Regional Integration and Dynamic Adjustments: Evidence from a Gross National Product Function for Canada and the United States

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Evidence from a Gross National Product Function for Canada and the United States[1]

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Abstract: We propose an empirical trade model to test for structural change and dynamic effects induced by free trade agreements for the Canadian and US economies. We estimated a translog Gross National Product (GNP) function along with output and factor shares and tested for structural change (abrupt or gradual) which is endogenously determined by the data. After this, we estimated Stolper-Samuelson (SS) and Rybcynski (R) elasticities, and assessed the stability of their sign and magnitude link to the structural change. The null hypothesis of no structural change is soundly rejected for both countries. For Canada, we found gradual structural change that started prior to the implementation of CUSTA and lasted for several years. In the US case, we found evidence of an abrupt structural change occurring in 1995, a year after NAFTA came into force. More interestingly, several SS and R elasticities experienced sign reversals and a magnification effect over the different sub-periods, implying that the categorization of goods in terms of friends or enemies of labour and capital changed during the transition.

Keywords: GNP function, regional integration, structural change, smooth transition regression, dynamic adjustments.

JEL Classification: C32, F13, F14, F15, Q11

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1. Introduction

The Canada-U.S. Trade Agreement (CUSTA) took effect on January 1 of 1989. The two economies were each other's most important trading partners before the creation of the free trade zone and were already highly integrated. Tariffs on goods produced within the free trade zone were rapidly eliminated and in some cases, the pace of liberalization was even accelerated over the 10-year phase-out as initially planned. Plans to enlarge the free trade zone to include Mexico were agreed upon in December of 1992, but the North American Free Trade Agreement (NAFTA) took effect in January of 1994. Since this period, Canada and the United States of America (USA henceforth) have been active in seeking other regional agreements and are strongly involved in pursuit of bilateral trade agreements mirroring the actions of the international community. The number of regional trade agreements (RTAs) notified by the WTO in December of 2008 was 421. However, according to the political and social context in the 1980's, for Canada, 1989 clearly marked the beginning of a new era in terms of trade policy. In addition, recently the debate about NAFTA and its benefits was revived in Canada and in the USA during the 2008 US democratic presidential campaign when candidates Hillary Clinton and Barack Obama said they wanted to renegotiate the agreement particularly in the field of labour standards and the environment.

It has been known for a long time that RTAs have ambiguous aggregate welfare effects (e.g., Lipsey, 1957) and that there will generally be losers even when long run aggregate welfare changes are positive.[3] This is why regional trade agreements are so

[3] Krishna and Panagariya (2002) have demonstrated that it is possible to implement lump sum transfers keeping prices and purchases from the rest of the world unchanged within each country belonging to a free trade area that make no individual worse off and the government's budget in each member country non-negative. Clearly a free trade area can be welfare-enhancing for its members, but in practice free trade areas usually involve some trade diversion that violates the condition that trade with outside countries remain unchanged. Baldwin and Venables (1995, p.1601) propose a decomposition of welfare effects arising from regional trade agreements. The "trade volume" effect pertains to the creation of trade following the reduction of tariffs between member countries. The "trade costs" effect weighs lost revenues from tariffs against reductions in policy rents captured by foreign interests and the "terms of trade" effect measures the gain from being able to purchase a cheaper import bundle.

controversial.[4] Back in the mid-1980s, the economic debate in Canada around the potential gains from CUSTA revolved around the exploitation of economies of scale and pro-competitive effects. In essence, it was argued that smaller Canadian plants could exploit economies of scale through improved access to the US market and that integration would make Canadian markets more competitive. Under this premise, computable general equilibrium models predicted large gains for Canada (Harris, 1984; Cox and Harris, 1985). Head and Ries (1999) investigated the effect of CUSTA on plant scale and found small net effects arising from the offsetting effects of US and Canadian tariff reductions. Trefler (2004) relied on disaggregated data to show that pre-CUSTA tariffs were higher than commonly believed and that the tariff cuts were large enough to "matter".[5] In fact, he found that CUSTA had strong negative effects on employment in the most impacted import-competing industries and strong positive effects on labour productivity in the most impacted export-oriented industries. Interestingly, he also found substantial increases in labour productivity in industries that were duty-free prior to CUSTA. CUSTA encouraged entry and exit of firms (in industries with low sunk costs) and allowed some plants in export-oriented industries to expand and reach the so-called minimum efficient scale[6]. Trade reforms are also known to encourage firms to become more technically efficient (Tybout et al., 1991). Efficiency within firms is also likely to rise when competition stiffens. The empirical evidence about the so-called X-efficiency

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[4] Regional trade agreements can be politically divisive, to the point of being the single most important issue in an election. Before his election as Prime Minister of Canada in 1993, then opposition leader Jean Chrétien promised to renegotiate NAFTA to garner the support of labour unions. In the United States, Ross Perot and more recently Barack Obama made similar threats. Whatever apprehension Prime Minister Chrétien might have held toward regional initiatives must have subsided because NAFTA was enforced as planned and numerous initiatives were negotiated during his three terms in office.

