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# ARE DIFFERENT RULES OF ORIGIN EQUALLY COSTLY?

# ESTIMATES FROM NAFTA*

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**Abstract**

Preferential market access, either in the recent OECD initiatives or in the North-South FTAs require the use of rules of origin (RoO). Recent studies have questioned the extent of market access provided by these preferences. Using data on Mexican exports to the US in 2001, this paper estimates the likely costs of different RoO for final and intermediate goods, and compares these results with those obtained from a synthetic index. Econometric results are plausible (they satisfy the revealed preference criterion that estimated costs of RoO should be less than preference rates when utilization rates of NAFTA preference are significantly positive), and they indicate that changes in tariff classification are more costly for final goods than for intermediate goods. For activities subject to regional value content minima, we carry out illustrative simulations indicating what tariff preference margin would be necessary to compensate for the import content minima. Overall, our cost estimates suggest, that at least in the case of NAFTA, preferential market access was quite small, leading us to speculate that these conclusions may carry over to other North-South preferential schemes.

JEL classification: F13, F15
Keywords: Rules of Origin, costs, NAFTA.

**Résumé**

L' accès préférentiel à un marché, que ce soit dans le cadre d'accords entre pays de l'OCDE ou de type "Nord-Sud", nécessite l'utilisation de règles d'origine. De récentes études ont remis en cause l'importance de l'accès au marché offert par ces systèmes de préférences. Basé sur des données d'exportations mexicaines destinées au marché des US en 2001, ce papier estime le coût représenté par les différentes règles d'origine pour les biens intermédiaires et finals, et compare ces résultats à ceux obtenus à partir d'un indice synthétique. Les résultats économétriques satisfont le critère de "préférence révélée": le coût estimé est inférieur au taux de préférence pour les biens dont le taux d'utilisation de l'ALENA est significativement positif. Les résultats indiquent qu'un changement de classification tarifaire est plus coûteux pour un bien final que pour un bien intermédiaire. Pour les activités sujettes à un critère de "contenu régional minimum", des simulations sont proposée afin de mesurer quelle marge de préférence tarifaire serait nécessaire pour compenser le coût d'un tel critère. De manière générale, nos estimations de coûts confirment, au moins dans le cadre de l'ALENA, que l'accès au marché préférentiel a été relativement faible, ce qui doit être également le cas dans d'autres schémas préférentiels de type "Nord-Sud".

JEL classification: F13, F15
Mots Clefs: Règle d'origine, coûts, ALENA.

## 1. INTRODUCTION

Rules of origin (RoO) are a key ingredient in any preferential trading agreement (PTA) short of a customs union, as well as in any preferential market access scheme such as the generalized system of preference (GSP) or the more recent "everything but arms" (EBA) and African growth opportunity act (AGOA) initiatives. Low rates of utilization have led many observers to question the extent of market access, not only because of lower most favored nation (MFN) tariffs worldwide or because there may be significant learning effects that contribute to low utilization rates in the early years of implementation, but mostly because of the presumed cost-raising effects of these seemingly "'made-to-measure" RoO. Yet, there is little systematic direct evidence documenting the cost-raising effects of RoO. This paper provides more systematic evidence for NAFTA.

Useful anecdotic evidence abounds. For example there is ample documentation of the stringent requirements that must sometimes be satisfied to meet origin (i.e. the definition of 'vessel' under the EBA (Brenton 2005), the description of the triple transformation rule widely applied in textiles or the detailed description of RoO in SADC (Flatters and Kirk 2005). Several contributions have used gravity trade models with dummy variables or synthetic indices to capture the effects of RoO. These studies typically conclude that, after controlling for other factors, trade volumes are indirectly related either to indices of the presence of RoO or of their levels of restrictiveness (see e.g. Augier et al. 2005; Estevadeordal and Suominen 2005; Cadot et al. 2005).[1]

Another promising approach, inspired from earlier work on EFTA (Herin, 1986) has used revealed preference to estimate upper and lower bounds on the cost of RoO. The assumption here is that for sectors with utilization rates close to 100%, the utilization rate would give an upper bound on the costs of RoO while for sectors with close to zero utilization rates, preference rates would provide a lower bound of the costs associated with RoO. Under the assumption that transitional adjustment to the administrative requirements of the RoO has taken place, this non-parametric method is a useful way to obtain bounds on the costs of RoO when one has data on utilization rates (see e.g. Cadot et al. 2004 and below).

While useful, these comparisons of utilization rates do not exploit the variance in the types of RoO used across sectors. Estevadeordal (2000) was the first to recognize explicitly the importance of different RoO in terms of their potential cost-raising effects by constructing a synthetic index that explicitly accounted

[1] Other contributions have sought to provide more direct estimates. For example, in the context of The Europe Agreements, Brenton and Manchin (2003) have observed that several East European partners have preferred to enter the EU market under overseas processing trading (OPT) arrangements than under the presumably more generous market access provided by the FTA. More recently, in an assessment of market access provided by the EU under the EBA and the GSP, Brenton (2005) concludes that the low take-up of preferences under the EBA must at least partly be due to costs associated with the accompanying RoO.

for differences in types of RoO.[2] The appeal of a synthetic index is potentially of great practical use since, like suitably constructed effective rates of protection that provide a summary description of a country's trade regime, a synthetic index describing the set of RoO that accompany a preferential agreement could also provide an overall idea of the restrictiveness of the system of RoO.

As explained below, the observation rule is not confronted with the data (for example broad categories of sectors (raw materials, intermediates and final goods) may not be affected in the same way by a given RoO (say a change of chapter). Nor is its usefulness as a measure of restrictiveness of RoO under NAFTA systematically analyzed. Within the limits imposed by data availability (the effects of different types of RoO can only be captured by dummy variables and firm heterogeneity accounting for observations at the tariff line cannot be controlled for), this paper provides a more direct estimate of the costs of the three important categories of RoO under NAFTA: change of tariff classification, existence or not of a regional value content (RVC) scheme, and the presence or not of a technical (TECH) requirement. Our estimates also allow us to check the reasonableness of the assumptions used in building the $r_i$ index described above. Finally for sectors subject to a RVC, we provide illustrative simulations of the costs-raising effects of these RoO.

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[2] Estevadeordal built an observation rule that built relied on this assumption: a RoO requiring a change of chapter heading would be more restrictive than one requiring a change of classification at the tariff line (HS-8) level, and (other things equal), adding a regional value-content requirement or a technical requirement would make the RoO more restrictive (and hence more costly), resulting in an ordinal integer index at the HS-8 level, $r_i$ , in the range [$0<r_i<7$], with the property that larger values of $r_i$ would correspond to a more restrictive RoO. This synthetic index was constructed on the same data for Mexican exports to the US under NAFTA.

The remainder of the paper is organized as follows. Section 2 discusses the particular characteristics of the RoO map negotiated under NAFTA that are relevant for the econometric estimates that follow, and present non-parametric estimates that can be obtained by the use of a synthetic index. Section 3 presents a simple model leading to econometric estimates that take into account differences across broad categories of goods and across types of RoO. Results from estimating this model are presented in section 4. How these cost estimates compare with Estevadeordal's index is discussed in section 5. Section 6 then carries out illustrative cost calculations in the case where RoO take the form of a RVC. Conclusions follow in section 7.

