Trade Protection for Maturing Industries: Canadian Trade Patterns and Trade Policy during the First Era of Globalization[†]

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Abstract

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In this paper I use granular, product-specific (HS4) annual information on Canadian trade flows and average weighted tariffs, covering the years 1870-1913, to investigate the relationship between trade policy and industrial maturation. Maturity is reflected in producers' ability to compete on domestic and international markets. I find a strong, robust negative connection between tariff rates and trade performance for manufactured products that matured during the first decade after Canada adopted protectionist policy objectives in 1879. For products that did not mature, I find that improved trade performance was coincident with tariff 'entrenchment'. Linking tariffs to industrial maturation in this way is consistent with theoretical trade models that describe optimal tariff policy in the presence of external learning effects. These relationships also hold at a more aggregate industry level, where I can control for import penetration, use historically contemporaneous trade elasticity estimates, link trade performance to trade restrictiveness and effective rates of protection, and where I can address identification concerns by instrumenting for import penetration and trade performance using a two-stage IV-GMM estimation approach. The results suggest that after 1890 the Canadian government narrowly selected maturing producers for tariff cuts, and these cuts significantly lowered partial equilibrium measures of static deadweight loss from Canadian trade policy during the post-1890 period.

JEL Codes: N71, F14.

Keywords: Historical trade policy; Canadian trade policy; infant industry protection.

Introduction

As a result of falling transport costs and sharply increasing international trade volumes, migrant flows and capital movements, the 1870-1913 period has come to be known as the 'first era of globalization' (O'Rourke and Williamson 1999, Estevadeordal, Frantz and Taylor 2003). During the early 1870s, Canadian trade patterns reflected the country's emergence as a small open economy that was actively engaged in this process of globalization. Import penetration among rubber products, transport equipment, petroleum products, and iron and steel products, for example, increased sharply after 1870, while Canadian wood products, processed food, and raw materials experienced large increases in export volumes. In part as a response to the powerful market integrating forces at work in the international economy, John A. Macdonald's newly elected Conservative government introduced what they proudly proclaimed to be Canada's new 'National Policy' as part of their first federal budget on March 14, 1879.[1] This policy delivered on three of the Conservative's main promises from the 1878 federal election campaign: the promotion of European migration into Canada, specifically into the Canadian west; subsidizing the construction of a trans-continental railway line entirely within Canada's borders; and the protection of Canadian manufacturers from foreign competition (Easterbrook and Aitken 1956: 394).

Virtually every line of the Canadian tariff schedule was re-written under the National Policy. The average weighted tariff (AWT) on all manufactured imports rose from 14% to just over 21%, effective rates of protection (ERP) rose by 14 percentage points, trade restrictiveness (TRI) increased by seven percentage points, and the static partial equilibrium deadweight loss (DWL) resulting from the Canadian tariff schedule increased from 0.5% of GDP to 0.9% (Alexander and Keay 2017a and 2017b). This policy change marked an abrupt shift in the objectives underlying Canadian trade policy – away from revenue generation as the sole objective, in favour of a more balanced approach prioritizing protectionism.

In this paper I use finely disaggregated product-specific (HS4) annual information on Canadian trade flows and average weighted tariffs covering the years 1870-1913, to investigate the relationship between changes in Canadian trade policy *after* the introduction of the National Policy in 1879, and industry maturation, where industry maturity is measured by changes in import penetration and exports' share of domestic production. My empirical specifications are based on theoretical trade models that describe how optimal tariffs may be set in the presence of external learning effects (Melitz 2005, Karacaovali 2011). For manufactured products that were protected under the National Policy (AWT_{1880} >

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[1] The National Policy was also touted a response to the substantial tariff increases imposed by the government of the United States during the 1860s. Over all traded products, average weighted tariffs in the US increased from just 15% in 1859 to 45% in 1867 (Irwin 2010: Table 2).

0), I find a strong, robust negative connection between net export performance and tariff protection, but this relationship only holds after allowing for a 10-year learning period (1880-1889), and it only holds for products that show signs of maturation – rising net exports – during this learning period. For products that remained immature – falling net exports during the 1880s – and for non-manufactured raw materials and unprocessed foodstuffs, I find a positive correlation between net export performance and tariff levels after 1890, which is indicative of tariff entrenchment. There is no statistically significant connection between trade performance and tariff rates for maturing or immature products during the 1880s, and I cannot distinguish between maturing and immature products' tariff rates or their tariff-trade connections before 1890.

The product level tariff-trade performance relationships are consistent with predictions derived from the theoretical models of optimal tariff setting in the presence of external learning effects, and they continue to hold even when I aggregate from the HS4 product level, up to the SIC2 industry level. Shifting my focus to more aggregated industries, allows me to test for a connection between trade performance and AWT, trade restrictiveness and effective rates of protection. At the industry level I can also use historically contemporaneous trade elasticities and import penetration ratios as independent explanatory variables, and perhaps most importantly, I can employ a two-stage instrumental variables (IV-GMM) estimation approach to address identification concerns related to simultaneity and omitted variable bias.

Simple 'back-of-the-envelope' counterfactual calculations reveal the importance of the estimated tariff-trade performance links. A one standard deviation reduction in net exports for the manufactured products that showed signs of maturation during the 1880s, results in a counterfactual increase in aggregate partial equilibrium static DWL due to the Canadian tariff schedule between 1890-1913 of approximately 0.27% of domestic GDP ($4.3 billion in 2015 CAD). From a policy perspective, if the federal government had maintained the much weaker, uniform tariff-trade link that I estimate for the 1880-1889 period after 1890, counterfactual partial equilibrium static DWL between 1890-1913 would have risen by just over 0.18% of domestic GDP ($2.8 billion in 2015 CAD). Improving trade performance after 1890, and the government's transition to narrowly targeted tariff cuts directed at maturing industries, appears to have substantially improved Canadian welfare during the first era of globalization.

On average after 1890, for those products and industries that matured in the wake of the adoption of protectionist policy objectives under the National Policy, the Canadian government cut tariffs as producers matured, experience was accumulated, and ultimately, trade performance improved. For products and industries that did not mature during the decade after the National Policy was introduced, improving trade performance was associated with tariff entrenchment. These findings suggest that, at least for those products for which an infant industry argument is feasible, the distortionary price effects of the tariff schedule were reduced as producers approached the peak of their learning curves and the dynamic productivity advantages of infant industry protection waned.

Trade Policy in Canada, 1870-1913

In 1871, William Mills and Robert Melvin were the proprietors of one of the largest industrial establishments in Guelph Ontario, a small town of 6,900 residents straddling the confluence of the Speed and Eramosa Rivers, 80 miles north of the US border along the Grand Trunk Railway's mainline. Mills and Melvin employed 16 workers in 1871, not including themselves, producing $28,000 worth of stoves and stove parts (HS4 7321). Between 1870-1877 Mills and Melvin, and their 5,425 fellow stove producers listed in the 1871 *Canadian Industrial Census*, faced increasingly stiff international competition. On average over these years, more than $370,000 worth of stoves and stove parts were imported into Canada annually, primarily from the United States. Canadian producers exported a grand total of 0 stoves between 1870-1877.

With the introduction of the National Policy in 1879, Canadian stove producers' trade protection, including Mills and Melvin's firm in Guelph, rose from 16.25% to 25%. Stove imports dropped from $370,000 per year to just over $30,000 during the 1880s, and, although exports did not exactly take off during this decade, over 2,300 stoves were shipped out of Canada between 1880-1890, averaging about $2,700 per year in gross exports.

These figures suggest that stove producers might be a good example of an infant industry that was successfully protected by the National Policy. During the late nineteenth and early twentieth centuries, stoves were produced in relatively large, steam powered, and technologically advanced establishments, like Mills and Melvin's Guelph factory. The introduction of tariff protection in 1879 dramatically reduced foreign import competition in Canada, allowing domestic producers to expand production, accumulate experience, exploit scale economies, and improve their productivity. With experience and productivity improvement came lower marginal costs and the ability to successfully compete in domestic and, eventually, foreign markets. However, as stove producers' trade performance improved through the decade following the introduction of protectionist policy objectives, their tariff levels remained stubbornly high – rising from 25% to 30% in 1887, before dropping back slightly to 27.5% in 1894, and only slowly slipping back further, towards 25% on the eve of WW1. This tariff pattern is consistent with the entrenchment of Canadian stove producers' trade protection, even after they showed signs of maturation.

There is a substantial body of literature that documents the late nineteenth century trade policy shift embodied in Canada's National Policy, and its effects on industrial development through the 1880-1913 period. Much of the earliest work made infant industry-type arguments in support of trade protection in Canada's parochial, resource intensive economic environment (Blackeby 1883, Willis 1883, Fowke 1952, Easterbrook and Aitken 1956). A revisionist literature drawing on neo-classical Ricardian trade theory shifted the focus towards the suppression of competition in domestic markets, rent capture, and static welfare losses due to price distortions (Dales 1966, Eaton, Gibson and Reed 1988, Beaulieu and Cherniwchan 2014). Recently, insights from 'new trade theory' have begun to be applied in studies of the impact of the National Policy. Inwood and Keay (2013) find that tariff increases through the 1880s were associated with increases in investment, firm turnover, technological choice, and location decisions for Canadian iron and steel producers. Harris, Keay and Lewis (2015) show that manufacturers who received the largest increases in tariff protection under the National Policy experienced disproportionately rapid output growth, productivity improvement and price reductions, and these effects can be linked to the presence of scale economies and evidence of rapid learning-by-doing. Alexander and Keay (2017b) use a multi-sector, differentiated product trade model to derive a measure of the general equilibrium welfare effects of Canada's move to protectionism. They find that the National Policy's positive impact on Canada's terms of trade may have more than offset the negative welfare effects of the tariff's distortionary impact on domestic prices.

