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Rules of Origin and Market Power*

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Abstract

We study how domestic content requirements in Free Trade Areas (FTAs) affect market power and market structure in concentrated intermediate goods markets. We show that content requirements increase oligopolistic markups beyond the level that would obtain under an equivalent import tariff, and we document patterns in Canadian export data and US producer price data that align with the model's predictions: producers of intermediate goods charge comparatively higher prices when the associated final goods producers are more constrained by FTA origin requirements and by Most Favoured Nation (MFN) tariffs for both intermediate and final non-FTA goods.

KEY WORDS: Free Trade Areas, Content Requirements, Market Power

JEL CLASSIFICATION: F12, F13, F14, D43

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1 Introduction

Free Trade Areas (FTAs) typically impose origin requirements as a condition for goods originating in a member country to be exportable to another member country without incurring a tariff. These rules of origin (ROOs) are meant to prevent importers of goods originating outside the FTA from using trans-shipments within the FTA as a way of minimizing payments of customs duties, but in practice they can translate into excessive protection of domestic producers of intermediate goods. This has been well documented both theoretically (Krishna and Krueger, 1995; Falvey and Reed, 2002; Krishna, 2005; Bombarda and Gamberoni, 2013) and empirically (Conconi et al., 2018).[1]

This paper studies how the domestic content requirements imposed by FTAs affect competition and prices. Our contribution is twofold. First, in a model of oligopolistic competition between producers of differentiated intermediate goods, we show that binding and stricter content requirements under oligopoly are associated with higher markups and more firm entry. These effects could dampen the well-documented pro-competitive effects of preferential trade liberalization, and should thus be factored in when assessing the pros and cons of alternative preferential trade arrangements.[2] Second, we verify our theoretical predictions empirically by focusing on the 1989 Canada-United States Free Trade Agreement (CUSFTA), using both Canadian trade data and US Census data. To the best of our knowledge, our paper is the first to document such effects for FTAs both in theoretical and empirical terms.

The broader debate on how different types of trade barriers may produce different effects on market outcomes is an old one, but has traditionally been restricted to the comparison between tariffs and quotas. The main conclusion is that price-based instruments (such as tariffs) and quantity-based instruments (such as quotas) produce the same effects under conditions of perfect competition but not so if competition is imperfect (Bhagwati, 1965).[3] Under monopoly, for example, a quota removes a portion of domestic demand faced by a domestic monopolist, but its monopoly pricing power remains unchanged for the residual portion of demand. In contrast, trade in the presence of a tariff fully removes the monopoly power of the sole trader by comparison with autarky.

As a trade barrier, ROOs cannot be readily slotted into either category—they are neither price-based nor quantity-based. We argue here that they indeed amount to a hybrid

[1]For welfare implications, see Krueger's (1997) survey on FTAs with ROOs versus Customs Union; and Brenton and Manchin (2003) for a discussion of implications for small developing countries such as the Balkans' FTAs with the EU. Lloyd (1993) also argues that using a tariff on value added produced outside the FTA would be more efficient than using ROOs.

[2]See Krueger (1999) for a review of the relevant literature.

[3]Krishna (1989) has also shown how quantity-based trade barriers can facilitate collusion.

between the two types of instruments. Specifically, we show that a *regional value content* (RVC) requirement can result in partial market segmentation, lowering the elasticity of demand for domestic intermediates produced within the FTA. When the market for intermediate inputs is oligopolistic (rather than monopolistically competitive), the lower demand elasticity can be shown to give rise to higher markups. In turn, absent barriers to entry, higher markups encourage inefficient entry. These effects on prices and market structure go beyond those that would be implied by an equivalent tariff barrier—a tariff that has the same effect on the volume of intermediate goods imports—because a tariff does not fundamentally change the elasticity of demand faced by suppliers of intermediate inputs.

Our theoretical analysis generates three main testable predictions. The first is that markups should be higher under a binding domestic content requirement than they are in its absence. The second is that a given content requirement is more likely to be binding the larger is the required level of domestic content, the smaller are Most Favoured Nation (MFN) input tariffs, and the larger are MFN output tariffs. To see why, assume there is absolutely free trade between FTA partners while there are non-zero MFN tariffs applied to non-FTA trading partners. High MFN input tariffs would induce final good producers to opt for inputs of FTA origin irrespective of input requirements, making the input requirement less likely to be binding. On the other hand, if MFN tariffs on final goods are non-negligible, obtaining origin status for final goods and being able to export them at zero tariff to other FTA regions has positive value for FTA producers. Intuitively, a more binding content requirement makes FTA producers of final goods more willing to pay a premium for intermediate inputs originating within the FTA, translating into greater pricing power for oligopolistic producers of intermediate inputs operating within the FTA.

The role origin requirements play in support of oligopolistic markups in turn limits the pro-competitive effects of preferential trade liberalization: absent barriers to entry/exit, the number of intermediate goods producers remains inefficiently higher, and their size remains inefficiently smaller, than would be the case under a preferential trade agreement that does not incorporate ROOs—our third prediction.

To test these predictions empirically, we focus on the 1989 CUSFTA and construct a novel product-level index that measures ROOs restrictiveness based on the input-output linkages in CUSFTA's rules of origin constructed by Conconi et al. (2018).[4] We first use

[4]CUSFTA came into force in January 1989 and was superseded by the North American Free Trade Agreement (NAFTA) in 1994 with the addition of Mexico. Our choice of CUSFTA over NAFTA is motivated by the fact that over 95% of NAFTA's rules of origin were already in place in CUSFTA (Conconi et al., 2018). Another advantage is that it enables us to draw a clear distinction between preferential and external MFN tariff rates, as during our sample period of 1989-1993 both Canada and the US had no other FTA partners (with the only exception being the 1985 US-Israel agreement).

monthly province-level trade statistics from Statistics Canada for the period of 1989-1993, and provide post-CUSFTA evidence that stricter and binding RVC requirements are associated with higher export unit values for Canadian exports to the US in comparison with exports of comparable products to other destinations (by roughly ten percent on average). Such gap can be interpreted as reflecting a differential markup applied by Canadian intermediate goods exporters on sales to FTA producers (who face origin requirements).[5] To relate price changes to ROOs in comparison with the pre-CUSFTA levels, we turn to annual US PPI data for manufacturing industries from the US Bureau of Labor Statistics, matched with concentration measures (Herfindahl-Hirschman Index, HHI) from the Economic Census for identifying market structures for the years of 1987 and 1992. In difference-in-difference specifications, we find strong support for our theoretical predictions, and we show that our findings apply to only oligopoly industries, consistent with our theoretical setup.

This paper builds on and contributes to the literature that examines how different trade policies may impact on market power and firm entry. A large body of literature has documented a pro-competitive effect under imperfectly competitive market structures and showed that trade liberalization reduces markups, both theoretically (Melitz and Ottaviano, 2008) and empirically (Levinsohn, 1993; Harrison, 1994; Feenstra and Weinstsein, 2017).[6] It has also been well-documented that trade liberalization can lead to exit by the least productive firms exit the market: see Pavcnik (2002) for the case of Chile, and Trefler (2004) for the case of CUSFTA.[7] Our contribution here is in showing that binding rules of origin under oligopolistic competition generate the opposite effects in terms of markups and firm entry, and therefore should not be neglected when assessing the impact of FTAs.

Among the papers that examine the effects of rules of origin, most are theoretical papers that focus on the protection of domestic producers of intermediate goods. Ju and Krishna (2002; 2005) are probably the first studies to formalize how ROOs could affect the prices of intermediate goods in the FTA region. In a framework with inelastic supply and perfect substitution between FTA and non-FTA inputs, they document a non-monotonic effects due to demand shifts for FTA inputs, depending on whether het-

[5]It should be noted that although Canada is a much smaller economy than the US, it is the largest export market for US producers—US exports to Canada account for 21.52% of total US exports in 1989 and the share remains steady to date at around 20%—and Canada is also one of the largest suppliers to the US —US imports from Canada account for roughly 18% of annual total US imports from 1989 to 2002 before slowly dropping to about 12% in 2018. This means that origin requirements do matter to US producers of final goods.

[6]Other studies that have contributed to this debate are Cox and Harris (1985), Head and Ries (1999), and Caliendo and Parro (2015).

[7]For a survey of both theory and empirics on heterogeneous firms and trade, see Melitz and Redding (2014).

erogeneous firms choose to comply with ROOs. Our paper differs from theirs by studying how ROOs affect trade prices via changes in market power and markups rather than through decreasing returns in production.

Empirical attempts to measure the restrictiveness of ROOs in different industries and evidence of their trade effects have been scarce. One notable example is Conconi et al. (2018) who provide a mapping of input-output product linkages of ROOs in NAFTA and CUSFTA, upon which our ROO measures are based.[8] Their focus, however, is on how NAFTA ROOs lead to significant reductions in imports of intermediate goods from third countries relative to NAFTA trading partners, rather than on the effects of ROOs on prices. A study that examines effects on both trade volumes and prices is Romalis (2007), which documents a substantial boost in trade between NAFTA partners but only a modest increase in relative output prices of traded goods between NAFTA members versus the rest of the world for very protected sectors with high MFN tariffs. His structural estimations, however, do not account for ROOs. Our paper complements these studies by providing evidence on how ROOs affect trade prices for intermediates, employing a novel measure of ROO tightness that accounts for variations in the levels of protection across traded goods.[9]

The remainder of the paper is organized as follows. Sections 2 and 3 present our main theoretical framework. In Section 2, we demonstrate how content requirements in ROOs result in partial market segmentation and lower the elasticity of demand facing domestic producers of intermediates. In Section 3, we introduce oligopolistic competition and analyze the effects on prices, markups and market competitiveness. Section 4 describes our data and presents results of our empirical analysis. Section 5 concludes. Proofs of theoretical results are in the appendix.

2 Content requirements and input choice

We develop our arguments for a scenario with a regional value content (RVC) requirement, which is by far the most widely adopted form of ROOs across the FTAs we observe, and study a setting with two identical trading regions.

Producers of final goods in each region use symmetrically differentiated varieties of intermediate inputs, some of which are produced by domestic suppliers and some of which are produced by foreign suppliers. There is an equal number, N, of these

[8] See also Estevadeordal (2000) for a categorization of the restrictiveness of ROOs coded from 1 (least restrictive) to 7 (most restrictive).

[9] Our study is also related to work on pricing to market and markup adjustments using customs data (Knetter, 1989; Corsetti et al., 2018). Although our empirical analysis has a different focus, it addresses similar issues in controlling for observable marginal costs with trade prices derived from customs data.

suppliers in each region. Production takes place via CES technologies:

$$y(q) = \left(\sum_{j=1}^{2N} q_j^{(\sigma-1)/\sigma} \right)^{\sigma/(\sigma-1)}, \tag{1}$$

where q_j is input of the intermediate good produced by supplier j. The corresponding unit cost is

$$e(p) = \left(\sum_{j=1}^{2N} p_j^{1-\sigma} \right)^{1/(1-\sigma)}, \tag{2}$$

where the p_j's are unit prices for each of the symmetrically differentiated inputs and $\sigma > 1$ is the elasticity of substitution between them.

Consider first a scenario where $N = 1$, i.e. there is a single supplier of intermediates in each region. Let p_D denote the price of domestically produced intermediates for a representative producer in one of the two regions, and p_M the price of imported intermediates (inclusive of any trade costs). Absent any constraint, unit cost can be written as

$$e(p_D, p_M) = \left(p_D^{1-\sigma} + p_M^{1-\sigma} \right)^{1/(1-\sigma)}. \tag{3}$$

This is the minimum cost, at prices p_D and p_M, of a combination of inputs s.t.

$$\left(q_D^{(\sigma-1)/\sigma} + q_M^{(\sigma-1)/\sigma} \right)^{\sigma/(\sigma-1)} = 1. \tag{4}$$

The conditional demand for a representative domestic intermediate and a representative imported intermediate, using Shephard's Lemma, can then be expressed as

$$\begin{aligned} q_D(p_D, p_M) &= \frac{\partial e(p_D, p_M)}{\partial p_D} = e(p_D, p_M)^{\sigma} p_D^{-\sigma}, \\ q_M(p_D, p_M) &= \frac{\partial e(p_D, p_M)}{\partial p_M} = e(p_D, p_M)^{\sigma} p_M^{-\sigma}. \end{aligned} \tag{5}$$

Suppose now that domestic producers face an RVC requirement: a certain proportion, r, of the *value* of their input must be sourced within the FTA region for their output to be sold to FTA buyers at zero tariff; if this requirement is not met, then they must also incur the same trade costs internally as they do for sales to non-FTA buyers. Satisfying an RVC requirement of r implies that, to produce a unit of the final good, the final good producers must choose a combination of intermediate inputs that achieves the required output target for the given technology *and* such that, at the given prices, an input value share of at least r consists of goods produced within the FTA. As we shall show, this is equivalent to employing a technology featuring less substitutability between domestically sourced and foreign sourced intermediates than the elasticity of substitution that is implied by technology only.