## 2. NAFTA RoO MAP, AND NON-PARAMETRIC COST ESTIMATES

Section 2.1 describes briefly the main RoO in NAFTA, along with utilization rates in 2001, a year when NAFTA was just about in full force, since the average preferential rate of 4.1% for Mexican exports was almost equal to the average US MFN tariff (4.3%). Section 2.2, then turns to non-parametric cost estimates for 2000 and 2001, based on the $r_i$ index.

### 2.1 Preferences and Utilization Rates under NAFTA

Table 1 describes the data used in the calculation of the compliance cost estimates for Mexican exporters of RoO under NAFTA. All data are for 2001, when NAFTA was in full force, and are defined at the HS-6 level of aggregation, only for tariff lines with positive exports to the US. This represents 3555 observations[3], 99 chapters and 20 sectors. Utilization rates, denoted $u_i$, are defined as the ratio of USA imports from Mexico under US-NAFTA preferential tariffs to total USA imports from Mexico (at the 6-digit HS-level). Tariff preference margins, $\tilde{t}_i$ are also calculated at the product line level and are defined as:

$$\tilde{t}_i = \frac{t_i - t_i}{1 + t_i}; \quad \left( t_i = t_{i,mfn}^{us}; t_i = t_{i,mex}^{us} \right) \tag{0.1}$$

where world prices are set equal to one by choice of units. Table 1 also reports in column 5 the average value of Estevadeordal's index (which, as noted above, takes values in the range $1 < r_i < 7$). All data in table 1 are simple (unweighted) averages at the HS-2 level, i.e. for 20 sectors (with the number of HS-6 level tariff lines in each sector for 2001).

Table 1 here: Rules of Origin, Preferences and Utilization Rates

[3] In view of the econometric estimates that follow, we have eliminated 5 outliers with $\tilde{t}_i > 100\%$, 3 belonging to Chapter 24 (Tobacco) and 2 to Chapter 12 (Vegetables). These 5 outliers are classified as "raw materials" according to the WTO, and faced only a Change of Chapter, without exception, technical requirement or regional value content. The utilization rates for these five products are 100%.

In table 1, all data on RoO refers to percentage of tariff lines subject to the corresponding RoO. Take for example sector 11 (textiles & apparel, henceforth T&A) with 618 observations at the HS-6 level, and which represents 7.35% of the total Mexican exports to US in 2001. T&A has an average utilization rate of 79.9% and an average tariff preference margin of 10.4%, with 54% and 41% of the observations falling under the final and intermediate good respectively. Within that sector, 80% [19.7%] percent of observations had to satisfy a change of classification at the chapter [heading] levels, and 42% of the tariff lines had technical requirements.

Only T&A has an average tariff preference margins above 10%. Note also that some sectors with a substantial number of observations (i.e. over 100) have relatively high utilization rates in spite of low preference margins (e.g. stone & glass, sector 13).

According to stages of processing, raw materials are the least important sector, since about 30% of observations fall under the intermediate category (which represents only 4% of the total exports) and the remainder falls under the final good category (61% of the observations accounting for 87% of Mexican exports to the US). Finally, in spite of large dispersions within sectors, on average, tariff preference margins are the same for final and intermediate goods producing sectors, even though average utilization rates are much higher for the intermediate goods sectors (74% vs. 54%). If indeed, Mexico has a comparative advantage in final-goods producing activities, it would appear that RoO which are only slightly more restrictive according to the $r_i$ synthetic index for final producing activities, have a greater impact on utilization rates than for intermediate-producing activities.

Turn next to the distribution of types of RoO, recalling that their effects can only be captured by the use of dummy variables in the statistical analysis below. About 45% of the tariff lines have to meet a Change of Heading (CH) with the remainder (50%) having to meet a Change of Chapter (CC). This means that it would be futile to attempt to capture the effects of both types of changes in tariff classification since the dummy variables would be almost perfectly collinear. Along the same lines, note that exceptions (whose effects on costs are difficult to interpret anyway), denoted E, cover about half of the tariff lines, being present for 98% of the lines in T&A (sector 11) and 85% in chemicals (sector 6). Turning to the technical requirements (TECH) which cover only 8.6% of the lines and 6 sectors, they are concentrated in sector 11. Finally regional value content (RVC) is prevalent in four sectors, and covers 5% of the observations.

Finally, we look at the cumulative frequency distribution of the two variables of interest, utilization rates, $u_i$, and preference margins, $\tilde{t}_i'$. Utilization rates are evenly distributed around three groups of values: one third of the total sample with $u_i$ equal to zero, one quarter with $u_i$ equal of 1 and the remainder in-between. As to preference rates, the sample average preference is 4.11% with the following quartile distribution: [25%:0%]; [50%:2.58%] and [75%:5.5%].

The distribution of utilization rates and preference margins are quite different between intermediate and final goods: zero utilization rates ($u_i$=0%) apply for 20% [34%] for intermediate [final] goods. Full utilization rates ($u_i$=100%) apply for 50% [16%] for intermediate [final] goods. As to the extent of preferential access, the distribution of $\tilde{t}_i$, the average for the intermediate goods sample is around 4.81% and the quartile repartition are: [25%: 0.6%]; [median or 50%: 3.7%] and [75%: 5.5%], whereas for the final goods the average is 4.13% and the quartile distribution: [25%: 0%]; [median or 50%: 2.5%] and [75%: 7.36%]

**2.2. Non-Parametric Estimates**

Based on data for 2000 (very close to the data reported in table 1), Anson et al. (2003) used revealed preference arguments and Estevadeordal's (2000) synthetic index, $r_i$, to estimate the total compliance costs for Mexican exporters to NAFTA. As a starting point, we carry out the same exercise here with 2001 data when the average margin of preference was the almost the same (4.11% in 2001 vs. 4.10% in 2000) and the average utilization rate slightly higher (58% vs. 57%). We also compare these estimates with those for 2000 to see if one can detect any learning effects through time.

As a first step, we reproduce for 2001, the non-parametric estimates of compliance costs of RoO, $c_i$, expressed as a percentage of unit price, of Anson et al. carried out for 2000. This involves comparing preference margins and utilization rates for selected values of the index of restrictiveness, $r_i$. By revealed preference, for headings with $u_i = 100\%$, the preference margin is an upper-bound for compliance costs (as $c_i$ cannot be greater than the benefit conferred by $\tilde{t}_i$). Likewise, for headings with $u_i = 0\%$, the preference margin gives a lower-bound estimate. For the remaining sectors with $0\% < u_i < 100\%$, assumptions must be made. Anson et al. (2003) assumed that firms were indifferent to export to the US under the NAFTA or the MFN regimes (heterogeneity of firms notwithstanding). Then, an approximation of compliance costs would be given by the average rate of tariff preference computed for the remaining sectors, i.e. on the sample $0\% < u_i < 100\%$. Applying this reasoning, we obtain for 2000, [2001], $c = \tilde{t} = 6.11\%$, $\left[c = \tilde{t} = 6.16\%\right]$.