One of the challenges faced by those seeking to employ new trade models' infant industry and dynamic productivity arguments in the Canadian historical context, stems from a recognition that the advantageous effects predicted by these models are only expected to be felt until the newly protected industries mature. Once learning has occurred, scale economies have been exploited, technologies have been adopted, or terms of trade effects have been felt, only the welfare suppressing, distortionary price effects resulting from high tariffs remain. The initial productivity advantages of infant industry protection, therefore, may be swamped if distortionary tariffs are left in place – entrenched – after learning is complete. This is a very real concern if producers who have successfully matured under a protective tariff regime are more likely to have the resources and political influence to pressure the government to maintain their high, protective tariffs (Dales 1966, Bliss 1987, Watkins 1991, Williams 1991).

Studies of the political economy pressures affecting Canadian trade policy during this period identify conflicting forces at work (Caves 1976, Helleiner 1977, Beaulieu and Emery 2001). Industry characteristics – which can reflect industries' potential political influence – are related to changes in Canadian tariffs under the National Policy. More specifically, larger, more productive, more politically connected producers appear to have received disproportionately high tariffs in 1879 (Alexander and Keay 2017a). Of course, the longer run entrenchment of these tariffs is not necessarily inevitable. Governments trade-off revenue goals and pressure from domestic producers, against the potential political backlash associated with tariff-induced price distortions and conspicuous rent capture by protected firms. Another factor working against entrenchment is the recognition that producers who mature past the point where they can successfully compete against foreign competition in the domestic market, may not see the need to expend resources and political influence on the maintenance of high, but inconsequential tariff protection. To illustrate the effect of these conflicting forces, consider the post-1870 trade patterns and tariff changes experienced by Canadian petroleum refineries, particularly those specializing in the production of tar and pitch (HS4 2708).

Just around the corner from Mills and Melvin's stove factory in Guelph Ontario, Clark Orange operated a steam powered tar works on Wyndham Street, right up against the Grand Trunk Railway's Guelph maintenance sheds. Mr. Orange was one of only 49 Canadian petroleum tar producers in 1871, and according to the industrial census from that year, he employed 5 men in his shop, not including himself, and produced $10,800 worth of tar. Between 1870-1877 just over half a million dollars worth of petroleum tar was imported into Canada, again primarily from the United States, and, like domestically produced stoves, no tar was exported out of Canada during these years.

Under the National Policy the tariff on petroleum tar was raised from 0% to 10%, and imports fell quickly thereafter, from $58,000 in 1877 to $22,000 by 1885, and again to $19,000 by 1890. Not only was import penetration falling, but in every year between 1889-1913, tar was exported from Canada to the United States, averaging over $41,000 in gross exports per year. What is particularly noteworthy about Canadian petroleum tar producers, unlike Mills and Melvin, and their fellow stove producers, is that as the tar refineries matured – expanding production, accumulating experience, pushing foreign producers out of the domestic market, and eventually competing successfully on international markets – their tariff protection was removed. The tariff on petroleum tar was cut from 10% to 0% in 1894, and remained at 0% until at least 1913.

Our understanding of the consequences of the adoption of trade protection among converging economies like Canada during the first era of globalization, depends not only on the impact of the initial tariff increases, but on the subsequent policy adjustments that were put in place as a response to the new trade patterns that emerged in the protectionist environment. Under the National Policy, both stove and tar producers matured in Canada – during the 1880s, import volumes fell, and eventually, exports increased – but only tar producers' tariffs were cut as they matured. How we characterize the dynamic effects of trade protection during this period depends on policy makers' responses to industry maturation. The key question is whether more Canadian industries were like the stove producers, who entrenched their high tariffs even after achieving success in export markets, or the tar producers, whose distortionary tariff protection was removed as their net export performance improved?

Theory, Empirical Specifications and Data

In his *Principles of Political Economy,* J.S. Mill famously wrote (1848: 701-02), "…the only case in which, on mere principles of political economy, protecting duties can be defensible is when they are imposed temporarily (especially in a young and rising nation) in hopes of naturalizing a foreign industry…" Mill goes on to offer a succinct articulation of the infant industry justification for tariff protection that had become common in the political economy literature since at least the late eighteenth century (Irwin 1998: 116-37). His novel contribution was in the recognition that protection for infant industries will only be desirable as long as that protection can be removed gradually as industries accumulate experience, improve their productivity, and eventually, prove themselves capable of competing with foreign producers in home and foreign markets. Charles Bastable (1921) added a caveat to Mill's 'test' for advantageous infant industry protection, pointing out that this protection will only improve net social welfare if the benefits associated with facilitating the maturation of domestic producers exceed the distortionary costs associated with the imposition of tariff protection.

Marc Melitz (2005) provides a rigorous theoretical exposition of the Mill-Bastable test for tariff protection in the presence of bounded learning effects that spillover across individual producers. In his model, Melitz assumes constant returns to scale across all firms, with marginal costs that fall was firms accumulate experience – measured by cumulative production ($\sum_0^T Q_{ijt}$). The learning curve – marginal cost as a function of cumulative production – takes the standard logistic 'S-shape', reaching a lower bound at $\bar{c}_{ij}$ (where *i* = HS4 products and *j* = SIC2 industries). The most productive foreign competitors are assumed to have reached this lower bound, implying that they have fully matured and their learning process with existing technology is complete. Domestic consumers are assumed to have symmetric, quadratic utility functions with constant second and partial derivatives, which are dependent on additively separable domestic and foreign goods. Consumers may strictly prefer the foreign good if domestic prices exceed some maximum price p_{ijt}^0. Preferences between these traded goods depend on $\varphi_{ij}\epsilon[0,1]$, defined as an index of product differentiation, which will be inversely related to the elasticity of substitution between foreign and domestically produced goods – the trade elasticity η_{ij}. Markets are assumed to be competitive, tariffs are specific, and the government maximizes welfare (the unweighted sum of consumer and producer surplus, with negligible discounting) over period $t = 0 \rightarrow T$, without consideration for political economy pressures that may be exerted by domestic producers. If subsidies are not feasible due to government revenue constraints, for example, and if the application of tariffs is assumed to be fully flexible over time, then the interior solution to the maximization of the government's current value Hamiltonian yields an optimal tariff that is an increasing function of both product differentiation and learning potential, which is the difference between current domestic marginal cost c_{ijt} and the lower bound marginal cost associated with the bottom of the learning curve (Melitz 2005: 188-89)[2]:

$$\tau_{ijt}^{*} = \varphi_{ij}(c_{ijt} - \bar{c}_{ij})$$

To derive an empirical specification based on this theoretical structure, I take the natural logarithm of both sides of Melitz's optimal tariff expression, and I replace the index of product differentiation with the inverse trade elasticity. Year and industry fixed effects $(\boldsymbol{\lambda_i}, \boldsymbol{\phi_t})$ are included to control for industry and time invariant tariff shifts. These shifts could include the discontinuous tariff revisions that affected all industries in 1887, 1894, 1897 and 1907, for example, or the effects of potential political influence that vary across industries, but are persistent over time. Learning potential in the theoretical model $(c_{ijt} - \bar{c}_{ij})$ is assumed to be captured by trade performance – net (or gross) export values (or shares). As experience accumulates, learning occurs, marginal costs fall towards the international lower bound, and domestic producers first push imports out of their home markets – import penetration falls – then eventually, they begin to compete successfully in foreign markets – gross export shares rise. This process implies that improving trade performance (increasing net and gross exports) should reflect falling learning potential. In my empirical specifications, all continuous variables are scalar transformed such that their minimum natural logarithms are set equal to 0. To ease identification concerns related to reverse causality, net and gross exports are lagged by up to three years (*m = 0 → 3*) in an effort to chronologically separate tariffs and trade performance (Fernandes 2007).[3] A regression residual (ε_{ijt}) is included to allow for both measurement error and deviations between the theoretical environment and the late nineteenth – early twentieth century Canadian economy.

[2] Between 1870-1913, tariffs consistently generated approximately 55-60% of federal government revenues in Canada, which suggests the presence of binding revenue constraints on the use of other policy tools in this context. There is ample evidence of tariff flexibility in Canada during this period, with six significant discontinuities in the tariff schedule between 1870-1913 (1874, 1879, 1887, 1894, 1897, 1907), and continuous smaller annual revisions and adjustments (McDiarmid 1946, Gillespie 1991).

[3] The trade data used is measured over fiscal years that end June 30 (until 1907). This implies that the calendar year in which any given tariff change occurred spans two fiscal years. By lagging my independent variables (some of which are measured over calendar years) by up to three years I am guaranteeing that any changes in these variables chronologically precede observed changes in the dependent variables. Of course, if tariffs are correlated over time, this approach does not resolve all endogeneity bias due to reverse causality (Karacaovali 2011: 45).

$$\ln(\tau_{ijt}) = \beta_0 + \beta_1 \ln\left(netx_{ijt-m}\right) + \beta_2 \ln\left(\eta_{ij}^{-1}\right) + \boldsymbol{\lambda_i} + \boldsymbol{\phi_t} + \varepsilon_{ijt} \quad (1)$$

Baybars Karacaovali (2011) generalizes Melitz's model along three dimensions that are important for my empirical investigation. First, he expands the government's policy objective function by allowing optimal tariffs to be chosen in an effort to maximize the weighted sum of consumer and producer surplus, labour income and tariff revenue. The weight (ω_{ij}) in this function reflects the potential political influence of domestic producers by capturing the 'importance' the government puts on producer surplus relative to its other (consumer-centric) objectives. Second, Karacaovali allows productivity in the domestic firm's production function to depend more generally on tariff-induced dynamic productivity effects. These effects can be modelled as a function of Melitz-type external learning, in which case accumulated experience can reduce the dynamic productivity effect: $\partial(A_{ijt}) / \partial(\sum_0^T Q_{ijt}) < 0$, where learning potential in the Melitz model falls as $\sum_0^T Q_{ijt}$ rises (Karacaovali 2011: 41). A_{ijt} in this model captures a wide range of productivity improvements associated with not only learning-by-doing, but also technological choice, internal scale economies, or location decisions (agglomeration economies). And finally, Karacaovali explicitly recognizes the potential simultaneity connecting domestic production, trade volumes and optimal tariffs, by modelling output, imports and productivity as a function of tariff levels. Choosing tariffs to maximize the government's objective function in this more general economic environment results in a specification closely related to the optimal tariff equation from Grossman and Helpman's (1994) protection-for-sale model. Optimal tariffs in Karacaovali's model are an increasing function of producers' potential political influence ω_{ij}, the tariff induced dynamic productivity effect A_{ijt}, and inverse import shares, scaled by trade elasticity $\left[Q_{ijt} / \eta_{ij} M_{ijt}\right]$:

$$\tau_{ijt}^{*} = (\omega_{ij} - 1) A_{ijt} (\eta_{ij} * msh_{ijt})^{-1}$$

Aside from the broader interpretation of its determinants and the recognition of potential simultaneity, the only difference between my estimating equation based on Karacaovali's model (equation (2)) and the Melitz specification (equation (1)), is the inclusion of the natural logarithm of lagged inverse import shares interacted with trade elasticity, and (in some specifications) a potential political influence indicator variable.[4]

$$\ln\left(\tau_{ijt}\right) = \beta_0 + \beta_1 \ln\left(netx_{ijt-m}\right) + \beta_2 \ln\left(\left(msh_{ijt-m} * \eta_{ij}\right)^{-1}\right) + \beta_3 Influence_{ij} + \boldsymbol{\lambda_i} + \boldsymbol{\phi_t} + \varepsilon_{ijt} \quad (2)$$

[4] Note that Q_{ijt} is defined as domestic market size = domestic output + gross imports – gross exports. In most specifications industry fixed effects, rather than the 'political influence' dummy variable, are included to capture (ω_{ij} – 1).

