# Rules of Origin as Export Subsidies [*]

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**Abstract**

The paper estimates the effect of NAFTA's rules of origin (ROO) on Mexican access to the US market simultaneously with the endogenous determination of ROOs. The first equation determines Mexico's NAFTA (preferential) exports to the US as a function of, inter alia, the rate of tariff preference and Estevadeordal's qualitative index of ROO strictness. The second equation determines ROO strictness on the basis of a Grossman-Helpman model identifying channels through which lobbying by US intermediate-good producers leads to deep preferences and stiff rules of origin in downstream sectors. Estimates from the first equation suggest that ROOs largely offset the market-access benefit of tariff preferences, while estimates from the second equation suggest that the creation of a captive market for upstream intermediate-good producers is indeed one of their political determinants.

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# 1 Introduction

With the proliferation of preferential trading agreements over the last two decades, considerable attention has been devoted to assessing their effect on market access. Notwithstanding the fact that GATT Article XXIV, para. 8(b) requires the removal of trade barriers on “substantially all trade” in Free-Trade Agreements (FTAs), in reality numerous barriers to intra-bloc trade are often left intact or even erected as part of the agreements. Prominent among those barriers are Rules of Origin (ROOs) which are included in every FTA. In principle, ROOs are meant to prevent the trans-shipment of goods imported into the area via member states with low external tariffs into member states with higher ones. In practice, these rules often have the effect of exporting protection from high-tariff members to low-tariff ones, as pointed out by Krueger and Krishna (1995) and Krueger (1997). This interpretation of ROOs seems particularly relevant in North-South agreements in which a Northern country wants to protect an upstream, capital-intensive sector without incurring the welfare of cost of protecting the whole value chain. Preferential trade liberalization-cum-ROOs can be used to create a captive market for the upstream industry by forcing the Southern partner’s final-good producers to source in the North (rather than seeking the most efficient suppliers in the rest of the world). If final-good assembly is relatively labor-intensive, partnering with a relatively labor-abundant Southern country reduces the welfare cost of protection compared to protecting the whole value chain in the North.

Based on this type of reasoning, the literature has stressed the trade-diverting effect of ROOs and, more generally, their potential to create inefficiencies (Falvey and Reed, 2000). However, the recent political-economy literature has also highlighted the fact that ROOs can sometimes make welfare-enhancing bilateral agreements politically feasible in circumstances where they would’nt be without them (Panagaryia and Duttagupta, 2000).

While the theoretical analysis of ROOs has made considerable strides since Krueger’s pioneering work, their empirical analysis is still in its infancy, partly because their complex legal nature makes measurement difficult. Estevadeordal (2000) recently overcame this difficulty by creating a qualitative index of ROO strictness. Using the fact that most ROOs are —at least in recent agreements— expressed as a required change in tariff heading at various levels of aggregation, Estevadeordal’s index takes values that increase in the level of aggregation of the required change, the idea being that a change at a more aggregate level is "wider" and hence the required rule of origin is more stringent. On the basis of his index, he identified a strong negative effect of NAFTA's ROOs on Mexican market access. Using the same index, Anson et al. (2003) showed that the effect of NAFTA's tariff preferences is systematically reduced by ROOs.

However, as Estevadeordal (2000) and Sanguinetti (2003) point out, it is difficult to assess the effect of ROOs on market access without taking into account the fact that they are themselves endogenous. ROOs result from a political bargaining process that is itself bound to be affected by trade patterns, creating a simultaneity problem. Rather than relying on instrumental variable techniques to deal with the resulting endogeneity bias, we take the problem as a starting point for a political-economy analysis of the determination of ROOs.

In order to keep the story analytically tractable, we focus on one specific type of political issues. Namely, we assume that US intermediate-good interests wish to use NAFTA to create a captive market in Mexico. The mechanism consists of inducing, via ROOs, Mexican final-good makers to source in the US in order to qualify for preferential access. This clearly reduces the degree of effective protection that access to the protected US final-good market confers to Mexican assemblers. We assume that Mexico is on its "participation constraint", i.e. that effective protection, once taken into account the rule of origin, is reduced to zero for Mexican assemblers (this assumption is in accordance with the results of Cadot et al., 2001). In other words, Mexican assemblers are indifferent between shipping through NAFTA (and complying to the rule of origin) and shipping through the Most Favored Nation regime. As deep tariff preferences make strict ROOs more palatable for the Mexican side, the two are correlated along Mexico's participation constraint. Thus, upstream intermediate-good producers in the US might lobby for deep tariff preferences downstream, because, alongside the South Participation constraint, tariff preferences buy stiffer ROOs. We take this lobbying to be the driving force behind the determination of ROOs, and the analytical framework that we adopt to explore the issue is a simplified version of Grossman and Helpman (1994) highlighting vertical linkages.

We estimate the first-order condition from the political-economy model simultaneously with a market-access equation in which Mexican exports to the United States under NAFTA's preferential regime are functions, inter alia, of tariff preferences and ROOs. NAFTA provides a laboratory experiment to test the effect of ROOs. It is the quintessential example of the North-South agreement due to the comprehensive tariff liberalization built in the agreement and the fact that member countries share borders, eliminating the need to account for distance as in traditional gravity exercises. We construct a panel dataset with information dating back to 1989 on commodity imports from Mexico to United States under different preferential programs. The data was compiled mostly from USITC sources at the 6-digit HS disaggregation level and contains information on tariff preferences (GSP and NAFTA rates) granted by the United States to Mexico. From 1989 to 1994, Mexico's exports to the United Stated benefited from the Generalized System of Preferences (GSP), after which this regime was overhauled by NAFTA. The data on rules of origin comes from Estevadeordal (2000).

The results are in conformity with the model's predictions. All variables are significant —most of them at the 1% level— and have the expected signs. Tariff preferences and ROOs exert positive and negative influences respectively on Mexican exports, and the key variable influencing endogenously-determined ROOs —a product of input-output coefficients and US intermediate exports to Mexico— has the predicted sign and is significant at the 1% level.

The paper is organized as follows. Section 2 sets out the political-economy model and characterizes its equilibrium. Section 3 presents prima-facie evidence in support of the model's basic assumptions. Section 4 presents the empirical methodology and results, and section 5 concludes.