Anson et al. further break down total compliance costs, $c_i$, into an administrative component, $d_i$, and a distortionary component, $s_i$:

$$c_i = d_i + s_i \qquad (0.2)$$

where all variables expressed as a percentage of unit price. To come up with an estimate of administrative costs, they assume that administrative costs would be negligible for firms on their participation constraint, ($0\% < u_i < 100\%$), provided that they would also have low values of $r_i$ i.e. values corresponding to a change of tariff classification at the heading level, CH, i.e. when $r_i \leq 2$ (not much paperwork is involved in "proving" a change of heading). Hence, calculating preference margins for utilization rates close to 100% (say $u_i$=95%) when $r_i \leq 2$, gives an upper bound of the distortionary component, $s_i$. These average preference margins for 2000, [2001] are $\tilde{t} = 4.30\%$ $[\tilde{t} = 4.44\%]$. Recalling that the average total compliance costs for 2000, [2001] are $c = \tilde{t} = 6.11\%$, $[c = \tilde{t} = 6.16\%]$, we get average administrative cost estimates for $d$ of $d = 6.11\% - 4.30\% = 1.81\%$ $[d = 6.16\% - 4.44\% = 1.72\%]$.

Both estimates are close, though interestingly the administrative cost estimate for 2001 is less than that for 2000 both in absolute terms and in relative terms, as it falls from 45% to 42% of the total compliance costs (by assumption equal to the average preference margin). These non-parametric estimates confirm the hunch that there may be significant learning effects that could explain low utilization rates in early years of preferential access (see i.e. Brenton 2005 in his explanation of low take-up under EBA).

## 3. A SIMPLE MODEL

The above non-parametric cost estimates are averages across sectors, rely entirely on values taken by the $r_i$ index, and potentially gloss over differences across types of RoO.[4] If one is ready to assume that utilization rates provide some information on the stringency of RoO and to make a few additional assumptions, one sketch a simple model that improves along these two dimensions.

Assume first that aggregation from the firm to the tariff line level does not introduce systematic biases (which we can't check for anyway in the absence of firm-level data)[5]. Assume next that the utilization rate of NAFTA for product line $i$ is a positive function of the difference between the tariff preference rate, $\tilde{t}_i$, and (unobserved) total compliance costs, $c_i$, again expressed as a percentage of unit price, associated with applying the RoO criteria, i.e.:

$$u_i = f(\tilde{t}_i - c_i); \quad f'(.) > 0 \tag{0.3}$$

where $\tilde{t}_i$ is defined in (0.1). This assumption is only defensible in the absence of firm-level information (see appendix) that would recognize that the utilization rate is a zero-one decision for the firm. So think of (0.3) as a specification for costs at the aggregated HS-8 level that circumvents the problems associated with heterogeneous behavior associated with firm heterogeneity (see Ju and Krishna 2003 and Krishna 2005).

For compliance costs associated with the RoO, $c_i$, assume a linear relation with each of the set of relevant RoO, i.e.:

[4] Spreads in utilization rates are also assumed to reflect differences in administrative costs rather than firm heterogeneity. Unfortunately, we have no data to control for firm heterogeneity, so this source of bias in the model presented here, cannot be controlled for.

[5] Observed utilization rates at the HS-6 level are an aggregation of binary firm decisions of using or not the NAFTA regime (see the description of the firm's decision problem in appendix A.1).

$$c_i = d + b' RoO_i + n_i \quad (0.4)$$

Here, $RoO_i$ is a vector of dummies capturing the RoO described in table 1 and $d$ captures the administrative cost of RoO. For reasons discussed below, we will include dummy variables for tariff classification change at the chapter level ($CC_i$), regional value content ($RVC_i$) , and technical requirement ($TECH_i$) .

Equations (0.3) and (0.4), lead to the following reduced form for estimation:

$$u_i = a\left(t_i - d - b' RoO_i\right) + \left(m_i - a n_i\right) \quad (0.5)$$

Hence we estimate the following equation:

$$u_i = l + a t_i + q RoO_i + e_i \quad (0.6)$$

Estimation of (0.6) yields estimates of $\hat{a}$ and $\hat{q}$ which can then be used to approximate the distorsion costs generated by RoO, $\hat{c}_i$, i.e.:[6]

$$\hat{c}_i = \frac{\hat{q}}{\hat{a}} RoO_i \quad (0.7)$$

Equation (0.7) states that the costs of a RoO will be proportional to the responsiveness of the utilization rate to the RoO (just like the costs of protection are an increasing function of the elasticity of import demand) and inversely proportional to the responsiveness of the utilization rate to the preference margin.

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[6] we do not estimate total compliance costs of RoO, i.e. $\hat{c}_i = \frac{\hat{l}}{\hat{a}} + \frac{\hat{q}}{\hat{a}} RoO_i$ as for econometric reasons it is difficult to give an economic interpretation for the regression constant term (notably due to the econometric procedure used and to the introduction of dummy variables for section and stage of production, see in section4).

Since the dependent variable (the utilization rate) takes a value of only between zero or one, the appropriate estimation procedure for the reduced form (0.6) is a two-limit (or double-censored) Tobit (see e.g. Maddala 1983, chap. 6).[7]

In this model set-up, it is assumed that preferential rates and RoO are both exogenous. In reality, RoO are negotiated knowing that the preference margin will be the MFN tariff (unless it is also under negotiation multilaterally). So there is a potential multicollinearity between the RoO and $\tilde{t}_i$ variables in equation (0.6). An endogeneity problem would arise if a second equation explaining RoO as a function of $\tilde{t}_i$ and another variable that would also influence the endogenous variable $u_i$. While this may be the case, in any event we do not have at our disposal a good variable to instrument the RoO variable. Morever, instrumenting would be difficult anyway since it would take place over dummy variables.

In general (and certainly in the case of NAFTA as explained by Estevadeordal 2000) negotiations can be viewed as a "game" played by three parties in which negotiation is over two instruments: speed of preferential tariffs *phase-in* and RoO criteria. Moreover, in our NAFTA application, we use data for 2001, a year quite late in the NAFTA process of preferential tariff liberalization (the preference margin for Mexican imports was equal to the US MFN tariff for 3215

[7] The use of the maximum likelihood Tobit estimates of the linear model coefficients is preferred to the standard OLS estimates using the White correction for heteroskedacity, because the Tobit model makes expected values of the dependent variable conditional on the probability of censoring in the sample. Since there is censoring, we will usually report double-censored estimates, OLS estimates being available upon request.

tariff lines out of 3555 (at HS-6 level). Finally, the US MFN tariff cannot be suspected of endogeneity with the NAFTA RoO. Nonetheless, a more ambitious assessment of RoO would rely on a political-economy approach as in Cadot et al. (2005).