Both the Melitz and Karacaovali models predict that optimal tariffs should fall as $netx_{ijt-m}$ rises ($\beta_1 < 0$), because improved trade performance accompanies reduced learning potential and declining external productivity effects from learning-by-doing. Because higher trade elasticities and higher import shares are associated with higher price distortions and greater DWL, ${\eta_{ijt}}^{-1}$ and $(msh_{ijt-m} * \eta_{ijt})^{-1}$ are positively correlated with optimal tariffs ($\beta_2 > 0$) in these models, and because potential political influence increases the weight governments put on producer surplus, $Influence_{ij}$ is also positively correlated with tariff levels ($\beta_3 > 0$) in Karacaovali's model. Armed with these predictions, we shift our focus to data availability in our Canadian historical context.

Canadian Trade, Production and Price Data (1870-1913)

To investigate the relationship between Canadian trade policy and industry maturation during the first era of globalization, I use equations (1) and (2) to document the chronological patterns in trade performance and tariffs during the years following the introduction of protectionist policy objectives in 1879. To estimate the parameters from these equations I need information on product *i*, industry *j* and time *t*-specific: tariff rates (τ_{ijt}); gross exports (X_{ijt}); export shares (X_{ijt} / Q_{ijt} where Q_{ijt} = gross value of domestic production); gross imports (M_{ijt}); import penetration ratios (M_{ijt} / [Q_{ijt} + M_{ijt} - X_{ijt}]); net exports (X_{ijt} - M_{ijt}); net export shares ($netX_{ijt}$ / [Q_{ijt} + M_{ijt} - X_{ijt}]); and product and industry-specific trade elasticities (η_{ij}).[5]

To measure tariff rates, gross exports and gross imports, I use newly-compiled granular, product-specific data drawn from the Canadian *Trade and Navigation Tables*. These tables are included in the federal government's Sessional Papers, which are published annually starting in 1868. The trade tables report the total value of exports of Canadian production, the total value of imports for home consumption, and the total value of all duties collected, for all manufactured and non-manufactured traded goods. Average weighted tariffs are calculated as the total value of all duties collected divided by the total value of imports for home consumption.

Following Beaulieu and Cherniwchan (2014), the goods reported in the trade tables are aggregated up to commonly identified six-digit Harmonized Commodity Description and Coding System (HS6) products. These products are further aggregated up to the four-digit level for use in this study, and each HS4 product has been assigned to one of 16 two-digit Standard Industrial Classification (SIC2)

[5] Like the trade elasticities, the potential political influence dummy variables are product and industry-specific, but time invariant.

manufacturing industries, or an aggregate non-manufacturing sector.[6] The non-manufactured products in the trade tables include raw materials and unprocessed foodstuffs. Non-traded goods listed in the tables, such as 'settlers' effects' or 'gold coin and bullion' are dropped from the analysis in this study.

The gross value of domestic production is not available at the HS4 product level on an annual basis through my period of study. However, the enumerators for the 1871 Canadian industrial census did collect information on the quantities and values of the primary output products and inputs used by all industrial establishments in Canada during that year (Inwood 1995). Using the manuscripts from this census, HS4 product codes can be assigned to the primary products enumerated, and the reported gross output figures can be aggregated over all establishments to derive a measure of the value of gross output at the product level for Canadian manufacturers in 1871. Urquhart (1993: Table 4.1) reports annual gross output figures for Canadian SIC2 manufacturing industries from 1870-1926. As this discussion implies, export shares, net export shares, and import penetration ratios can be calculated for Canadian manufacturing industries annually from 1870-1913, but because of the absence of gross output information, these shares can only be calculated for individual HS4 products in 1871.

Karacaovali (2011: 45-47) describes two potential sources of endogeneity inherent in the estimation of equations (1) and (2). First, if import demand elasticity is not exactly equal to 0, we should expect rising tariffs to lead to falling import values through their effect on domestic prices. This suggests a positive correlation linking net exports and tariff rates, with the direction of causation running from tariffs to net exports. Lagging trade values in the empirical specifications can help overcome this 'reverse causality' simultaneity problem, but if tariffs are correlated over time, chronologically separating the dependent and independent variables will not solve the problem. Karacaovali's second endogeneity concern stems from the potential connection, described by protection-for-sale political economy trade models, linking producers' political influence to their tariff rates. If improved trade performance provides domestic producers with additional resources, and therefore, greater potential political influence, then we can reasonably expect a positive correlation between net exports and tariffs that has nothing to do with industry maturation. This suggests that there could be an omitted variable problem in equations (1) and (2). Industry fixed effects and 'potential political influence' indicator variables derived from the 1871 census manuscripts will help to address this concern, but only if we are confident that variation in potential political influence is persistent through the 1870-1913 period. Both of these sources of potential

[6] 1948 SIC industry classifications are used so that the trade figures can be matched to Urquart's (1993) manufacturing industry output data and the price data used in Harris, Keay and Lewis (2015). For a more detailed discussion of the composition of the Canadian historical trade data see Alexander and Keay (2017a).

endogeneity in the empirical specifications work against the theoretical predictions in the Melitz and Karacaovali models by introducing a positive bias in the estimated tariff-trade performance link. However, any potential bias must encourage us to pay careful attention to identification, which in turn suggests the need to find plausibly exogenous instruments for trade performance in equations (1) and (2).

Most of the instruments suggested by Trefler (1993), Fernandes (2007) and Karacaovali (2011) – industry concentration, capital intensity, returns-to-scale, and TFP in ‘up-stream’ industries, for example – are either unavailable or invalid for my period of study. However, even though no price information is available for Canada or its trade partners at the HS4 product level, prices for internationally traded raw materials, fuel and capital are available annually from 1870-1913 for the aggregate manufacturing sector in the United States and Britain, and for all SIC2 manufacturing industries in Canada (Harris, Keay and Lewis 2015: data appendix). Relative prices for internationally traded inputs are important determinants of competitiveness on international markets, but it is not obvious that these relative prices would have any other direct connection to the determination of Canadian tariff levels.[7]

The identification of trade elasticities in my historical context poses a significant empirical challenge. Typically, those studying late nineteenth and early twentieth century trade policy rely on modern elasticity estimates reported in empirical trade literature. Beaulieu and Cherniwchan (2014), for example, use highly disaggregate (HS6) estimates derived from international panel data covering the 1988-2001 period, reported in Kee, Nicita and Olarreaga. (2008), while Irwin (2010) uses four sets of elasticities, all estimated with data from the post-1970 period. Using modern elasticities to study Canadian trade policy before 1913 requires that we assume that the degree of substitutability between domestic and foreign products has been constant over the long run. While this assumption is unlikely to hold, the product level data required to estimate disaggregate trade elasticities simply does not exist for the 1870-1913 period (Federico and Vasta 2015). There is, however, another possibility – time series evidence on industry level prices and production can be used to estimate more aggregate, but historically contemporaneous import demand elasticities. The problem with this approach is that these more aggregate estimates ignore variation in substitutability among products within each industry, and theory consistent multilateral resistance factors cannot be included (Hillberry and Hummels 2013, Imbs and Mejean 2015).

[7] In 1880 unmanufactured raw materials (including coal) accounted for over 40% of the total value of all goods traded by the US, Britain and Canada, combined. Wages are not considered as plausibly exogenous instruments because they may be related to trade policy through the government’s objective function and/or firms’ technological choices (Mitchener and Yan 2014).

In the specifications using HS4 product level data, I following Beaulieu and Cherniwchan (2014), and Alexander and Keay (2017b) in my use of Kee-Nicita-Olarreaga's highly granular, but modern trade elasticity estimates. When I move to higher levels of aggregation, I use both Kee-Nicita-Olarreaga's estimates (aggregated up to the industry level), and newly estimated historically contemporaneous SIC2 industry-specific trade elasticities derived from import demand specifications described in Irwin (2000), and Inwood and Keay (2013). The derivation of these new historical elasticity estimates is described in greater detail in Alexander and Keay (2017b).

In some specifications, rather than relying on industry fixed effects to control for potential political influence – (ω_{ij} – 1) in Karacaovali's model – I include an explicit political influence indicator variable ($Influence_{ij}$). This variable takes the value 1 for products enumerated in the 1871 manufacturing census that have potentially influential establishment characteristics, location characteristics and political representation that place them in the top quartile of all enumerated products.[8] Because the only product-specific measures of potential political influence available during my period of study capture 'initial conditions', as reported in the manuscripts of the 1871 industrial census, in the specifications that include the $Influence_{ij}$ indicator variable, we must assume considerable persistence in political influence over time, and there is a much smaller sub-set of products available for estimation. A more detailed description of the derivation of the political influence dummy is provided in Alexander and Keay (2017a).