# 2 Politically-determined ROOs

This section uses a simple, stripped-down political-economy model to illustrate the simultaneous determination of tariff preferences and ROOs. Although the model borrows from Grossman and Helpman (1994) the appearance of a general-equilibrium model, it is best thought of as a partial-equilibrium one as interindustry linkages are nonexistant except for the vertical linkages around which the discussion is centered.

## 2.1 The economy

Consider a PTA formed by two small economies, North (N) and South (S). The North produces, under increasing cost, an intermediate good denoted by the subscript $I$ and exports it to the South which uses it to assemble a final good denoted by the subscript $F$. Southern supply of the final good is not enough to cover the North's consumption at its tariff-ridden price, so the North also imports from the rest of the world. The South imports all its own consumption of the final good from the rest of the world and exports all its production to the North.

Households in both countries consume the final good and an aggregate of all other goods, which also serves as numeraire, under identical and quasilinear preferences. Let $c_F$ and $c_0$ denote respectively the quantities of final and 'other' goods consumed by a representative consumer in either country. The utility function is

$$U = c_0 + u(c_F) \tag{1}$$

where $u' > 0$ and $u'' < 0$.

The final good is produced by combining value added and the intermediate good. Value added is created with intersectorally mobile labor $\ell$ and specific capital $\kappa$ under a technology $f(\ell, \kappa)$. The technology producing the final good, into which the value-added production function is nested, is of the Leontieff type with input-output coefficient $a_{IF}$. Letting $y_F$ and $x_I$ stand respectively for the final-good output and quantity of intermediate good consumed in the process,

$$y_F = \min\{f(\ell, \kappa); x_I/a_{IF}\}. \tag{2}$$

Let $p_I^*$ and $p_F^*$ be respectively the intermediate and final goods' world prices. Under free trade, given the technology postulated, the 'net price' out of which a Southern producer can remunerate value added (wages and profits) is

$$p^* = p_F^* - a_{IF} p_I^*. \tag{3}$$

With the stock of specific capital fixed, the technology $f$ which generates value added displays diminishing returns on labor. The supply of value added is therefore upward sloping in its net price $p^*$, and economic rents accrue to owners of specific capital, who are assumed to be the industry's residual claimants.

The rest of the economy uses only labor under constant returns to scale, which fixes the wage rate. Given this assumption, the model becomes a quasi-partial equilibrium one. In this setting, Southern final-good producers' surplus under free trade, $\pi_F^*$, is a monotone increasing function of $p^*$:

$$\pi_F^* = p^* y_F - w^S \ell_F.$$

Letting $p$ be generic notation for the net price, $(p - p^*)/p$ is the effective rate of protection granted to Southern producers when selling on the Northern market.[1]

The intermediate good is produced in the North with value-added only under a technology similar to $f$. Letting $y_I$ be its output, producer surplus is

$$\pi_I = p_I y_I - w^N \ell_I. \tag{4}$$

Finally, we will measure the intermediate good in units that make its world price $p_I^*$ equal to one, and we will treat its supply elasticity in the North, $\varepsilon_I \equiv p_I y_I' / y_I$, as a constant.

## 2.2 The politics

In order to keep things simple, we will treat MFN (external) tariffs on the final and intermediate goods as predetermined to the PTA and hence parametric. Northern tariffs are respectively $t_F^N$ and $t_I^N$ and Southern ones $t_F^S$ and $t_I^S$. In order to focus on the effects of Northern tariffs and ROOs, we will set $t_F^S = t_I^S = 0$. Extensions to other cases are straightforward but add little to the analysis.[2]

The model's endogenous political-economy variables are the preferential tariff applied, as part of the PTA, on Southern exports of the final good, $\tau$, and the regional content [use proper term here: the share of input originating from the Free trade area ? ] of the ROO, $r$. Let $x_I^N$ be the amount of intermediate good sourced in the North (as opposed to imported from the rest of the world), and let $\delta = t_F^N - \tau$ be the rate of preference (in specific form) The price at which Southern final-good producers can sell in the North is

$$p_F = \begin{cases} p_F^* + \delta & \text{if } x_I^N \geq r x_I \\ p_F^* & \text{otherwise.} \end{cases} \tag{5}$$

That is, Southern producers can sell under the PTA's preferential regime if they satisfy the ROO. If not, they sell under the MFN regime, i.e. at the world price.

[1] Might perhaps be explained in more detail.

[2] Note that endogenous determination of MFN tariffs would yield $t_I^S = t_F^N = 0$ given that the South does not produce the intermediate good and the North does not produce the final one. However if specialization is a result of the PTA and MFN tariffs are predetermined to it (say, because they are negotiated in multilateral rounds and thus constitute valuable bargaining chips), they will not be eliminated after the PTA's formation.

Given the ROO, Southern producers selling under the preferential regime source a proportion $r$ of their intermediate good in the North. The price of the value-added net price is thus

$$p = p_F^* + \delta - a_{IF}\left[rp_I + (1-r)p_I^*\right]. \tag{6}$$

The politics is described by a Grosssman-Helpman game in which the relevant producer lobby faces its government with a contribution schedule $C_i(\delta, r)$, $i = I, F$, conditioned on the policy variables of interest to it, $\delta$ and $r$. The function $C$ has the 'truthfulness' property that

$$\left.\frac{\partial C_i}{\partial r}\right|_{r^e,\delta^e} = \left.\frac{\partial \pi_i}{\partial r}\right|_{r^e,\delta^e} \text{ and } \left.\frac{\partial C_i}{\partial \delta}\right|_{r^e,\delta^e} = \left.\frac{\partial \pi_i}{\partial \delta}\right|_{r^e,\delta^e}$$

where the subscript $e$ designates equilibrium values. Note that there is only one lobby in each country, so that the standard common-agency game degenerates into a single principal-agent game. Withouth any hidden action, the principal (the lobby) is then able to appropriate all the rents from protection. Any equilibrium will then have the property that the government is just indifferent between implementing the policy preferred by the lobby and implementing its own (free trade). In other words, the lobby's contribution just compensates the efficiency loss generated by trade protection.