## 4. COST ESTIMATES BY TYPE OF RoO AND CATEGORY OF ACTIVITIES

The usefulness of costs estimates obtained from (0.7) depends on the plausibility of the first stage results for the reduced form estimation, and should satisfy the revealed-preference criterion used in the non-parametric estimates above. Estimation is carried out for the whole sample and for broad categories of goods (intermediates and final goods[8]) adding sector dummy variables, $D_k$, to control for sector-specific heterogeneity:

$$u_i = l + a t_i + q RoO_i + \sum_k D_k + e_i \qquad (0.8)$$

where $i = 1,\dots,3550;\quad k = 1,\dots,20;\quad RoO_i = CC_i, TECH, RVC_i$.[9]

Expected signs in (0.8) are $\hat{a} > 0, \hat{q}_1 < 0, \hat{q}_2 < 0, \hat{q}_3 < 0$.

Note the bounds on the estimated coefficient values in (0.8). Since all variables are in the interval [0,1] (we have eliminated the five preference rates above one), when plugging values obtained from (0.8) into (0.7), one should obtain reasonable cost estimates provided that measurement errors and biases for the coefficients in the numerator and denominator are not systematic. One would

[8] Adding raw materials does not affect overall results as this category represents only 9% of the sample. Furthermore, the only RoO component for these products is a CC. However, as previously explained, we eliminated this part of the sample because all the outliers in terms of tariff preference margins belonged to this category.

[9] For multicollinearity reasons (see section 2), we could not add a dummy for CH and for E in addition to $CC_i$. Note also that the vector $RoO_i$ depends on the category considered, since some

also expect different coefficient values for the dummy variables across broad category of goods: for example a change of chapter should have a greater negative impact on utilization rates for final than for intermediate goods.

We start with the results for the two broad categories of sectors (intermediates and final goods), then comment briefly on results for the T&A sector. Table 2 reports the results of the OLS and two-limit Tobit estimates of (0.8). For the entire sample (3225 observations) all coefficients are strongly significant with the expected sign: the tariff preference margin influences positively the utilization rate and the sign of the dummy variables relative to RoO are all negative, indicating that these requirements reduce the use of the NAFTA regime. In this linear specification, in terms of magnitude, the strongest negative impact on utilization rates comes from the TECH requirement, a plausible result if one recalls that these requirements are added when it is felt that a change of tariff heading is “insufficient”.

Turning to the comparison of estimates for final and intermediate goods, note that TECH is only present for final goods (and applied mostly to the T&A sector), but RVC is present and significant for both categories.[10]

Table 2 here: Determinants of utilization rates and costs of RoO

categories of goods do not face certain types of RoO (e.g. intermediates do not face technical requirements).

[10] When the reduced form is estimated for raw materials, the tariff preference margin is positive and strongly significant (due to some outliers). But CC, the only RoO faced by this category is not significant. This is not surprising, and conforms with a priori expectations.

Turn now to the magnitudes of the coefficients on RoO dummies, recalling that only 5% of the tariff lines have an RVC, and less than 9% a TECH requirement. Model shortcomings deserve to be mentioned. First, according to (0.3), the coefficient for $\tilde{t}_i$ in (0.6) represents the impact of the difference between $\tilde{t}_i$ and $c_i$ on the utilization rate. If so, a given increase in $(\tilde{t}_i - c_i)$ has an impact on $u_i$ about three times as large for intermediates than for final goods. Unfortunately, in the absence of variation in the values of the RoO variables, the model is unable to provide clues for this difference in the data. Second, differences in coefficient values on the RoO variables (which combine the impact of the RoO variables on the cost $c_i$ and the impact of the difference $(\tilde{t}_i - c_i)$ on $u_i$ discussed above), cannot be interpreted within the model. This said, all coefficient values have the expected signs and are significant at the 5% level, justifying turning to the compliance cost estimates obtained by plugging estimates of (0.8) into (0.7). The contributions to costs of the different RoO are reported in table 4, columns 3 and 4, and will be discussed later.

Table 3 here: Costs and preference rates

For the estimates to be useful, they should meet the revealed preference criterion used in the non-parametric estimates reported in section 2.2. This means, that the estimated compliance costs should, on average, be lower [greater] than the average preference margin for products with an utilization rate of NAFTA of 100% [0%], whatever the category (total, final or intermediate). This is indeed the case for all product categories, for utilization rates of 100% [0%]. As to the products with $0\% < u_i < 100\%$, the estimated compliance costs are systematically inferior to the tariff preference margin, often by non-negligible margins. Given that the preference margins are almost at the same level for sectors with non-zero utilization rates, it could be that the absence of variation in the data prevents identifying costs, so that even with sector dummies, there is too much uncontrolled firm heterogeneity.

Unfortunately, the problem of uncontrolled firm heterogeneity cannot be alleviated by turning to sector-level estimates, because plausible results could only be obtained for one sector. Indeed, among the 2-digit sectors with more than 100 observations and average preference margins above 4% (an estimate of total compliance costs of 3% of which there are 6 sectors if one omits the misc. manuf. category), only the largest sector (the T&A sector with 618 observations) gives significant and plausible results. Since this is an important sector for Mexico in NAFTA and for developing countries engaged in preferential market access with Northern countries (e.g. under EBA and AGOA, or under other FTAs by the EU and US), estimates are reported in the last column of table 3.[11]

[11] The estimation of equation (0.8) for T&A sample (618 observations) by the two-limit Tobit model, yields the following first stage results:

$$u_i = \underset{(0.06)}{1.15} + \underset{(0.32)}{3.11} t_i - \underset{(0.06)}{0.21} CC_i - \underset{(0.05}{0.37} TECH_i$$

with standard errors in parenthesis and associated compliance cost estimates reported in the last column of table 3.

Comparing the estimates for the T&A sector with those for larger categories of activities, it is clear that both CC and TECH criteria represent larger costs (respectively 6.7% vs. 3.01% and 11.8% vs. 9.17%) which reflects the fact that utilization rates are not much higher than average in the T&A sector in spite of high preferential margins. In interpreting these results, one should be cautious since the CC and TECH coefficients must capture some of the effects associated with "exceptions" (98% percent of the lines face an exception in sector 11!). Also according to the distribution of TECH requirements, these are mostly on production processes (33% of technical requirements) with the remaining (9%) on both product and process.

To summarize, among the significant results, the revealed preference criterion is satisfied and the data classification of the RoO components in terms of estimated compliance costs is reasonable since $CC < RVC < TECH$. This is precisely the ranking assumption about restrictiveness used by Estevadeordal (2000) in setting up his observation rule to construct his synthetic index. Perhaps more importantly, estimates conform to a priori expectations with respect to the costs of RoO across broad categories of goods. For instance, the costs of each component are found to be different across the stages of production with CC and RVC representing a greater cost for final-goods producing than for intermediate-goods producing sectors. Since final-goods producers also faced technical requirements, it is not surprising to find total compliance costs (on average over all product lines) that are greater for final goods producing sectors than for intermediate-goods producing sectors (3.2%

vs. 2.0%). And given that the tariff preference margin is lower for final goods than for intermediate (4.3% vs. 4.8%), we can also expect (still in average terms over all product lines), a lower utilization rate for final goods producing sectors, than for intermediate goods producing sectors. This is indeed confirmed in table 2 (utilization rates are 53.9% and 74.3% respectively).

