Rules of Origin and Market Power*

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Abstract

We study how regional 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

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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 exported 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 protection of regional producers of intermediate goods.[1] 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).[2]

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 amongst producers of differentiated intermediate goods, we show that binding and stricter content requirements 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 therefore be factored in when assessing the pros and cons of alternative preferential trade arrangements.[3] 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) generate the same effects under conditions of perfect competition but not so if competition is imperfect (Bhagwati, 1965).[4] Under monopoly, for example, an import quota removes a portion of the domestic demand faced by a domestic monopolist, but its monopoly pricing power remains unchanged for the residual portion of demand. In contrast, trade under an import tariff fully removes the monopoly power of the single domestic producer 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]This effect is independent of whether or not trade deflection could be profitable in the absence of ROOs (Felbermayr et al., 2019).

[2]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.

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

[4]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 to be able to export them to other FTA regions at zero tariff 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).[5] We first use monthly province-level trade statistics from Statistics Canada for the period of 1989-

[5]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).

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).[6] 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 show that they apply only to oligopoly industries, consistently with our theoretical setup.

This paper builds on and contributes to the literature that examines how different trade policies can influence 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).[7] 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.[8] 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.

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 effect due to demand shifts for FTA inputs, depending on whether heterogeneous firms choose to comply with ROOs. Our paper differs from theirs in studying how ROOs affect trade prices via changes in market power and markups, rather than through decreasing returns in production.

[6]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.

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

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

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.[9] 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.[10]

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

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

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

[10] Our study is also related to work on pricing to market and markup adjustments using customs data (Knetter, 1989; Corsetti et al., 2019). 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.

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 such that

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

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 intermediate inputs 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 developing conditions for the RVC requirement to be binding. 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

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

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 exported final goods 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 $\tau_I = 1 + t_I$, and 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.[11] The levels of demand faced by a representative 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 respec-

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

tively equal to

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

with $\tau_F = 1 + t_F$; 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

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

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:

$$\hat{q}^j_{Dh} = \left(\frac{M}{\hat{P}_h} + \frac{M}{\tau_F \hat{P}_h}\right) \; r \qquad \left(\frac{\hat{P}_h}{p_{Dh}}\right) \left(\frac{p_{DH}}{p^j_H}\right)^{\sigma}$$
$$= M \; r \qquad (1 + 1/\tau_F) \; (p_{Dh})^{\sigma-1} \; (p^j_h)^{-\sigma},$$

$$\hat{q}^j_{Xh} = \left(\frac{M}{\hat{P}_{h'}} + \frac{M}{\tau_F \hat{P}_{h'}}\right) (1-r) \left(\frac{\hat{P}_{h'}}{p_{Dh'}}\right) \left(\frac{p_{Dh'}}{\tau \, p^j_h}\right)^{\sigma}$$
$$= M \, (1-r) \; (1 + 1/\tau_F) \; (p_{Dh'})^{\sigma-1} \, (\tau \, p^j_h)^{-\sigma}, \tag{20}$$

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

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

$$\hat{\mu}^* = 1 + \frac{1}{\sigma - 1} \; \frac{N}{N-1}. \tag{22}$$

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 higher 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

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

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

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

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.[12]

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

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

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:

[12] 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.

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. In particular, the same level of markups that would obtain under regional autarky (prohibitive trade barriers between the FTA and the rest of the world) can be supported by a binding domestic content requirement that does not fully restrict trade.

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.*

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 induces a comparable contraction in imports of intermediates.

Evidence that rules of origin act as trade barriers has been presented 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 countries 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.[13] 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-CUSFTA, 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 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

[13] In this case, for a given input type h, unit cost becomes $\lim_{r\to 1} \hat{c}^h(p_D^h, p_M^h, r^h) = 2^{1/(\sigma-1)}\, p_D^h$, 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).

value and the corresponding mass at the monthly frequency.[14]

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).[15] 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.[16] As shown in the table, our sample includes 1,636 intermediate products and 203 destination countries (including the US) with a total of 64,131 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 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),

[14]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.

[15]The mapping does not account for the effects of cumulation rules (Bombarda and Gamberoni, 2019).

[16]The 1989-1993 trade data include 2,662 products in total, among which 1,636 are intermediate goods, 667 are consumption goods, 350 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	64,131	–	–	–	–
Products	1,636	–	–	–	–
Destination countries	203	–	–	–	–
Log unit values (Canadian dollar): US	3.19	2.83	2.86	−4.35	14.66
Log unit values (Canadian dollar): non-US	2.97	2.34	2.9	−5.19	15.98
Log transaction values: US	15.29	15.57	2.95	4.8	22.77
Log transaction values: non-US	10.82	10.56	2.51	0.69	21.43
Preferential ad valorem tariffs (percent)	2.4	0.78	4.02	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.