Member-state governments set $\delta$ and $r$ in a cooperative game, i.e. at the levels that maximize their joint 'surplus'. Surplus is measured, in each country, by a political objective function taking the form of a linear combination of welfare and lobby contributions. That is,

$$G^N \equiv C_I(\tau, r) + aW(p_I, p_F)$$

and

$$G^S \equiv C_F(\tau, r) + aW(p_I, p_F).$$

The weight on welfare, $a$, is assumed to be the same in both countries. Extensions are straightforward. We consider two ways of splitting the joint surplus.

*Case 1*: The Northern government appropriates all the surplus and leaves the Southern government on its 'participation constraint'. Given that the South's consumption of the final good is always priced at $p_F^*$, consumer surplus is unaffected by changes in either $\tau$ or $r$. Moreover, under the postulated political game, there is complete pass-through from the equilibrium value of the function $G$ to the equilibrium level of profits of final-good producers (since the producers' lobby appropriates all the rents). Therefore the South's participation constraint is defined by the fact that the equilibrium net price of value added is equal to what it would be without the FTA, i.e. $p = p^*$.We will call this the PC solution.

*Case 2*: Nash bargaining solution with no PTA (i.e. no tariff preferences and no rules of origin) as the threat point. We will call this the NB solution.

## 2.3 Equilibrium

ROOs have the effect of segmenting the intermediate good's market in the trading bloc. Southern manufacturers of the final good selling on their home market are not affected by the ROO and consequently will under no conditions buy the intermediate at more than its world price (given that the South does not protect the intermediate good by assumption). Southern manufacturers selling on the Northern market, by contrast, must comply with the ROO if they want to benefit from the preferential regime. If they do, the market on which they buy their intermediate good is a 'closed-economy' market where Northern supply must match Southern demand without recourse to ROW imports. We now determine the price prevailing on that market.

**Price determination** With their home market unprotected, Southern manufacturers sell all their output on the protected Northern market where they enjoy preferential access. Suppose that $p_I > p_I^*$. In equilibrium, it will be. The ROO's domestic content is then binding, which means that a proportion $r$ of the South's intermediate-good demand will be sourced 'locally' (in the North). The market-clearing condition determining the intermediate good's domestic price is thus that the local demand induced by the ROO, $ra_{IF}y_F(p)$, be equal to the supply, i.e.

$$ra_{IF}y_F(p) = y_I(p_I) \tag{7}$$

where, as before, $y_F$ is the South's final-good production and $y_I$ is the North's intermediate-good production.

Let $p_I$ satisfy (7). If $p_I \leq p_I^* + t_I^N$, the ROO is not binding, which means that the North's supply of the intermediate good is sufficient to satisfy the

South's needs and more. We will henceforth disregard this case and suppose that the intermediate good's price determined by (7) is larger than its tariff-ridden price in the North.

**PC solution** Using (3) and (6) and recalling that $p_I^* = 1$ by choice of units, the South's participation constraint can be written as

$$p_F - a_{IF}\left[rp_I + 1 - r\right] = p_F^* - a_{IF}$$

or, using (5) and simplifying,

$$\delta = ra_{IF}\Delta p_I. \tag{8}$$

Written in full, the problem of maximizing the joint surplus under the South's participation constraint is

$$\begin{aligned} &\max_{\delta,r} G^N \equiv C_I(\delta, r) + aW^N(\delta, r) \\ &\text{s.t.} \\ &\delta = ra_{IF}\Delta p_I \\ &ra_{IF}y_F(p) = y_I(p_I) \\ &0 \leq r \leq 1,\ 0 \leq \delta \leq t_F^N. \end{aligned} \tag{9}$$

As an intermediate step before solving problem (9), we calculate two derivatives treating $r$ as predetermined: $dp_I/dr$ and $d\delta/dr$. Differentiating totally (6), (7) and (8) with respect to $p_I$, $\delta$ and $r$ and rearranging gives

$$\begin{aligned} d\delta &= a_{IF}\Delta p_I dr + ra_{IF}dp_I \\ a_{IF}y_F dr + ra_{IF}y_F' dp &= y_I' dp_I \end{aligned}$$

or

$$\left.\frac{dp_I}{dr}\right|_{PC} = \frac{a_{IF}y_F}{y_I'} = \frac{p_I}{r\varepsilon_I} > 0 \tag{10}$$

where $\varepsilon_I$ is the intermediate good's supply elasticity —which we will henceforth treat as constant— and

$$\begin{aligned} \left.\frac{d\delta}{dr}\right|_{PC} &= a_{IF}\Delta p_I + ra_{IF}\left.\frac{dp_I}{dr}\right|_{PC} \\ &= a_{IF}\left(\Delta p_I + \frac{p_I}{\varepsilon_I}\right) \qquad (11) \\ &= a_{IF}\left[p_I\left(1 + \frac{1}{\varepsilon_I}\right) - p_I^*\right] > 0. \qquad (12) \end{aligned}$$

Note that the ambiguity of the effect of ROOs on the intermediate good's price, noted by Ju and Krishna (1998, 2000) does not apply here because, by construction, along the South's participation constraint value-added in the final-good sector cannot go down, so (given the Leontieff technology) neither can output. Thus, ROOs cannot become so stiff as to become self-defeating.

We are now in a position to solve problem (9). Combining the constraint on $\delta$ with the participation constraint gives

$$ra_{IF}\Delta p_I \leq t_F^N.$$

Letting $\lambda$ and $\mu$ be two Lagrange multipliers, we have

$$£ = G[\delta(r), r] + \lambda(1-r) + \mu\left(t_F^N - ra_{IF}\Delta p_I\right)$$

and the Kuhn-Tucker conditions are

$$\begin{aligned}
\frac{dG}{dr} &\leq 0,\ r \geq 0,\ r\frac{dG}{dr} = 0; \\
1-r &\geq 0,\ \lambda \geq 0,\ \lambda(1-r) = 0; \\
t_F^N - ra_{IF}\Delta p_I &\geq 0,\ \mu \geq 0,\ \mu\left(t_F^N - ra_{IF}\Delta p_I\right) = 0.
\end{aligned}$$

We now construct the expression for $dG/dr$, which has two components: a contribution effect and a welfare effect.