Insert Table 1

In Table 1 I report summary statistics (mean and standard deviation) for the Kee-Nicita-Olarreaga modern, disaggregate trade elasticity estimates; average weighted tariffs; net exports; gross exports; and the number of product-year observations available for estimation. The summary statistics are provided for four time periods: 1870-1913; 1870-1877; 1880-1889; 1890-1913; and five product groups: all traded products; all manufactured products; manufactured products that matured (rising net exports during the 1880s); manufactured products that did not mature (falling net exports during the 1880s); and all non-manufactured products. When considering the figures in Table 1, it is important to keep in mind that the trade data is recorded over fiscal years that end June 30.[9] The immediate effect of the introduction of the National Policy in March 1879, therefore, spans the 1878 and 1879 fiscal years. All traded products in

[8] $Influence_{ij} = 1 \ \forall \ Polindex_{ij} \geq P(75)$, where $Polindex_{ij}$ = first principle component: output; employment; industry # establishments; Q/L; profitability; industry share steam power; industry concentration ratio; intermediate input industry size; industry geographic concentration; industry geographic dispersion; industry population density; OMA or MAM executive committee membership; manufacturing indicator; industry concentration in Toronto or Montreal. $Polindex_{ij}$ is aggregated up to the industry level from the product-specific figures for the SIC2 specifications.

[9] 1870-1906 fiscal years end June 30; 1907-1913 fiscal years end March 30. All available price and output data are recorded over calendar years.

each time period and sector are included in the derivation of the statistics reported in Table 1, even if they received no tariff protection (15% of the products included in the trade tables in 1880, for example), or reported no imports, exports or domestic production.

Results

In Table 2 I report the parameters from equations (1) and (2) estimated by OLS with HS4 product level data spanning the years 1890-1913 – unless otherwise noted. Year and SIC2 industry fixed effects are included, and standard errors (reported in parentheses) are clustered by year and industry. The right-hand-side trade performance variables are lagged by three years, and the (inverse, absolute value) Kee-Nicita-Olarreaga disaggregate, but modern trade elasticities are used to capture η_{ij}^{-1}.[10] Products that did not receive any protection under the National Policy (AWT_{1880} = 0), and therefore could not have had a tariff-trade performance connection triggered by the move to protectionist policy objectives, have been dropped. The choice of 1880-1889 as a 'learning period' is somewhat arbitrary, but these years span the period during which Canadian tariff levels for both maturing and immature products were rising and statistically indistinguishable, and the 1880s encompass an adjustment period during which consumers, producers and government were learning about and transitioning into the new protectionist policy regime. Only after 1890 do the maturing and immature manufactured products' tariff levels and tariff-trade performance links bifurcate (see Appendix Figure A1 and Table 2: columns (2a) – (3c)). Because all variables are measured in (scalar transformed) natural logarithms, the parameter estimates reflect elasticities – the percentage change in average tariff rates in response to a 1% increase in the relevant independent variable.

Insert Table 2

The parameters from the estimation of equation (1) are reported in column (1) of Table 2, with no distinction made between maturing products, immature products, or non-manufactured raw materials and unprocessed foodstuffs. After 1890, across all traded products within each industry-year, a 1% increase in a product's trade elasticity, and therefore, an increase in price distortion and deadweight loss due to tariff protection, was associated with a 0.14% reduction in that product's average weighted tariff. This relationship is strongly statistically significant, and it is consistent with the predictions of the infant industry theoretical models, which suggest that governments trade-off tariffs' dynamic productivity effects against their distortionary price effects. In column (1) we can also see that on average over all

[10] Lag length (*m=3*) has been chosen to guarantee that the trade figures on the right-hand-side (measured over fiscal years ending on June 30, until 1907), chronologically precede the dependent variables.

products, improved trade performance was (weakly) associated with tariff entrenchment. It is not surprising that statistical significance is weak here, since I am estimating over the widest possible range of products, which precludes the identification of policy selectivity – the targeting of products embodying infant industry-dynamic productivity effects.

Columns (2a), (2b) and (2c) in Table 2 report the main results from the estimation of equation (1) when I distinguish between non-manufactured products, maturing manufactured products, and immature manufactured products. Non-manufactured products faced very little import competition in Canada during my period of study, they included some of the most common raw material inputs used by Canadian manufacturers, and they were not the target of the National Policy's protectionist objectives. From column (2c) we see that even amongst the non-manufactured products, higher trade elasticities were associated with significantly lower tariffs, and I find strong evidence of tariff entrenchment after 1890 for these goods. A 1% increase in non-manufactured products' net exports, perhaps reflecting the availability of additional resources that could be used to exert political influence, was associated with a 0.68% increase in their average tariff rates.

I also find (weaker) evidence of entrenchment among the nearly 70% of manufactured products that did not mature during the first decade after the adoption of protectionist objectives under the National Policy. Immature producers are identified as those who experienced falling net exports through the 1880s, even after receiving increased tariff protection in 1879. On average, the immature producers enjoyed a 6.5 percentage point increase in their AWT under the National Policy – nearly a half percentage point higher than the maturing producers, whose net exports rose through the 1880s. From column (2b) we can see that a 1% increase in immature producers' net exports after 1890 was associated with a 1.6% increase in their average tariff rates. I find no statistically significant connection between the immature producer's trade elasticities and their tariff rates.

The contrast between the immature and the maturing products is stark. In column (2a) I report the parameters from equation (1) estimated for only those manufactured products that had positive tariffs in 1880 and rising net exports over the 1880-1889 period. A 1% increase in a maturing product's trade elasticity was associated with a 0.4% reduction in its AWT after 1890, and a 1% increase in a maturing product's net export performance was associated with a 1.5% *reduction* in its AWT. It appears, therefore, that after a learning period during which some manufactured products matured and some did not, improving trade performance among the maturing products, reflecting productivity improvement due to accumulated experience and declining learning potential, was strongly associated with reductions in their tariff protection – just as the optimal tariff-infant industry models predict. For this sub-set of traded goods (just over 32% of manufactured products and 25% of all products), the Canadian government was cutting tariffs, and reducing price distortions and DWL associated with those tariffs, as import penetration ratios fell and/or export performance improved.

In columns (3a) – (3c) I show that this clear distinction between the immature and the maturing manufactured products' (and non-manufactured products') tariff adjustments was not present during the 1880s. Over the first decade following the introduction of the National Policy, the maturing and immature products' trade-tariff and elasticity-tariff relationships are statistically indistinguishable, their net export point estimates are statistically indistinguishable from 0, and trade elasticities are already significantly negatively correlated with tariff levels. Canadian trade policy during the 1880s appears to have been fairly uniformly applied across these product groups.

In column (4), for maturing manufactured products only, gross export and gross import values are included separately. Both are statistically significantly negatively correlated with tariff levels (although only marginally so for imports). This suggests that after 1890 improved export performance among the maturing products was strongly related to lower tariff protection. More worrying is the negative parameter estimate on gross imports, which could be interpreted as evidence of simultaneity – higher tariffs driving down import volumes through their effect on domestic prices. The presence of simultaneity introduces the possibility that the parameter estimate on net exports, reported in column (2a) for example, may be biased downwards (towards 0) due to this endogenous relationship.

In the final two columns in Table 2 I turn to the estimation of Karacaovali's more general specification (equation (2)) with disaggregate, product level data. The key changes in the move from equation (1) to (2) are the inclusion of an explicit measure of political influence, and the inclusion of an inverse import penetration-trade elasticity interaction term, rather than simply the inverse trade elasticity. Because the only available information on gross output and indicators of political influence at the HS4 product level comes from the manuscripts of the 1871 industrial census, in these specifications we must assume that product specific import penetration ratios and political influence indicators were remarkably persistent over the late nineteenth and early twentieth centuries, and only those products enumerated in the 1871 census manuscripts can be included in the regressions. In column (5) the interaction term is included, but we allow industry fixed effects to capture potential political influence. We again see that improved trade performance after 1890 among the maturing products was associated with significant reductions in tariff rates, and when trade elasticities are interacted with import shares, tariff rates appear to have been even more sensitive to these measures of potential price distortion.

In column (6) a dummy variable that takes the value 1 for products with indicators of potential political influence in the top quartile of all products enumerated in the 1871 industrial census is included. This product-specific control for political influence is more narrowly defined than the general industry level fixed effects that are included in all other specifications. After 1890, the maturing manufactured products with the greatest potential political influence, as measured by their initial conditions in 1871, had statistically significantly higher tariffs than the average maturing product, but this effect is dwarfed by the significantly larger, negative tariff-trade performance relationship. Having potential political influence muted, but did not eliminate the downward pressure on maturing products' tariffs that was associated with improving net export performance after 1890.[11] In column (6) we can also see that the inverse import share-trade elasticity interaction term, although still positively correlated, becomes insignificant with the inclusion of an explicit control for political influence.

Although the conclusions that can be drawn from the estimation of equations (1) and (2) using product level data have the advantage of being based on finely detailed intra-industry-year variation across products, they are constrained by a lack of information about product-specific domestic production and prices. Import shares cannot be calculated annually, so only 'initial conditions' (msh_{1871} and $Influence_{1871}$) can be controlled for in these specifications; trade performance can only be measured in levels, rather than as a share of domestic production; only modern elasticities are available at the product level, so historically contemporaneous elasticities cannot be used; other measures of protection, including trade restrictiveness and effective rates of protection, cannot be calculated; and, perhaps most importantly, plausibly exogenous instruments for import shares and trade performance are not available, which means identification concerns related to endogeneity can only be superficially addressed by lagging right-hand-side variables and including industry fixed effects. When I move to a higher level of aggregation – the SIC2 industry level – annual output and price information is available. Intra-industry variation is lost at this higher level of aggregation, but as we can see from the parameter estimates reported in Table 3, robust identification of the relationships of interest is still possible.