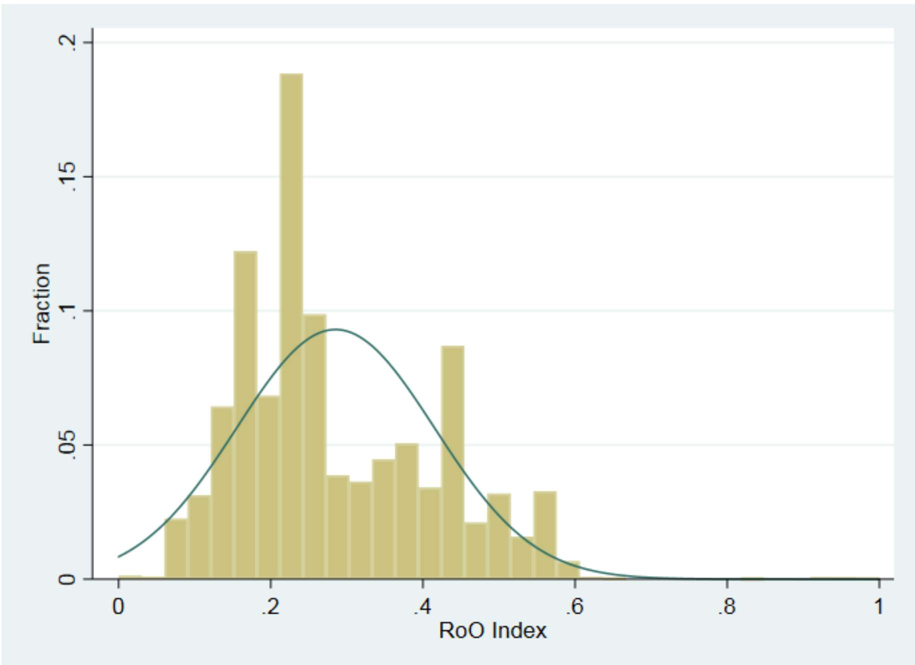

Figure 1: ROO Index: Distribution

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.

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 main theoretical predictions, i.e. 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 run the following regression:

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

where $\Delta p_{itnc} \equiv \ln p_{itn,US} - \ln p_{itnc}$ is the difference between the log unit value of exports to the US and that of exports to country c (other than the US) for goods of category i originating in province n in year t, and where ROI_{it} is the ROO index which measures the restrictiveness of CUSFTA's content requirements for good i as previously defined.[17] The role of import and export tariffs in producing binding constraints on US producers for given content requirements is captured by a dummy variable, D_i^{TB}, which takes the value of one if the following two conditions are met: (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 arbitrary threshold of the

[17]The time-varying dimension comes from the trade shares used as weights in the calculation of the ROO index.

sample median—taking a value of zero otherwise.[18, 19]

We include province×HS 2-digit industry×destination fixed effects, $\delta_{nj(i)c}$ (with $j(i)$ denoting the industry category to which good i belongs), that control for how systematic variation in quality across different combinations of destination, industry and region of origin within Canada may contribute to price differentials—e.g. arising from selection effects in response to variation in the relative incidence of transportation costs by distance (Alchian and Allen, 1967) or from income-related variation in the demand for quality across destinations.[20] We also include dummies, δ_{ct}, that control for time-varying and destination-specific factors such as income and exchange rate fluctuations. Our estimation of the α coefficients in (29) thus only relies on intra-temporal variation in price differentials within industries and province-destination pairs, and on how this co-varies with content requirements and the size of the relevant tariffs.

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. In the appendix, we also report results from several variants of (29) that include a dummy for high content requirements (D_i^{RH} rather than a continuous measure ROI_{it}), and also continuous input and output tariff measures (rather than a binding dummy D_i^{TB}).[21]

In specification (29), unit value gaps are used as a proxy for markup differences for a given product from the same province between markets in the US and non-FTA trading partner, c. Thus, we are testing directly Propositions 2 and 3 which predict that the unit value gap Δp_{itnc} is larger where ROI_{it} is comparatively higher and, simultaneously, the binding criteria for tariffs are met ($\alpha_3 > 0$).

[18] Although Canada's economy is much smaller than that of the US, Canada is an important export market for US producers—US exports to Canada accounted for 21.52% of total US exports in 1989 (the corresponding figure for 2020 about 20%).

[19] In variant specifications, we relax or tighten these thresholds to the 25^{th} or the 75^{th} percentile for both tariffs. 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 intermediate imports 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. In robustness checks, we carry out a placebo test that shows that MFN input tariffs facing Canada and output tariffs facing the US have no effects on price differentials.

[20] An alternative way of controlling for such 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 the appendix).

[21] Results are also robust to using industry-level tariff binding thresholds. These results are available upon request.

Results

Results for specification (29) with our full sample are reported in Panel A of Table 3. In columns (1)-(3) we begin with the median values (P50) for all tariffs as binding criteria; these build up to our preferred specification in column (4) with no or different combinations of fixed effects.

We first interpret these results qualitatively, focusing on our preferred specification in column (4). We can see that the main coefficient of interest is significantly greater than zero ($\hat{\alpha}_3 = 1.015 > 0$), which indicates that stricter and more likely to be binding content requirements, with median values as thresholds for both imports and export tariffs, are associated with a higher unit value gap between FTA and non-FTA regions. Notice that a higher ROO index itself is not necessarily associated with a higher unit value gap, as the coefficient for the ROO index, $\hat{\alpha}_1$, is mostly insignificant. This therefore suggests that it is not the content requirement alone but rather its interaction with the stringency of tariffs that is associated with higher unit value gaps. The negative coefficient on the binding tariffs dummy ($\hat{\alpha}_2 = -0.233 < 0$) isolates the effect of tariffs when content requirements are not binding, and can be interpreted as reflecting the fact that, when goods fall into the binding tariffs group $(D_i^{TB} = 1)$, they face lower input MFN tariffs, which translates into more competition in export markets and lower prices—consistently with the predicted positive relationship between the input tariff and the markup in (18) absent a content requirement.

In column (5), we consider stricter criteria for binding tariffs, using the 25^{th} percentile (P25) for input tariff gaps and the 75^{th} percentile (P75) for output tariff gaps. The estimated gap of unit values is wider ($\hat{\alpha}_1 = 2.9 > 0$), pointing to 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, our results remain significant.