**Contribution effect** Using Hotelling's lemma and the contribution function's truthfulness property, we have, in a neighborhood of the equilibrium,

$$\left.\frac{dC_I}{dr}\right|_{PC} = \frac{d\pi_I}{dr} = y_I\frac{dp_I}{dr} = \frac{p_I y_I}{r\varepsilon_I} > 0 \tag{13}$$

Thus, left to itself (i.e. absent any welfare consideration) the Northern intermediate-good lobby would be willing to push ROOs to a corner solution (namely, whatever the South will take).

Combining (13) and (11), it is apparent that the Northern intermediate-good lobby is willing to contribute in favor of 'deep' tariff preference in the downstream sector because, along the South's participation constraint, tariff preference buys stiffer ROOs which in turn are advantageous to the intermediate-good sector.

**Welfare effect** Let $m_F$ be the North's imports of final goods from the South and $m_F^*$ its imports of final goods from the rest of the world. Under quasilinear preferences, Northern welfare is the sum of income (from profits and tariff revenue) and consumer surplus, which by virtue of (1) comes only from consumption of the final good. That is,

$$W^N = \pi_I + w^N \ell_I + \tau m_F + t_F^N m_F^* + u(c_F) - p_F c_F.$$

Noting that $m_F = y_F$ and $m_F^* = c_F - m_F = c_F - y_F$, this becomes

$$W^N = \pi_I + w^N \ell_I + t_F^N c_F - \delta y_F + u(c_F) - p_F c_F. \tag{14}$$

Note that, along the South's participation constraint, $p$ is constant and, hence, so is $y_F$. Thus, treating $p_I$ and $\delta$ as endogenous variables along the problem's constraints,

$$\begin{aligned} \left.\frac{dW^N}{dr}\right|_{PC} &= y_I \left.\frac{dp_I}{dr}\right|_{PC} - y_F \left.\frac{d\delta}{dr}\right|_{PC} \\ &= \frac{p_I y_I}{r\varepsilon_I} - a_{IF} y_F \left[p_I \left(1 + \frac{1}{\varepsilon_I}\right) - p_I^*\right]. \end{aligned}$$

Using the fact that, by (7), $a_{IF} y_F = y_I / r$, this becomes

$$\begin{aligned} \left.\frac{dW^N}{dr}\right|_{PC} &= \frac{y_I}{r} \left\{\frac{p_I}{\varepsilon_I} - \left[p_I \left(1 + \frac{1}{\varepsilon_I}\right) - p_I^*\right]\right\} \\ &= -\frac{y_I}{r} \Delta p_I < 0. \end{aligned} \tag{15}$$

Combining the contribution effect with the welfare effect gives

$$\begin{aligned} \left.\frac{dG^N}{dr}\right|_{PC} &= \left.\frac{dC_I}{dr}\right|_{PC} + a \left.\frac{dW^N}{dr}\right|_{PC} \\ &= \frac{p_I y_I}{r\varepsilon_I} - a\frac{y_I}{r} \Delta p_I \\ &= \frac{p_I y_I}{r} \left(\frac{1}{\varepsilon_I} - \frac{a \Delta p_I}{p_I}\right). \end{aligned}$$

Under the first-order condition, this expression is equal to zero so, after simplifying,

$$\frac{p_I}{\Delta p_I} = a\varepsilon_I.$$

Using (8) to retrieve a semi-closed form for $r$ (it is not a real closed form since $p_I$ is on the RHS) gives

$$r = \frac{\delta a \varepsilon_I}{a_{IF} p_I}. \tag{16}$$

Re-introducing the inequality constraints, the solution is thus

$$r = \begin{cases} t_F^N / a_{IF} \Delta p_I & \text{if } \delta a \varepsilon_I \Delta p_I / p_I \geq t_F^N \\ 0 & \text{if } \delta a \varepsilon_I / a_{IF} p_I \leq 0 \\ \delta a \varepsilon_I / a_{IF} p_I & \text{otherwise.} \end{cases}.$$

With several inputs indexed by $i$ and one output indexed by $j$, it is easily verified that (16) becomes

$$r_j = \frac{a \delta_j}{\sum_i a_{ij} p_i / \varepsilon_i}. \tag{17}$$

# 3 Quantity and price effects: prima-facie evidence

## 3.1 Regional Intensity of Trade

Let $x_{ijk}$ be country $i$'s exports of good (or class of goods) $k$ to country (or region) $j$, let $x_{ij} = \sum_k x_{ijk}$ country $i$'s exports to $j$ aggregated over all commodities, $x_{ik} = \sum_j x_{ijk}$ country $i$'s exports of good $k$ to the world, and $x_i = \sum_j \sum_k x_{ijk}$ country $i$'s total exports aggregated over destination and commodities.

The Regional Intensity of Trade (RIT) index, which measures the share of a region in $i$'s exports of a good relative to the share of that region in $i$'s overall exports, is

$$R_{ijk} \equiv \frac{x_{ijk}/x_{ij}}{x_{ik}/x_i}.$$

Let $i$ be the US and $j$ be Mexico. Let also $k = I$ denote intermediate goods (codes 01 and 02 in the WTO's nomenclature) and $k = F$ final ones (code 03 in the WTO's nomenclature), and define

$$x_{ijI} \equiv \sum_{k \in I} x_{ijk}$$

and similarly for $x_{ijF}$. Letting

$$R_{ijI} \equiv \frac{x_{ijI}/x_{ij}}{x_{iI}/x_i}$$

and similarly for $R_{ijF}$ The hypothesis to be tested is that NAFTA has specialized Mexico-US trade into a 'vertical' exchange of the offshore-assembly type whereby the US ships semi-finished goods for final assembly in Mexico and then reimports them as finished products [Francois (2003)]. Under that hypothesis, if the argument $t$ denotes a year post NAFTA (2000) and 0 a year prior to NAFTA (1993), the hypothesis to be tested is

$$\frac{R_{ijI}(t)}{R_{ijF}(t)} > \frac{R_{ijI}(0)}{R_{ijF}(0)}.$$

Tables 1a-1b
Regional intensities of trade, 1992 and 2000

Table 1 shows that there is indeed an increase in the regional intensity of trade in the expected direction, US exports specializing in input more than Mexican exports.