[5] At the 4-digit level of product aggregation, tariffs in excess of 10 percent sheltered one in four Canadian industries in 1988, but almost no industries had tariffs in excess of 10 percent when industries are defined by 3-digit level data (Trefler, 2004 p.872).

[6] This result and other details are well documented in Gu et al (2003).

gains[7] suggests that trade liberalization causes various firm-level and industry-level effects (Tybout, 2003). Clearly, the impacts of regional trade agreements have been extensively studied, but little is known about the induced structural change for the economy and their impact on Stolper-Samuelson and Rybcynski elasticities.

Stolper-Samuelson studies have been useful in shedding light on the causes behind the widening gap between the wages of skilled and unskilled workers in industrialized countries (e.g., Leamer, 2001), but they have also been useful in identifying supporters and opponents of regional trade agreements. From survey data about the 1988 Canadian election, Beaulieu (2002) found that respondents'views about CUSTA could be explained by factors of production consideration such as labour skills[8]. Scheve and Slaughter (2001) found a similar result for the USA. A related question is whether CUSTA produced the anticipated Stolper-Samuelson rewards and punishments or whether structural change caused by CUSTA changed winners into losers and vice versa.

In this paper, we posit that firm-level, industry and macro impacts induced by CUSTA and NAFTA have had a significant effect on the technological characterization of the Canadian and USA economies[9], thus changing the way factor prices and outputs adjust to changes in terms of trade and in factor endowments. Accordingly, we test for structural change in Canada's and USA's GNP function and associated Stolper-Samuelson, Rybczynski, output and factor demand elasticities. The GNP function

[7] Corden (1974) provides an intuitive discussion while Sjostrom and Weitzman (1996) and Campbell and Vousden (2000) provide formal analyses.

[8] In a linked work, Beaulieu and Magee (2004) use data from Political Action Committee (PAC) divided in labor and capital groups with deference in the industries represented by each group to examine trade policy preference. They find that the factor that a group represents are more influential on trade views than the industry characteristics.

[9] We do not analyze the Mexican case because, despite the difficulties we had to collect comparable data to those of the USA or Canada; it was very difficult to isolate the effects of various economic shocks experienced by the countries to the impact of trade agreement. Indeed, the country has not only started a major move to reduce their tariffs in the early 1980s, but they also had a significant political instabilities in the early of 1990s and has faced major monetary problems that led the peso crisis between 1994 and 1995.

approach has been extensively applied to different countries to analyze a wide variety of issues.[10] Because CUSTA and NAFTA were not implemented along with other major economic reforms in response to significant macro disturbances, as it is often the case with trade liberalization analyses involving less developed countries, an analysis of CUSTA/NAFTA constitutes as "natural" an experiment as it can be hoped (Tybout, 2003). This suggests that structural change might have been abrupt. However, investments in new production capacity and factor movements do not have instantaneous effects on production. Also, because the negotiations take place over extended periods, but have a high probability of success, as indicated by the proliferation of regional trade agreements, adjustments might have begun before the implementation phase. As developed and explained by Freund and McLaren (1999), when a country joins a free trade agreement, there is a dynamic adjustment in their trade volume and this is essentially related to movements in cost levels and capital investments of firms involved in trade with other countries member. They talked about "preaccessing adjustments, accelerating and then decelerating adjustment, and a jump in the accession year" (p.16) for the member of the agreement[11]. As such, there could be a continuum of states between the two extreme regimes and economic agents do not act promptly and uniformly at the same moment, especially because they need time for learning and there are some delays before their reactions after some changes in the economic environment. In such cases, gradual switching or smooth transition regression models are most suitable to characterize the dynamics of adjustment by letting the data

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[10] Kolhi(1978) and Lawrence (1989) focused on the Canadian economy and Kolhi's (1990,1994) analyses pertained to the USA. Kolhi (1982) fitted a GDP function for Switzerland and Kohli and Werner (1998) fitted one for South Korea. Harrigan (1997) studied a group of ten OCDE countries. Kee et al (2008) derive import demand elasticities to analyze trade distortion in 88 countries. As for the choice of a flexible form, the most popular is by far the translog form used by Kohli (1978, 1990, 1983, 1994, 2003) and Sharma (2002). The symmetric normalized quadratic has also been used, notably by Kohli (1993).