## 5. EVALUATING ESTEVADEORDAL'S SYNTHETIC INDEX

Can synthetic indices of RoO regimes serve the same summary descriptive roles as ERPs for trade regimes? We raise this question for Estevadeordal's index, constructed from the same data set, and subsequently used by Estevadeordal and Suominen (2005) to summarize RoO for several FTAs.

Consider first the following calculation. Take US sectors with tariff peaks, i.e. 3 times or more the 2001 average US tariff around 4% and compare the corresponding average value of $r_i$ in those sectors with the corresponding values in the low-tariffs sectors (less than one-third the average tariff). Values for the index (number of observations in each group in parenthesis) are in decreasing order of protection: $r_i = 6.0(257)$ , and $r_i = 4.8(1432)$ . Since tariff escalation according to the stage of processing is widely observed across all countries, tariff peaks are concentrated in the final goods sectors. It follows that, at least according to this index of restrictiveness, under NAFTA, RoO would protect final-goods producing sectors.

Are costs similar across types of RoO? Recall from (0.7) that the costs of a given RoO are assumed to depend how utilization rates react to the RoO and to the response of utilization rates to preferential rates. Computations of the costs of each type of RoO (when it applies) according to (0.7) are reported in columns 3 and 4 of table 4. RVC criteria have similar effects for intermediate and final goods: the imposition of an RVC on a product generates a cost estimated at 4.5% [4.6%] for intermediate [final] goods. As one would expect, a change of classification at the chapter level (CC) generates a higher cost for final (3.7%) than for intermediate goods (2.3%).[12] Finally, again according to intuition, the greatest cost for final products results from technical requirements, with an impact of 11% on total compliance costs.

To evaluate Estevadeordal's index, we make the necessary assumptions to come up with a lexicographic ordering suggested by our estimates, then compare it with his constructed from the observation rule used to construct $r_i$ index.[13] Both rankings are summarized in table 4. On the one hand, Estevadeordal's (2000) is built around a finer distinction for the type of change of classification heading (CH, CS, CI levels), which was impossible to carry out in the econometric estimates due to quasi-perfect multicollinearity between the CC and CS dummy variables. On the other hand, for the more restrictive RoO (e.g. for the combination of RoO with values equal or superior to 5, our costs estimates allow for a finer distinction (5 values instead of 3) and for a non linear

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[12] This result still holds when one replaces the $CC_i$ dummy by a $CH_i$ dummy.

[13] We have assumed that for the RoO not included in our econometric indices, they would have taken a value of 1. This is probably plausible though one may question that CH would take a value of 1(our justification for this ranking is that cost estimates for CC are low). However, we use question marks to indicate that the rankings are assumed rather estimated.

classification. Furthermore, we propose an index different according to the stage of production, allowing the data to determine if the same RoO represents a different cost for intermediate-goods producing sectors or for final-goods producing sectors.

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Table 4 here: Comparison of Estevadeordal's Index and Costs Estimates.

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Table 4 shows that the ranking of costs according to the estimates corresponds to Estevadeordal's selection of observation rule: costs of CC < costs of RVC < costs of TECH. However, the two indicators do not generate the same rank ordering. For instance, since the costs of an RVC is superior to the costs of a CC, a combination of CH+RVC is more costly than the cost generated by a CC. Overall, however, for the sample of 3225 observations used in the estimations, the correlation between the two indices of costs of RoO is 0.66.

Comparisons based on RoO applied only for one preferential market access case cannot be expected to yield stylized facts, nor a robust assessment of the usefulness of a synthetic index. On the basis of the above, however, it is fair to say that the observation rule yields plausible results both in terms of relative rankings in terms of assumed costs of different types of RoO and in terms of restrictiveness when confronted with US tariff peaks (on the assumption that, for political-economy reasons, RoO should be expected to be more restrictive in sectors with tariff peaks compared with sectors with low rates of protection). However, if other comparisons point in the same direction, it might be worthwhile to distinguish changes in tariff classification in terms of the broad categories of sectors they apply to.

## 6. VALUE CONTENT RESTRICTIONS

Import content requirements (either in the form of value or quantity) are frequently used (see Estevadeordal and Suominen 2005, tables 1 and 3): Out of 87 PTAs, 68 require an import content for at least from products; 7 requiring some form of RVC, and another 67 use some restriction on the value of parts (VP). When applied, they usually require between 30% and 60% of the value (or quantity) under constraint to originate in the region. Among the types of RoO considered in this paper, import content restrictions hold the greatest promise for direct quantification of their cost-raising effects. As a first step in this direction, one can check orders of magnitude suggested by some simple simulations imposing accepted functional forms and cost-minimizing behavior in a competitive environment. The simulations below compute the extent of preferential market access necessary that would leave a cost-minimizing firm indifferent under different import restrictions.

Suppose then that a Mexican firm, or some other Southern partner firm, produces under constant returns to scale and perfect competition a final good, $X$ which it can sell either in the US (Northern) partner market, or on the ROW market. The final good is produced with value-added, $VA$, and intermediates, $Z$, i.e. $X = F(VA, Z)$. Value-added is produced by capital and labor, i.e.

$VA = H(K, L)$ at exogenously determined prices, $(w, r)$ while intermediates either come from the US partner, $Z^A$, or from the ROW, $Z^C$ so that $Z = G(Z^A, Z^C)$, also with exogenously given prices $p^{Z,A}$ and $p^{Z,C}$. Let $F(.)$ be Leontief, and $H(.)$ and $G(.)$, be CES functions. Profit maximization will imply that the unit cost function can be written as:

$$c(.) = a_Z P^Z + a_V P^V \tag{0.9}$$

where $a_Z, a_V$ are the per-unit input coefficients for intermediates and value-added respectively, with $P^Z, P^V$ their corresponding per-unit prices. Under the CES aggregation functions, the expressions for unit prices are:

$$P^Z = CES(P^{z,a}, P^{v,c}; g_Z, a_Z, s_Z) \tag{0.10}$$

where $g_Z$ is a calibration parameter, $a_Z$ is the share parameter and $s_Z$ is the elasticity of substitution between intermediates of different origin. Likewise, the unit value-added price is given by:

$$P^V = CES(w, r; g_V, a_V, s_V) \tag{0.11}$$

where the parameters have the same meaning as in the previous expression.

Perfect competition implies that unit price for the good, $P^X$ equals unit cost, i.e.:

$$P^X = C(.) \tag{0.12}$$

Finally let there be some market segmentation (or product differentiation by destination) by assuming that it is costly to reallocate $X$ across markets. Then unit prices obtained in each market are $P^{X,A}$ in the US and $P^{X,C}$ in the ROW. Let the ease of substitution across markets be captured by the constant elasticity of transformation (CET) function, with unit sales given by:

$$P^{x} = CET(p^{X,A}, p^{X,C};\ g_{x}, a_{x}, s_{x}) \qquad (0.13)$$

where the parameters have the same meaning as in the CES case.