## 3.2 Price effects

We measure $p_k^i = p_k^*(1+t_k^i)$ using unit values, provided by the USITC's online database, of goods imported into the US from Asia not claiming any special program (a proxy for world prices at the US border) augmented by the US's MFN tariff (also from the USITC's database). We measure $\widetilde{p}_k^i$ using the unit values of the same goods for export into Mexico. If ROOs have, as claimed, the effect of segmenting the market for intermediate goods, raising their price when used for the production of goods re-exported into the US, the ratio of the two should be higher, ceteris paribus, for intermediate goods than for final ones. We differentiate between intermediate and final goods using the WTO's classification of goods into raw materials, semi-finished goods, and fully processed goods. Ignoring CIF/FOB differences, the hypothesis to be tested is thus

$$\gamma_I \equiv \frac{\overline{p}_I^{US}}{p_I^*(1+t_I^{US})} > \gamma_F \equiv \frac{p_F^{US}}{p_F^*(1+t_F^{US})} = 1.$$

Taking account of the fact that the US border price is CIF for imported goods and FOB for exported ones, the middle term should be less than one since the denominator should be raised by the CIF/FOB margin. [Get estimates of CIF/FOB margins for trade between Asia and the US–perhaps from Carrere, Guillaumont and de Melo?]

Alternatively, let $\gamma_{kt}$ be the value of index after NAFTA and $\gamma_{k0}$ its value before NAFTA. A weaker hypothesis to test is

$$\frac{\gamma_{It}}{\gamma_{It}} > \frac{\gamma_{F0}}{\gamma_{F0}}.$$

Evidence is provided in Table 2.

Table 2
Price effects on intermediate and final goods

# 4 Market access and ROO determination

## 4.1 The data

The empirical exercise that follows is based on a panel dataset covering the period from 1989 to 1994 and containing information on commodity trade and tariffs between Mexico to United States under MFN and preferential regimes. The data was compiled mostly from USITC sources at the 6-digit HS level of disaggregation. The preferential regime for Mexico was the Generalised System of Preference from 1989 to 1993, and NAFTA after 1994. The data on rules of origin comes from Estevadeordal (2000).

## 4.2 Empirical estimation

The set of equations to be estimated is

$$\ln y_j = \alpha_0 + \alpha_1 \ln \delta_j + \alpha_2 r_j + \alpha_3 x_j + u_{jt} \qquad (18)$$

where$\delta_j$ is the rate of preference granted to good $j$ under NAFTA, $r_j$ is Estevadeordal's (2000) qualitative index of ROO strictness and $x_j$ is a supply-side determinant proxied by Mexican exports to the rest of the world, and, putting (17) in logs,

$$\ln r_j = \beta_0 \ln a + \beta_1 \ln \delta_j - \beta_2 \ln \left( \sum_i a_{ij} p_i / \varepsilon_i \right) + v_{jt}. \tag{19}$$

Alternatively, noting that, by (10)

$$\frac{p_i}{\varepsilon_i} = \frac{r a_{ij} y_j}{y_i'} = \frac{y_i}{y_i'},$$

it follows that

$$\sum_i \frac{a_{ij} p_i}{\varepsilon_i} = \sum_i \frac{a_{ij} y_i}{y_i'},$$

so letting $z_j = \sum_i a_{ij} y_i / y_i'$, the equation to be estimated becomes

$$\ln r_j = \beta_0 \ln a + \beta_1 \ln \delta_j - \beta_2 \ln z_j + v_{jt}. \tag{20}$$

where $\beta_0 = \ln a$, $\beta_1 = 1$, $\beta_2 > 0$ and $z_j = \sum_i a_{ij} y_i / y_i'$ is proxied (with measurement errors since $y_i'$ is unobserved) by $\sum_i a_{ij} y_i$, the sum, over all goods $i$ upstream of $j$, of the product of US exports of good $i$ to Mexico, $y_i$, times the share $a_{ij}$ of good $i$ in good $j$'s output.

## 4.3 Results

Results are shown in Tables 3-7. All estimates are significant at the 1% level and have the expected sign. Table 4 shows that Mexico's exports to the US under NAFTA are enhanced by the preferential tariff but there is a countervailing effect going through the restrictiveness of rules of origin. Table 4 confirms this finding with an alternative definition of Rules of origin where we used directly the primary set of dummies depending on the type of substantial transformation criteria classification required by the rule (a change of tariff classification (CTC) at the chapter, heading, sub-heading or item levels, the existence of exceptions to the CTC, a minimum requirement of regional value content, or a technological test requirement). Again, rules of origin have a negative impact of the volume of preferential trade. Changes of heading and changes of chapters that represent respectively 40 and 54 percent of the tariff lines (Estevadeordal and Suominen, 2003) are quite detrimental in that respect. Exceptions to the rule alleviate the negative impact of rules of origin on trade (meaning that these exceptions are actually somekind of allowances).

Table 3-4
Regression results, ROOs and Utilization Rates

Table 5 introduces interaction terms between the restrictiveness index and year dummies. Contrary to expectations, results do not seem to suggest a strong learning curve. Of course, most of the action is likely to happen in some specific sectors as was the case for the bilateral trade between Canada and the United States (see Estevadeordal and Suominen, figure 1).

Tables 5-6 here

Table 6 takes as the dependent variable, the utilization rate, that is, the ratio of Mexican preferential imports over total Mexican imports. The use of a logistic regression is supported by figure 1 (histogram of utilization rates) that shows that most goods at the HS-6 digit level of disagregation are either never traded through the NAFTA regime or always traded through the preferential scheme. The regression in table 6 exhibit the same pattern: rules of origin counterbalances the positive effect of preferential tariffs on Mexican trade.

Finally, Table 7 shows regression results for the political determination of ROOs, i.e. equation (20) in the model. The results are consistent with the theory's prediction. The variable labeled "upstream" which stands for $\sum_i a_{ij} y_i$ has a negative and significant coefficient. Moreover, tariff preferences come out as a positive influence on ROOs at the tariff-line level, lending support to the participation-constraint approach adopted here.