Assume first that the domestic content requirement is *unconditional*, i.e. that it must be met whether or not the producer wishes to be able to sell its output without facing a tariff. If this is binding, we can write

$$\frac{p_D\, q_D}{p_D q_D + p_M q_M} \geq r, \tag{6}$$

From this, we obtain

$$q_D = \frac{r}{1-r}\frac{p_M}{p_D} q_M = \tilde{q}_D(p_D, p_M, q_M, r). \tag{7}$$

We can substitute this expression into (4), solve for $q_M = \hat{q}_M(p_D, p_M, r)$, and then substitute again into (7) to derive an expression for $q_D = \hat{q}_D(p_D, p_M, r)$. We obtain conditional demands under a binding RVC constraint as:

$$\begin{aligned} \hat{q}_D(p_D, p_M, r) &= r \qquad p_D^{-1}\ \hat{e}(p_D, p_M, r), \\ \hat{q}_M(p_D, p_M, r) &= (1-r)\ p_M^{-1}\ \hat{e}(p_D, p_M, r), \end{aligned} \tag{8}$$

where

$$\hat{e}(p_D, p_M, r) = \left(\left(\frac{p_D}{r}\right)^{(1-\sigma)/\sigma} + \left(\frac{p_M}{1-r}\right)^{(1-\sigma)/\sigma} \right)^{\sigma/(1-\sigma)} \tag{9}$$

is unit cost under a binding RVC constraint.

Comparing equation (9) with the expression for unconstrained unit cost in (3), we can see the $1-\sigma$ in the first expression being replaced by $(1-\sigma)/\sigma$ in the other (which also features share parameters); so it would seem that a binding content requirement simply implies a lower elasticity of substitution—the value $\widehat{\sigma}$, s.t. $1-\widehat{\sigma} = (1-\sigma)/\sigma$. In this case, however, Shephard's Lemma does not apply (i.e. $\hat{q}_D(p_D, p_M, r) \neq \partial\hat{e}(p_D, p_M, r)/\partial p_D$ and $\hat{q}_M(p_D, p_M, r) \neq \partial\hat{e}(p_D, p_M, r)/\partial p_M$).

Next, we turn to develop the binding conditions for the RVC requirement. Consider a conditional requirement for sales of final goods to FTA destinations: an ad valorem tariff at rate t_I is levied on intermediates that are traded across regions, and an ad valorem tariff at rate t_F is levied on final goods that are traded within regions but are produced without satisfying the domestic content requirement. Also, let $\tau_I = 1 + t_I$, $\tau_F = 1 + t_F$, and $p_M = \tau_I p_W$, where p_W is the net-of-tariff price charged by foreign exporters of intermediates.

Absent an RVC constraint, regional value content would be $p_D q_D / e(p_D, p_M)$, which using (5), equals $\left(1+(p_M/p_D)^{1-\sigma}\right)^{-1} \equiv \rho(p_D, p_M)$, and so the constraint is only binding for $r \geq \rho(p_D, p_M)$. For $r = \rho(p_D, p_M)$, RVC-constrained unit cost $\hat{e}(p_D, p_M, r)$ equals unconstrained unit cost $e(p_D, p_M)$; for $r > \rho(p_D, p_M)$, we have $\hat{e}(p_D, p_M, r) > e(p_D, p_M)$, and the gap between them increases with r. This binding condition $r \geq \rho(p_D, p_M)$ can then be expressed as an upper bound of input tariff:

$$\tau_I \leq (p_D/p_W)\left(\frac{r}{1-r}\right)^{1/(\sigma-1)} \equiv (p_D/p_W)\,\xi(r) \equiv \overline{\tau}_I(r). \tag{10}$$

Moreover, if satisfying the domestic content requirement is a condition for the producer to be able to sell its good without incurring an ad valorem tariff at rate t_F within the FTA region, then abiding by the content requirement should minimize overall unit cost. This condition can be expressed as a lower bound of output tariff:

$$\hat{e}(p_D, p_M, r) < \tau_F\, e(p_D, p_M) \quad \Leftrightarrow \quad \tau_F \geq \frac{\hat{e}(p_D, \tau_I\, p_W, r)}{e(p_D, \tau_I\, p_W)} \equiv \underline{\tau}_F(r, t_I) \geq 1, \tag{11}$$

where the last inequality follows from $\hat{e}(p_D, \tau_I\, p_W, r) \geq e(p_D, \tau_I\, p_W)$. Otherwise overall unit cost will be minimized by producing the final goods ignoring the content requirement and incurring the tariff, and so, while the conditionality requirement will still be binding, the RVC constraint as such will cease to be binding.

Thus, over the full range of possible price combinations and tariff levels, unit cost equals

$$B(r, \tau_I, \tau_F)\,\hat{e}(p_D, \tau_I p_W, r) \;+\; \left(1 - B(r, \tau_I, \tau_F)\right) e(p_D, \tau_I p_W) \equiv \tilde{e}(p_D, \tau_I p_W, r), \tag{12}$$

where $B(r, \tau_I, \tau_F) \equiv \mathbb{1}_{\tau_F \geq \underline{\tau}_F(r, t_I)}\ \mathbb{1}_{\tau_I \leq \overline{\tau}_I(r)}$, with $\mathbb{1}$ denoting an indicator function. In other words, a regional content requirement is only binding for producers of final goods (and thus affects their choice between domestic and imported inputs) if tariffs on imported inputs are sufficiently low and if exports that do not meet the content requirements face sufficiently high tariffs.

3 Oligopolistic markups under a regional input requirement

We now turn to the analysis of the effects of an RVC requirement under oligopoly in the context of a symmetric model with four economies and two FTAs. Agents in each economy are endowed with a certain amount, $\bar{L}$, of a non-produced, immobile factor (the same amount in both regions). In a symmetric equilibrium the price of the immobile factor will be equalized across economies, and so we can normalize this price at the outset to be unity in all economies. Two of these economies are members of an FTA and the remaining two are members of a separate FTA, each denoted by $h \in \{1, 2\}$.

Focusing on a single industry, we assume that the total value of demand originating from any given economy for final goods produced by this industry is equal to a fraction, $\theta \bar{L}$, $\theta \in (0, 1)$, of total income in each country, and that the value of demand for goods originating in each of the four economies is one-quarter of that, i.e. $\theta \bar{L}/4 \equiv M$. This specification is consistent with Cobb-Douglas substitution possibilities in final demand across industries and between domestically produced final goods and imported final goods.

Producers of intermediate goods produce symmetrically differentiated inputs using only the non-produced factor at a constant marginal cost of c and incurring a fixed cost equal to F, and operate under conditions of oligopoly, each pricing its output non-cooperatively so as to maximize gross profits.

3.1 Equilibrium markups

We first examine the case where there is a fixed number, $N/2$, of active intermediate goods producers in each economy, i.e. N producers of intermediate goods in each FTA. The implications of free entry are examined in the next section. Without loss of generality, we assume a constant marginal cost of $c = 1$.

Intermediate goods and final goods traded across the two regions of the FTA face ad valorem tariffs at rates respectively equal to t_I and t_F, the same for all economies. The same tariff applies to final goods traded between economies of an FTA if produced in a way that does not satisfy regional content requirements. Intermediate goods traded across economies of an FTA face no tariffs. Final goods meeting content requirements and traded across economies of an FTA face no tariffs. There are no other trade costs beyond tariffs. The requirement that producers of final goods must meet in order to be able to export their goods within an FTA at zero tariff is an RVC input requirement at level r.

Absent a content requirement, the unit cost of production for a representative producer of final goods in region h is $e(p_{Dh}, p_{Mh}) \equiv P_h$, where

$$p_{Dh} = \left(\sum_{j=1}^{N} \left(p_h^j\right)^{1-\sigma} \right)^{1/(1-\sigma)}, \qquad p_{Mh} = \left(\sum_{j=1}^{N} \left(\tau_I p_{h'}^j\right)^{1-\sigma} \right)^{1/(1-\sigma)}. \tag{13}$$

with p_h^j and $p_{h'}^j$ denoting the-net-of-tariff prices charged by each supplier of intermediates indexed by j in each of the two FTAs.[10] The levels of demand faced by a represen-

[10]This implies horizontal input differentiation; i.e. $e(p_{Dh}, p_{Mh}) = \left(\sum_j \left(p_h^j\right)^{1-\sigma} + \sum_j \left(\tau_I p_{h'}^j\right)^{1-\sigma} \right)^{1/(1-\sigma)}$.

tative supplier of intermediate goods, j, originating from producers of final goods in the FTA to which they belong and from the other FTA are then respectively equal to

$$q^j_{Dh} = \left(\frac{M}{P_h} + \frac{M}{\tau_F P_h}\right) \left(\frac{P_h}{p_{Dh}}\right)^\sigma \left(\frac{p_{Dh}}{p^j_h}\right)^\sigma = M\left(1 + 1/\tau_F\right) e(p_{Dh}, p_{Mh})^{\sigma-1} \left(p^j_h\right)^{-\sigma},$$
$$q^j_{Xh} = \left(\frac{M}{P_{h'}} + \frac{M}{\tau_F P_{h'}}\right) \left(\frac{P_{h'}}{p_{Mh'}}\right)^\sigma \left(\frac{p_{Mh'}}{\tau_I p^j_h}\right)^\sigma = M\left(1 + 1/\tau_F\right) e(p_{Dh'}, p_{Mh'})^{\sigma-1} \left(\tau_I p^j_h\right)^{-\sigma}; \tag{14}$$

and so its net profits are

$$\Pi^j_h = (p^j_h - 1)\left(q^j_{Dh} + q^j_{Xh}\right) - F = \mu^j_h \left(q^j_{Dh} + q^j_{Xh}\right) - F, \tag{15}$$

where $\mu^j_h \geq 1$ represents a markup factor on marginal cost.

Given the pricing choices of all other suppliers, the profit maximizing pricing choice of a representative supplier of intermediates satisfies

$$\frac{\partial \Pi^j_h}{\partial p^j_h} = 0. \tag{16}$$

In a symmetric equilibrium, we have $\mu^j_h = \mu^j_{h'} = \mu$, $\forall j$, and so the profit maximization condition for a representative supplier from either region is

$$\left.\frac{\partial \Pi^j_h}{\partial p^j_h}\right|_{\mu^j_h = \mu^j_{h'} = \mu,\ \forall j} \equiv \Omega(\mu, N) = 0. \tag{17}$$

Solving for the optimal markup μ, we obtain

$$\mu^* = 1 + \frac{1}{\sigma - 1} \frac{N}{N - \Phi(\tau_I)}, \tag{18}$$

where

$$\Phi(\tau_I) \equiv \left(1 + (1 + \tau_I)/({\tau_I}^{1-\sigma} + {\tau_I}^{\sigma})\right)^{-1} < 1. \tag{19}$$

Note that the markup is increasing in τ_I. For $\tau_I = 1$ (i.e. with a zero tariff on imports of intermediates), $\Phi(\tau_I)$ equals $1/2$ and so the denominator of the second ratio in (18) equals $N - 1/2$. For τ_I approaching infinity and $\sigma > 1$, $\Phi(\tau_I)$ approaches unity and so the denominator of the second ratio in (18) equals $N - 1$.

Under a binding domestic content requirement, we can proceed in the same way and use (8) and (9) to derive expressions for the levels of demand and profits:

$$
\begin{aligned}
\hat{q}^j_{Dh} &= \left(\frac{M}{\hat{P}_h} + \frac{M}{\tau_F \hat{P}_h}\right) \;\; r \qquad\quad \left(\frac{\hat{P}_h}{p_{Dh}}\right) \left(\frac{p_{DH}}{p^j_H}\right)^{\sigma} \\
&= M \;\; r \qquad\quad (1 + 1/\tau_F) \; \left(p_{Dh}\right)^{\sigma-1} \; \left(p^j_h\right)^{-\sigma}, \\
\hat{q}^j_{Xh} &= \left(\frac{M}{\hat{P}_{h'}} + \frac{M}{\tau_F \hat{P}_{h'}}\right) (1-r) \left(\frac{\hat{P}_{h'}}{p_{Dh'}}\right) \left(\frac{p_{Dh'}}{\tau \, p^j_h}\right)^{\sigma} \\
&= M \, (1-r) \; (1 + 1/\tau_F) \; \left(p_{Dh'}\right)^{\sigma-1} \left(\tau \, p^j_h\right)^{-\sigma}, \qquad (20)
\end{aligned}
$$

$$
\hat{\Pi}^j_h = \hat{\mu}^H_j \left(\hat{q}^j_{Dh} + \hat{q}^j_{Xh}\right) - F, \qquad (21)
$$

where $\hat{P}_h = \hat{e}(p_{Dh}, p_{Mh}, r)$. We can then use these to derive a symmetric profit-maximization condition, $\hat{\Omega}(\hat{\mu}, \hat{N}) = 0$. Solving this condition for μ gives

$$
\hat{\mu}^* = 1 + \frac{1}{\sigma - 1} \, \frac{N}{N-1}. \qquad (22)
$$

Comparing this expression with unconstrained markup in (18) gives us our first testable prediction:

Proposition 1 *Equilibrium markups are higher under a binding domestic content requirement than they are in its absence.*

(Proofs of theoretical results are in the appendix.)