Panel B of the table reports the differences in predicted effects on $\Delta\hat{p}_{itnc}$ between different levels of ROO index, conditional on tariffs being binding $(D_i^{TB} = 1)$. These differences allow us to gauge the magnitude of the combined effect $\hat{\alpha}_1 + \hat{\alpha}_3$ in (29) at different points of the distribution of ROI_{it}. Focusing again on column (4), on average goods at the 75^{th} percentile ROO index have roughly 21 percentage points higher unit value gaps between FTA and non-FTA export markets, by comparison with those with at 25^{th} percentile ROO index.[22] Alternatively, we can interpret this result as a roughly 23.5 percent higher absolute unit value for exports to the US versus exports to other destinations (i.e., $p_{itn,US}/p_{itnc}$) for those goods that have a higher ROO index (at P75) relative to those with a lower ROO index (at P25).[23] In line with results in Panel A,

[22] $\left(\hat{\beta}_1 + \hat{\beta}_3 \mid ROI_{it} = \text{P75 and } D_i^{TB} = 1\right) - \left(\hat{\beta}_1 + \hat{\beta}_3 \mid ROI_{it} = \text{P25 and } D_i^{TB} = 1\right) = 0.211.$

[23] Denote with $\hat{p}_1 \equiv p_{itn,US}/p_{itnc}$ the predicted absolute unit value ratio for the high ROO index group ($ROI_{it} = P75$ & $D_i^{TB} = 1$) and with $\hat{p}_2$ the corresponding ratio for the low ROO index group ($ROI_{it} = P25$

Table 3: Rules of origin and unit export values

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						
ROI_{it}	-0.240^a	-0.027	-0.201^a	0.048	0.083	-0.563^a
	(0.069)	(0.084)	(0.072)	(0.083)	(0.078)	(0.086)
D_i^{TB}	-0.465^a	-0.388^a	-0.402^a	-0.304^a	-1.005^a	-1.418^a
	(0.041)	(0.044)	(0.044)	(0.046)	(0.179)	(0.042)
$ROI_{it} \times D_i^{TB}$	1.551^a	1.481^a	1.099^a	1.015^a	2.9^a	1.243^a
	(0.166)	(0.165)	(0.182)	(0.181)	(0.471)	(0.136)
Panel B: Predicted effects of ROI_{it} on $\Delta\widehat{p}_{itnc}$ for $D_i^{TB} = 1$						
ROI_{it} : P50 − P25	0.076^a	0.084^a	0.052^a	0.061^a	0.172^a	0.039^a
	(0.011)	(0.011)	(0.012)	(0.012)	(0.029)	(0.007)
P75 − P25	0.261^a	0.289^a	0.179^a	0.211^a	0.593^a	0.135^a
	(0.036)	(0.038)	(0.04)	(0.041)	(0.099)	(0.023)
P95 − P25	0.473^a	0.524^a	0.324^a	0.383^a	1.075^a	0.245^a
	(0.066)	(0.07)	(0.072)	(0.075)	(0.18)	(0.042)
FE: prov.× ind.×country	No	Yes	No	Yes	Yes	Yes
FE: country×time	No	No	Yes	Yes	Yes	Yes
Observations	64,131	64,131	64,131	64,131	64,131	64,131
R^2	0.021	0.184	0.046	0.176	0.177	0.178

Notes: Extra controls include product trends and initial MFN tariffs. All columns are weighted with relative trade values of good i in year t between the US and non-FTA partner c. ^{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 product×country level.

the estimated gap of unit values becomes wider with stricter tariff binding criteria (column (5) of Panel B), at roughly 59 percentage points, again suggesting stronger market power of Canadian exporters under more strictly binding content requirements. In column (6), with more liberal tariff binding thresholds, the estimate is lower, at roughly 14 percentage points.

To put the size of these effects into context, we can carry out a rough, back-of-the-envelope calculation against the literature evidence on trade elasticities. Typical estimates are around −5 (Imbs and Mejean, 2017). In a model with product differentiation, CES demand and monopolistic competition (and no content requirements), these elasticities translate into a markup rate of roughly 25%. By comparison with this figure, the effects shown in Panel B are sizeable.[24]

Table 4 explores how effects vary across different types of inputs. Results are from a variant specification (29) that includes a further dummy variable D_i^{GC} that categorizes goods in terms of the degree of product differentiation based on the Rauch classification

& $D_i^{TB} = 1$). We can derive the predicted value for $(\hat{p}_1 - \hat{p}_2)/\hat{p}_2$ as $(e^{0.211} - 1) \approx 0.2349$.

[24] A demand elasticity of $\varepsilon = -\sigma = -5$ translates into a profit-maximizing markup rate of $1/(|\varepsilon| - 1) = 1/(\sigma - 1) = 1/4$.

Table 4: Rules of origin and unit export values: good characteristics

Dep. variable: Δp_{itnc}	D_i^{GC}: Rauch homogeneous (1)	D_i^{GC}: Rauch reference priced (2)	D_i^{GC}: BEC capital & cons. goods (3)
$ROI_{it} \times (D_i^{GC} = 0)$	-0.055 (0.089)	0.336^a (0.110)	-0.158^a (0.055)
$ROI_{it} \times (D_i^{GC} = 1)$	0.141 (0.344)	-0.636^a (0.091)	0.705^a (0.072)
$D_i^{TB} \times (D_i^{GC} = 0)$	-0.568^a (0.073)	-0.294^a (0.050)	-0.375^a (0.042)
$D_i^{TB} \times (D_i^{GC} = 1)$	0.162^b (0.081)	-0.150^c (0.085)	0.054 (0.034)
$ROI_{it} \times D_i^{TB} \times (D_i^{GC} = 0)$	1.656^a (0.235)	1.442^a (0.216)	1.194^a (0.157)
$ROI_{it} \times D_i^{TB} \times (D_i^{GC} = 1)$	-0.639 (0.460)	-0.018 (0.243)	-0.454^a (0.104)
FE: prov.×ind.×country	Yes	Yes	Yes
FE: country×time	Yes	Yes	Yes
Observations	62,476	62,476	279,813
R^2	0.178	0.179	0.124

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.

(Rauch, 1999) and in terms of the main end-use of products based on the Broad Economic Categories (BEC) classification.[25] The binding criteria for tariffs are as in column (4) of Table 3.