# 5 Concluding remarks

Our results highlight the deleterious effect of rules of origin on the benefits generated by preferential trade liberalization, in terms of market access, for Southern partners. These results, which are in conformity with the findings of the recent literature, suggest that ROOs should indeed be viewed as an economically sensitive item rather than a technical one in the agenda of any future bilateral trade negotiations. However, our results have more of a positive than normative flavour. We use a standard model of endogenous trade policy —Grossman and Helpman's common-agency model— to explore the logic of ROO determination. On the assumption that the Mexican side is on its "participation constraint", i.e. that the rate of effective protection conferred to Mexican final-good producers by the simultaneous use of tariff preferences and ROOs is just about zero, the model shows that preferences-cum-ROOs amount to a pure transfer from US taxpayers to intermediate-good producers, i.e. to a hidden export subsidy.

Empirically, the model suggests the inclusion, among the right-hand side variables of the second equation (ROO determination), of the product of input-output coefficients by US intermediate sales to Mexico. This unintuitive prediction provides a test of the approach's validity, since it is difficult to think of an alternative theoretical approach that would lead to the inclusion of that particular algebraic term. Empirical results are in striking conformity with the model's predictions. In sum, they suggest that the use of NAFTA to create a captive market for US intermediates was indeed one of the forces shaping the agreement's rules of origin.

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# 6 Tables and figures

Attached file "tables and figures.doc"

Tables and figures for Cadot, Estevadeordal and Suwa-Eisenmann

Table 1a
Regional Intensity of Trade indices, US exports, 1992-2000

| | 1992 | 2000 | delta % |
|---|---|---|---|
| 01 | 0.6935 | 0.7203 | 3.86 |
| 02 | 0.9689 | 1.0673 | 10.16 |
| 03 | 1.1033 | 0.9953 | -9.79 |
| 01/03 | 0.6286 | 0.7237 | 15.13 |
| 02/03 | 0.8782 | 1.0723 | 22.11 |

Source: US ITC (hs10) for trade flows, WTO for classification of goods by stage of processing, *i = US, j = Mexico*

Table 1b
Regional Intensity of Trade indices, Mexican exports, 1992-2000

| | 1993 | 2000 | delta % |
|---|---|---|---|
| 01 | 0.8843 | 0.8822 | -0.24 |
| 02 | 0.7598 | 0.7813 | 2.83 |
| 03 | 1.0688 | 1.0377 | -2.91 |
| 01/03 | 0.8274 | 0.8501 | 2.75 |
| 02/03 | 0.7109 | 0.7529 | 5.91 |

Source: COMTRADE (hs6) for trade flows, WTO for classification of goods by stage of processing, *i = Mexico, j = US*

Table 2
FOB Unit values of exports to Mexico/CIF AT unit values of imports from Asia, 2000

| **Section** | Unit-value increase | | |
|---|---|---|---|
| Description | $\tilde{a}_1$ | $\tilde{a}_2$ | $\tilde{a}_3$ |
| Live animals | 0.85 | 0.90 | 0.00 |
| Veg. prod. | 0.86 | 0.76 | 1.12 |
| Fats & oils | n.a. | n.a. | 1.55 |
| Food, bev. & tobacco | 1.31 | 1.22 | 0.70 |
| Mineral products | 1.04 | 0.92 | 1.05 |
| Chemicals | n.a. | 1.06 | 0.82 |
| Plastics | 1.14 | 0.96 | 1.14 |
| Leather goods | 1.15 | 0.67 | 1.61 |
| Wood products | 0.60 | 0.66 | 1.27 |
| Pulp & paper | 1.58 | 0.78 | 0.87 |
| Textile & apparel | 1.36 | 1.00 | 0.70 |
| Footwear | n.a. | n.a. | 0.77 |
| Stone & glass | n.a. | 1.25 | 1.05 |
| Jewelry | 0.83 | 1.07 | 0.00 |
| Base metals | 0.98 | 1.14 | 1.04 |
| Mach. & elect. Equip. | n.a. | n.a. | 1.29 |
| Transport Equip. | n.a. | n.a. | 1.04 |
| Optics | n.a. | n.a. | 1.30 |
| Arms & amm. | n.a. | n.a. | 1.64 |
| Miscellaneous | n.a. | n.a. | 1.25 |

**Notes**
Weighted average gamma by section and stage of processing; weight: US exports to Mexico
Tariff for gamma calculation: MFN AVE, ITC
**Source:** imp from Asia, exp to Mex, 2000, value, hs10, ITC

Table 3
NAFTA ROOs (overall index) and Mexico's Preferential exports

Dependent Variable: Preferential US Imports from Mexico [ln (Imports)] W-OLS Estimates

| | NAFTA (1994-2001) | | | | PRE-NAFTA and NAFTA (1989-2001) | | | |
|---|---|---|---|---|---|---|---|---|
| ln(1+Total Mex. Exp. RoW) | 0.51 | 0.51 | 0.51 | 0.51 | 0.45 | 0.45 | 0.45 | 0.45 |
| | *(102.08)* | *(101.71)* | *(102.08)* | *(101.7)* | *(100.47)* | *(96.644)* | *(100.42)* | *(96.627)* |
| ln(Preferential tariff A) | 0.34 | | | | 0.42 | | | |
| | *(37.14)* | | | | *(51.031)* | | | |
| ln(1+ Preferential tariff A) | | 2.64 | | | | 3.39 | | |
| | | *(13.044)* | | | | *(16.717)* | | |
| ln(Preferential tariff B) | | | 0.34 | | | | 0.42 | |
| | | | *(37.087)* | | | | *(50.858)* | |
| ln(1+ Preferential tariff B) | | | | 2.60 | | | | 3.34 |
| | | | | *(12.915)* | | | | *(16.556)* |
| ln(RoO restrictiveness) | -0.43 | -0.45 | -0.43 | -0.45 | -0.61 | -0.65 | -0.61 | -0.65 |
| | *(13.845)* | *(14.486)* | *(13.853)* | *(14.484)* | *(20.224)* | *(20.908)* | *(20.224)* | *(20.905)* |
| Constant | 14.70 | 11.61 | 14.69 | 11.61 | 13.26 | 9.44 | 13.25 | 9.44 |
| | *(80.382)* | *(69.939)* | *(80.352)* | *(69.936)* | *(72.604)* | *(53.875)* | *(72.528)* | *(53.873)* |
| Observations | 20'210 | 20'949 | 20'210 | 20'949 | 27'293 | 28'247 | 27'293 | 28'247 |
| Adjusted R-squared | 0.693 | 0.669 | 0.693 | 0.669 | 0.695 | 0.664 | 0.695 | 0.664 |

Notes
Absolute value of t-statistics in parentheses
Similar results obtained using TOBIT and/or using ln (Mexican Exports to RoW lagged one period) to control for potential endogeneity.
Preferential tariff A is [(MFN rate - Tariff on Mexican goods) / (1 + Tariff on Mexican goods)].
Preferential tariff B is (MFN rate - Tariff on Mexican goods).