Insert Table 3

In columns (1a) and (1b) in Table 3 the parameters from equation (1), estimated by OLS using Kee-Nicita-Olarreaga's modern elasticity estimates aggregated up to the industry level, are reported. Standard errors (reported in parentheses) are clustered by year. Trade performance is now measured as the natural logarithm of lagged net exports as a share of domestic gross output, and industry fixed effects have been

[11] For immature products the political influence dummy is positively correlated with tariff levels, but the link is small and statistically insignificant.

dropped due to collinearity. We can see that trade performance after 1890 is still negatively related to tariff levels for the industries that matured during the 1880-1889 period, and positively related to tariff levels for the industries that did not mature.[12] Immaturity, even at the industry level, is still associated with tariff entrenchment, while maturity is still associated with reductions in tariffs, and therefore, lower price distortions.[13]

In columns (2a) and (2b) the parameters from equation (2) are reported for maturing industries, with annual (lagged) industry import penetration ratios interacted with trade elasticities. Because all industries have positive gross export shares over the 1890-1913 period – in contrast to the large proportion of HS4 products that have 0 gross exports for at least some of the period – and because gross exports are less likely than net exports (which are in part dependent on import values) to suffer from simultaneity bias due to reverse causality, trade performance has now been measured with both lagged net export shares and lagged gross export shares in columns (2a) and (2b), respectively. After 1890, trade performance, measured as either gross or net export shares, is strongly negatively correlated with industry tariffs, and inverse import shares interacted with trade elasticities are strongly positively correlated with tariffs. Once again, these results are consistent with the theoretical predictions – governments seek to avoid price distortions so, higher import shares and trade elasticities are associated with lower tariffs, and as industries mature, learning potential is reduced, trade performance improves, and tariffs are cut.

To address concerns about endogeneity in the OLS parameter estimates reported so far, I report results from a two-stage instrumental variables, generalized method of moments (IV-GMM) estimation approach in the remaining columns in Table 3. In the first stage, Canadian relative to US and British industry-specific raw material, fuel and capital input prices (Harris, Keay and Lewis 2015) are used as instruments to predict trade performance and import shares (interacted with trade elasticities). In the second stage, the predicted values of the independent variables from stage one are used in equation (2), along with year fixed effects. The standard IV diagnostics have been performed, including: first stage

[12] Maturing industries include: food and beverages; tobacco products; rubber products; textiles; clothing; wood products; paper products; printing and publishing; iron and steel products; transport equipment; and non-ferrous metal products. The immature industries: leather products; non-metallic mineral products; petroleum and coal products; chemicals; and miscellaneous products; had the highest proportion of immature HS4 products during the 1880s. Alternate strategies for categorizing industries, including industry level net export performance during the 1880s, yield highly correlated industry rankings.

[13] An odd result in Table 3: column (1a) is the negative parameter estimate on maturing industries' inverse trade elasticities. This is the only significant negative estimate for inverse elasticity in any of the specifications reported in Tables 2, 3 or 4. If the tobacco products industry – which has the highest estimated trade elasticity at the SIC2 level – is dropped, the point estimate flips back to the expected positive sign.

Kleibergen-Paap weak instrument F-tests; Hansen valid instrument over-identification tests; and Hausman exogeneity tests. The results from these tests are reported in the bottom rows in Table 3.

In columns (3a) and (3b) the IV-GMM estimates of Karacaovali's equation (2) parameters are reported for the maturing industries. As expected the IV estimates are slightly larger (farther from 0) than the OLS estimates, but all remain strongly statistically significant, and the theoretical predictions continue to hold. According to the IV estimates, a 1% increase in the maturing industries' net export shares after 1890 led to a 1.4% reduction in their tariff rates, while a 1% increase in these industries' trade elasticities (interacted with their import penetration ratios) led to a 1.3% reduction in their tariffs. If we use gross exports to measure trade performance, a 1% increase in the maturing industries' export shares led to a 0.52% reduction in their tariff rates.

Improvements in predicted trade performance, therefore, appear to have been strongly associated with reductions in maturing industries' protection from foreign competition. This result holds even if we use historically contemporaneous trade elasticities in place of the Kee-Nicita-Olarreaga modern estimates – columns (4a) and (4b); trade restrictiveness instead of AWT as our measure protection – columns (5a) and (5b); or effective rates of protection instead of AWT – columns (6a) and (6b).[14] More specifically, the reported estimates indicate that after 1890 a 1% increase in maturing industries' net export shares was associated with a 0.4% reduction in effective rates of protection; 0.2% reduction in trade restrictiveness; and a 1.4% reduction in average weighted tariff rates when historical elasticities are used. All of the estimates reported in columns (4a) – (6b) in Table 3 have been derived using the IV-GMM estimation approach, all are statistically significant, and all are consistent with the predictions of the Melitz and Karacaovali models.[15]

Insert Figure 1

To illustrate the economic significance of the estimated connections linking improved trade performance to Canada's post-1890 tariff schedule, I have performed two simple 'back-of-the-envelope' counterfactual deadweight loss calculations. Using modern trade elasticity estimates and industry level annual data, I employ a standard Andeson-Neary approach to measure the static partial equilibrium

[14] $TRI = \left[\frac{\sum M_j \eta_j \tau_j^2}{\sum M_j \eta_j}\right]^{0.5}$ and $ERP_j = \frac{\tau_j^{output} - s_{inpj}\tau_j^{input}}{1 - s_{inpj}}$. See Alexander and Keay (2017a) for a detailed discussion of the derivation of TRI and ERP for Canadian manufacturing industries during the 1870-1913 period.

[15] I cannot reject exogeneity of the trade performance variables in the TRI regressions, and instrument validity is questionable in these regressions. The OLS estimates of the net export and gross export-TRI connections are very similar in size and significance to the reported IV-GMM estimates.

deadweight loss resulting from Canada's observed tariff schedule, annually over the full 1870-1913 period (Beaulieu and Cherniwchan 2014, Alexander and Keay 2017b):

$$\frac{DWL_t}{GDP_t} = 0.5 * \left[\sum {M_{jt}\eta_j \tau_{jt}^2}/_{GDP_t}\right]$$

For the first calculation (*CF1*), I derive counterfactual tariff rates for the maturing manufacturing industries using the post-1890 IV-GMM parameter estimates reported in Table 3: column (3a), under the assumption that net export shares were one standard deviation lower than the observed shares from 1890-1913. I then re-calculate the change in static partial equilibrium DWL for these years using the counterfactual AWT in place of the observed tariff rates. The results from this exercise, depicted in Figure 1, indicate that the downward pressure on tariffs due to improved trade performance must have had a substantial impact on aggregate Canadian DWL at the end of the nineteenth and beginning of the twentieth centuries. Instead of falling by nearly 0.1% per year on average over the post-1890 period, counterfactual DWL/GDP would have increased by 1.6% per year if the maturing producers' net export performance had been just one standard deviation lower than what we observe, while deadweight losses would have risen from 0.9% of GDP under the observed tariff schedule, to 1.2% of GDP under the counterfactual tariffs. As a share of Canada's 2015 GDP, this counterfactual increase in deadweight loss amounts to a reduction in Canadian welfare equivalent to just under $4.3 billion.

Rather than lowering net exports while maintaining the observed policy environment, in the second counterfactual calculation (*CF2*), counterfactual tariff rates for the maturing manufacturing industries are derived by maintaining observed net export levels, but I now use the uniform, less sensitive IV-GMM parameter estimates from the 1880-1889 learning period for all years after 1890. This calculation involves a counterfactual policy change (or rather a counterfactual absence of any change in policy) that eliminates the selectivity in Canadian policy after 1890, reducing the responsiveness of Canadian tariffs to changes in the maturing industries' net export performance from the -1.4% reported in Table 3: column (3a), to just over -0.5%. Counterfactual tariffs, and hence DWL/GDP, would have been higher if Canadian trade policy's uniform response to improving trade performance from the 1880s had been maintained through the 1890s and early 1900s – deadweight loss would have risen by nearly 0.8% per year, thereby increasing welfare losses to 1.12% of GDP, on average (see Figure 1). As a share of Canada's 2015 GDP, this counterfactual increase in DWL totals $2.8 billion. Improving trade performance among the maturing manufacturing industries, and the government's new-found willingness to target reductions in price distorting tariffs at maturing industries, was not only statistically important after 1890, but the economic impact was clearly substantial.

Robustness and Sensitivity Testing

In Table 4 I report the results from a series of robustness and sensitivity tests, using the parameters from equation (1), estimated with data on the manufactured HS4 products that matured during the 1880s. In Test (1) separate equations are estimated using gross exports and gross imports to capture trade performance. Both trade flows were negatively correlated with tariff levels after 1890. For gross exports, this is consistent with the results from my primary specifications. For gross imports this is another indication of the potential presence of reverse causality, which further reinforces concerns that the OLS estimates may be biased towards 0.

Insert Table 4

In Test (2) net exports are interacted with trade elasticity. The strongly statistically significant negative parameter estimate on the interaction term suggests that the threat of greater price distortions augmented the government's tendency to reduce tariffs for industries that were maturing. Test (3) replaces the scalar transformed natural logarithmic dependent and independent variables with their untransformed levels – the signs and significance of the trade and elasticity effects remain unchanged. Test (4) uses the first difference in the natural logarithm of AWT as the dependent variable. We can see that after 1890, among the maturing manufactured products, higher net exports and higher trade elasticities were associated with falling tariffs, as well as lower tariff levels. Tests (5) and (6) look at the effect of selecting different 'learning periods' – 1880-1887 and 1880-1894, respectively. Again, the impact on the parameter estimates is small, and the qualitative conclusions are unaffected.

Some 'initially mature' manufactured products had positive net exports and rising gross exports during the 1870s even before the National Policy tariff was introduced. Many of these products did not receive large tariff increases in 1879, and some saw their trade performance slip during the 1880s, so initially mature products are not necessarily included among the maturing products. In Test (7) only these initially mature products are included, and improved trade performance and higher trade elasticities are again associated with lower tariff rates after 1890. Test (8) includes only contemporaneous right-hand-side variables (lags are set equal to 0), and in Test (9) industry-specific linear time trends are included instead of industry and year fixed effects. In both of these tests, trade performance and elasticities are still negatively related to tariffs for the maturing products. For Test (10), potential political influence, assessed on the basis of products' initial conditions as recorded in the 1871 industrial census, is interacted with net export performance. We can see that the most politically influential maturing products do have tariff rates that were significantly less sensitive to improvements in trade performance after 1890, but political influence only reduces the estimated sensitivity by 9% (= 0.099/1.061). Finally, in Figure A2 I report the parameters (and 90% confidence intervals) for the net export terms in equation (1), estimated separately for each year from 1873-1913, using the maturing manufactured products only. The correlation between net exports and tariffs becomes negative only after the introduction of the National Policy in 1879, and it becomes significant only during the late 1880s and through the last half of the 1890s.