Column (1) compares Rauch homogeneous goods ($D_i^{GC} = 1$) with non-homogeneous goods ($D_i^{GC} = 0$). We would expect market power to be more relevant, and thus our theoretical predictions to hold, for non-homogeneous goods than for homogeneous ones. We can see that this is indeed the the case: we obtain $\hat{\alpha}_3 > 0$ for non-homogeneous priced goods (see row 5), whereas for reference priced goods these coefficient is insignificant (row 6).[26] In column (2) we consider Rauch reference priced goods ($D_i^{GC} = 1$) versus non-reference priced goods ($D_i^{GC} = 0$); and again the main coefficient of interest is significant and of the expected sign only for non-reference priced 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 only on in-

[25]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.

[26]The coefficients do not coincide with those in column (4) of Table 3 because here we do not allow fixed effects to vary by D_i^{GC}.

termediate goods used to produce final goods qualifying for FTA preferential tariffs, excluding those goods that are classified as consumption and capital goods in BEC. In column (3) we also include those goods in the 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). We find that the interaction term between the ROO index and binding dummy does not have the expected sign, consistently with the theoretical prediction that binding ROOs should boost market power only for goods that are used as manufacturing inputs.

The controls that we include in our specification ensure that results are not driven by systematic quality gaps across origin-industry-destinations cells, and mean that parameter estimates are only based on variation in export price differentials within those cells rather than across them. But we can restrict the estimation to be based only on price differentials that lie within an even narrower range of variation. In column (1) of Table 5 we derive results for a sub-sample of goods that exhibit negative unit value gaps, while in column (2) we report results for the opposite case where unit values are always higher for exports to the US than for exports to other destinations. Results are robust in both sub-samples. In column (3), we add an extra control of initial quality differentials, proxied by pre-CUSFTA price gap in the year of 1988. This addresses a potential concern that the higher unit value gaps that we observe in correspondence of tighter origin requirements may due to endogenous quality upgrading by buyers in response to binding ROOs. In column (4), we add an extra control of actual tariff gaps (between the preferential and MFN tariffs). In column (5), we consider a restricted sub-sample that only includes exports to advanced economies—for which we should expect demand for quality to be comparatively more homogeneous.[27] Finally, our results are also robust to using a sub-sample with non-advanced countries only, in column (6).[28]

In summary, we find evidence in support of our theoretical predictions that binding content requirements should be associated with higher market power for producers of intermediate goods, and that the effect of given content requirements on market power should depend on the levels of MFN input and output tariffs. We also find evidence that these effects are only in evidence for homogeneous goods and for goods that are used as intermediate inputs.

[27] 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. Results are almost identical to using Canada's top ten trading partners (by export shares) instead.

[28] Our results are also robust to omitting Mexico (Canada's second FTA trading partner via NAFTA) from the sample.

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

Dep. variable:	Neg. Δp_{itnc}	Nonneg. Δp_{itnc}	Control: Δp^{88}_{itnc}	Control: tariffs	Advanced	Non-Advanced
	(1)	(2)	(3)	(4)	(5)	(6)
ROI_{it}	-0.244^a	0.063	0.263^c	0.024	0.143	-0.107
	(0.079)	(0.100)	(0.154)	(0.084)	(0.119)	(0.094)
D_i^{TB}	-0.050^c	-0.622^a	-0.210^a	-0.356^a	-0.335^a	-0.272^a
	(0.029)	(0.056)	(0.056)	(0.049)	(0.066)	(0.062)
$ROI_{it} \times D_i^{TB}$	0.205^b	1.931^a	1.068^a	1.068^a	1.259^a	0.746^a
	(0.098)	(0.183)	(0.242)	(0.182)	(0.259)	(0.237)
FE: prov.×ind.×country	Yes	Yes	Yes	Yes	Yes	Yes
FE: country×time	Yes	Yes	Yes	Yes	Yes	Yes
Observations	28,481	32,737	27,120	64,131	34,002	28,610
R^2	0.253	0.289	0.299	0.176	0.142	0.225

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.

Robustness checks

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

We first run regressions using variant specifications which consider a dummy for above-median content requirements (D_i^{RH} rather than a continuous measure ROI_{it}), and also continuous input and output tariffs (rather than a binding dummy D_i^{TB}). We therefore have 3 other sets of interactions: (i) both with dummies ($D_i^{RH} \times D_i^{TB}$), (ii) dummy for content requirements and continuous tariffs ($D_i^{RH} \times$ tariffs), and (iii) both continuous ($ROI_{it} \times$ tariffs). These results are reported in Tables B1-B3.

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 report the same specification as in Table 3 but interact with dummy variables for each industry. Overall, we observe a similar pattern across industries as in Table 3 (see Table B4).

Our results are also 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)), and to a sub-sample excluding agricultural products (Table B5, column (3)).

Finally, we run our main specification (29) with a series of alternative fixed effects, including (i) province×country×time fixed effects to control for province-destination specific and time-variant cost shocks, (ii) province×product fixed effects to further control for province specific quality gaps between FTA and non-FTA for a given product, and (iii) province$\times$product$\times$country and product$\times$country fixed effects to account for country specific tastes for a specific province$\times$product pair or a product. All these results reported in Table B6 are in line with those reported in Table 3.

4.2 Evidence from US Census data

Our main empirical results provide post-CUSFTA evidence for Canadian exporters of intermediate goods, supporting our theoretical prediction states that content requirements, if they are binding, could bolster market power for producers of protected inputs. In this section, we turn to compare pre- versus post-CUSFTA US price data for cross-validation of our main finding.

The idea behind this exercise is that binding content requirements on US exporters should increase market power for Canadian exporters of intermediates goods as well as for competing US producers of the same intermediates.[29] In turn, changes in market power for US producers can be proxied by changes in US producer price indices, which we can then relate to the ROO index and the binding criteria that were used in our main analysis.