Table 4
NAFTA's ROOs (categorical dummies) and Mexico's Preferential Exports

Dependend Variable: Preferential US Imports from Mexico [ln (Imports)] W-OLS Estimates

| | NAFTA (1994-2001) | | | | PRE-NAFTA and NAFTA (1989-2001) | | | |
|---|---|---|---|---|---|---|---|---|
| ln(1+Total Mex. Exp. RoW) | 0.48 | 0.49 | 0.48 | 0.49 | 0.43 | 0.42 | 0.43 | 0.42 |
| | *(95.057)* | *(94.48)* | *(95.05)* | *(94.463)* | *(93.961)* | *(89.889)* | *(93.907)* | *(89.869)* |
| ln(Preferential tariff A) | 0.32 | | | | 0.40 | | | |
| | *(34.824)* | | | | *(49.084)* | | | |
| ln(1+ Preferential tariff A) | | 2.03 | | | | 2.80 | | |
| | | *(10.133)* | | | | *(13.895)* | | |
| ln(Preferential tariff B) | | | 0.32 | | | | 0.40 | |
| | | | *(34.745)* | | | | *(48.893)* | |
| ln(1+ Preferential tariff B) | | | | 1.99 | | | | 2.75 |
| | | | | *(9.996)* | | | | *(13.731)* |
| CTC dummy | -0.31 | -0.30 | -0.31 | -0.30 | -0.82 | -0.82 | -0.82 | -0.82 |
| | *(4.953)* | *(4.776)* | *(4.959)* | *(4.771)* | *(14.02)* | *(13.645)* | *(14.004)* | *(13.637)* |
| CTH dummy | -0.34 | -0.35 | -0.34 | -0.35 | -0.43 | -0.46 | -0.43 | -0.46 |
| | *(7.293)* | *(7.325)* | *(7.276)* | *(7.323)* | *(9.251)* | *(9.448)* | *(9.234)* | *(9.445)* |
| CTS dummy | -0.22 | -0.30 | -0.22 | -0.30 | 0.07 | -0.01 | 0.07 | -0.01 |
| | *(3.622)* | *(4.961)* | *(3.594)* | *(4.958)* | *(1.161)* | *(0.13)* | *(1.193)* | *(0.124)* |
| CTI dummy | -0.06 | 0.37 | -0.06 | 0.37 | 0.21 | 0.73 | 0.22 | 0.73 |
| | *(0.419)* | *(2.868)* | *(0.389)* | *(2.874)* | *(1.42)* | *(5.636)* | *(1.458)* | *(5.644)* |
| Exceptions dummy | 0.53 | 0.62 | 0.53 | 0.62 | 0.28 | 0.36 | 0.28 | 0.36 |
| | *(14.571)* | *(16.941)* | *(14.53)* | *(16.935)* | *(7.988)* | *(9.96)* | *(7.932)* | *(9.951)* |
| RVC dummy | -0.54 | -0.57 | -0.54 | -0.57 | -0.45 | -0.51 | -0.45 | -0.51 |
| | *(16.627)* | *(17.46)* | *(16.617)* | *(17.473)* | *(14.365)* | *(15.641)* | *(14.365)* | *(15.657)* |
| Constant | 14.21 | 11.32 | 14.20 | 11.32 | 13.39 | 9.74 | 13.38 | 9.74 |
| | *(77.863)* | *(67.852)* | *(77.819)* | *(67.849)* | *(72.978)* | *(55.48)* | *(72.892)* | *(55.478)* |
| Observations | 20'295 | 21'035 | 20'295 | 21'035 | 27'378 | 28'333 | 27'378 | 28'333 |
| Adjusted R-squared | 0.703 | 0.682 | 0.703 | 0.682 | 0.702 | 0.673 | 0.702 | 0.673 |

Notes
Absolute value of t-statistics in parentheses
Year and Section effects not shown.
Similar results obtained using TOBIT and/or using ln (Mexican Exports to RoW lagged one period) to control for potential endogeneity.

Table 5
NAFTA's ROOs and Mexico's Preferential Exports: time interactions

Dependend Variable: Preferential US Imports from Mexico [ln (Imports)] W-OLS Estimates