The results from the tests reported in Table 4 suggest that among the maturing manufactured products, the tariff-trade performance relationship is robust. Over all of these specifications, there appears to have been a strong tendency for tariffs to be lower between 1890-1913 as these products improved their trade performance, and the distortionary effects of high trade elasticities augment this relationship.

Discussion: Mechanisms

There are two closely related, and as yet unresolved issues that call for some further discussion. The first deals with the question of why some manufactured products 'matured' during the first decade following the Canadian government's move to protectionist policy objectives under the National Policy in 1879, while other products remained 'immature'. I identify maturing products as those with rising net export values through the 1880s, while immature products' net exports fell between 1880-1889. The application of the newly protectionist National Policy tariffs in 1879 was highly selective (Alexander and Keay 2017a), and from Tables 2 and 3, it appears that the tariff reductions we observe after 1890 were also narrowly targeted – maturing products' tariffs fell as their net exports increased, and immature products' tariffs rose. A better understanding of the process of product and industry maturation, therefore, can reveal much about the government's policy objectives (and policy outcomes) with respect to selectivity.

When we think about product or industry maturation from a theoretical perspective, the three-step process is structurally straightforward (Head 1994, Irwin 1998 and 2000). First, in the presence of non-zero trade elasticities, protective tariffs reduce the competitiveness of foreign imports, which can allow domestic producers to expand production and accelerate their acquisition of output experience. Second, with the more rapid accumulation of experience, producers move along their learning curves, improving their productivity and lowering their marginal costs. And finally, productivity improvement and lower marginal costs can facilitate import substitution in domestic markets, and successful competition in foreign markets. Improved trade performance, therefore, is a consequence of maturation, but in the absence of any of these three steps, maturation is not necessarily an inevitable outcome of protection.

As I have already noted, the maturing and immature products (and industries) received virtually identical tariff increases in 1879 with the introduction of the National Policy: 6% and 6.5%, respectively. However, as we would expect given the immature products' slightly lower (modern and historical) trade elasticities, the immature producers' gross output levels, and hence the rate at which they were accumulating production experience, rose slightly slower than the maturing producers during the 1880s: 3.4% per year and 4.6%, respectively. The relative insensitivity of the immature producers' production levels to increases in import prices may be related to differences in their competitive environments, stemming from local market segmentation, economic remoteness, or transport cost protection, for example.

Harris, Keay and Lewis (2015: Table 6) report learning rates for Canadian manufacturing industries, derived by regressing the natural logarithm of industry level cumulative output over the 1880-1913 period, on industry total factor productivity (TFP). These learning rates measure the percentage increase in TFP in response to a doubling of production experience. Higher rates reflect steeper learning curves and greater learning potential associated with more complex, human capital intensive and scale intensive production technologies. The Spearman rank correlation coefficient between the Harris-Keay-Lewis' learning rates and the proportion of each industry's HS4 products that I identify as immature, is a strongly statistically significant -0.55, indicating that lower learning rates (flatter learning curves) are coincident with more immature products. When I use the post-National Policy Harris-Keay-Lewis data in pooled regressions with industry fixed effects to estimate learning curves for the maturing and immature industries as a group, I find significantly lower learning rates among the industries identified as immature, relative to the maturing industries: 2.3% and 5.8%, respectively.

Moving to the last step in the maturation process, rising productivity and falling marginal costs can lead to improved trade performance if the competitive environments in domestic and foreign markets are conducive to market integration. After 1890, among the maturing industries a 1% increase in TFP was associated with a 0.5% increase in net exports and a 1.4% increase in gross exports. In contrast, for the immature industries, productivity increases had a much weaker connection to trade performance during this period, with a 1% increase in TFP being associated with only a 0.11% increase in net exports and a 0.12% increase in gross exports.

Despite receiving slightly larger tariff increases under the National Policy, the immature products and industries accumulated output experience during the 1880s a little slower than their maturing counterparts; their learning curves were a little flatter; their ability to convert productivity gains into improvements in trade performance was a little weaker; and furthermore, these differences were not transitory. Over 92% of the products identified as immature at the end of the 1880s were still immature at the end of the 1890s, and 89.6% of these products remained immature at the very end of my period of study in 1913 – there is no evidence of 'delayed maturity'. The maturing and immature producers had substantive and persistently different responses to trade protection, perhaps due to unique technological and market structure characteristics. The result of these differences was that, in sharp contrast to the maturing producers' tariff patterns after 1890, Canadian trade policy was characterized by tariff entrenchment for the products and industries with the slowest growth and lowest learning potential.

This brings us to the second unresolved issue that calls for some discussion in light of the estimated tariff-trade performance connections reported in Tables 2 and 3. After 1890, why did the government differentially target the maturing products? Or to think about this issue in a slightly different way – why were the maturing producers unable to resist tariff cuts after 1890, while the immature producers successfully entrenched their tariffs? To answer this question, we need to think carefully about what might have changed in the Canadian policy environment for the maturing and immature producers around 1890.

Although potential political influence was significantly related to Canadian tariff levels after 1890, from Tables 2 and 4 we can see that its impact is small relative to the impact of improving trade performance. I have also already noted that there is no significant difference between the political influence of the immature and maturing products, and there is no evidence that the impact of political influence on tariff rates for the maturing products weakened through the 1880s, 1890s or early 1900s – in equation (2) the parameter estimate on political influence remains strongly statistically significant (and positive) in all three periods. It is difficult to see, therefore, how the rather abrupt policy shift we observe around 1890 – cutting tariffs as trade performance improves for maturing industries, while entrenching tariffs for the immature producers – could be attributed to the relatively weak, but chronologically and cross-sectionally stable effect of potential political influence.

Another possibility is that the importance the government placed on revenue generation relative to protectionism increased in Canada after 1890. On average, the Canadian federal government raised 56.3% of its total revenue from tariffs between 1870-1877, 59.1% during the 1880s, and 55.9% through the 1890-1913 period. Tariffs' share of total federal government revenues was rising after 1890 by more than 0.3% per year. Revenue objectives must have played an important role in the targeting of tariffs throughout the entire 1870-1913 globalization era, but after 1890, in conjunction with Wilfrid Laurier and his Liberal Party's rising popularity, the political environment in Canada was starting to turn against the Conservatives' protectionist agenda (McDiarmid, 1946, Easterbrook and Aitken 1956, Gillespie, 1991).

Among the immature products (and industries), domestic production levels during the late nineteenth and early twentieth centuries were low relative to the maturing products; import penetration ratios were higher; and both modern and historically contemporaneous trade elasticities were lower. All of these features suggest that the revenue potential from taxing immature products' import competition would have been greater than the revenue that could have been generated from the same tariff applied to an import good that was in competition with a maturing product. The policy shift we observe after 1890 is consistent with an increase in the importance of revenue generation in the government's objective function, relative to protectionist goals.

Patricia Tovar (2009) describes an economic environment in which policy makers are averse to the negative economic outcomes that can result from international competition. Governments in this environment have a strong tendency towards loss aversion, which leads them to favor tariff entrenchment for producers who have shown themselves to be susceptible to contraction in the presence of foreign competition. After a learning period following the introduction of a newly protectionist trade regime, some domestic producers reveal their inability or unwillingness to compete against foreign suppliers in either home or foreign markets. An aversion to domestic output or employment loses will lead governments to optimally choose higher tariffs for these 'immature' producers. 'Maturing' producers who successfully compete in home and foreign markets during the learning period are therefore at a disadvantage, particularly when pressure to reduce tariffs is growing in the broader political environment. The evidence from the Canadian experience during the late nineteenth and early twentieth centuries is certainly consistent with Tovar's theoretical predictions, but without more information about Canadian policy makers' aversion to loses due to international competition, and an appreciation for how this aversion might manifest itself in the government's objective function, a more explicit test of the loss aversion narrative is infeasible in my historical and geographic context.

In light of this discussion, it seems unlikely that chronological or cross-sectional differences in political influence can account for the government's differential treatment of the maturing and immature producers after 1890. What is at least consistent with the evidence available to us, is the possibility that the policy bifurcation that we observe in Canadian tariff rates around 1890 can be attributed to loss aversion within the government's objective function and/or a resurgent effort to rebalance protectionist and revenue policy objectives.

Conclusions

William Mills and Robert Melvin, and their fellow Canadian stove producers, received a large increase in their tariff protection under the National Policy in 1879. Stove imports fell and exports rose, but the tariff on product HS4 7321: stoves and stove parts, remained stubbornly high. This appears to be an example of tariff entrenchment by a maturing manufacturing industry, and theoretical models of optimal tariff setting in the presence of external learning and dynamic productivity infant industry effects tell us that entrenchment of this sort may be a reflection of government acquiescence to political pressure. Tariff entrenchment leads to persistent price distortions that generate deadweight losses that can swamp any advantageous dynamic productivity effects stemming from the protection of domestic infant industries.

The results reported in this paper for finely disaggregated products and more aggregated manufacturing industries, suggest that Mills and Melvin's stove industry was not typical of the Canadian experience during the first era of globalization. Clark Orange's petroleum tar industry was more reflective of the average – increased tariff protection under the National Policy, maturation during the 1880s, then reductions in tariff protection as import penetration fell and export shares rose. For manufacturing industries that matured during the decade immediately following the adoption of protectionist trade policy objectives in Canada in 1879, I find a strong, robust negative relationship between both tariff rates and trade elasticities, and tariff rates and trade performance. These relationships are predicted by optimal tariff, infant industry models, and they hold across a wide range of specifications, measurement techniques and estimation approaches. The economic impact of the tariff-trade connection on Canadian welfare was large, and the mechanisms at work likely operated through the differential targeting of products and producers on the basis of their growth rates and learning potential, in a political environment in which revenue generation and loss aversion were of increasing importance.