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 6 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). We also report the distribution of the ROO index, as previously defined, but weighted at the SIC level.[30] The 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 across industries (the minimum

[29] Similarly, Canadian producers of final goods face the same constraints of content requirements in order to export to the US, and this could translate to higher market power of US intermediate good exporters as well as Canadian domestic intermediate producers. We do not examine this other side of evidence due to data constraint, but one can easily argue that the effects identified in this paper could be stronger due to Canada's comparatively higher export dependence on the US.

[30] For how the weighted ROO index is calculated, see equation (30) for details.

Table 6: 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.

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:

$$\begin{aligned} PPI\_Change_j = \quad & \gamma_0 + \gamma_1\, ROI_j + \gamma_2\, D_j^{TB} + \gamma_3\, ROI_j \times D_j^{TB} + \gamma_4\, Sales\_Change_j \\ & + \gamma_5\, N\_Change_j + \delta_{SIC\_2_j} + \epsilon_j, \end{aligned} \tag{30}$$

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. Similarly to (29), ROI_j represents a weighted average of the ROO index defined in the main analysis, and D_j^{TB} is a binding dummy which takes the value of one (and zero otherwise) if (i) the input tariff gap of industry j between the US's external MFN and preferential tariffs is below the sample median, and (ii) the output tariff gap of final goods associated with industry j between Canada's MFN and preferential tariffs is above the sample median.[31] Log changes in firm numbers and sales between the years of 1987 to 1992 ($Sales\_Change_j$ and N_Change_j) are used as extra controls.

Fixed effects are included at the SIC 2-digit level to account for sector-specific factors that could affect marginal costs. The 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

[31] For 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.

decisions.[32] We further interact all variables with a dummy for industries with a high HHI, indicating market structures closer to oligopoly as assumed in our theory, and we test the theoretical prediction that γ_3 should be positive in oligopolistic industries.[33]

The theory also predicts that, other things equal, 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 again data from the US Census (described in Section 4.2) to run the following specification (analogous to (30)):

$$D_j^{FN} = \theta_0 + \theta_1\, ROI_j + \theta_2\, D_j^{TB} + \theta_3\, ROI_j \times D_j^{TB} + \theta_4\, Share\_Change_j + \delta_{SIC\_2_j} + \epsilon_j, \tag{31}$$

where D_j^{FN} is a dummy variable that takes the value of one if the proportional change of firm numbers from 1987 (pre-CUSFTA) to 1992 (post-CUSFTA) for sub-industry j (at SIC 4 digit level) is positive and zero otherwise.[34] All other variables in specification (31), as well as trade weights given to each industry j to reflect the relevance of rules of origin, are as in specification (30); and, as in (30), we further interact variables with a dummy for industries with high HHI indicating market structures closer to oligopoly as assumed in our theory, and test the theoretical prediction that $\theta_3 > 0$ for oligopoly industries.

Results

Table 7 reports results from specification (30), using medians for tariffs as binding thresholds. In column (1) of Table 7, we begin with the full sample of 334 SIC 4-digit industries; even without distinguishing between market structures, the coefficient of interest has the expected sign—the last row has $\gamma_3 = 0.123 > 0$—but is only significant at the 10% level. In columns (2)-(3) we interact all variables with a dummy which takes the value of one if the industry's HHI was above 1,500 in 1987 ($Olig = 1$). This gives 45 oligopoly industries. Results from our main specification are reported in column (2) and show that stricter and binding ROOs are associated with higher prices for oligopoly

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

[33] Changes in PPIs reflect changes in prices that affect all users and are therefore fully independent of quality variation in sales across different buyers. An obvious caveat in this exercise, however, 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.

[34] Note that this specification focuses on *variation* in changes in market structure across industries, and thus allows for the possibility that changes in firm numbers were the result of the introduction of CUSFTA *a*nd of content requirements of varying stringency.

Table 7: Rules of origin and US PPIs

Dep. variable: PPI_change_j		HHI $\geq 1,500$ as oligopoly		HHI $\geq 1,800$ as oligopoly	HHI $\geq 1,200$ as oligopoly
	(1)	(2)	(3)	(4)	(5)
ROI_j	-0.037 (0.034)	–	–	–	–
$ROI_j \times (Olig = 0)$	–	-0.031 (0.035)	-0.026 (0.034)	-0.029 (0.035)	-0.024 (0.036)
$ROI_j \times (Olig = 1)$	–	-0.034 (0.129)	-0.031 (0.128)	-0.082 (0.140)	-0.091 (0.117)
T_j^{TB}	-0.046 (0.029)	–	–	–	–
$D_j^{TB} \times (Olig = 0)$	–	-0.017 (0.024)	-0.018 (0.024)	-0.014 (0.024)	-0.017 (0.024)
$D_j^{TB} \times (Olig = 1)$	–	-0.744^a (0.214)	-0.748^a (0.215)	-0.941^a (0.242)	-0.675^a (0.235)
$ROI_j \times D_j^{TB}$	0.123^c (0.065)	–	–	–	–
$ROI_j \times D_j^{TB} \times (Olig = 0)$	–	0.074 (0.055)	0.073 (0.056)	0.067 (0.056)	0.071 (0.056)
$ROI_j \times D_j^{TB} \times (Olig = 1)$	–	1.811^a (0.646)	1.820^a (0.647)	2.334^a (0.857)	1.672^b (0.699)
Binding criteria	P50, P50	P50, P50	P50, P50	P50, P50	P50, P50
FE: Sector	Yes	Yes	Yes	Yes	Yes
Controls: Tariff changes	No	No	Yes	No	No
Observations	334	334	334	334	334
R^2	0.195	0.261	0.297	0.272	0.254

Notes: The *Olig* dummy, ROI_j and the controls (changes in sales and firm numbers) 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.

industries only, offering evidence in support of our theoretical prediction that effects should be stronger in oligopolistic markets (see the last row where γ_3 is significantly greater than zero at the 1% level, whereas the coefficient for non-oligopoly industries is not statistically significant). The coefficients for ROI_j and D_j^{TB} are also consistent with those reported in Table 3 for oligopoly industries.[35]

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 a higher HHI threshold for defining oligopoly industries (giving us 28 oligopoly industries) and observe larger magnitude for the coefficient γ_3 for oligopoly industries only. In column (5) we consider a lower HHI threshold for defining oligopoly industries (giving us now 53 oligopoly industries);

[35] Using stricter binding criteria do not change the results qualitatively whereas using more liberal binding criteria generate results with the expected signs but become insignificant. Using the 1992 HHI yields very similar results.