The RVC constraint is more likely to be binding, and thus markups more likely to be higher, the larger is r. However, in order for the pricing behaviour described by (22) to correspond to equilibrium behaviour, it is not enough for the RVC constraint to be binding when all producers price in this way; it must also be the case that there are not unilateral price deviations that can make the constraint slack and be gainful. As shown in the proof of our next result, this latter condition is the one that defines the necessary lower bound on r, although the same conclusion applies, i.e. the larger r, the more likely the RVC constraint is to bind:

Proposition 2 *A given domestic content requirement is more likely to be binding for producers of final goods (and thus to raise equilibrium markups for producers of intermediates) the larger is the required level of domestic content, with the lowest level of domestic content above which the requirement is binding lying strictly above the unconstrained domestic content level.*

As previously discussed, for the RVC constraint to be binding, we must have $\tau_I \leq \overline{\tau}_I(r)$ (condition (10)), where

$$\overline{\tau}_I(r) = \xi(r) = \left(\frac{r}{1-r}\right)^{1/(\sigma-1)}. \qquad (23)$$

Moreover, satisfying the domestic content requirement is only cost-minimizing for producers of final goods (and thus to be binding for them) if $\tau_F \geq \underline{\tau}_F(r, t_I)$ (condition (11)), where

$$\underline{\tau}_F(r,\tau_I) = \left(\left(\frac{1}{r}\right)^{(1-\sigma)/\sigma} + \left(\frac{\tau_I}{1-r}\right)^{(1-\sigma)/\sigma}\right)^{\sigma/(1-\sigma)} / \left(1+\tau_I^{1-\sigma}\right)^{1/(1-\sigma)}. \qquad (24)$$

Our next result follows immediately from (23) and (24):

Proposition 3 *A given domestic content requirement is more likely to be binding for producers of final goods (and thus to raise equilibrium markups for producers of intermediates) the larger are tariffs on imports of non-FTA final goods and the smaller are tariffs on imports of non-FTA intermediate inputs.*

A testable implication of these results is that, for a given τ_F, we should expect to see larger markups when r is comparatively higher and, simultaneously, τ_I is comparatively lower.

3.2 Domestic content requirements as an import barrier

It is easy to show that a domestic content requirement acts as a trade barrier on imports of intermediates: letting $\tau_I = 1$ (zero import tariffs) and comparing, for a representative firm, the net-of-tariff equilibrium values of trade in intermediate goods across FTA boundaries that obtain with and without a domestic content requirement, which are respectively equal to $\hat{p}\hat{q}_X = \hat{p}_h^j \hat{q}_{Xh} = \hat{p}_{h'}^j \hat{q}_{Xh'}$ and $pq_X = p_h^j q_{Xh} = p_{h'}^j q_{Xh'}$, by using expressions (13)-(22), we obtain

$$\hat{p}\hat{q}_X - pq_X = \frac{M\,(1+1/\tau_F)}{N}\,(1/2-r), \qquad (25)$$

which is negative for $r > 1/2$.

However, this conclusion does not mean that introducing a domestic content requirement is fully equivalent to introducing a tariff, as the former produces different effects on markups and market structure:

Proposition 4 *Under oligopolistic competition between suppliers of intermediate inputs, a binding domestic content requirement raises markups more than does an import tariff that, absent a content requirement, produces the same same effect on imports of intermediates.*

The effects of content requirements on the markups and profits of import-competing producers thus go beyond those of trade barriers that have comparable effects on trade flows. And, conversely, in order to generate effects on markups and profits that are comparable to those of a content requirement, a tariff must produce larger effects on trade flows.[11]

3.3 Free entry

If entry and exit are free and costless, the number of active intermediate goods producers will adjust endogenously so that profits, net of the fixed operating cost, are zero in equilibrium, i.e.

$$\Pi_h^j\Big|_{\mu_h^j=\mu_{h'}^j=\mu,\ \forall j} \equiv \Pi(\mu, N) = 0. \tag{26}$$

Conditions (17) and (26) then together identify an equilibrium number of firms, N^*:

$$N^* = \frac{(M/F)\left(1+\tau_I{}^{\sigma}\right)^2 + (\sigma-1)\left(\tau_I + \tau_I{}^{2\sigma}\right)}{\sigma\left(1+\tau_I{}^{\sigma}\right)\left(\tau_I+\tau_I{}^{\sigma}\right)}. \tag{27}$$

The corresponding number of firms under a binding domestic content requirement is

$$\hat{N}^* = \frac{(M/F)\left(1+r(\tau_I-1)\right) + (\sigma-1)\,\tau_I}{\sigma\,\tau_I}, \tag{28}$$

which is increasing in r. Expressions for equilibrium markups, as a function of the number of firms, are as before.

The same ranking of markup levels that applies for an exogenously given N applies under conditions of free entry, but the equilibrium number of active firms is higher under a binding RVC constraint:

Proposition 5 *Under conditions of free entry, both the equilibrium level of markup and the equilibrium number of suppliers of intermediate inputs are higher under a binding domestic content requirement than they are in its absence.*

[11] In particular, the same level of markups that would obtain under autarky can be supported by a binding domestic content requirement that does not fully restrict trade: since $\sigma > 1$, the gap between $\hat{\mu}^*$ and μ^* vanishes as as τ_I approaches infinity (and trade in intermediate goods approaches zero); i.e. the level of markup under an origin requirement coincides with the level of markup under a prohibitive import tariff.

The results that we have first derived for an exogenous number of firms thus extend to a setting where the number of active firms varies with the size of markups. However, under free entry, the model additionally predicts that a domestic input requirement will encourage entry. A well established result in the literature, which applies under fairly general conditions, is that oligopolistic competition produces excessive entry, translating into a sub-optimal firm size (Bresnahan and Reiss, 1991). By encouraging entry, a domestic input requirement will exacerbate this.

As noted in the introduction, the implications of preferential trade liberalization for market structure have been the subject of a large literature. The theoretical experiment considered in those studies is to characterize the effects of a move from a pre-agreement scenario to a zero bilateral-tariff scenario, an exercise that is typically carried out in a monopolistic competitive setting where, with symmetric firms, there are no scale effects if demand is derived from CES preferences or technologies. Under oligopolistic competition—the environment we focus on here—the elasticity of demand, and thus markups, vary with the number of firms even when preferences and technologies are of the CES type, and so preferential liberalization can generate positive scale effects and firm exit. On the other hand, Proposition 5 implies that ROOs in FTAs will tend to limit the pro-competitive effects of preferential trade liberalization.

4 Empirical analysis

Our theoretical analysis has shown that the implications of FTA origin requirements for market power lie somewhere in between those of import tariffs and import quotas. While rules of origin do not segment demand as rigidly as import quotas do, they still generate a degree of market segmentation. Under oligopolistic competition, if the constraint is binding, this translates into higher markups. Because of this, rules of origin do not just distort input decisions by firms, causing firms to substitute away from non-FTA inputs and acting as a *de facto* import barrier, but they also generate inefficient entry. The effects of origin requirements on market power go beyond those that would be generated by an import tariff that supports a comparable contraction in intermediate imports.

Evidence that rules of origin act as a trade barrier has been given elsewhere (Conconi et. al, 2018). Here we specifically look for evidence of a relationship between markups and origin requirements. Focusing on Canadian exports over the period 1989-1993, which follows the formation of the 1989 Canada-United States Free Trade Agreement (CUSFTA), we compare prices for exports to the US (where exporters of final goods face CUFSTA's regional content requirements) with export prices to non-CUSFTA destinations. This means that we examine evidence arising from a situation in which FTA counties trade with each other as with other non-FTA countries, whereas the markup expressions (18) and (22) have been derived with reference to a scenario involving two symmetric FTAs. However, proceeding as we did in Section 3, it is easy to show that the same expressions, and the same conclusions, apply to an asymmetric scenario involving a single FTA trading with the rest of the world, with FTA-based oligopolistic producers of intermediate goods pricing their exports to perfectly competitive non-FTA markets at marginal cost.

Another aspect where our empirical analysis veers from the theoretical setting of Section 3 is with respect to the form of content requirements: while most FTAs prescribe a value-based input requirement as we have characterized it in our theoretical analysis, CUSFTA imposes specific input requirements prescribing 100% FTA origin for selected types of inputs. Our theoretical analysis assumes a single type of differentiated inputs, but can be readily extended to allow for multiple types of inputs. In that case a 100% input requirement for a specific input would correspond to imposing an RVC requirement, r, that approaches unity for that input, and all of our our predictions and conclusions continue to apply.[12] At the same time, while value-based requirements often impose a single RVC ratio for most goods, the peculiar structure of CUSFTA content requirements implies substantial variation in content requirements across different goods, which we can exploit in our empirical application. Our theoretical predictions that stricter and binding ROOs are associated with higher markups should also apply to US domestic prices of intermediate goods that are used for producing final products qualified for preferential CUSFTA tariffs.

We provide cross-validation for the results from our main analysis by documenting how changes in US Producer Price Indices (PPI) for different goods between 1987 (pre-CUSFTA, in the absence of regional content requirements) and 1992 (post-CUFSTA, when regional content requirements were in place), as well as the changes in the numbers of firms producing those goods, vary with the stringency of ROOs and the size of MFN tariffs.

4.1 Evidence from trade data

Data and descriptive statistics

We rely on monthly product-level trade statistics from Statistics Canada for a sample of Canada's exports over the period of 1989-1993. Annual tariff data and all other trade data are from the World Integrated Trade Solution (WITS).

Information on monthly exports data includes the 6-digit HS classification of product

[12]In this case, for a given input type h, unit cost becomes $\lim_{r\to 1} \hat{e}^h(p_D^h, p_M^h, r^h) = 2^{1/(\sigma-1)}\, p_D^h$, and the formulation we have derived for the case $r \in (0,1)$ provides an approximation to a scenario with multiple input types and 100% domestic content requirements applying to a subset of input types representing a fraction r of all input types (assuming symmetric substitution amongst those input types).

codes, the province of origin, the value, the mass, the unit of measurement, the time of exports (year and month), and the destination country. Given that export prices are not observed, we proxy export prices with unit values computed as the ratios between the value and the corresponding mass at the monthly frequency.[13]

We clean up the data in several ways. First, we drop those observations for which the value of exports is indicated as positive but the corresponding mass is zero or undefined. Second, we aggregate the data at an annual frequency by computing the yearly average of unit values for each observation at the province×product×country level. Finally, to minimize the influence of potential outliers, we exclude the 0.5 percent of observations with the largest and smallest log differences in unit values between FTA and non-FTA regions (our dependent variable)—one percent of all observations in total.

We construct a ROO index for our baseline analysis based on the mapping of CUSFTA's rules of origin constructed by Conconi et al. (2018). For each intermediate good defined in CUSFTA's rules of origin, we derive a weighted count of the number of final goods that require that input to be of FTA origin in order to qualify for FTA status, with the weight being equal to Canada's trade share in US exports of that final good multiplied by the number of other regional inputs that are also included in the origin requirement for that final good. We then standardize the index at the 2-digit HS industry level and normalize it to lie in the range of zero to unity. This ROO index measures the overall restrictiveness imposed by origin requirements when sourcing a certain intermediate good used to produce final goods that qualify for preferential tariffs.

Table 1 reports summary statistics for our main sample involving only intermediate inputs (for industrial use) that are defined in CUSFTA's rules of origin.[14] As shown in the table, our sample includes 1,633 intermediate products and 203 destination countries (including the US) with a total of 63,813 observations. On average, unit values and transaction values are slightly higher for US-bound exports than for exports to the rest of the world. Table 1 also shows the distributions of CUSFTA's preferential tariffs and MFN tariffs, as reported by the US. Overall, CUSFTA's preferential tariffs are significantly lower on average, and although many products face a zero rate, trade barriers within CUSFTA are not completely eliminated.

In the sample, the same goods are exported to both the FTA region (the US, which accounts for 87 percent of total exports) and the non-FTA destinations (the rest of the

[13]The data contain 18 very detailed units of measurements. These include, for example, KGM (kilogram), NMB (number), TNE (Metric tonne), MTK (square metre), TMQ (1,000 cubic metres), TSD (metric tonne air dry), LTR (litre), and PAR (pair). With this additional information we are able to measure unit values more correctly.

[14]The 1989-1993 trade data include 2,657 products in total, among which 1,633 are intermediate goods, 667 are consumption goods, 348 are capital goods and 9 are undefined. Results for consumption and capital goods can be found in Table 6. Good classification is based on the Broad Economic Categories (BEC).

Table 1: Canadian exports: summary statistics

	Mean	Median	Std. dev.	Min.	Max.
Observations	63,813	–	–	–	–
Products	1,633	–	–	–	–
Destination countries	203	–	–	–	–
Log unit values (Canadian dollar): US	3.2	2.84	2.86	−4.35	14.66
Log unit values (Canadian dollar): non-US	2.95	2.33	2.89	−5.19	15.98
Log transaction values: US	15.3	15.57	2.94	4.8	22.77
Log transaction values: non-US	10.82	10.55	2.51	0.69	21.43
Preferential ad valorem tariffs (percent)	2.4	0.77	4.03	0	78.4
MFN ad valorem tariffs (percent)	4.61	3.45	5.66	0	86.74

Notes: For each variable, the table reports its mean, median, standard deviation, and the minimum and maximum values.

