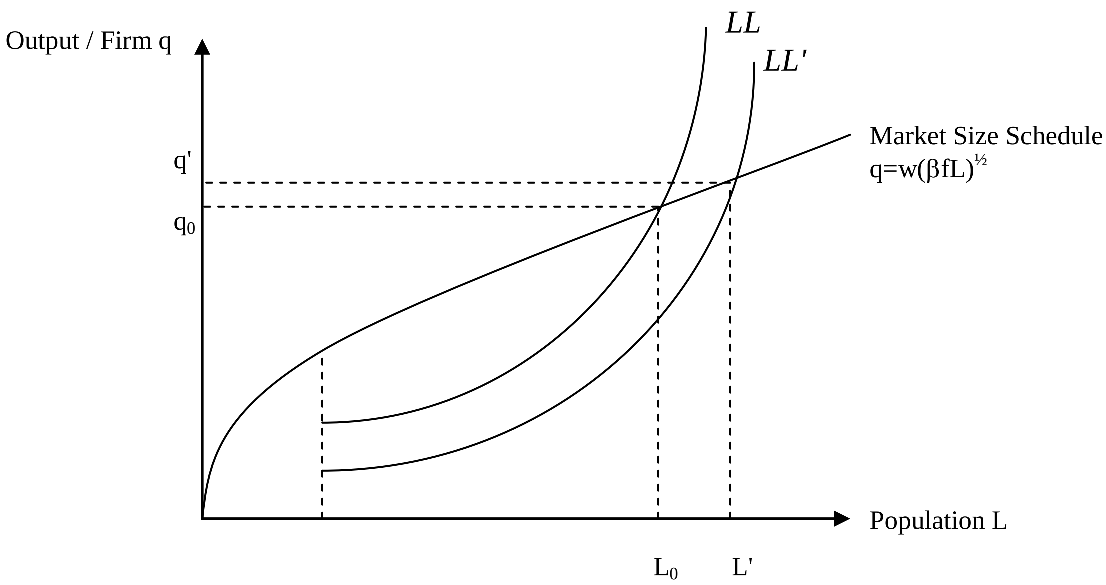

Figure 2: Learning-by-Doing Model: The Effect of a Tariff