[11] This paper of Freund and McLaren is also interesting in the way that, it provides some theoretical and anecdotal arguments to convince on how some anticipatory investment induced by the adoption of trade policy such as adoption of trade agreement has impact at aggregate level on open economies.

determine the beginning and length of the transition period. Otherwise, tests looking for one or more abrupt changes at endogenously-determined dates would be warranted. One way or the other, it is most pertinent to assess whether SS and R elasticities experienced sign reversals, implying that the categorization of goods in terms of friends or enemies[12] of factors changed and to compare the magnitude of the elasticities before and after structural changes.

There are very few empirical papers analyzing the dynamic aspects of the impact of free trade agreements on the economy of the countries involved in the agreement. Among these we can cite those of Carrère (2006) and Freund and McLaren (1999) which analyze the impact of FTAs on trade for countries mainly involved in the four biggest trade blocs (NAFTA, European Union (EU), Common Market of the South (MERCOSUR) and European Free Trade agreement (EFTA)). They use a dynamic linear equation based on the trade share and trade intensity index of each country. Konno and Fukushige (2002) used the gradual switching approach to analyze the impact of CUSTA on U.S. and Canadian bilateral import functions. Magee (2008) also showed that the effects of regional agreements on bilateral trade flows are gradual, but relied on lagged variables to model trade flow dynamics. Even though empirical GNP functions have been featured in many studies, to the best of our knowledge, our work is the first to thoroughly consider structural change in a context of vector smooth transition regression[13]. However, structural change has been considered in the estimation of Stolper-Samuelson effects in Leamer (2001), the classic paper which compares the evolution of U.S. wages for skilled and unskilled labour for three different decades. In contrast to Leamer, we postulate that change occurred gradually and started and ended

[12] These concepts are adapted from Jones and Schienkman (1977). A good is a friend to a factor if an increase in its price (in the factor's endowment) causes an increase in the factor's price (in output of the good). If the effect is reversed, then the good is an enemy of the factor.

[13] The are many studies about the effects of trade agreements on the welfare and volume of trade of member and non-member countries. Most rely on the gravity model (e.g, Romalis (2007) and Baier and Bergstrand (2007)).

at dates to be determined by the data. We postulate that, in our specification, the structural change is implicit but the date is endogenous. Thus, we specify a Smooth Multivariate Transition system GNP function model to test for gradual change. We rely on the flexible translog functional form to approximate the Canadian (US) GNP function and use aggregated data covering the period 1970-2005 (1970-2007). The alternative approach proposed by Qu and Perron (2007) posits that structural change is abrupt and can occur more than once at unspecified dates.

The main result of our paper is that, as suggested by Magee (2008), Carrère (2006) or Freund and Mclaren (1999), the effect of free trade agreements are not necessary punctual but also dynamic, and they can be anticipated or persistent after the date of the adoption of the agreement. This finding is illustrated with the case of USA and Canada economies in the context of the adoption of CUSTA and NAFTA. For Canada, we found gradual structural change that started prior to the implementation of CUSTA and lasted for several years. In the US case, we found evidence of an abrupt structural change occurring in 1995, a year after NAFTA came into force. The empirical analysis also shows that several SS and R elasticities experienced sign reversals and a magnification effect over the different sub-periods.

Our paper is organized as follows. The next section presents the GNP function, its theoretical properties and the empirical specification adopted for estimation purposes. The third section focuses on the data, the econometric estimation and our structural change test. The implications of structural change for Stolper-Samuelson, Rybcynski, output and factor demand elasticities are analyzed in section four. The last section summarizes our results and their policy implications.