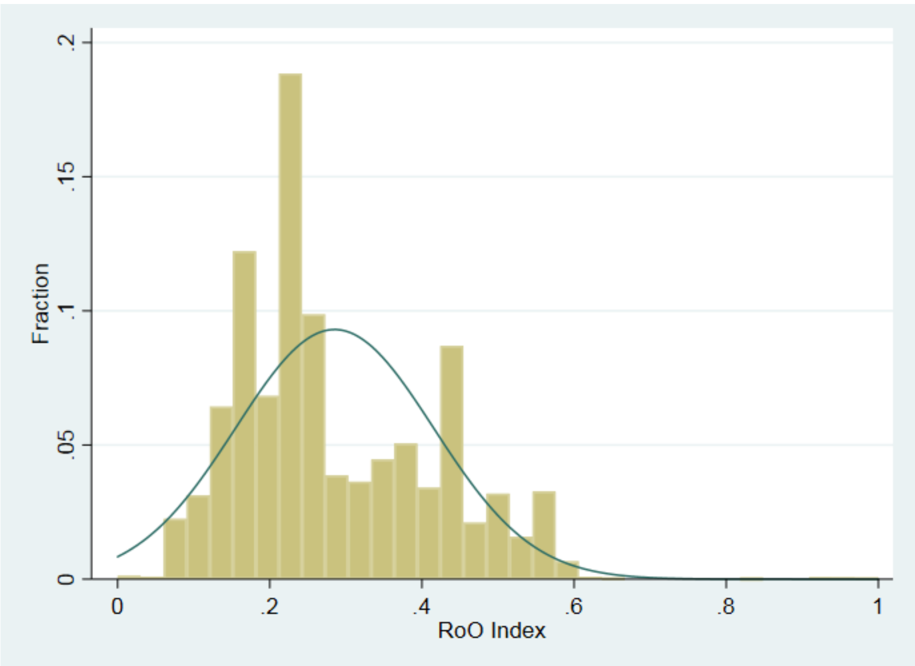

Figure 1: ROO Index: Distribution

Table 2: Average ROO index for exported products by area of destination

	Mean	Std. dev.	Observations
Africa	0.284	0.149	3,760
Asia	0.276	0.134	19,396
Europe	0.273	0.140	21,591
Latin America and the Caribbean	0.319	0.151	10,574
Oceania	0.292	0.140	3,111
South America	0.294	0.143	5,381
Total	0.285	0.142	63,813

Notes: For each area, the table reports the mean and standard deviation of the ROO index, and the number of observations. Statistics for the US correspond to those of the full sample.

world), with a broad coverage of destination countries. The largest market in the non-FTA region is Japan (25.16 percent), followed by the UK (7.32 percent), China (5.71 percent), Germany (5.26 percent), South Korea (5.24 percent), Belgium (3.55 percent), Netherlands (3.36 percent), and Italy (3.36 percent).

Figure 1 plots the distribution of the main variable of interest, the ROO index. As the index is standardized at the industry level, and the composition of exports tends to vary by destination, there could be systematic variation across different destination regions. These results are presented in Table 2. Overall, the ROO index appears to be evenly distributed across different destinations.

Empirical strategy

To test our theoretical predictions, we first run the following regression:

$$\Delta p_{itnc} = \alpha_0 + \alpha_1 D_i^{TB} \times D_i^{RH} + \alpha_2 D_i^{TB} + \alpha_3 D_i^{RH} + \vec{\alpha}_\Lambda^\top \Lambda_{it} + \delta_{nc} + \delta_{ct} + \varepsilon_{itnc}\,, \quad (29)$$

where $\Delta p_{itnc} \equiv \ln p_{itn,US} - \ln p_{itn,c}$ is the difference in log unit values for good i originating in province n between exports to the US and exports to country c in year t; D_i^{RH} is a dummy variable taking the value of one if the ROO index is above the median and zero otherwise.[15] To capture the binding criteria in the forms of tariffs, we introduce a dummy variable D_i^{TB} that takes the value of one (and zero otherwise) if (i) the input tariff gap of good i between the US's external MFN and preferential tariffs is below an arbitrary threshold of the sample median, and (ii) the output tariff gap of final goods associated with good i between Canada's MFN and preferential tariffs is above an arbi-

[15]We first consider specifications with a discrete categorization of high versus low ROO index, rather than the index itself, for easier interpretation of the coefficients. As a robustness check, we then consider specifications that directly incorporate the continuous ROO index (see Appendix B).

trary threshold of the sample median.[16] As our focus is on the prices charged by Canadian exporters to US importers of intermediate inputs, the relevant MFN input tariffs are those that apply to competing imports of intermediate goods into the US from non-FTA regions. And as US final goods producers are the ones facing origin requirements, the relevant MFN output tariffs are those that apply to competing imports of final goods into Canada from non-FTA regions.[17]

We also include fixed effects δ_{nc} to control for province×destination-specific factors affecting the cost or quality of exports—e.g. selection effects arising from variation in the relative incidence of transportation costs by distance (the so-called Alchian-Allen effect)—and δ_{ct} to control for time-variant and destination-specific macro variables such as income and exchange rates. Two further controls are included in Λ_{it}: these are PT_{it} (time-varying), for product trends such as quality upgrading, and initial MFN tariffs for good i, MFN_i (time-invariant), to account for possible selection effects, whereby inputs originally facing high input tariffs could be more likely to be included in CUSFTA's content requirements. All regressions are weighted by relative trade values, so that observations with higher trade shares relative to the US would be assigned higher weights.

This specification directly relates to the prediction of Proposition 1, which says that markups should be higher under a binding domestic content requirement than they are in its absence. Our dependent variable is meant to proxy for markup differences for a given product from the same province between markets in the US and non-FTA trading partner, c. Thus, an estimate of α_1 that is significantly greater than zero indicates that stricter and more likely to be binding content requirements for a product ($D_i^{RH} = 1$ and $D_i^{TB} = 1$) are associated with higher unit value gaps (i.e. higher gaps in markups) between exports to FTA and non-FTA destinations.[18] We also test whether conditional on tariffs being binding, predicted $\Delta\hat{p}_{itnc}$ is significantly different between high ROO index ($D_i^{TB} = 1, D_i^{RH} = 1$) and low ROO index ($D_i^{TB} = 1, D_i^{RH} = 0$).

To test the predictions of Propositions 2 and 3—stating that a given content requirement is more likely to be binding the larger is the required level of domestic content, the smaller are input tariffs, and the larger are output tariffs—we use continuous tariff rates interacted with the ROO index, ROI_i, in the following specification:

$$\begin{aligned}\Delta p_{itnc} = \quad & \beta_0 + \beta_1\, ROI_{it} \times \Delta T_{it}^{I} + \beta_2\, ROI_{it} \times \Delta T_{it}^{O} + \beta_3\, ROI_{it} + \beta_4\, \Delta T_{it}^{I} + \beta_5\, \Delta T_{it}^{O} \\ & + \vec{\beta}_{\Lambda}^{\top}\, \Lambda_{it} + \delta_{nc} + \delta_{ct} + \varepsilon_{itnc}\,, \end{aligned} \tag{30}$$

[16]We then relax or tighten these thresholds with the 25^{th} percentile or the 75^{th} percentile for both tariffs. Later, in robustness checks, we turn to identify actual binding criteria by industry.

[17]In robustness checks, we carry out a placebo test to show that MFN output tariffs facing US exporters of final goods do not matter.

[18]We later carry out diagnostics to ensure that price gaps are not driven by systematic quality differentials (see Table 5).

where ROI_i measures the restrictiveness of CUSFTA's content requirements for good i as previously defined, ΔT^I_{it} is the input tariff gap for good i between the external MFN rates and the preferential tariffs facing US importers in year t, and ΔT^O_{it} is the average output tariff gap between external MFN rates and the preferential tariffs faced by Canadian importers in year t for all final goods associated with intermediate input i.[19] We include the same fixed effects and controls as in specification (29). Propositions 2 and 3 predict that $\beta_1 < 0$ and $\beta_2 > 0$.

Results

Panel A of Table 3 reports estimates for specification (29) using our main sample (i.e. including all intermediate goods defined in CUSFTA's ROOs). In columns (1)-(3) of Table 3, we begin with median values (P50) for both tariffs as binding thresholds; these build up to our preferred specification in column (4) with different combinations of fixed effects.

We first interpret our results qualitatively, focusing on our preferred specification in column (4). We can see that the main coefficient of interest is significantly greater than zero ($\hat{\alpha}_1 = 0.247 > 0$), which indicates that stricter and more likely to be binding content requirements (with median values as thresholds for both tariffs and the ROO index) are associated with higher unit value gaps between FTA and non-FTA regions. This is consistent with Proposition 1. Note that when goods fall into the binding tariffs group $(D^{TB}_i = 1)$, they also face lower input MFN tariffs. When ROOs for these goods are not restrictive $(D^{RH}_i = 0)$, this translates into more competitive pressure from non-FTA sources, which could explain the lower unit value gap ($\hat{\alpha}_2 = -0.233 < 0$). Also note that it is not the ROO requirement alone, but rather its interaction with the tariff binding criteria, that is associated with higher unit value gaps (as $\hat{\alpha}_3 = -0.15 < 0$).

In column (5), we consider stricter tariff binding thresholds, using the 25^{th} percentile (P25) for input tariff gaps and the 75^{th} percentile (P75) for output tariff gaps. As expected, the estimated gap of unit values is wider ($\hat{\alpha}_1 = 0.394 > 0$), suggesting stronger market power of Canadian exporters under more strictly binding content requirements. In column (6), where we consider more liberal tariff binding thresholds with P75 for input tariff gaps and P25 for output tariff gaps, the estimated coefficient becomes insignificant. By the logic of our theoretical analysis, this is to be expected under more loosely defined binding criteria.

For easier quantitative interpretation of our results, we report in Panel B the total predicted effects on $\Delta\hat{p}_{itnc}$ for each group of high ROO index ($D^{RH}_i = 1$) versus low ROO index ($D^{RH}_i = 0$) and whether tariffs meet binding criteria ($D^{TB}_i = 1$, and $D^{TB}_i = 0$ otherwise). Focusing on column (4) again, we compare the differences between the first

[19] Using trade weighted output tariffs does not change our results.

Table 3: Rules of origin and unit export values: binding tariff and ROO thresholds

Dep. variable: Δp_{itnc}	P50, P50 (1)	P50, P50 (2)	P50, P50 (3)	P50, P50 (4)	strict P25, P75 (5)	liberal P75, P25 (6)
Panel A: Estimates						
$D_i^{TB} \times D_i^{RH}$	0.363^a (0.042)	0.364^a (0.042)	0.241^a (0.043)	0.247^a (0.043)	0.394^a (0.11)	0.005 (0.029)
D_i^{TB}	-0.241^a (0.022)	-0.233^a (0.023)	-0.247^a (0.023)	-0.233^a (0.023)	-0.072 (0.084)	-0.067^a (0.02)
D_i^{RH}	-0.154^a (0.016)	-0.166^a (0.016)	-0.144^a (0.016)	-0.15^a (0.016)	-0.13^a (0.015)	-0.113^a (0.023)
Panel B: Predicted $\Delta \hat{p}_{itnc}$						
$D_i^{TB} = 1, D_i^{RH} = 1$	0.299^a (0.037)	0.301^a (0.036)	0.174^a (0.04)	0.164^a (0.04)	0.506^a (0.074)	0.131^a (0.025)
$D_i^{TB} = 1, D_i^{RH} = 0$	0.091^a (0.019)	0.103^a (0.02)	0.077^a (0.029)	0.067^b (0.03)	0.242^a (0.087)	0.24^a (0.027)
$D_i^{TB} = 0, D_i^{RH} = 1$	0.177^a (0.011)	0.17^a (0.011)	0.18^a (0.021)	0.151^a (0.023)	0.184^a (0.022)	0.193^a (0.028)
$D_i^{TB} = 0, D_i^{RH} = 0$	0.332^a (0.012)	0.336^a (0.011)	0.324^a (0.016)	0.3^a (0.018)	0.314^a (0.018)	0.306^a (0.018)
FE: province×country	No	Yes	No	Yes	Yes	Yes
FE: country×time	No	No	Yes	Yes	Yes	Yes
Observations	63,813	63,813	63,813	63,813	63,813	63,813
R^2	0.02	0.05	0.05	0.06	0.06	0.06

Notes: Country×product trends and the initial MFN tariffs as controls are included but not reported. All columns are weighted with relative trade values of good i in year t between the US and the non-FTA partner c. Columns (1)-(4) use P50 for both tariffs as binding thresholds. Column (5) uses stricter binding thresholds, P25 for input tariff gaps and P75 for output tariff gaps. Column (6) uses more liberal binding thresholds, P75 for input tariff gaps and P25 for output tariff gaps. ^{a} indicates significance at the one percent level, and ^{b} indicates significance at the five percent level. Standard errors are clustered at the product×country level.

two rows to see the effect of content requirements on unit value gaps, conditional on tariffs being binding ($D_i^{TB} = 1$). On average, goods with a high ROO index (above median) have roughly ten percentage points higher unit value gaps between FTA and non-FTA export markets, compared to those with low ROO index. The actual predicted difference is 0.097 (= 0.164 − 0.067) and significant at the five percent level ($p = 0.0228$). Alternatively, we can interpret this result as a roughly ten percent higher absolute unit value for exports to the US versus exports to other destinations (i.e., $p_{itn,US}/p_{itn,c}$) for those goods that have a higher ROO index relative to those with a lower ROO index.[20]

On the other hand, when tariffs are not likely to be binding (comparing rows 3 and 4 in column (4)), more restrictive content requirements are associated with lower unit value gaps between FTA and non-FTA export markets. The difference is significant at

[20]Denote with $\hat{p}_1 \equiv p_{itn,US}/p_{itn,c}$ the predicted absolute unit value ratio for the high ROO index group ($D_i^{TB} = 1$ & $D_i^{RH} = 1$) and with $\hat{p}_2$ the corresponding ratio for the low ROO index group ($D_i^{TB} = 1$ & $D_i^{RH} = 0$). We can derive the predicted value for $(\hat{p}_1 - \hat{p}_2)/\hat{p}_2$ as $(e^{0.097} - 1) \approx 0.1019$.

the one percent level ($p < 0.0001$). This result further strengthens our theoretical finding that it is the restrictiveness of content requirements interacted with binding tariffs, rather than the ROO index alone, that drives up unit value gaps.