| | NAFTA (1994-2001) | | | | PRE-NAFTA and NAFTA (1989-2001) | | | |
|---|---|---|---|---|---|---|---|---|
| ln(1+Total Mex. Exp. RoW) | 0.51 | 0.52 | 0.51 | 0.52 | 0.46 | 0.46 | 0.46 | 0.46 |
| | *(103.093)* | *(103.149)* | *(103.091)* | *(103.138)* | *(101.752)* | *(98.2)* | *(101.698)* | *(98.185)* |
| ln(Preferential tariff A) | 0.36 | | | | 0.44 | | | |
| | *(37.888)* | | | | *(52.347)* | | | |
| ln(1+ Preferential tariff A) | | 2.65 | | | | 3.49 | | |
| | | *(12.94)* | | | | *(16.972)* | | |
| ln(Preferential tariff B) | | | 0.36 | | | | 0.44 | |
| | | | *(37.816)* | | | | *(52.152)* | |
| ln(1+Preferential tariff B) | | | | 2.62 | | | | 3.44 |
| | | | | *(12.819)* | | | | *(16.817)* |
| (Restrictiveness)(1994) | 0.15 | -0.09 | 0.15 | -0.09 | 0.13 | -0.15 | 0.13 | -0.15 |
| | *(4.295)* | *(3.075)* | *(4.231)* | *(3.077)* | *(3.713)* | *(5.046)* | *(3.637)* | *(5.048)* |
| (Restrictiveness)(1995) | 0.00 | -0.08 | 0.00 | -0.08 | -0.04 | -0.14 | -0.04 | -0.14 |
| | *(0.032)* | *(3.274)* | *(0.092)* | *(3.299)* | *(1.492)* | *(5.503)* | *(1.563)* | *(5.534)* |
| (Restrictiveness)(1996) | -0.11 | -0.13 | -0.11 | -0.13 | -0.16 | -0.19 | -0.16 | -0.19 |
| | *(4.673)* | *(5.618)* | *(4.706)* | *(5.633)* | *(7.003)* | *(7.963)* | *(7.036)* | *(7.981)* |
| (Restrictiveness)(1997) | -0.10 | -0.09 | -0.10 | -0.09 | -0.17 | -0.16 | -0.17 | -0.16 |
| | *(4.816)* | *(4.269)* | *(4.839)* | *(4.285)* | *(8.24)* | *(7.455)* | *(8.261)* | *(7.474)* |
| (Restrictiveness)(1998) | -0.16 | -0.12 | -0.16 | -0.12 | -0.24 | -0.20 | -0.24 | -0.20 |
| | *(7.849)* | *(5.857)* | *(7.847)* | *(5.859)* | *(12.044)* | *(9.486)* | *(12.031)* | *(9.487)* |
| (Restrictiveness)(1999) | -0.12 | -0.08 | -0.12 | -0.08 | -0.21 | -0.16 | -0.20 | -0.16 |
| | *(6.159)* | *(3.964)* | *(6.13)* | *(3.939)* | *(10.371)* | *(7.547)* | *(10.323)* | *(7.515)* |
| (Restrictiveness)(2000) | -0.07 | -0.04 | -0.07 | -0.04 | -0.15 | -0.11 | -0.15 | -0.11 |
| | *(3.693)* | *(1.962)* | *(3.662)* | *(1.938)* | *(7.658)* | *(5.369)* | *(7.61)* | *(5.337)* |
| (Restrictiveness)(2001) | -0.10 | -0.06 | -0.10 | -0.06 | -0.18 | -0.13 | -0.18 | -0.13 |
| | *(5.133)* | *(2.941)* | *(5.102)* | *(2.916)* | *(9.142)* | *(6.385)* | *(9.092)* | *(6.353)* |
| Constant | 13.36 | 11.25 | 13.36 | 11.25 | 13.38 | 9.37 | 13.37 | 9.38 |
| | *(55.118)* | *(54.068)* | *(55.112)* | *(54.066)* | *(72.72)* | *(53.208)* | *(72.629)* | *(53.205)* |
| Observations | 20'210 | 20'949 | 20'210 | 20'949 | 27'293 | 28'247 | 27'293 | 28'247 |
| Adjusted R-squared | 0.692 | 0.667 | 0.692 | 0.667 | 0.694 | 0.661 | 0.694 | 0.661 |

Table 6

NAFTA ROOs (categorical dummies) and Utilization Rates

| | NAFTA (1994-2001) | | | | | |
|---|---|---|---|---|---|---|
| Dependent variable: Utilization Rate [0,1] Logistic estimation | | | | | | |
| ln(tar_pref1) | 0.128 | | | | 0.127 | |
| | (9.053) | | | | (9.008) | |
| ln(1+ tar_pref1) | | 4.125 | | | | 3.841 |
| | | (13.591) | | | | (12.725) |
| ln(tar_pref2) | | | 0.127 | | | |
| | | | (8.966) | | | |
| ln(1+ tar_pref2) | | | | 4.039 | | |
| | | | | (13.41) | | |
| ln(Restrictiveness) | -0.733 | -0.507 | -0.732 | -0.506 | | |
| | (9.827) | (7.591) | (9.823) | (7.579) | | |
| CTC dummy for RoO | | | | | -0.539 | -0.497 |
| | | | | | (6.845) | (6.848) |
| CTH dummy for RoO | | | | | -0.256 | -0.285 |
| | | | | | (3.243) | (3.908) |
| CTS dummy for RoO | | | | | -0.265 | -0.941 |
| | | | | | (1.983) | (7.764) |
| Exceptions CT dummy for RoO | | | | | 0.095 | 0.312 |
| | | | | | (2.095) | (7.52) |
| RVC dummy for RoO | | | | | 0.439 | 0.23 |
| | | | | | (7.617) | (4.321) |
| Constant | 2.176 | -0.581 | 1.764 | -0.579 | 1.363 | -0.723 |
| | (11.072) | (3.699) | (8.924) | (3.687) | (8.377) | (5.79) |
| Observations | 21505 | 28005 | 21505 | 28005 | 21600 | 28120 |

**Notes:**

Preferential tariff A is [(MFN rate - Tariff on Mexican goods) / (1 + Tariff on Mexican goods)].

Preferential tariff B is (MFN rate - Tariff on Mexican goods).

z-statistics in brackets

Table7
Politically-determined ROOs

| | NAFTA (1994-2001) | | PRE-NAFTA and NAFTA (1989-2001) | |
|---|---|---|---|---|
| Dependent Variable: restrictiveness of rules of origin [ln (restrict)] ordered logistic estimates | | | | |
| upstream | -0.15 | -0.25 | -0.16 | -0.24 |
| | *(-10.5)* | *(-19.9)* | *(-13.49)* | *(-24.02)* |
| ln(tar_pref1) | 0.09 | | 0.04 | |
| | *(6.59)* | | *(3.97)* | |
| ln(1+tar_pref1) | | 1.35 | | 0.31 |
| | | *(5.39)* | | *(1.98)* |
| Observations | 18'224 | 23'628 | 25'576 | 35'611 |
| Adjusted $R^2$ | 0.2418 | 0.2475 | 0.2489 | 0.2557 |

**Notes**
Absolute value of t-statistics in parentheses
Year and Section effects not shown.