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Tables and Figures

Table 1: Summary Statistics

		Trade Elasticity (Kee et al 2008)	AWT	Net X (Mil. CAD)	Gross X (Mil. CAD)	# Product-Years
1870-1913:	**All**	-3.587	0.175	-0.064	0.280	20,800
		(7.304)	(0.213)	(2.230)	(1.976)	
Manufactured:	**All**	-3.144	0.204	-0.117	0.197	16,681
		(6.392)	(0.231)	(1.670)	(1.474)	
	Maturing	-3.358	0.184	0.110	0.474	4,719
		(4.936)	(0.117)	(2.695)	(2.516)	
	Immature	-3.060	0.213	-0.206	0.089	11,962
		(6.875)	(0.269)	(1.007)	(0.715)	
Unmanufactured:	**All**	-5.164	0.102	0.127	0.575	4,119
		(9.728)	(0.130)	(3.564)	(3.156)	
1870-1877:	**All**	-3.756	0.129	-0.061	0.255	2,104
		(7.253)	(0.157)	(1.529)	(1.166)	
Manufactured:	**All**	-3.260	0.135	-0.090	0.227	1,653
		(6.798)	(0.155)	(1.624)	(1.252)	
	Maturing	-3.333	0.119	0.067	0.491	453
		(4.160)	(0.076)	(2.744)	(2.172)	
	Immature	-3.230	0.146	-0.155	0.118	1,200
		(7.618)	(0.188)	(0.794)	(0.493)	
Unmanufactured:	**All**	-5.043	0.114	0.015	0.330	451
		(8.184)	(0.162)	(1.245)	(0.901)	
1880-1889:	**All**	-3.582	0.209	-0.044	0.167	4,615
		(7.303)	(0.205)	(1.176)	(1.013)	
Manufactured:	**All**	-3.022	0.226	-0.071	0.127	3,622
		(5.826)	(0.205)	(1.158)	(1.029)	
	Maturing	-3.352	0.224	0.048	0.284	1,154
		(4.906)	(0.094)	(1.895)	(1.731)	
	Immature	-2.864	0.228	-0.128	0.052	2,468
		(6.214)	(0.251)	(0.500)	(0.338)	
Unmanufactured:	**All**	-5.468	0.162	0.047	0.304	993
		(10.684)	(0.196)	(1.235)	(0.942)	
1890-1913:	**All**	-3.565	0.175	-0.074	0.328	13,332
		(7.340)	(0.220)	(2.625)	(2.350)	
Manufactured:	**All**	-3.174	0.210	-0.141	0.218	10,828
		(6.522)	(0.245)	(1.838)	(1.649)	
	Maturing	-3.375	0.187	0.152	0.564	2,936
		(5.106)	(0.124)	(2.998)	(2.872)	
	Immature	-3.102	0.220	-0.245	0.095	7,892
		(6.957)	(0.281)	(1.156)	(0.830)	
Unmanufactured:	**All**	-5.095	0.089	0.187	0.758	2,504
		(9.758)	(0.102)	(4.531)	(4.029)	

Notes: HS4 product-level trade elasticities from Kee, Nicita and Olarreaga (2008), estimated with international panel data from 1988-2001. AWT = total duty collected / value imports (HS4 products weighted by import values). Net X = gross value exports – gross value imports (000,000 CAD). Gross X = aggregate value exports (000,000 CAD). Maturing and Immature = Manufactured products only. # Product-Years = aggregate number HS4 products over reported years. Standard deviations reported in parentheses.

Table 2: Linking Net Exports and Trade Elasticity to Average Weighted Tariffs (HS4 Products, 1890-1913 unless otherwise noted)

		Manufactured Products			**1880-1889**					
	(1) All Products Drop AWT=0	**(2a) Maturing**	**(2b) Immature**	**(2c) Nonmanu. Products**	**(3a) Maturing**	**(3b) Immature**	**(3c) Nonmanu.**	**(4) Sep. Gross X and M**	**(5) Interact $(msh_{71} \times \eta)^{-1}$**	**(6) Include $Influence_{71}$**
Net X	0.199	-1.489**	1.545*	0.684***	-0.487	-0.614	0.105		-1.840***	-1.111***
	(0.524)	(0.634)	(0.927)	(0.240)	(0.484)	(2.705)	(0.307)		(0.521)	(0.292)
Gross X								-0.327***		
								(0.119)		
Gross M								-0.508*		
								(0.293)		
Trade Elasticity (η^{-1})	0.143***	0.432***	0.072	0.101***	0.340**	0.178**	0.054**	0.337***		
	(0.055)	(0.158)	(0.090)	(0.023)	(0.134)	(0.090)	(0.027)	(0.130)		
$(msh_{71} \times \eta)^{-1}$									0.456**	0.214
									(0.204)	(0.191)
Political $Influence_{71}$										0.331**
										(0.136)
P Value H_0: Mat=Imm		0.007			0.961					
Industry FE	✓	✓	✓		✓	✓	✓	✓	✓	✓
Year FE	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
$N_{HS4\text{-}Yrs}$	9,776	2,600	5,625	1,551	883	1,794	620	2,600	1,525	951

Note: All dependent and independent variables measured as natural logarithms (scalar transformed, minimum value = 0). Dependent variable = HS4 products' average weighted tariffs. Independent variables (trade values) lagged over three fiscal years (= $L_3Netx; L_3X; L_3M$). Standard errors reported in parentheses clustered by year and SIC2 industry. Trade elasticity (= η) from Kee, Nicita and Olarreaga (2008). msh_{71} = 1871 gross imports / (1871 gross value domestic production + 1871 gross imports – 1871 gross exports), where gross value of domestic production derived from manuscripts of 1871 *Canadian Census of Industrial Establishments*. *Political* $Influence_{71}$ = 1 for products in top quartile of 1871 potential political influence index, 0 otherwise (Alexander and Keay 2017a). Columns (1) – (2c) and (4) – (6) estimated over 1890-1913; columns (3a) – (3c) estimated over 1880-1889. Columns (1) – (6) estimated for products with *AWT > 0* only. Columns (4) – (6) estimated for maturing manufactured products only. H_0: *Mat = Imm* reports P values for χ^2 test of common lagged net export ($L_3.netx$) parameters for maturing and immature manufactured products. Maturing products = HS4 products with rising net exports between 1880-1889. See text for detailed specifications and variable definitions. *, **, *** indicate statistical significance at 90%, 95%, 99% level of confidence.

Table 3: Linking Net Exports, Trade Elasticity and Import Penetration to Average Weighted Tariffs (SIC2 Industries, 1890-1913)

	Manufacturing Only		Interact (msh x η)$^{-1}$		IV-GMM		Historical η		TRI		ERP	
	(1a) Maturing	(1b) Immature	(2a)	(2b)	(3a)	(3b)	(4a)	(4b)	(5a)	(5b)	(6a)	(6b)
Net Xsh	-0.129***	0.339***	-0.298***		-1.357***		-1.423***		-0.226***		-0.433***	
	(0.030)	(0.089)	(0.041)		(0.143)		(0.358)		(0.066)		(0.055)	
Gross Xsh				-0.258***		-0.518***		-0.779***		-0.565***		-1.126***
				(0.018)		(0.060)		(0.065)		(0.030)		(0.144)
Trade Elasticity (η^{-1})	-0.665***	0.094										
	(0.021)	(0.179)										
(msh x η)$^{-1}$			0.780***	0.658***	1.246***	0.660***	1.546***	1.013***			0.333***	0.257***
			(0.025)	(0.021)	(0.077)	(0.023)	(0.422)	(0.057)			(0.028)	(0.015)
P Value H_0: Mat=Imm	0.000											
Year FE	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
$N_{SIC2\text{-}Yrs}$	264	120	264	264	264	264	264	264	264	264	264	264
P value Exog. Test					0.000	0.000	0.000	0.000	0.689	0.972	0.000	0.000
P value Valid Inst. Test					0.393	0.936	0.397	0.129	0.000	0.000	0.196	0.143
Weak Inst. F stat					22.15	44.57	17.79	25.10	207.03	136.01	35.01	61.93

Note: See Table 2 notes. Columns (1a) – (6b) estimated for manufacturing industries only with *AWT>0*, over years 1890-1913. Columns (2a) – (6b) estimated for maturing industries only (leather products, rubber products, printing and publishing, non-metallic mineral products, and chemicals dropped). AWT, gross exports and gross imports > 0 for all industries in all years. Standard errors reported in parentheses clustered by year. Estimates reported for trade values and import shares lagged over three fiscal years (= L_3). H_0 Hausman exogeneity test: endogenous regressors may be treated as exogenous. H_0 Hansen valid instrument over-identification test: excluded instruments are uncorrelated with second stage error term, and correctly excluded from second stage. H_0 Kleibergen-Paap weak instrument F test: excluded instruments are weakly identified in first stage (all reported F statistics easily exceed 5% Stock-Yogo critical values, rejecting the weak instrument null). Two-stage IV-GMM excluded instruments include industry-specific raw material, fuel and capital input prices relative to US and/or UK aggregate raw material, fuel and capital input prices (Harris, Keay and Lewis 2015: Data Appendix). Derivation of trade restrictiveness index and effective rates of protection described in Alexander and Keay (2017a).