Similar to the results in Panel A, in column (5) with stricter tariff binding thresholds, we can see that the estimated gap of unit values is wider, at roughly 25 percentage points ($= 0.506 - 0.242$) and significant at the five percent level, again suggesting stronger market power of Canadian exporters under more strictly binding content requirements. In column (6) with more liberal tariff binding thresholds, the result is now reversed and resembles the non-binding group. Overall, our results in Table 3 provide strong evidence that stricter and binding content requirements are associated with higher unit value gaps, in line with Proposition 1.

Results for specification (30) are reported in Table 4. Columns (1)-(3) build up to our main specification, reported in column (4). Estimated coefficients are $\hat{\beta}_1 = -13.23 < 0$ and $\hat{\beta}_2 = 9.577 > 0$. These results offer evidence in support of Propositions 2 and 3, which predict that a domestic content requirement is more likely to be binding the larger is the ROO index, the smaller are input tariffs, and the larger are output tariffs, resulting in higher unit value gaps between FTA and non-FTA regions. Notice again that a higher ROO index itself is not necessarily associated with a higher unit value gap, as the coefficients for the ROO index is mostly insignificant.

Our interpretation of these unit value gaps as reflecting gaps in markups, however, hinges on exports to the US and exports to other destinations containing goods of similar quality. The inclusion of dummies for combinations of province of origin and destination country controls for systematic variation in quality that is associated with different areas of origin or destinations but is common across products. But there may still be variation in quality that is product-and-destination specific. To check that our results are not driven by higher quality products (proxied by higher prices) being shipped to the US whereby unit value gaps Δp_{itnc} are always positive, we derive estimates, in column (1) of Table 5, for a sub-sample of goods that feature negative unit value gaps. In column (2) we report results for the opposite case where unit values are always higher for exports to the US. Results are robust for both sub-samples.

In column (3) of Table 5 we also report estimates for a restricted sub-sample that only includes exports to advanced economies with more homogeneous product quality.[21] In column (4), we only include exports to developing economies, defined as all other countries excluding advanced ones in column (3), and find that the output tariff channel

[21] As defined by the IMF, the 39 advanced economies are: Australia, Austria, Belgium, Canada, Cyprus, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hong Kong, Iceland, Ireland, Israel, Italy, Japan, Korea, Latvia, Lithuania, Luxembourg, Macao, Malta, Netherlands, New Zealand, Norway, Portugal, Puerto Rico, San Marino, Singapore, Slovak Republic, Slovenia, Spain, Sweden, Switzerland, Taiwan, the UK, and the US.

Table 4: Rules of origin and unit export values: using ROO index

Dep. variable: Δp_{itnc}	(1)	(2)	(3)	(4)
$ROI_{it} \times \Delta T_{it}^{I}$	-10.602^{a}	-11.97^{a}	-12.097^{a}	-13.23^{a}
	(2.372)	(2.473)	(2.516)	(2.578)
$ROI_{it} \times \Delta T_{it}^{O}$	10.563^{a}	11.144^{a}	9.175^{a}	9.577^{a}
	(2.589)	(2.607)	(2.76)	(2.763)
ROI_{it}	-0.013	-0.048	0.032	0.013
	(0.085)	(0.09)	(0.086)	(0.09)
ΔT_{it}^{I}	6.562^{a}	6.764^{a}	5.514^{a}	5.593^{a}
	(0.708)	(0.736)	(0.729)	(0.92)
ΔT_{it}^{O}	-1.003	-1.202	-1.653^{b}	-1.683^{b}
	(0.804)	(0.81)	(0.826)	(0.828)
FE: province×country	No	Yes	No	Yes
FE: country×time	No	No	Yes	Yes
Observations	63,813	63,813	63,813	63,813
R^2	0.03	0.05	0.05	0.06

Notes: Country×product trends and the initial MFN tariffs as controls are included but not reported. All columns are weighted with relative trade values of good i in year t between the US and the non-FTA partner c. ^{a} indicates significance at the one percent level, and ^{b} indicates significance at the five percent level. Standard errors are clustered at the product×country level.

Table 5: Rules of origin and unit export values: controlling for quality differentials

Dep. variable:	Neg. Δp_{itnc}	Nonneg. Δp_{itnc}	Advanced	Developing	Excl. Mexico	Top 10 partners
	(1)	(2)	(3)	(4)	(5)	(6)
$ROI_{it} \times \Delta T_{it}^{I}$	-4.541^{a}	-21.518^{a}	-18.947^{a}	-7.1^{b}	-13.119^{a}	-17.194^{a}
	(1.48)	(3.17)	(3.898)	(2.77)	(2.613)	(5.54)
$ROI_{it} \times \Delta T_{it}^{O}$	6.213^{a}	10.719^{a}	14.747^{a}	3.712	9.462^{a}	16.782^{a}
	(1.759)	(3.058)	(4.161)	(3.164)	(2.802)	(6.098)
ROI_{it}	-0.177^{a}	0.133	0.148	-0.169	0.025	0.172
	(0.058)	(0.12)	(0.132)	(0.105)	(0.091)	(0.171)
ΔT_{it}^{I}	-0.697	8.779^{a}	7.716^{a}	3.043^{a}	5.451^{a}	7.398^{a}
	(0.446)	(0.941)	(1.125)	(0.838)	(0.756)	(1.571)
ΔT_{it}^{O}	-2.145^{a}	-1.219	-2.558^{b}	-0.842	-1.616^{b}	-3.686^{b}
	(0.574)	(0.953)	(1.223)	(1.029)	(0.838)	(1.687)
FE: province×country	Yes	Yes	Yes	Yes	Yes	Yes
FE: country×time	Yes	Yes	Yes	Yes	Yes	Yes
Observations	29,585	34,228	34,100	26,713	62,576	19,653
R^2	0.09	0.1	0.05	0.09	0.06	0.06

Notes: Country×product trends and the initial MFN tariffs are included as controls but not reported. All columns are weighted with relative trade values of good i in year t between the US and the non-FTA partner c. ^{a}, ^{b}, and ^{c} indicate significance at the one, five, and ten percent levels, respectively. Standard errors are clustered at the product×country level.

becomes insignificant. Our results are also robust to omitting Mexico (Canada's second FTA trading partner via NAFTA) from the sample, in column (5). Finally, in column (6) we find very similar results when we include only Canada's top ten trading partners (other than the US) by export shares.[22]

An alternative way of controlling for quality gap is by including province×product fixed effects, which allows for province-specific price gaps between FTA and non-FTA goods for a particular product. Our results are robust to this change (see Appendix B).

Given that product differentiation translates into more market power for producers, effects on markups should be more evident in markets for differentiated goods. Table 6 reports results obtained from specification (30) with a further dummy variable D_i^{GC} to capture good characteristics based on the Rauch classification for product heterogeneity (Rauch, 1999) and the Broad Economic Categories (BEC) classification for the main end-use of products.[23]

In column (1) of Table 6 we compare Rauch reference priced goods ($D_i^{GC} = 1$) with non-reference priced goods ($D_i^{GC} = 0$). We would expect market power to be more relevant, and thus our results to hold, for non-reference priced goods. We can see that this is indeed the the case: we obtain $\hat{\beta}_1 < 0$ and $\hat{\beta}_2 > 0$ for non-referenced priced goods, whereas for reference priced goods these coefficients are either insignificant or do not have the expected sign. Similarly, in column (2) we consider Rauch homogeneous goods ($D_i^{GC} = 1$) versus differentiated goods ($D_i^{GC} = 0$); and again coefficients are significant and of the expected sign only for non-homogeneous products. Overall, these findings are consistent with the notion that product differentiation confers more market power.

Guided by our theoretical predictions, our main analysis has focused on intermediate goods used to produce final goods qualifying for FTA preferential tariffs. In column (3) we also include BEC consumption and capital goods originally excluded from our sample. Here the dummy variable D_i^{GC} takes a value of one for consumption and capital goods and zero otherwise (which corresponds to our main sample).[24] We find that the interactions between the ROO index and tariffs have no statistical significance, consistently with the theoretical prediction that ROOs should alter market power only for goods that are used as manufacturing inputs.

[22]These partners include: Japan, United Kingdom, China, Germany, South Korea, Belgium, Netherlands, Italy, Union of Soviet Socialist Republics and France.

[23]The Rauch classification categorises goods according to three types: differentiated products, reference priced goods, or homogeneous goods. The BEC classification categorizes goods into three types: intermediate goods for industrial use, capital goods or consumption goods.

[24]Note however that the coefficients do not coincide with those in column(4) in Table 4 because we do not allow fixed effects to vary by D_i^{GC}.

Table 6: Rules of origin and unit export values: good characteristics

Dep. variable: Δp_{itnc}	D_i^{GC}: Rauch reference priced	D_i^{GC}: Rauch homogeneous	D_i^{GC}: BEC capital & consum. goods
	(1)	(2)	(3)
$ROI_{it} \times \Delta T_{it}^I \times (D_i^{GC} = 1)$	-2.315 (2.87)	13.5 (9.018)	-3.893 (2.949)
$ROI_{it} \times \Delta T_{it}^I \times (D_i^{GC} = 0)$	-29.839^a (3.388)	-24.331^a (3.26)	-12.636^a (2.462)
$ROI_{it} \times \Delta T_{it}^O \times (D_i^{GC} = 1)$	-12.02^a (2.67)	-40.138^a (10.64)	-2.822 (2.707)
$ROI_{it} \times \Delta T_{it}^O \times (D_i^{GC} = 0)$	27.306^a (3.386)	12.68^a (3.003)	10.44^a (2.742)
$ROI_{it} \times (D_i^{GC} = 1)$	-0.089 (0.084)	0.507^b (0.221)	0.625^a (0.071)
$ROI_{it} \times (D_i^{GC} = 0)$	0.072 (0.114)	0.02 (0.096)	-0.084 (0.079)
$\Delta T_{it}^I \times (D_i^{GC} = 1)$	4.803^a (1.031)	-2.549 (0.67)	3.083^a (0.95)
$\Delta T_{it}^I \times (D_i^{GC} = 0)$	6.964^a (0.888)	7.912^a (0.94)	6.035^a (0.723)
$\Delta T_{it}^O \times (D_i^{GC} = 1)$	2.817^a (1.06)	0.691 (1.821)	0.035 (0.807)
$\Delta T_{it}^O \times (D_i^{GC} = 0)$	-4.617^a (0.973)	-2.234^b (0.976)	-2.143^a (0.831)
FE: province×country	Yes	Yes	Yes
FE: country × time	Yes	Yes	Yes
Observations	63,813	63,813	117,276
R^2	0.07	0.07	0.05

Notes: Country×product trends and the initial MFN tariffs as controls are included but not reported. All columns are weighted with relative trade values of good i in year t between the US and the non-FTA partner c. ^{a} indicates significance at the one percent level, and ^{b} indicates significance at the five percent level. Standard errors are clustered at the product×country level.

Further robustness checks

Appendix B reports a whole battery of robustness checks, focusing on industry-level evidence and alternative samples and fixed-effects specifications. Overall, the patterns we find are supportive of our main findings.

In Table B1 of Appendix B, we report results for a variant of specification (29) in which the ROO dummy variable is replaced by the actual ROO index, ROI_i. These results are consistent with those reported in Table 3.

To check that our results are not driven by the industry composition of our sample but rather by the interactions between tariffs and the restrictiveness of content requirements, we identify industry-specific binding thresholds using rolling regressions. Using these more precisely-defined thresholds does not qualitatively change our main findings (Tables B2-B4).

Our results are robust to excluding from our sample products which had high initial MFN tariffs above the median tariffs (Table B5, column (1)). This addresses a potential

concern about selection: industries that were initially protected by high tariffs might have lobbied more for protection through ROOs in CUSFTA negotiations. We also show that our results are robust to a longer sample period of 1989-2000 (Table B5, column (2)). As a placebo test, we replace the MFN output tariffs with WTO tariffs (for US exports), and confirm that what matters for the market power of Canadian exporters of intermediate goods are indeed the CUSFTA preferential rates relative to Canada's MFN rates (Table B5, columns (3)-(4)). What tariffs other WTO members levy on US products is of no consequence. Finally, we run our main specification (30) with a subsample of differentiated goods including a series of additional fixed effects, including (i) province×country×time fixed effects to control for province-destination specific and time-variant cost shocks, (ii) province×pro-
duct fixed effects to further control for province specific quality gaps between FTA and non-FTA for a given product, (iii) industry×country fixed effects, to take into account other cost factors that may be specific to an industry, and (iv) province×product×country fixed effects to account for country specific tastes for a specific province×product pair. All these results reported in Table B6 are in line with those reported in Table 4.