Table 8: Rules of origin and firm entry

Dep. variable: D_j^{FN}		HHI $\geq 1,500$ as oligopoly		HHI $\geq 1,800$ as oligopoly	HHI $\geq 1,200$ as oligopoly
	(1)	(2)	(3)	(4)	(5)
ROI_j	-0.039 (0.271)	–	–	–	–
$ROI_j \times (Olig = 0)$	–	-0.086 (0.367)	-0.022 (0.375)	-0.110 (0.296)	-0.065 (0.38)
$ROI_j \times (Olig = 1)$	–	0.234 (0.928)	0.384 (0.937)	0.741 (1.040)	-0.031 (1.049)
T_j^{TB}	-0.016 (0.106)	–	–	–	–
$D_j^{TB} \times (Olig = 0)$	–	0.092 (0.121)	0.091 (0.109)	0.070 (0.113)	0.106 (0.131)
$D_j^{TB} \times (Olig = 1)$	–	-2.072^a (0.618)	-2.073^a (0.530)	-1.892^a (0.510)	-2.285^a (0.706)
$ROI_j \times D_j^{TB}$	-0.254 (0.351)	–	–	–	–
$ROI_j \times D_j^{TB} \times (Olig = 0)$	–	-0.464 (0.447)	-0.518 (0.448)	-0.437 (0.387)	-0.457 (0.438)
$ROI_j \times D_j^{TB} \times (Olig = 1)$	–	6.342^a (2.150)	6.202^a (1.903)	5.917^a (1.786)	6.789^b (2.362)
Binding criteria	P50, P50	P50, P50	P50, P50	P50, P50	P50, P50
FE: Sector	Yes	Yes	Yes	Yes	Yes
Controls: Tariff changes	No	No	Yes	No	No
Observations	333	333	333	333	333
R^2	0.205	0.233	0.242	0.236	0.240

Notes: The *Olig* dummy, changes in sales as an extra control and the variable ROI_j are included but not reported. All columns are weighted with Canada's share in US imports of intermediate goods in 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.

overall, our results still hold, but with a slight drop in the significance level.

Table 8 reports estimation results for specification (31). Column (1) reports results for the full sample of of 334 SIC 4-digit industries.[36] We can see that without distinguishing market structures, none of the coefficients appears significant. In columns (2)-(3) we interact all variables with a dummy which takes the value of one if the industry's HHI in 1987 was above 1,500 ($Olig = 1$). 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 last row, where $\theta_3 > 0$).

In column (3), we further control for tariff changes, including both input and output tariffs changes from 1987 to 1992; results remain similar to those in column (2). The results are also quite robust to adopting a higher HHI threshold for defining oligopoly industries, reported 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

[36]Compared to the PPI exercise, one industry is dropped due to missing data on firm numbers.

significance. Overall, these findings provide 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, and should be accounted for when considering the choice between a CU and a FTA arrangement in preferential trade areas.

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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. $\square$

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

$$N^* = \frac{M}{F}\,\frac{\mu^*-1}{\mu^*}\,\frac{1+\tau_I{}^{\sigma}}{\tau_I+\tau_I{}^{\sigma}}; \tag{32}$$

$$\mu^* = \frac{\sigma}{\sigma-1}\left(1-\frac{F}{(1+1/\tau_F)\,M}\,\frac{\tau_I+\tau_I{}^{2\sigma}}{(1+\tau_I{}^{\sigma})^2}\right)^{-1}. \tag{33}$$

$$\hat{N}^* = \frac{M}{F}\,\frac{\hat{\mu}^*-1}{\hat{\mu}^*}\,\frac{1+(\tau_I-1)\,r}{\tau_I}; \tag{34}$$

$$\hat{\mu}^* = \frac{\sigma}{\sigma-1}\left(1-\frac{F}{(1+1/\tau_F)\,M}\,\frac{\tau_I}{1+(\tau_I-1)\,r}\right)^{-1}. \tag{35}$$

Examining the expressions (33) and (35), 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

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

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 (32) and (34), 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

Variant specifications

We report results using several variants of specification (29). In Table B1 we replace the ROO index ROI_{it} in specification (29) with a dummy for high content requirements D_i^{RH}. Overall our results remain very robust to different combinations of thresholds and binding criteria.

In Table B2 we replace the tariff binding dummy D_i^{TB} with two variables of continuous tariffs, ΔT_{it}^I and ΔT_{it}^O, where ΔT_{it}^I 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_{it}^O is the average output tariff gap between external MFN rates and the preferential tariffs facing Canadian importers in year t for all final goods associated with intermediate input i.[37] We can see that the interaction terms between the ROO dummy and ΔT_{it}^I have negative coefficients and the interactions between the ROO dummy and ΔT_{it}^O have positive coefficients (see row 3 and row 5), consistently with Propositions 2 and 3, which predict that a domestic content requirement is more likely to be binding the stricter is the content requirement, the smaller are input tariffs, and the larger are output tariffs, resulting in higher unit value gaps between FTA and non-FTA regions.[38]

In Table B3 we report results using the ROO index and continuous tariffs, ΔT_{it}^I and ΔT_{it}^O. Similarly, we can see that the interactions between the ROO dummy and ΔT_{it}^I have negative coefficients and the interactions the ROO dummy and ΔT_{it}^O have positive coefficients (see row 3 and row 5). As binding criteria are not needed when continuous tariffs are used, we show that these results are robust to using different combinations of fixed effects.