Let, $t^{A}$ be the US ad-valorem tariff, and let the RoO be a RVC in quantity terms. If subscript zero denotes the optimal per-unit use of the intermediate originating in the US, and subscript one, the corresponding choices by the firm when it faces a RoO and preferential access, on the cost side:

$$z^{R} = Z_{1}^{A} / Z^{C} > z^{*} = Z_{0}^{A} / Z^{C};\ Z_{1}^{A} > Z_{0}^{A}$$

leading to the restricted cost function, $c^{R}(.)$. Since $c^{R}(z^{R}) > c^{0}(z^{0})$, one can ask what rate of preference in the US market is necessary to leave the Mexican firm indifferent between choosing to export under NAFTA or under MFN, i.e. compute $t = (P_{1}^{X,A})/(P_{0}^{X,A})$ so that:

$$P_{1}^{x} = CET(p_{1}^{X,A}, p^{X,C}) = c^{R}(.) \qquad (0.14)$$

Table 5 reports the results of illustrative simulations that calculate the margin of preference that would leave indifferent a Mexican (Southern) exporter facing an RVC for intermediate purchases.

Table 5 here: Marginal Preferences and Costs under RVC

Columns (1) to (4) could be representative of a final-producing goods industry, with a relatively low value-added ratio, while columns (5) to (8) could be representative of an intermediate-goods industry with a higher value-added ratio (lees roundaboutness in the methods of production).

All simulations start from an initial equilibrium situation in which all prices are unity and in which the share of exports to the US is 50%. For simplicity, we assume that the two elasticities in the simulations are unity: a Cobb-Douglas for the substitution for intermediates of different origin and an elasticity of transformation across export destinations of unity. In this partial equilibrium set-up, we also assume that the industry is a price-taker in input markets and in the market for export sales. Finally to ease the interpretation of results, we also limit the amount that is exported to the initial equilibrium quantities, so that all firms do is readjust the export mix in response to the change in incentives to sell in the US market.[14]

Interpreting the results, note first that the required preferential access is higher for each RVC constraint in the final (low value-added activity). This is of course inherent in the model set-up. Next turn to orders of magnitude, given that it is not clear what the extent of restrictiveness is. For example, Estevadeordal and Suominen report that, when they are used, RVC percentages are 50% or 60%. So suppose it is 60%. According to the simulations, if the initial RVC was 40%

[14] If one were interested in computing welfare effects, one would incorporate a price responsive demand curve for total exports, so that binding RoO would then have two effects: a change in

[50%], a preference margin of 11% [3%] would be needed to leave the Mexican exporter indifferent.

## 6. CONCLUSIONS

Exporters benefiting from preferential market access have to contend with a vast array of RoO whose cost-raising effects have, so far, escaped quantification. Using the RoO map negotiated under NAFTA, this paper has attempted to quantify these costs. Using non-parametric methods based on a widely-used synthetic index, we have estimated total compliance costs and the administrative component of total costs. Comparisons between 2000 and 2001 reveal some learning effects as utilization rates increased in spite of insignificant changes in market access. Calculations also revealed that administrative costs fell in absolute terms, but also as a percentage of total compliance costs.

Turning to the econometric estimates carried out for broad categories of goods (final and intermediates), subject to the limitations imposed by the data in the form of RoO taking zero-one values), estimates conform to a priori expectations with respect to the type of RoO and to the costs of a given set of RoO across broad categories of goods. Other things equal, compliance costs are the least for a change of tariff classification (here captured by CC), followed by a regional

volume and a change in export destination mix. The model would be closed by specifying an upward-sloping supply curve for primary factors on production in the industry.

value content (RVC) and by a technical requirement (TECH). Regarding stages of production, an RVC is more costly for final-goods producing sectors than for intermediate-goods producing sectors. Estimates also showed that the lower rate of utilization for final-goods producing sectors under NAFTA (presumable the sectors in which Mexico had a comparative advantage) could be attributed to the battery of RoO they faced (after controlling for differences in preferential access).

Synthetic indices, such as the one proposed by Estevadeordal, which will continue to be used notably when utilization rates are not available, can give a summary measure of overall restrictiveness of a given RoO map. We have therefore compared the lexicographic ordering used by Estevadeordal in his observation rule with the ordering emerging from our cost estimates. We find that his ordinal ranking is the same as ours when it comes to individual RoO. However, they differ when several RoO enter simultaneously, and especially when it come to the distinction between final-goods producing activities and intermediate-goods producing activities. This suggests that it might be useful to build different synthetic indexes for broad categories of activities.

Finally, we have estimated rates of preferential market access that would be needed to counteract the cost-raising effects for regional value content requirements when they apply. Under cost-minimization assumptions, and under acceptable functional forms, it would appear that preference margins of about 10% would be needed to compensate for a “typical” regional value content RoO. While much still remains to be done before we get better handle on the cost-raising effects of RoO, the evidence presented here suggests that RoO go a long way towards negating the benefits of preferential market access for the Southern partners that are the presumed beneficiaries of these preferences.

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**APPENDIX : THE MODEL**

This appendix develops the firm's decision to indicate the link between the variables determined at the firm level and the observed data at the HS-6 level, and justifies the econometric specification.

Firm's decision. Let index i refer to an HS-6 tariff line observation (this is the product line for which we have observations on utilization rates and preference rates). Let there be j=1,…,n Mexican firms export to the US under product category i. Rank firms so that j=1,…,k export to the US under NAFTA regime and j=k+1,…,n export under the MFN regime. Let $u_j$ =1 [0] represent the firm's decision to export under NAFTA [MFN], and $E_j$ firm's j exports to the US. Finally total unit compliance costs, $c_j$, associated with RoO include an administrative component, $d_j$, and a distortionary cost associated with implementing the RoO requirement itself, $s_j$, i.e. $c_j = d_j + s_j$. The above relations suggest that we can write the firm's costs as :

$$c_j = f(RoO_i, d_j) \qquad (0.15)$$

Implicitly, in (0.15) we have assumed that all firms differ in their costs when they sell product i only because of costs associated with implementing RoO, an assumption that will certainly be violated in practice. With this notation, the firm's decision will boil down to:

$$\begin{aligned} u_j = 0 \Leftrightarrow E_j = E_j^{MFN} \quad & if \quad \tilde{t}_i < c_j \\ u_j = 1 \Leftrightarrow E_j = E_j^{NAFTA} \quad & if \quad \tilde{t}_i \geq c_j \end{aligned} \qquad (0.16)$$

Note that the rate of preference is observed at the HS-6 product level while the utilization rate decision takes place at the firm level. However, the utilization rate in the data is also observed at the product level, and it is defined as:

$$u_i = \frac{\sum_{j=1,\dots,k} E_j^{NAFTA}}{\sum_{j=1,\dots,k} E_j^{NAFTA} + \sum_{j=k+1\dots,n} E_j^{MFN}} \quad \text{with} \quad \begin{cases} u_i = 0 & if \quad k = 0 \\ u_i = 1 & if \quad k = n \\ 0 < u_i < 1 & if \quad 0 < k < n \end{cases} \qquad (0.17)$$

We assume linear specifications for the utilization rate of NAFTA at the product level:

$$u_i = a(\tilde{t}_i - c_i) + m_i \qquad (0.18)$$

with $c_i$, the unit costs associated with RoO at the product level. $c_i$ is a weighted average of the firms' costs $c_j$. Unfortunately we have no information on the distribution of these $c_j$ in each HS-6 level, *i*. However, we can reasonably assume that:

$$c_i = d + b' RoO_i + n_i \qquad (0.19)$$

where $b$ is a t×1 vector of unknown parameters and *RoOi* is a is a t×1 vector of explanatory variables.