4.2 Evidence from US Census data

Data and descriptive statistics

We combine annual US PPI data for manufacturing industries from the US Bureau of Labor Statistics, with industry-level concentration measures (Herfindahl-Hirschman Index, HHI), values of shipments and total number of firms from the Economic Census. All these data use the Standard Industrial Classification (SIC). After dropping industries with no products defined in CUSFTA's ROOs, our full sample covers 334 industries at the 4-digit SIC level out of the total of 440 in manufacturing sector (SIC 20-39).

Table 7 reports descriptive statistics of these 334 SIC industries. PPI changes between 1987 and 1992 average to about 13.57 percent (at the minimum and maximum, PPI changes are −31.69 percent and 45.41 percent, respectively).[25] We also report the distribution of the ROO index, as previously defined, but weighted at the SIC level.[26] The Herfindahl-Hirschman Index (HHI) ranges between 4 and 2,830 with a mean of 671. We also report changes from pre- to post-CUSFTA firm numbers and sales. On average firm numbers barely increase (an increase of about 0.57 percent) but there is variation

[25] An obvious caveat in this exercise is that we cannot separate intermediate inputs from final goods. In our empirical specification, we address this issue with fixed effects at the SIC 2-digit level as industries in the same SIC 2-digit sector are likely to have similar good characteristics in terms of the end-use of products.

[26] For how the weighted ROO index is calculated, see equation (31) for details.

Table 7: PPI and market concentration: summary statistics, US industries (SIC)

	Mean	Median	Std. dev.	Min	Max
Observations	334	–	–	–	–
PPI change (%), 1987-1992	13.57	14.07	0.09	−31.69	45.41
ROO index	0.32	0.28	0.12	0	1
Herfindahl-Hirschman Index (HHI)	671	461	610.06	4	2,830
Firm number change (%), 1987-1992	0.57	2	0.19	−146.63	53.41
Sales change (%), 1987-1992	17.25	18.28	0.21	−72.15	113.17

Notes: For each variable, the table reports its mean, median, standard deviation, and the minimum and maximum values.

across industries (the minimum implies firm exit by 150 percent and the maximum implies firm entry by 53 percent). Sales grow by 17.25 percent on average, but growth rates differ across industries (the minimum and maximum being −72.15 percent and 113.17 percent, respectively).

Empirical strategy

Information on PPIs is used to run the following specification:

$$\begin{aligned} PPI\_Change_j = \quad & \gamma_0 + \gamma_1\, ROI_j \times \Delta T_j^I + \gamma_2\, ROI_j \times \Delta T_j^O + \gamma_3\, ROI_j + \gamma_4\, \Delta T_j^I + \gamma_5\, \Delta T_j^O \\ & + \gamma_6\, N\_Change_j + \gamma_7\, Share\_Change_j + \delta_{SIC\_2_j} + \epsilon_j, \end{aligned} \tag{31}$$

where $PPI\_Change_j \equiv \ln(PPI_{j,92}) - \ln(PPI_{j,87})$ is the log change of PPI from 1987 (pre-CUSFTA) to 1992 (post-CUSFTA) for industry j, ΔT_j^I is the weighted average of post-CUSFTA (1989-92) input tariff gaps for industry j between the external MFN rates and preferential tariffs (facing US importers), and ΔT_j^O is the weighted average of post-CUSFTA output tariff gaps between MFN and preferential rates of all final goods associated with industry j's intermediate inputs (facing Canadian importers).[27] Similarly to (30), ROI_j represents a weighted average of the ROO index defined in the main analysis.[28]

We also add two control variables $N\_Change_j \equiv \ln(N_{j,92}) - \ln(N_{j,87})$ as the log change of firm numbers and $Share\_Change_j \equiv \ln(Share_{j,92}) - \ln(Share_{j,87})$ as the log change of

[27] Note that pre-CUSFTA tariff gaps would be zero (as preferential tariffs did not exist prior to CUFSTA), and so our approach is akin to a diff-in-diff analysis. Post-CUSFTA tariff changes are used as additional controls (see column (3) of Table 8).

[28] For both tariffs and the ROO index, we use trade shares as weights to convert from the HS 6-digit to SIC 4-digit level. The weight assigned to each HS product is calculated with its export share within a given SIC industry during the sample period. Using import shares as weights does not qualitatively change the results.

shipment value between the years of 1987 to 1992. Fixed effects are included at the SIC 2-digit level to account for sector-specific factors that could affect marginal costs. The whole regression is weighted by Canada's share in US exports of final goods associated with industry *j*'s products used as intermediate inputs, which reflects the relative importance of CUSFTA's rules of origin in industry *j*'s pricing decisions.[29]

We further interact all variables with a dummy for industries with high HHI indicating market structures closer to oligopoly as assumed in our theory, and we test the theoretical predictions that $\gamma_1 < 0$ and $\gamma_2 > 0$ for oligopoly industries.

Results

Table 8 reports results from specification (31). In column (1) of Table 8, we begin with a binding sub-sample using an arbitrary binding criteria of P75 for input tariff gaps and P25 for output tariff gaps.[30] We can see that, even without distinguishing between market structures, the coefficients have the expected signs—the first two rows have $\gamma_1 < 0$ and $\gamma_2 > 0$—but only one of them is significant at the 5% level. In columns (2)-(5) we interact all variables with a dummy which takes the value of one if the industry's HHI in 1987 was above 1,800 ($Olig = 1$). This gives thirty-five oligopoly industries.[31] Results from our main specification are reported in column (2) and show that stricter and binding ROOs are associated with higher prices for oligopoly industries only, offering evidence in support of our theoretical prediction that effects should be stronger in oligopolistic markets. It is also worth noting that firm entry significantly lowers prices for oligopoly industries only, whereas higher value of shipments is associated with higher prices only for non-oligopoly industries. In column (2), with our preferred specification, a 10% increase in firm numbers is associated with a price drop of 7.5 percentage points ($= 0.746 \times 100\% \times 0.1$) for oligopoly industries.

In column (3), we further control for post-CUSFTA tariff changes, including log changes in both input and output tariffs from 1989 to 1992, and our results remain very similar to those in column (2). In column (4) we use stricter binding criteria and observe larger magnitudes for both coefficients γ_1 and γ_2 for oligopoly industries only.[32] In column (5) we consider looser criteria and our results remain robust. Finally, in column (6) we use a lower HHI threshold for defining oligopoly industries (giving us now seventy

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[29] Using Canada's share in US imports of intermediate goods yields very similar results.

[30] Recall that lower input tariffs and higher output tariffs make ROOs more binding. Here we choose a relatively loose criteria to remove industries facing tariff rates that are unlikely to be binding (i.e. excluding industries facing very high input tariffs and very low output tariffs at the same time).

[31] Using the 1992 HHI yields very similar results.

[32] Note that for output tariffs, P25 corresponds to one percentage point difference between the external MFN and FTA preferential rates. Any stricter threshold would eliminate too many observations so we keep P25 for output tariffs.

Table 8: Rules of origin and US PPIs

Dep. variable: PPI_change_j		HHI≥1800 as oligopoly				HHI≥1200 as oligopoly
	(1)	(2)	(3)	(4)	(5)	(6)
$ROI_j \times \Delta T_j^I$	-1.472 (4.48)	–	–	–	–	–
$ROI_j \times \Delta T_j^O$	20.823^b (10.383)	–	–	–	–	–
$ROI_j \times \Delta T_j^I \times (Olig = 1)$	–	-104.37^a (34.709)	-104.2^a (35.012)	-917.11^a (254.897)	-121.85^a (43.015)	-68.44^b (31.511)
$ROI_j \times \Delta T_j^I \times (Olig = 0)$	–	1.587 (3.967)	1.617 (3.948)	8.403 (9.753)	-2.651 (3.609)	0.16 (4.002)
$ROI_j \times \Delta T_j^O \times (Olig = 1)$	–	209.31^a (71.993)	209.14^a (74.887)	420.78^a (82.948)	94.11^a (34.978)	177.08^a (51.26)
$ROI_j \times \Delta T_j^O \times (Olig = 0)$	–	15.362^c (8.687)	15.548^c (8.786)	28.923 (17.65)	13.11^b (6.127)	15.244^c (8.483)
N_change_j	-0.08^c (0.041)	–	–	–	–	–
$Share\_change_j$	0.124^a (0.043)	–		–	–	–
$N\_change_j \times (Olig = 1)$	–	-0.746^a (0.209)	-0.747^a (0.213)	-1.437^a (0.273)	-0.185 (0.187)	-0.304^c (0.17)
$N\_change_j \times (Olig = 0)$	–	-0.06 (0.4)	-0.063 (0.4)	-0.073 (0.479)	-0.041 (0.36)	-0.061 (0.41)
$Share\_change_j \times (Olig = 1)$	–	0.206 (0.135)	0.207 (0.099)	-0.153 (0.173)	0.064 (0.111)	0.211^b (0.1)
$Share\_change_j \times (Olig = 0)$	–	0.109^a (0.04)	0.109^a (0.04)	0.081 (0.049)	0.082^b (0.036)	0.102^b (0.043)
Binding criteria	P75, P25	P75, P25	P75, P25	P50, P25	P90, P25	P75, P25
FE: Sector	Yes	Yes	Yes	Yes	Yes	Yes
Controls: Tariff changes	No	No	Yes	No	No	No
Observations	191	191	191	129	232	191
R^2	0.31	0.4	0.44	0.53	0.38	0.38

Notes: Constant terms and the variables $ROI_j, \Delta T_j^I, \Delta T_j^O$ are included but not reported. All columns are weighted with Canada's share in US exports of final goods associated with industry j's products used as intermediate inputs. ^{a} indicates significance at the one percent level, ^{b} indicates significance at the five percent level and ^{c} indicates significance at the ten percent level. Robust standard errors are reported in parentheses.

oligopoly industries) and, overall, our results still hold.

4.3 Rules of origin and firm entry

In this section we provide evidence in support of the theoretical prediction that the equilibrium number of suppliers of intermediate inputs should be higher under a binding domestic content requirement than in its absence (Proposition 5)—i.e. that rules of origin encourage entry. To relate ROOs to changes in firm numbers pre- versus post-CUSFTA, we use US census data described in Section 4.2 and run the following specification (analogous to (31)):

$$\begin{aligned} D_j^{FN} = \quad & \theta_0 + \theta_1 \, ROI_j \times \Delta T_j^I + \theta_2 \, ROI_j \times \Delta T_j^O + \theta_3 \, ROI_j + \theta_4 \, \Delta T_j^I \\ & + \theta_5 \, \Delta T_j^O + \theta_6 \, Share\_Change_j + \delta_{SIC\_2_j} + \epsilon_j, \end{aligned} \tag{32}$$

where D_j^{FN} is a dummy variable that takes the value of one if the percentage change of firm numbers from 1987 (pre-CUSFTA) to 1992 (post-CUSFTA) for sub-industry j (at SIC 4 digit level) lies above its broader industry mean (at SIC 2 digit level) and zero otherwise. The reason for focusing on relative rather than absolute changes in firm numbers is that we wish to isolate the differential effects of differential ROOs from the first-order effects on industry composition triggered by the introduction of CUSFTA. By using this empirical strategy, we can measure the *comparative* effects of CUSFTA on firm entry across sectors facing differential ROOs within a broad industry.

All other variables in specification (32), as well as trade weights given to each industry j to reflect the relevance of rules of origin, are as defined in (31). And as (32), we further interact variables with a dummy for industries with high HHI indicating market structures closer to oligopoly as assumed in our theory, and we test the theoretical predictions that $\theta_1 < 0$ and $\theta_2 > 0$ for oligopoly industries. Table 9 reports estimation results.

In column (1) of Table 9, we report results for a sub-sample of binding cases using an arbitrary binding criteria of P75 for input tariff gaps and P25 for output tariff gaps. We can see that without distinguishing market structures, the coefficient is as expected and significant for output tariff (see the second rows that $\theta_2 > 0$) but not for input tariff. In columns (2)-(4) we interact all variables with a dummy which takes the value of one if the industry's HHI in 1987 was above 1,800 ($Olig = 1$). Results from our main specification are reported in column (2) where we confirm that stricter and binding ROOs are associated with relatively higher firm entry for oligopoly industries only (see the first two rows that $\theta_1 < 0$ and $\theta_2 > 0$). Notice that in our sample, 8 out of 20 industries at SIC 2 digit level (or 150 out of 334 sub-industries at SIC 4 digit level) experienced an average drop in firm numbers (see Table 7). Our results thus suggest that for these industries, sub-industries that have been comparatively more sheltered by tight rules of origin have

Table 9: Rules of origin and firm entry

Dep. variable: D_j^{FN}		HHI≥1800 as oligopoly			HHI≥1500 as oligopoly	HHI≥1200 as oligopoly
	(1)	(2)	(3)	(4)	(5)	(6)
$ROI_j \times \Delta T_j^I$	14.801 (33.68)	–	–	–	–	–
$ROI_j \times \Delta T_j^O$	225.31[a] (64.66)	–	–	–	–	–
$ROI_j \times \Delta T_j^I \times (Olig = 1)$	–	−181.41[a] (49.54)	−194.82[a] (46.01)	−159.34[a] (50.67)	−161.644[c] (90.29)	−99.84 (90.4)
$ROI_j \times \Delta T_j^I \times (Olig = 0)$	–	4.917 (27.17)	11.437 (31.38)	7.723 (23.13)	2.473 (27.48)	−0.968 (27.6)
$ROI_j \times \Delta T_j^O \times (Olig = 1)$	–	587.92[a] (153.53)	656.407[a] (153.29)	581.9[a] (89.21)	615.9[a] (163.99)	651.46[a] (156.49)
$ROI_j \times \Delta T_j^O \times (Olig = 0)$	–	151.6[c] (72.85)	143.514[c] (82.67)	100.5[a] (34.93)	134.668[c] (68.07)	113.57[c] (64.67)
$Share\_Change_j$	0.649[a] (0.165)	–	–	–	–	–
$Share\_Change_j \times (Olig = 1)$	–	−0.209 (0.232)	−0.23 (0.241)	−0.099 (0.134)	−0.298 (0.207)	−0.143 (0.11)
$Share\_Change_j \times (Olig = 0)$	–	0.811[a] (0.223)	0.803[a] (0.231)	0.841[a] (0.232)	0.82 [a] (0.192)	0.916[a] (0.198)
Binding criteria	P75, P25	P75, P25	P75, P25	P90, P10	P75, P25	P75, P25
FE: sector	Yes	Yes	Yes	Yes	Yes	Yes
Controls: tariff changes	No	No	Yes	No	No	No
Observations	191	191	191	234	191	191
R^2	0.23	0.31	0.32	0.28	0.33	0.36

Notes: Constant terms and the variables $ROI_j, \Delta T_j^I, \Delta T_j^O$ are included but not reported. All columns are weighted with Canada's share in US imports of intermediate goods in industry j. [a] indicates significance at the one percent level, [b] indicates significance at the five percent level and [c] indicates significance at the ten percent level. Standard errors are clustered at the sector (SIC 2-digit) level.

experienced comparatively less exit.