Table 4: Robustness and Sensitivity Testing (HS4 Products)

	(Test 1)		(Test 2)	(Test 3)	(Test 4)	(Test 5)	(Test 6)	(Test 7)	(Test 8)	(Test 9)	(Test 10)
	Gross X	**Gross M**	**Interact (Net X x η)**	**Levels**	**Δ AWT**	**1887-1913**	**1894-1913**	**Mature Only**	**No Lags**	**Ind. FE x Yrs**	**NetX x Influence$_{71}$**
Ln(Gross X)	-0.416***										
	(0.158)										
Ln(Gross M)		-0.580*									
		(0.321)									
Ln(Net X)			-1.347**		-0.028**	-1.453**	-1.566**	-2.126***	-1.738*	-1.548**	-1.061***
			(0.586)		(0.014)	(0.605)	(0.712)	(0.199)	(0.919)	(0.619)	(0.322)
Ln(Trade Elasticity^{-1})	0.397***	0.359***			0.006	0.423***	0.470***	2.141***	0.427***	0.433***	0.054
	(0.147)	(0.135)			(0.007)	(0.160)	(0.153)	(0.088)	(0.157)	(0.158)	(0.190)
Ln(Net X x η)			-0.133***								
			(0.049)								
Net X				-0.743***							
				(0.125)							
Trade Elasticity^{-1}				3.149**							
				(1.413)							
Net X x Influence$_{71}$											0.099***
											(0.023)
Industry FE	✓	✓	✓	✓	✓	✓	✓	✓	✓		✓
Year FE	✓	✓	✓	✓	✓	✓	✓	✓	✓		✓
Industry FE x Yrs										✓	
$N_{HS4\text{-}Yrs}$	2,600	2,600	2,600	2,600	2,600	2,817	2,163	240	2,633	2,600	951

Note: See Table 2 and 3 notes. Estimates reported for HS4 manufactured products with *AWT > 0* over years 1890-1913 (scalar transformed ln-ln, independent variables lagged L_3), unless otherwise noted. Test 1: net exports separated into gross exports and gross imports, estimated separately. Test 2: includes net export and trade elasticity interaction term. Test 3: all dependent and independent variables measured in levels. Test 4: dependent variables measured in first differences: $Ln(AWT_t) – Ln(AWT_{t-1})$. Test 5 and 6: assume learning period ends in 1887 and 1894, respectively. Test 7: estimated for products with positive net exports prior to National Policy. Test 8: drops lags (only contemporaneous independent variables included). Test 9: industry-specific linear time trends included. Test 10: includes 1871 potential political influence dummy interacted with net exports.

Figure 1: Aggregate Observed and Counterfactual DWL / GDP
(CF1: Maturing Produts' Net X ↓ 1 Std Dev Post-1890)
(CF2: 1880s Tariff-Net X Policy Maintained Post-1890)

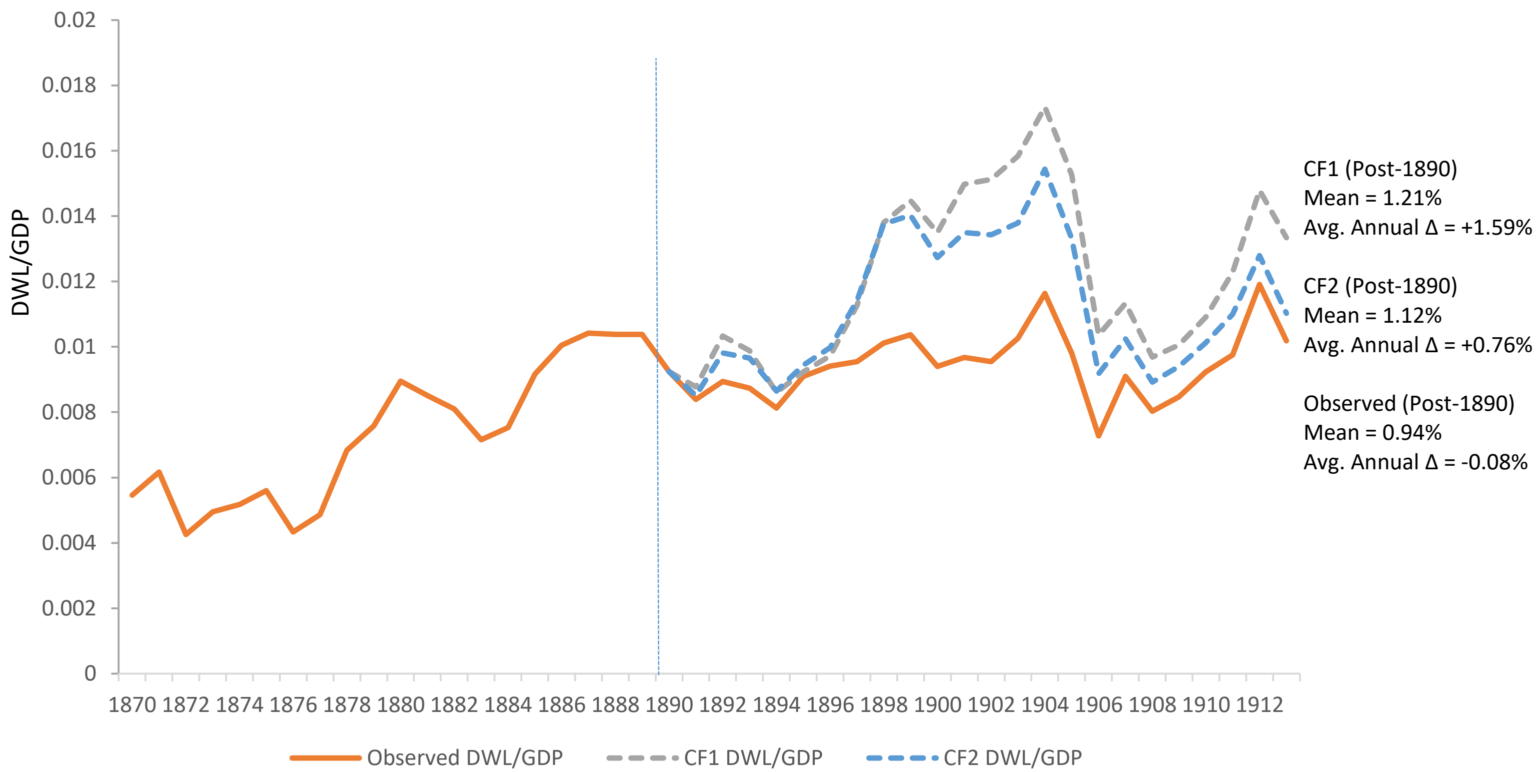

Figure A1: Manufacturing Products' Average Weighted Tariff

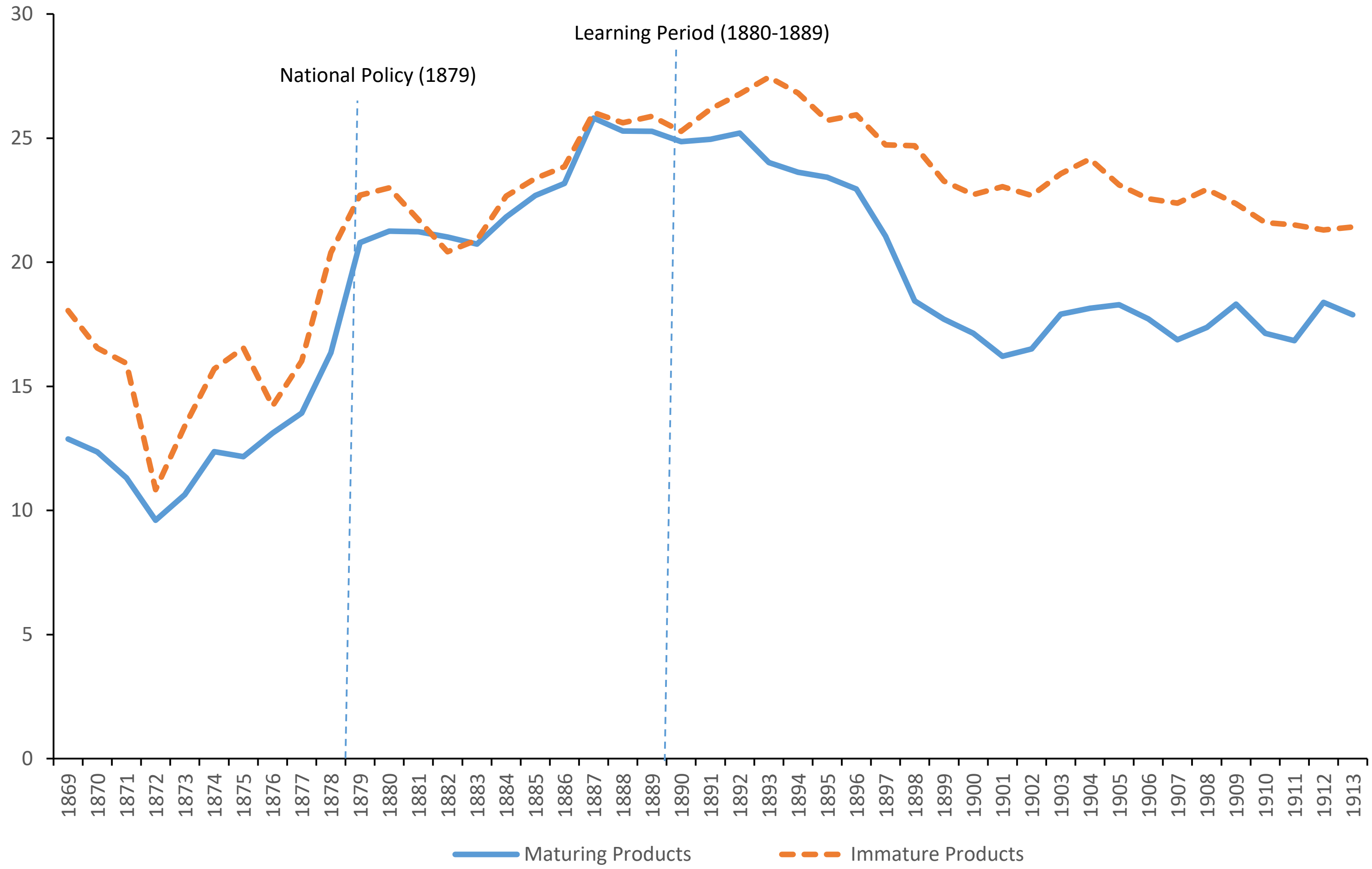

Figure A2: Annual Net X Parameter Estimates (HS4 Products)
(with 90% Confidence Intervals)