Industry-level evidence

Table B4 reports industry-level evidence using the same specification as in (29) but interact with dummy variables for each industry. For simplicity, we only report the coefficients of the interaction term as our main variable of interest. Overall, we observe a similar pattern across industries as in Table 3 except for a few industries such as mineral

[37]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.

[38]This result holds if the magnitudes of input tariff gaps outweigh the differences in ROO index, i.e., unit value gaps are higher for goods with slightly higher ROO index but significantly lower input tariffs.

Table B1: Rules of origin and unit export values: both dummies

Dep. variable: Δp_{itnc}	(1)	(2)	(3)	(4)	(5)	(6)
D_i^{RH}	-0.107^a	-0.081^a	-0.200^a	-0.012	-0.028	-0.079^c
	(0.018)	(0.017)	(0.025)	(0.021)	(0.022)	(0.047)
D_i^{TB}	-0.168^a	-0.105	-0.147^a	-0.106^a	-0.108^a	-0.078^c
	(0.025)	(0.095)	(0.021)	(0.023)	(0.030)	(0.046)
$D_i^{RH} \times D_i^{TB}$	0.292^a	0.379^a	0.224^a	0.234^a	0.091^b	0.009
	(0.044)	(0.121)	(0.033)	(0.049)	(0.043)	(0.054)
D_i^{RH} thresholds	P50	P50	P50	P75 (strict)	P25 (liberal)	P10 (liberal)
D_i^{TB} binding criteria	P50, P50	P25, P75 (strict)	P75, P25 (liberal)	P50, P50	P50, P50	P50, P50
FE: prov.× ind.×country	Yes	Yes	Yes	Yes	Yes	Yes
FE: country×time	Yes	Yes	Yes	Yes	Yes	Yes
Observations	64,131	64,131	64,131	64,131	64,131	64,131
R^2	0.176	0.175	0.176	0.175	0.175	0.175

Notes: Extra controls include product trends and initial MFN tariffs. All columns are weighted with relative trade values of good i in year t between the US and non-FTA partner c. ^{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 product×country level.

Table B2: Rules of origin and unit export values: ROO dummy and continuous tariffs

Dep. variable: Δp_{itnc}	(1)	(2)	(3)	(4)
D_i^{RH}	-0.073^a	0.012	-0.019	-0.158^a
	(0.021)	(0.025)	(0.026)	(0.057)
ΔT_{it}^I	-0.080	-0.071	2.099^a	-0.911
	(0.433)	(0.422)	(0.808)	(0.803)
$D_i^{RH} \times \Delta T_{it}^I$	-2.528^a	-2.936^a	-2.775^a	0.441
	(0.672)	(0.813)	(0.750)	(0.759)
T_{it}^O	0.015	0.138	-1.671^b	-3.593^b
	(0.472)	(0.448)	(0.721)	(1.458)
$D_i^{RH} \times T_{it}^O$	2.040^a	2.108^a	3.017^a	4.593^a
	(0.660)	(0.716)	(0.795)	(1.559)
D_i^{RH} thresholds	P50	P75 (strict)	P25 (liberal)	P10 (liberal)
FE: prov.× ind.×country	Yes	Yes	Yes	Yes
FE: country×time	Yes	Yes	Yes	Yes
Observations	64,131	64,131	64,131	64,131
R^2	0.175	0.175	0.175	0.175

Notes: Extra controls include product trends and initial MFN tariffs. All columns are weighted with relative trade values of good i in year t between the US and non-FTA partner c. ^{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 product×country level.

Table B3: Rules of origin and unit export values: both continuous

Dep. variable: Δp_{itnc}	(1)	(2)	(3)	(4)	(5)
ROI_{it}	-0.047	-0.049	-0.016	-0.005	-0.039
	(0.086)	(0.086)	(0.097)	(0.088)	(0.097)
ΔT^I_{it}	5.301^a	6.477^a	4.367^a	5.351^a	2.598^a
	(0.688)	(0.718)	(0.771)	(0.741)	(0.780)
$ROI_{it} \times \Delta T^I_{it}$	-7.556^a	-10.151^a	-10.147^a	-11.695^a	-11.52^a
	(2.51)	(2.416)	(2.714)	(2.568)	(2.777)
T^O_{it}	-1.628^b	-1.057	-2.387^a	-1.822^b	-3.357^a
	(0.827)	(0.825)	(0.840)	(0.848)	(0.850)
$ROI_{it} \times T^O_{it}$	12.044^a	10.997^a	15.868^a	9.487^a	14.574^a
	(2.689)	(2.687)	(2.703)	(2.868)	(2.821)
FE: prov.× ind.×country	No	No	Yes	No	Yes
FE: country×time	No	No	No	Yes	Yes
Extra controls	No	Yes	Yes	Yes	Yes
Observations	64,131	64,131	64,131	64,131	64,131
R^2	0.009	0.025	0.163	0.045	0.176

Notes: Extra controls include product trends and initial MFN tariffs. All columns are weighted with relative trade values of good i in year t between the US and non-FTA partner c. ^{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 product×country level.

products (HS 25-27), plastics (HS 39-40) machinery (HS 84-85). Overall, our results are not driven by the industry composition of our sample, but rather by the interactions between tariff binding criteria and the restrictiveness of content requirements.