In column (3), we further control for tariff changes, including both input and output tariffs changes from 1987 to 1992, and our results remain very similar to those in column (2). The results are also quite robust to adopting less restrictive binding criteria in column (4). In column (5) we use a lower level of HHI for defining oligopoly industries, and we can see that our results hold qualitatively but lose some significance for input tariffs. When using an even lower HHI threshold in column (6), where more competitive industries are now included as oligopolists, we can see that the results start to change sign for input tariffs and none of the two coefficients of interest are significant. This provides strong support for our theoretical predictions on firm entry being applicable to industries with an oligopolistic market structure.

5 Conclusion

Rules of origin in FTAs generate a degree of market segmentation that boosts the market power of oligopolistic producers of intermediate goods, translating into higher markups and higher prices even in the absence of decreasing returns to scale in production. We should then expect to observe higher markups under a binding domestic content requirement than they in its absence. In turn, domestic content requirements should be more likely to be binding the tighter is the requirement, the smaller are MFN input tariffs, and the larger are MFN output tariffs. These predictions are borne out by evidence in Canadian export data and US PPI data.

As discussed in Section 3, these effects of ROOs on market power and markups imply that origin requirements have the potential of generating efficiency costs that go beyond those associated with the substitution of domestic intermediates for imported intermediates by domestic producers (as measured by the trade-barrier equivalent effect of ROOs). These additional efficiency costs stem from inefficient firm entry (and potentially inefficient selection of heterogeneously productive intermediate producers) due to ROOs sheltering domestic oligopolists from foreign competition.

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A Proofs of theoretical results

PROOF OF PROPOSITION 1: Since $\Phi(\tau_I) < 1$, the ratio $N/(N-1)$ is greater than the ratio $N/(N-\Phi(\tau_I))$, i.e. a binding content requirement results in a higher level of markup in comparison with the unconstrained case. □

PROOF OF PROPOSITION 2: Let $\Pi(p) = (M/N)\,(1-c/p)\,\big((1+\tau_I{}^{\sigma})/(\tau_I+\tau_I{}^{\sigma})\big) - F$ denote individual profits, in an unconstrained scenario where all suppliers charge a price p, with c denoting marginal cost; and let $\hat{\Pi}(p,r) = (M/N)\,(1-c/p)\,\big(1+r\,(\tau_I-1)\big)/\tau_I - F$ denote individual profits in a constrained scenario at level r where all producers charge a price p. Also, for given input tariffs, let $\tilde{r} = \tau_I{}^{\sigma}/(\tau_I+\tau_I{}^{\sigma})$ denote the regional value content under a common input price, p: this is independent of p. Finally let $\hat{p}(r)$ denote the equilibrium price under an RVC constraint at level r.

It is easy to verify that $\hat{\Pi}(p,\tilde{r}) = \Pi(p)$. Thus, in the absence of constraint, if all producers were to charge a price coinciding with $\hat{p}(\tilde{r})$, profits would be the same with and without a constraint. Next, suppose that, absent a constraint, all producers charge a price $\hat{p}(\tilde{r})$, and consider a unilateral price deviation by a single domestic producer, h. As $\hat{p}(\tilde{r})$ exceeds the unconstrained equilibrium price, and since $\hat{\Pi}(p,\tilde{r}) = \Pi(p)$, a downwards deviation in p_h from $\hat{p}(\tilde{r})$ must but profitable, and so the optimal price deviation, $p_h^*(\hat{p}(r)) = p^*(r)$ must lie below $\hat{p}(\tilde{r})$. Denoting the regional value content under such a deviation with $\check{r}\big(\hat{p}(r), p^*(r)\big)$, homotheticity implies $\check{r}\big(\hat{p}(r), p^*(r)\big) = \check{r}\big(1, p^*(r)/\hat{p}(r)\big) = \bar{r}(\gamma^*(r))$, where $\gamma^*(r) = p^*(r)/\hat{p}(r)$. The assumption $\sigma > 1$ implies $\bar{r}\big(\gamma^*(\tilde{r})\big) > \tilde{r}$, making a constraint at level $r = \tilde{r}$ slack under an optimal unilateral deviation, which implies that an outcome where all producers price at $\hat{p}(r)$ cannot be an equilibrium under a binding constraint $r = \tilde{r}$. If the RVC requirement, r, equals or exceeds the level $\underline{r} > \tilde{r}$ for which $\bar{r}\big(\gamma^*(\underline{r})\big) = \underline{r}$, on the other hand, unilateral deviations to $p^*(r) = \gamma^*(r)\,\hat{p}(r)$ cannot produce a switch to an unconstrained regime where $\tilde{r} > r$. (A value $\underline{r}$ such this must exist by continuity given that $\bar{r}\big(\gamma^*(\tilde{r})\big) > \tilde{r}$ and $\bar{r}\big(\gamma^*(1)\big) < 1$.) In this case an outcome where all producers price at $\hat{p}$ corresponds to an RVC constrained oligopolistic equilibrium outcome. □

PROOF OF PROPOSITION 3: This follows directly from (23) and (24). □

Proof of Proposition 4: For a given level of $\tau_I > 1$, the equilibrium level of domestic value content in the absence of an RVC constraint is $\rho(p, \tau_I p_D)$. Setting $\tau_I = 1$ (i.e. zero tariffs in intermediate imports) and imposing an RVC constraint at the level $r = \rho(p, \tau_I p_D)$ will thus produce the same effect on the relative value of imported intermediates in total intermediates use as imposing the tariff ($\tau_I > 1$) does. As long at the RVC constraint is binding, however, the expression for the markup under a binding RVC constraint, given by (22), is independent of r and always greater than the corresponding expression (18) for any level of τ_I. □

Proof of Proposition 5: Equilibrium levels for markups and the number of firms can be expressed as

$$N^* = \frac{M}{F}\,\frac{\mu^* - 1}{\mu^*}\,\frac{1 + {\tau_I}^{\sigma}}{\tau_I + {\tau_I}^{\sigma}}; \tag{33}$$

$$\mu^* = \frac{\sigma}{\sigma - 1}\left(1 - \frac{F}{(1 + 1/\tau_F)\,M}\,\frac{\tau_I + {\tau_I}^{2\sigma}}{(1 + {\tau_I}^{\sigma})^2}\right)^{-1}. \tag{34}$$

$$\hat{N}^* = \frac{M}{F}\,\frac{\hat{\mu}^* - 1}{\hat{\mu}^*}\,\frac{1 + (\tau_I - 1)\,r}{\tau_I}; \tag{35}$$

$$\hat{\mu}^* = \frac{\sigma}{\sigma - 1}\left(1 - \frac{F}{(1 + 1/\tau_F)\,M}\,\frac{\tau_I}{1 + (\tau_I - 1)\,r}\right)^{-1}. \tag{36}$$

Examining the expressions (34) and (36), and letting $K = \big(\tau_I + {\tau_I}^{2\sigma}\big)/(1 + {\tau_I}^{\sigma})^2$, $\hat{K} = \big(1 + (\tau_I - 1)\,r\big)/\tau_I$, we can see that $\hat{K} > K$ implies $\hat{\mu}^* > \mu^*$.

The denominator of the expansion of $\hat{K} - K$ is positive. The numerator equals

$$\tau_I\big(1 + {\tau_I}^{\sigma}\big)^2 - \big(\tau_I + {\tau_I}^{2\sigma}\big)\big(1 + (\tau_I - 1)\,r\big) \equiv A_1.$$

Since $\sigma > 1$ and $\tau_I \geq 1$, this is monotonically decreasing in r, reaching a minimum at $r = 1$; and so

$$A_1 \geq \tau_I\big(1 + {\tau_I}^{\sigma}\big)^2 - (\tau_I + {\tau_I}^{2\sigma})(1 + (\tau_I - 1)\,r) \equiv A_2.$$

Dividing this by τ_I, expanding and simplifying, we obtain:

$$\frac{A2}{\tau_I} = 1 + 2{\tau_I}^{\sigma} - \tau_I,$$

which is positive for $\sigma > 1$ and $\tau_I \geq 1$. The inequalities $A_1 > A_2$ and $A_2 > 0$ imply $A_1 > 0$. This implies $\hat{K} > K$ and hence $\hat{\mu}^* > \mu^*$.

Comparing next (33) and (35), we can conclude that, since $\hat{\mu}^* > \mu^*$, a sufficient condition for $\hat{N}^* > N^*$ is $\big(1 + (\tau_I - 1)\,r\big)/\tau_I \geq \big(1 - {\tau_I}^{\sigma}\big)/\big(\tau_I - {\tau_I}^{\sigma}\big)$. A sufficient condition for this to be met is $\tau_I \leq \big(r/(1 - r)\big)^{1/(\sigma - 1)}$; this coincides with condition (10), a necessary condition for the domestic content requirement to be binding. □

B Further empirical results and robustness checks

Results for continuous ROO index

In Table B1 we report results for a variant of specification (29) in which the ROO dummy variable is replaced by the continuous ROO index. These results are consistent with those reported in Table 3.

Results for actually binding tariffs

The binding criteria we use in deriving the results of Table 4 are rather arbitrary and do not necessarily reflect actual binding thresholds. To assess whether binding thresholds differ across industries, we use specification (29) with industry dummy variables to run a series of rolling regressions, using different input and output tariff thresholds. We start with the most loosely defined one until we find the first threshold level that yields a significant $\hat{\alpha}_1$.[33] By doing so we could in principle determine tariff levels that are as close as possible to actual binding tariffs.

We report detailed thresholds for each industry in Table B2. In our sample, most industries have input tariff thresholds at around 3.5 percentage points ($\Delta \overline{T}^I = 0.035$), implying that the difference between MFN and preferential rate for these inputs has to be below 3.5 percentage points to make ROOs binding. Most industries have output tariff thresholds at around 0.5 percentage point ($\Delta \overline{T}^O = 0.005$), implying that the difference between MFN and preferential rate for the associated final goods has to be greater than half of a percentage point in order for ROOs to be binding.

We then use these thresholds to check that our results are not driven by the industry composition of our sample, but rather by the interactions between tariffs and the restrictiveness of content requirements. In Table B3 we report results from the same specification used in column (4) of Table 4 but interacted with industry dummy variables. In column (1), when comparing across industries, we see results consistent with those reported in Table 4 except for a few industries: Chemicals, Textiles and Transportation for input tariffs, and Vegetables, Mineral Products, Stone and Glass, Transportation and Miscellaneous for output tariffs. In column (2) we report results for a sub-sample where tariffs are binding at the industry level, with missing coefficients implying that there is no evidence of binding tariffs for a particular industry. Conditional on tariffs being binding, the interactions between the ROO index and input tariffs are still significant except for Foodstuffs, Chemicals, Textiles and Miscellaneous. The interaction between the ROO index and output tariffs is significant, except for Vegetables. Intuitively, in those industries where tariffs are actually binding for content requirements, changes in tariffs do not account for higher price gaps.

To further investigate whether industry-level binding thresholds are relevant for

[33] We report results with separate rolling thresholds for input tariffs and output tariffs. Results with joint thresholds do not vary much.