2. The Gross National Product Function: Theory and Empirics

The GNP function of an economy $G(P,V)$ is conditioned by *I* output prices and *J* factor endowments. It is defined as the maximum that can be produced by an economy through optimal resource allocation given its technology, factor endowment $V=(V_1,...,V_J)$, and output prices $P=(P_1,...,P_I)$:

$$G(P,V) \equiv \max_{v_i \geq 0} \sum_{i=1}^{I} P_i f_i(v_i) \qquad s.t. \qquad \sum_{i=1}^{I} v_i \leq V \quad \text{; Where } v_i = (v_{i1},...,v_{iJ}) \qquad (1)$$

The GNP function results from equilibrium conditions pertaining to the full employment of factors of production, perfect competition or unit cost pricing and from the technological assumption that production functions $Y_i = f_i(v_i)$ be positive, increasing, concave and homogenous of degree one (Feenstra, 2004 p.65). Thus, changes in output prices induce changes in input allocation that maintain production on the production possibility frontier. The GNP function is increasing and homogenous of degree one in prices, increasing and homogenous of degree one in endowments, twice differentiable and convex in prices and twice differentiable and concave in endowments (Wong, 1995). By the envelope theorem, equilibrium output levels can be obtained by the following first derivatives:

$$\partial G / \partial P_i = f_i(v_i) = Y_i, i = 1,...,I \qquad (2)$$

By Young's theorem, $\partial Y_i / \partial P_j = \partial^2 G / \partial P_i \partial P_j = \partial^2 G / \partial P_j \partial P_i = \partial Y_j / \partial P_i$. The convexity (in prices) property insures that the matrix of second derivatives is positive semi-definite which implies that diagonal elements are non-negative: $\partial Y_i / \partial P_i \geq 0$. Under the aforementioned assumptions, GNP can be expressed in terms of the value of endowments or of outputs since $\sum_{j=1}^{J} w_j V_j = \sum_{i=1}^{I} P_i Y_i$ (w_j is the price of factor j). From the envelope theorem, the relationship between factor prices and factor endowments can be obtained from a simple derivative:

$$\partial G / \partial V_j = P_i \partial f_i / \partial v_{ij} = w_j \qquad i = 1, ..., I;\ j = 1, ..., J \qquad (3)$$

The so-called reciprocity relations can be obtained by appealing to Young's theorem:

$$\partial w_j / \partial P_i = \partial^2 G / \partial V_j \partial P_i = \partial^2 G / \partial P_i \partial V_j = \partial Y_i / \partial V_j \qquad (4)$$

The first derivative is the Stolper-Samuelson (SS) relation and it is identical to the Rybczinsky (*R*) relation. The signs of SS effects identify the "friends" and "enemies" of each factor as an increase in the price of a given output generally hurts some factors and helps others. The magnitude of the *SS* effects is of great interest because the gains and losses of factors can be assessed by looking at how much their prices decrease or increase. The fact that they are reported as elasticities makes for easy comparisons across factors. The *R* effects tell us about how an increase in the endowment of a factor changes the level of output of a product under the assumption that output prices and others factors are constant.

The most common functional form for the GNP function, and the one used in our study, is the Translog function. It is typically estimated with product and input shares as a system of equations:

$$\ln G = \alpha_0 + \sum_{i=1}^{I} \alpha_i \ln P_i + \sum_{j=1}^{J} \beta_j \ln V_j + \frac{1}{2} \sum_{i=1}^{I} \sum_{k=1}^{I} \gamma_{ik} \ln P_i \ln P_k + \frac{1}{2} \sum_{j=1}^{J} \sum_{h=1}^{J} \phi_{jh} \ln V_j \ln V_h + \sum_{i=1}^{I} \sum_{j=1}^{J} \delta_{ij} \ln P_i \ln V_j \qquad (5)$$

where, $\sum_{i=1}^{I}\alpha_i = \sum_{j=1}^{J}\beta_j = 1, \sum_{i=1}^{I}\gamma_{ik} = \sum_{i=1}^{I}\delta_{ij} = \sum_{j=1}^{J}\delta_{ij} = \sum_{j=1}^{J}\phi_{jk} = 0, \gamma_{ik} = \gamma_{ki}, \phi_{jh} = \phi_{hj}$ are restrictions related to adding-up, homogeneity and symmetry properties. These parametric restrictions greatly reduce the number of parameters to be estimated.[14]

Differentiation of GNP function (5) with respect to $\ln P_i$ yields to the share of output *i*:

$$s_i = \partial \ln G / \partial \ln P_i = \alpha_i + \sum_{j=1}^{I}\gamma_{ij}\ln P_j + \sum_{j=1}^{J}\delta_{ij}\ln V_j \qquad (6)$$

Differentiation of GDP function (5) with respect to $\ln V_j$ yields the share of input *j*:

$$s_j = \partial \ln G / \partial \ln V_j = \beta_j + \sum_{h=1}^{J}\phi_{jh}\ln V_h + \sum_{i=1}^{J}\delta_{ji}\ln P_i \qquad (7)$$