Alternative samples and tariffs

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.[39] 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 columns (3)-(5) we consider placebo tariff thresholds with WTO tariffs: for input tariffs, we consider tariff gaps between MFN tariffs and CUSFTA's preferential rates facing Canada, and for output tariffs, we consider tariff gaps between MFN tariffs and CUSFTA's preferential rates facing the US.[40] Our results suggest that the mechanism through which stricter and binding ROOs increase market power only works through the relevant tariffs identified in our theoretical predictions. The placebo tariffs used in this exercise, following the same logic, would have an impact on the market power only on American exporters of intermediate goods selling to Canada.

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

[40] We use Canada's reported MFN input tariffs from Japan, Canada's main partner outside CUSFTA and trade-weighted MFN output tariffs from all non-FTA countries reported by the US.

Table B4: Rules of origin and unit export values: by industry

Dep. variable: Δp_{itnc} HS2-Industry	(1) $ROI_{it} \times D_i^{TB}$	(2) $ROI_{it} \times D_i^{TB}$	(3) $ROI_{it} \times D_i^{TB}$	(4) $ROI_{it} \times D_i^{TB}$
01-05 Animal & Animal Products	1.136 (0.909)	1.24 (0.903)	—	7.441^a (1.273)
06-15 Vegetable Products	1.701^a (0.311)	1.714^a (0.311)	2.947^a (0.509)	1.301^a (0.763)
16-24 Foodstuffs	1.106^c (0.617)	1.01^c (0.601)	4.359^a (1.343)	3.001^a (0.763)
25-27 Mineral Products	1.195 (1.009)	1.316 (1.011)	—	0.376 (0.498)
28-38 Chemicals & Allied Industries	0.726^a (0.249)	0.817^a (0.515)	3.547^b (1.407)	1.343^a (0.156)
39-40 Plastics / Rubbers	-1.125^b (0.514)	-1.070^b (0.515)	—	0.591^a (0.220)
41-43 Raw Hides, Skins, Leather, Furs	11.836^a (0.131)	11.937^a (0.138)	—	-1.889^b (0.901)
44-49 Wood & Wood Products	0.208 (0.222)	0.307 (0.225)	2.348 (1.442)	2.46^a (0.193)
50-63 Textiles	1.932^a (0.352)	1.953^a (0.351)	—	2.03^a (0.217)
68-71 Stone / Glass	3.369^a (0.826)	3.384^a (0.826)	5.907^a (0.936)	4.011^a (0.590)
72-83 Metals	1.820^a (0.430)	1.877^a (0.436)	—	0.992^a (0.116)
84-85 Machinery / Electrical	-3.812 (3.068)	-3.397 (3.074)	—	-1.866 (3.150)
86-89 Transportation	2.090^a (0.498)	2.174^a (0.496)	—	1.180^a (0.227)
90-97 Miscellaneous	0.696^a (0.168)	0.720^a (0.168)	2.299^a (0.543)	1.18^a (0.152)
Binding tariffs criteria	P50, P50	P50, P50	P25, P75 (strict)	P75, P25 (liberal)
FE: prov.× ind.×country	Yes	Yes	Yes	Yes
FE: country× time	Yes	Yes	Yes	Yes
Extra controls	No	Yes	No	No
Observations	64,131	64,131	64,131	64,131
R^2	0.178	0.178	0.177	0.183

Notes: Extra controls include actual input tariff gaps and output tariff gaps. 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.

Alternative fixed effects

Finally, in Table B6 we run our main specification (29) with a series of alternative fixed effects, including (i) province×country×time fixed effects to control for province-destination specific and time-variant cost shocks, in column (1), (ii) province×product fixed effects to further control for province specific quality gaps between FTA and non-FTA for a given product, in column (2), and (iii) province×product×country or product×country fixed effects to account for country specific tastes for a product, in columns (3) and (4). All these results reported in Table B6 are in line with those reported in Table 3.

Table B5: Alternative samples or tariff measures

Dep. variable: Δp_{itnc}	Excl. init. tariffs above median	1989-2000 long sample	Placebo WTO tariffs		
	(1)	(2)	(3)	(4)	(5)
ROI_{it}	0.352^b (0.139)	-0.042 (0.057)	0.225^b (0.102)	0.187^b (0.090)	0.317^a (0.106)
D_i^{TB}	-0.276^a (0.061)	-0.326^a (0.042)	0.054 (0.041)	0.156^b (0.078)	0.119^a (0.034)
$ROI_{it} \times D_i^{TB}$	1.170^a (0.226)	1.051^a (0.159)	-0.198^c (0.120)	-0.289 (0.195)	-0.277^a (0.104)
Binding tariffs criteria	P50, P50	P50, P50	P50, P50	P25, P75 (strict)	P75, P25 (liberal)
FE: province×country	Yes	Yes	Yes	Yes	Yes
FE: country×time	Yes	Yes	Yes	Yes	Yes
Observations	30,850	147,908	64,131	64,131	64,131
R^2	0.257	0.178	0.175	0.175	0.175

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.

Table B6: Alternative fixed-effects specifications

Dep. variable: Δp_{itnc}	(1)	(2)	(3)	(4)
ROI_{it}	-0.239^a (0.076)	-5.396^a (1.406)	-6.127^a (1.714)	-7.409^a (1.733)
D_{it}^{TB}	-0.459^a (0.048)	-0.090^b (0.043)	-0.122^a (0.044)	-0.137^a (0.045)
$ROI_{it} \times D_{it}^{TB}$	1.302^a (0.193)	0.312^b (0.143)	0.541^a (0.145)	0.514^a (0.150)
Binding tariffs criteria	P50, P50	P50, P50	P50, P50	P50, P50
FE: province×country	Yes	Yes	Yes	Yes
FE: country×time	Yes	Yes	Yes	Yes
Extra FEs	prov.×coun.×time	prov.×product	prod.×prov.×coun.	prod.×coun.
Observations	64,131	64,131	64,131	64,131
R^2	0.078	0.308	0.663	0.536

Notes: Country×product trends and the initial MFN tariffs (dropped in columns (2)-(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.