Table B1: Rules of origin and export unit values: binding tariff thresholds and ROO index

Dep. variable: Δp_{itnc}	P50, P50 (1)	P50, P50 (2)	P50, P50 (3)	P50, P50 (4)	Strict P25, P75 (5)	Liberal P75, P25 (6)
$D^{TB} \times ROI_{it}$	1.615^a	1.641^a	1.178^a	1.191^a	3.355^a	0.62^a
	(0.157)	(0.158)	(0.172)	(0.174)	(0.448)	(0.127)
D^{TB}	-0.499^a	-0.503^a	-0.435^a	-0.427^a	-1.126^a	-0.253^a
	(0.04)	(0.041)	(0.042)	(0.043)	(0.17)	(0.039)
ROI_{it}	-0.237^a	-0.275^a	-0.195^a	-0.212^a	-0.151^b	-0.372^a
	(0.069)	(0.073)	(0.071)	(0.073)	(0.069)	(0.081)
FE: province×country	No	Yes	No	Yes	Yes	Yes
FE: country×time	No	No	Yes	Yes	Yes	Yes
Observations	63,813	63,813	63,813	63,813	63,813	63,874
R^2	0.02	0.05	0.05	0.06	0.06	0.06

Notes: Country×product trends and the initial MFN tariffs as controls are included but not reported. All columns are weighted with relative trade values of good i in year t between the US and the non-FTA partner c. Binding thresholds are the same as in Table 3. ^{a} indicates significance at the one percent level, and ^{b} indicates significance at the five percent level. Standard errors are clustered at the product×country level.

Table B2: Actually binding ROOs: criteria

HS2 Industry	Jointly binding	$(\Delta\bar{T}^I, \Delta\underline{T}^O)$
01-05 Animal & Animal Products	Output only	$(-, P25) = (-, 0.01)$
06-15 Vegetable Products	Yes	$(P75, P10) = (0.035, 0.005)$
16-24 Foodstuffs	Yes	$(P75, P50) = (0.035, 0.02)$
25-27 Mineral Products	No	—
28-38 Chemicals & Allied Industries	Yes	$(P75, P10) = (0.035, 0.005)$
39-40 Plastics / Rubbers	Yes	$(P75, P10) = (0.035, 0.005)$
41-43 Raw Hides, Skins, Leather, Furs	Yes	$(P75, P10) = (0.035, 0.005)$
44-49 Wood & Wood Products	Yes	$(P50, P10) = (0.02, 0.005)$
50-63 Textiles	Yes	$(P75, P10) = (0.035, 0.005)$
64-67 Footwear / Headgear	Not in sample	
68-71 Stone / Glass	Yes	$(P75, -) = (0.035, -)$
72-83 Metals	Yes	$(P50, P10) = (0.02, 0.005)$
84-85 Machinery / Electrical	Yes	$(P75, -) = (0.035, -)$
86-89 Transportation	No	—
90-97 Miscellaneous	Input only	$(P50, -) = (0.02, -)$

Notes: All Footwear / Headgear are consumption (final) goods and therefore are dropped from the main sample.

Table B3: ROO index and tariffs, by industry

Dep. variable: Δp_{itnc}	(1) Full sample		(2) Tariff binding	
HS2-Industry	$ROI_{it} \times \Delta T^I_{it}$	$ROI_{it} \times \Delta T^O_{it}$	$ROI_{it} \times \Delta T^I_{it}$	$ROI_{it} \times \Delta T^O_{it}$
01-05 Animal & Animal Products	-74.489^b	154.989^a	—	135.106^b
	(31.053)	(22.207)		(62.144)
06-15 Vegetable Products	-13.097^a	-14.841^b	-11.699^b	-17.33^b
	(4.8)	(32.313)	(4.932)	(6.907)
16-24 Foodstuffs	-34.406^a	56.242^a	1.88	90.539^a
	(6.603)	(10.735)	(6.374)	(11.664)
25-27 Mineral Products	-19.154^a	-98.578^a	—	—
	(6.025)	(11.407)		
28-38 Chemicals & Allied Industries	0.845	20.277^a	6.797	20.597^a
	(4.228)	(4.008)	(4.762)	(4.311)
39-40 Plastics / Rubbers	-41.071^a	35.863^a	-37.952^a	33.906^a
	(4.344)	(4.612)	(5.137)	(5.137)
41-43 Raw Hides, Skins, Leather, Furs	-35.743^a	37.331^a	-40.51^a	31.992^a
	(9.975)	(8.499)	(11.092)	(11.369)
44-49 Wood & Wood Products	-9.732^b	4.994^b	-19.15^a	4.928^b
	(3.858)	(2.422)	(6.405)	(2.764)
50-63 Textiles	−2.331	6.475^a	−1.261	6.312^b
	(2.285)	(2.348)	(2.832)	(2.659)
68-71 Stone / Glass	-76.704^a	11.199	-73.634^a	—
	(10.487)	(9.225)	(10.596)	
72-83 Metals	-6.409^c	9.986^b	-23.856^b	20.077^a
	(3.78)	(4.219)	(9.956)	(6.397)
84-85 Machinery / Electrical	-46.354^a	14.845	-41.665^a	—
	(5.454)	(9.382)	(5.695)	
86-89 Transportation	1587.508	−143.755	—	—
	(643.497)	(114.894)		
90-97 Miscellaneous	-215.546^c	-83.395^a	−442.151	—
	(128.024)	(32.313)	(307.536)	
Fixed effects:	prov.×country + country×time		prov.×country + country×time	
Observations	63,813		41,405	
R^2	0.12		0.11	

Notes: Industry dummy, country×product trends and the initial MFN tariffs as controls are included but not reported. All columns are weighted with relative trade values of good i in year$t$ between the US and the non-FTA partner c. ^{a}, ^{b}, and ^{c} indicate significance at the one, five, and ten percent levels, respectively. Standard errors are clustered at the product×country level.

Table B4: ROO index and tariffs, with tariff related binding dummy

Dep. variable: Δp_{itnc}	Full sample	Excl. non-binding industries	Only jointly binding industries
	(1)	(2)	(3)
$ROI_{it} \times \Delta T^{I}_{it} \times \left(D^{BI}=0\right)$	-16.103^{a} (4.264)	-34.369^{a} (5.079)	-26.222^{a} (5.16)
$ROI_{it} \times \Delta T^{I}_{it} \times \left(D^{BI}=1\right)$	-11.717^{a} (2.859)	-12.201^{a} (2.864)	-9.879^{a} (2.911)
$ROI_{it} \times \Delta T^{O}_{it} \times \left(D^{BI}=0\right)$	0.567 (4.387)	-13.742^{b} (5.415)	-17.083^{a} (5.445)
$ROI_{it} \times \Delta T^{O}_{it} \times \left(D^{BI}=1\right)$	11.926^{a} (2.989)	12.568^{a} (2.988)	7.263^{b} (3.073)
$ROI_{it} \times \left(D^{BI}=0\right)$	-0.028 (0.136)	0.677^{a} (0.155)	0.503^{a} (0.159)
$ROI_{it} \times \left(D^{BI}=1\right)$	-0.013 (0.113)	-0.028 (0.114)	0.378^{a} (0.109)
$\Delta T^{I}_{it} \times \left(D^{BI}=0\right)$	7.091^{a} (1.169)	9.835^{a} (1.351)	8.063^{a} (1.372)
$\Delta T^{I}_{it} \times \left(D^{BI}=1\right)$	5.299^{a} (0.825)	5.422^{a} (0.827)	4.641^{a} (0.81)
$\Delta T^{O}_{it} \times \left(D^{BI}=0\right)$	-4.739^{a} (1.566)	4.54^{b} (2.231)	9.291^{a} (2.238)
$\Delta T^{O}_{it} \times \left(D^{BI}=1\right)$	-3.625^{a} (0.936)	-3.397^{a} (0.938)	0.54 (0.911)
FE: province×country	Yes	Yes	Yes
FE: country×time	Yes	Yes	Yes
Observations	63,813	60,304	54,175
R^2	0.07	0.07	0.06

Notes: The binding dummy, country×product trends and the initial MFN tariffs as controls are included but not reported. All columns are weighted with relative trade values of good i in year t between the US and the non-FTA partner c. ^{a} indicates significance at the one percent level, and ^{b} indicates significance at the five percent level. Standard errors are clustered at the product×country level.

how content requirements are transmitted to prices, we run a variant of (30) that includes a dummy variable taking a value of one if tariffs fall into the binding criteria ($D^{BI} = 1$) and zero otherwise. These results are reported in Table B4, and show that higher ROO index and higher input tariffs are associated with lower price gaps, and that this finding applies to both binding and non-binding groups (see the first and second rows in Table B4). Also, a higher ROO index and higher output tariffs are associated with higher price gaps, but this is only true when tariffs make ROOs binding (see row 3 and 4). Our results remain robust in column (2), where we exclude industries with non-binding ROOs (i.e. Mineral Products and Transportation) and, in column (3), where we further exclude industries where ROOs are partially binding (Animal Products, Stone/Glass, Machinery and Miscellaneous).

Table B5: Alternative samples or tariff measures

Dep. variable: Δp_{itnc}	Excl. initial tariffs above median	1989-2000 longer sample	WTO output tariffs	WTO output weighted tariffs
	(1)	(2)	(3)	(4)
$ROI_{it} \times \Delta T^I_{it}$	-48.78^a	-6.475^a	-9.512^a	-10.696^a
	(9.465)	(1.345)	(2.091)	(2.061)
$ROI_{it} \times \Delta T^O_{it}$	25.773^a	5.737^a	-0.001	-0.019
	(4.4)	(1.027)	(0.001)	(0.003)
ROI_{it}	0.217^c	-0.08	0.191^c	0.375^a
	(0.1276)	(0.84)	(0.107)	(0.119)
ΔT^I_{it}	20.886^a	2.002^a	4.797^a	5.027^a
	(3.045)	(0.372)	(0.662)	(0.657)
ΔT^O_{it}	-8.832^a	-0.409^b	0.000	0.005^a
	(1.349)	(0.165)	(0.0004)	(0.001)
FE: province×country	Yes	Yes	Yes	Yes
FE: country×time	Yes	Yes	Yes	Yes
Observations	34,530	148,990	63,813	63,813
R^2	0.1	0.06	0.06	0.06

Notes: Country×product trends and the initial MFN tariffs as controls are included but not reported. All columns are weighted with relative trade values of good i in year t between the US and the non-FTA partner c. ^{a}, ^{b}, and ^{c} indicate significance at the one, five, and ten percent levels, respectively. Standard errors are clustered at the product×country level.

Results for alternative samples

In Table B5 we report results for alternative samples. In column (1) we show that our results are robust to excluding products which had high initial MFN tariffs above the median tariffs in our sample.[34] This addresses a potential selection concern about industries initially protected by high tariffs being more likely to lobby for tight ROOs. In column (2) we show that our results are robust to a longer sample period of 1989-2000. In column (3) we replace the MFN output tariffs with WTO tariffs (for US exports), and hence the independent variable ΔT^O_{it} becomes the difference between WTO tariffs and CUSFTA's preferential rates. It is not surprising that the interaction term for output tariff gaps becomes insignificant. Intuitively, CUSFTA's rules of origin are more likely to be binding when US producers need to meet content requirements for exporting final products to Canada with preferential rates. What matters for the market power of Canadian exporters of intermediate goods are therefore the preferential rates relative to Canada's MFN rates. Our results suggest this is indeed the case, and that how other WTO members levy tariffs on US products is of no consequence. In column (4) we use weighted WTO tariffs instead and find very similar results.

[34] Excluding tariffs higher than the 90^{th} or 95^{th} percentiles does not qualitatively change the results.

Table B6: Alternative fixed-effects specifications

Dep. variable: Δp_{itnc} binding + differentiated	(1)	(2)	(3)	(4)
$ROI_{it} \times \Delta T^{I}_{it}$	-46.852^{a} (5.525)	-26.056^{a} (6.29)	-48.69^{a} (5.179)	-14.683^{c} (7.839)
$ROI_{it} \times \Delta T^{O}_{it}$	33.033^{a} (4.03)	7.79^{b} (3.297)	33.617^{a} (3.658)	11.354^{a} (3.796)
ROI_{it}	0.135 (0.192)	-8.409^{a} (1.575)	0.443^{b} (0.19)	-10.098^{a} (1.903)
ΔT^{I}_{it}	9.431^{a} (1.435)	3.023 (2.088)	5.391^{a} (1.378)	0.008 (2.753)
ΔT^{O}_{it}	-5.647^{a} (1.544)	1.221 (1.489)	−2.36 (1.489)	−0.024 (1.662)
FE: province×country	Yes	Yes	Yes	Yes
FE: country×time	Yes	Yes	Yes	Yes
Extra FEs	prov.×coun.×time	prov.×product	ind.×country	prod.×prov.×coun.
Observations	19,871	19,871	19,871	19,871
R^2	0.13	0.48	0.19	0.69

Notes: Country×product trends and the initial MFN tariffs (dropped in column (4) due to collinearity) as controls are included but not reported. All columns are weighted with relative trade values of good i in year t between the US and the non-FTA partner c. ^{a}, ^{b}, and ^{c} indicate significance at the one, five, and ten percent levels, respectively. Standard errors are clustered at the product×country level.

Results for alternative fixed-effects specification

In Table B6 we check whether our results remain robust to using alternative fixed effects as further controls (recall that our main specification controls for province×country and country×time fixed effects). In doing so, we run our main specification (30) with a sub-sample of differentiated goods where tariffs are binding at the industry level (as defined in B2). In column (1), we add province×country×time fixed effects to control for province-destination specific and time-varying cost shocks. In column (2) we add province×product fixed effects to further control for province specific quality gaps between FTA and non-FTA products. In column (3) we include industry×country fixed effects to take into account other cost factors that may be specific to an industry (at SICT 1-digit level). In column (4) we report results with province×product×country fixed effects to account for country specific tastes for a specific province×product pair. All these results are in line with those reported in Table 4.