Equations (0.18) and (0.19), lead to the reduced form for estimation:

$$u_i = a\left(\tilde{t}_i - d - b' RoO_i\right) + \left(m_i - a n_i\right) \qquad (0.20)$$

<u>Econometric specification</u>

The dependent variable being truncated at both high and low values, the model becomes:

$$u_i^* = l + a\tilde{t}_i + q' RoO_i + e_i \qquad (0.21)$$

where $u_i^*$ is the latent variable, $e_i$ are residuals that are independently and normally distributed, with mean zero and a common variance $s^2$ and:

$$\begin{cases} u_i = 0 & if \quad u_i^* \le 0 \\ u_i = u_i^* & if \quad 0 < u_i^* < 1 \\ u_i = 1 & if \quad u_i^* \ge 1 \end{cases}$$

Here, 0 and 1 are the lower and upper limits. The likelihood function for this model is given by:

$$L(l, a, b, s \mid u_i, \tilde{t}_i, RoO_i, 0, 1) = \prod_{u_i=0} \Phi\left(\frac{0 - l - a\tilde{t}_i - q' RoO_i}{s}\right) \prod_{u_i=u_i^*} \frac{1}{s} f\left(\frac{u_i - l - a\tilde{t}_i - q' RoO_i}{s}\right) \prod_{u_i=1} \left[1 - \Phi\left(\frac{1 - l - a\tilde{t}_i - q' RoO_i}{s}\right)\right] \qquad (0.22)$$

In (0.22), $f(.)$ and $\Phi(.)$ are, respectively, the density function and distribution function of the standard normal evaluated at $\frac{l + a\tilde{t}_i + q' RoO_i}{s}$ (see Maddala 1983, chapter 6 for algebraic details).

## Tables to
## Are Different RoO Equally Costly? Evidence from NAFTA

**TABLE 1: ROO MAP, PREFERENCES AND UTILIZATION RATES.**

| Section | | Obs | | Export to US | $u$ | $t_i$ | CC | CH | CSI | E | TECH | RVC | $r_i$ | Interm | Final |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | % | % | Mean | Mean | % | % | % | % | % | % | Mean | % | % |
| 1 | Live Animals | 80 | 2.3 | 0.71 | 30.7 | 4.1 | 100 | 0.0 | 0.0 | 15.0 | 0.0 | 0.0 | 6 | 6.3 | 23.8 |
| 2 | Vegetable Prod. | 150 | 4.2 | 2.17 | 70.3 | 3.6 | 100 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 6 | 12.7 | 8.0 |
| 3 | Fats & Oils | 27 | 0.8 | 0.02 | 77.9 | 5.1 | 100 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 5.9 | 0.0 | 100.0 |
| 4 | Food. Bev. & tob. | 123 | 3.5 | 1.75 | 76.6 | 7.6 | 79.7 | 18.7 | 1.6 | 17.1 | 0.8 | 0.0 | 5.6 | 11.4 | 86.2 |
| 5 | Mineral Products | 86 | 2.4 | 7.17 | 11.8 | 0.3 | 80.2 | 19.8 | 0.0 | 19.8 | 0.0 | 0.0 | 5.6 | 16.3 | 4.7 |
| 6 | Chemicals | 430 | 12.1 | 1.35 | 62.3 | 3.4 | 75.4 | 20.0 | 4.7 | 84.7 | 1.2 | 0.9 | 5.5 | 73.5 | 26.3 |
| 7 | Plastics & Rubber | 175 | 4.9 | 1.36 | 71.7 | 3.8 | 11.4 | 88.0 | 0.6 | 26.3 | 5.7 | 64.0 | 4.9 | 60.6 | 30.9 |
| 8 | Leather Goods | 52 | 1.5 | 0.18 | 51.3 | 4.0 | 61.5 | 38.5 | 0.0 | 42.3 | 0.0 | 0.0 | 5.5 | 32.7 | 46.2 |
| 9 | Wood Products | 55 | 1.5 | 0.24 | 37.3 | 2.1 | 7.3 | 92.7 | 0.0 | 7.3 | 0.0 | 0.0 | 4.2 | 43.6 | 45.5 |
| 10 | Pulp & Paper | 97 | 2.7 | 0.52 | 56.2 | 0.7 | 57.7 | 42.3 | 0.0 | 42.3 | 0.0 | 0.0 | 5.2 | 39.2 | 55.7 |
| 11 | Textiles & Apparel | 618 | 17.4 | 7.35 | 79.9 | 10.4 | 80.3 | 19.7 | 0.0 | 97.9 | 41.6 | 0.0 | 6.0 | 40.9 | 53.9 |
| 12 | Footwear | 47 | 1.3 | 0.28 | 67.6 | 6.8 | 19.2 | 80.9 | 0.0 | 72.3 | 0.0 | 48.9 | 4.9 | 0.0 | 100.0 |
| 13 | Stone & Glass | 129 | 3.6 | 1.15 | 60.1 | 3.2 | 54.3 | 43.4 | 2.3 | 43.4 | 0.0 | 0.0 | 5.0 | 10.1 | 89.9 |
| 14 | Jewellery | 35 | 1.0 | 0.37 | 45.5 | 2.7 | 60.0 | 40.0 | 0.0 | 40.0 | 0.0 | 0.0 | 5.2 | 34.3 | 40.0 |
| 15 | Base Metals | 430 | 12.1 | 3.56 | 67.9 | 2.0 | 42.6 | 56.1 | 1.4 | 45.4 | 1.2 | 0.0 | 4.8 | 50.5 | 48.1 |
| 16 | Mach. & Elec. Eq. | 631 | 17.7 | 39.52 | 35.5 | 1.5 | 0.0 | 81.3 | 18.7 | 31.9 | 4.6 | 1.4 | 3.8 | 0.0 | 100.0 |
| 17 | Transp. Equip. | 85 | 2.4 | 20.38 | 56.4 | 3.4 | 2.4 | 91.8 | 5.9 | 14.1 | 0.0 | 22.4 | 4.2 | 0.0 | 100.0 |
| 18 | Med. Instruments | 170 | 4.8 | 3.69 | 45.2 | 2.1 | 15.3 | 76.5 | 8.2 | 14.7 | 0.0 | 3.5 | 4.2 | 0.0 | 100.0 |
| 19 | Arms & Ammunition | 8 | 0.2 | 0.02 | 13.4 | 0.5 | 62.5 | 37.5 | 0.0 | 0.0 | 0.0 | 0.0 | 5.3 | 0.0 | 100.0 |
| 20 | Misc. Manufact. | 127 | 3.6 | 8.20 | 40.4 | 3.1 | 82.7 | 11.8 | 5.5 | 0.8 | 0.0 | 0.0 | 5.4 | 0.0 | 100.0 |
| **Total** | | **3555** | **100** | **100** | **58.0** | **4.1** | **50.0** | **45.1** | **5.0** | **47.0** | **8.6** | **4.9** | **5.1** | **29.5** | **61.2** |
| Raw | | 330 | 9.3 | 9.4 | 34.2 | 1.8 | 95.2 | 4.5 | 0.3 | 10.3 | 0.9 | 0.0 | 5.9 | - | - |
| Interm. | | 1048 | 29.5 | 4.1 | 74.2 | 4.8 | 58.4 | 39.4 | 2.2 | 68.4 | 0.2 | 8.7 | 5.2 | - | - |
| Final | | 2177 | 61.2 | 86.6 | 53.9 | 4.2 | 39.1 | 53.9 | 7.0 | 42.2 | 13.9 | 3.8 | 4.9 | - | - |

Notes: total Mexican exports to US under NAFTA = $131 million
All calculations are at the 6-digit level of the HS (so the table presents simple *average* by sector and category and not the *aggregate* indicator. i.e. weighted by the imports values of each line).
$u_i$ = utilization rate of the NAFTA regime; $t_i$= tariff preference margin; $r_i$ = the Estevadeordal (2000) index of Rules of Origin ($1<r_i<7$. a higher value indicating a more restrictive RoO. see text).
CC = Change in Chapter / CH = Change in Heading / CS = Change in Subheading / E = Exception to Change of Tariff Classification / RVC = Regional Value Content / TECH = Technical Requirement.

**TABLE 2: DETERMINANTS OF UTILIZATION RATES AND TOTAL COSTS OF ROO.**

| $u_i$ | Total Sample | | Intermediate Goods | | Final Goods | |
|---|---|---|---|---|---|---|
| | OLS | Tobit | OLS | Tobit | OLS | Tobit |
| $\tilde{t}_i$ | 2.2757** | 4.3683** | 3.0389** | 9.0450** | 2.0910** | 3.9310** |
| | (0.41) | (0.20) | (0.47) | (0.54) | (0.45) | (0.21) |
| $CC_i$ | -0.0684** | -0.1676** | -0.0604** | -0.2122** | -0.0801** | -0.1447** |
| | (0.02) | (0.04) | (0.03) | (0.09) | (0.02) | (0.04) |
| $TECH_i$ | -0.2088** | -0.4975** | - | - | -0.2288** | -0.4391** |
| | (0.03) | (0.08) | | | (0.04) | (0.09) |
| $RVC_i$ | -0.1065** | -0.1517** | -0.2850** | -0.4058* | -0.1147** | -0.1811* |
| | (0.05) | (0.04) | (0.12) | (-0.24) | (0.05) | (0.11) |
| *Obs.* | *3225* | *3225* | *1048* | *1048* | *2177* | *2177* |
| *$R^2$-adj* | *0.39* | | *0.38* | | *0.40* | |
| *Log likelihood* | | *-2995.5* | | *-959.8* | | *-2024.8* |

Notes:
Constant and Dummy variables for section and stage of production are included but not reported in order to save space
OLS: coefficients estimate with Ordinary Least Squared with White correction.
TOBIT: coefficients estimate with the Two-Limit Tobit Model .
Standard deviations in parenthesis.
** and * respectively significant at the 5% and 10% level.

**TABLE 3: COSTS AND PREFERENCE RATES.**

| | Total Sample | | | Intermediate Goods | | | Final Goods | | | Textiles and Apparel | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Obs | $\tilde{t}_i$ | $\hat{c}_i^{TOBIT}$ | Obs | $\tilde{t}_i$ | $\hat{c}_i^{TOBIT}$ | Obs | $\tilde{t}_i$ | $\hat{c}_i^{TOBIT}$ | Obs | $\tilde{t}_i$ | $\hat{c}_i^{TOBIT}$ |
| 0%< $u_i$ <100% | 1410 | 5.92% | 3.86% | 322 | 5.28% | 2.04% | 1088 | 6.10% | 4.17% | 337 | 11.82% | 13.01% |
| $u_i$ =0% | 954 | 0.38% | 1.71% | 211 | 0.76% | 1.69% | 743 | 0.27% | 1.43% | 34 | 1.87% | 6.63% |
| $u_i$ =100% | 861 | 6.32% | 3.01% | 515 | 6.17% | 1.61% | 346 | 6.55% | 3.69% | 247 | 9.71% | 5.65% |

Notes:
Computed from coefficients estimated in (0.8) applied to (0.7).

$\hat{c}_i^{TOBIT}$ : cost obtained from Two-Limit Tobit Model estimations.

**TABLE 4: COMPARISON OF ESTEVEDEORDAL'S INDEX AND COSTS ESTIMATES.**

| RoO criteria | obs. | Estevadeordal's index | Costs estimates a/ | | |
|---|---|---|---|---|---|
| | | | Total | Final | rank |
| CI | 9 | 1 | N.A. | N.A. | 1(?) |
| CS | 134 | 2 | N.A. | N.A. | 1(?) |
| CS+RVC b/ | 2 | 3 | **3.84%** | **4.61%** | 3 |
| CS+TECH b/ | 30 | 3 | **11.39%** | **11.17%** | 4 |
| CH | 1400 | 4 | N.A. | N.A. | 1(?) |
| CH+RVC b/ | 167 | 5 | **3.84%** | **4.61%** | 3 |
| CH+TECH b/ | 16 | 5 | **11.39%** | **11.17%** | 4 |
| CH+RVC+ TECH | 4 | 5 | **15.23%** | **15.77%** | 6 |
| CC | 1209 | 6 | **3.47%** | **3.68%** | 2 |
| CC+TECH | 254 | 7 | **14.86%** | **14.85%** | 5 |

Notes:
a/ Estimates obtained from substituting values obtained in equation (0.7) in equation (0.8)
b/ No distinction between CH and CS in econometric estimates (See text).
N.A. Not applicable (See text).

**TABLE 5: RVC AND COMPENSATING PREFERENCE MARGINS**

| | (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) |
|---|---|---|---|---|---|---|---|---|
| Value Added | 30% | 30% | 30% | 30% | 60% | 60% | 60% | 60% |
| Intermediates | 70% | 70% | 70% | 70% | 40% | 40% | 40% | 40% |
| Initial Vus/(Vus+Vrow) | 20% | 30% | 40% | 50% | 20% | 30% | 40% | 50% |
| Final Vus/(Vus+Vrow) [RoO] | 40% | 40% | 60% | 60% | 40% | 40% | 60% | 60% |
| Initial share of exports to US | 50% | 50% | 50% | 50% | 50% | 50% | 50% | 50% |
| Final share of exports to US | 55.9% | 51.5% | 55.3% | 51.4% | 53.6% | 50.9% | 53.2% | 50.8% |
| Initial Pus* | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| New Pus* | 1.13 | 1.03 | 1.11 | 1.03 | 1.07 | 1.02 | 1.07 | 1.02 |