From the estimated coefficients and product and input shares, several elasticities can be computed. More specifically, since $s_k = \frac{w_k V_k}{G}, \ln w_k = \ln s_k + \ln G - \ln V_k$, and $s_i = \frac{P_i Y_i}{G}$, $\ln Y_i = \ln s_i + \ln G - \ln P_i$, *SS* and *R* elasticities are computed as:

$$\partial \ln w_k / \partial \ln P_i = \frac{\delta_{ki}}{s_k} + s_i; \qquad (8)$$

$$\partial \ln Y_i / \partial \ln V_k = \frac{\delta_{ik}}{s_i} + s_k; \qquad (9)$$

while factor price flexibilities and output elasticities are computed as:

$$\partial \ln w_j / \partial \ln V_h = \begin{cases} \frac{\phi_{jj}}{s_j} + s_j - 1, \text{if } j = h \\ \frac{\phi_{jh}}{s_j} + s_h, \text{if } j \neq h \end{cases} \qquad (10)$$

[14] The convexity in prices and concavity in endowments properties cannot be imposed through simple parametric restrictions. If the properties do not hold at points of interest (i.e., at the mean or for a particular year), then it is possible to impose the properties locally as shown in Diewert and Wales (1997) and Ryan and Wales (1998).

$$\partial \ln Y_i / \partial \ln P_k = \begin{cases} \dfrac{\gamma_{ii}}{s_i} + s_i - 1, \text{if } k = i \\ \dfrac{\gamma_{ik}}{s_i} + s_k, \text{if } k \neq i \end{cases} \quad (11)$$

For practical consideration, each equation in (6) and (7) can be written more compactly as:

$$y_t = \theta X_t + e_t \quad (12)$$

where y_t is a vector of dependent variables, θ a vector of parameters, X_t a vector of independent variables and e_t a vector of error terms.

The introduction of gradual structural change is implemented by a multivariate smooth transition regression model developed by Bacon and Watts (1971), Tsurumi (1980), Ohtani and Takayama (1985) and Tsurumi et al (1986).[15] The challenge is to correctly identify the beginning of the transition and its speed. With a gradual structural change, equation (12) can be rewritten as follows:

$$y_{ht} = \theta_{1,h} X_{ht} + \theta_{2,h} X_{ht} \times F\left(TV_t, \gamma, \mu\right) + \varepsilon_{ht} \quad (13)$$ [16]

where TV_t the transition variable, X_{ht} is a vector of exogenous variables, $\theta_{1,h}$ and $\theta_{2,h}$ are ($p_h \times 1$) vectors of parameters, and ε_h denotes a sequence of independent identically distributed errors, the subscript *h* denotes a particular equation in the system. $F(TV_t, \gamma, \mu)$ is the transition function. It is continuous, bounded between 0 and 1 and it varies with the transition variable s_t according to the estimated parameters γ and μ.[17]

In most applications, $F(TV_t, \gamma, \mu)$ is approximated by the logistic function or the exponential function. As noted by Van Dijk et al. (2002), the choice between these two

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[15] Camacho (2004) provides an excellent review of multivariate or vector smooth transition regressions. Smooth transition regressions have been also used in system of demand estimation among other by Moschini and Meilke (1989), Goodwin (1992), Holt and Balagtas (2009) and Goodwin et al. (2003).

[16] An alternative representation is $y_{ht} = \theta_{1,h} X_{ht} \left(1 - F\left(TV_t, \gamma, \mu\right)\right) + \theta_{2,h} X_{ht} \times F\left(TV_t, \gamma, \mu\right) + \varepsilon_{ht}$.

[17] Here we suppose that the transition function is the same in all equations because we impose a common regime switching for all equations.

functions generally depends on the nature of the dynamics to be investigated. For example, the logistic function is more appropriate to study business cycles, but the exponential function is more appropriate for regime switching between two different and distinct regimes. Accordingly, we chose the exponential function which is defined as:

$$F(TV_t, \gamma, \mu) = 1 - \exp\left\{-\gamma\left(TV_t - \mu\right)^2\right\},\ \gamma > 0.$$

This function is non-monotonic and symmetric around μ. The parameter μ is the threshold representing the date at which the transition begins (i.e., $F\left(\mu, \gamma, \mu\right) = 0$) and γ is the speed of adjustment between the two regimes. The transition variable chosen is the linear trend of the model ($TV_t = t$). As a result, our model can be construed as a time-varying multivariate smooth transition model.

The abrupt structural change model is that developed by Qu and Perron (2007). In essence, the case with coefficients taking one set of values throughout the period covered by the sample is pitted against models with coefficients taking two or more values over the sample[18]. The main advantage of the procedure is that the number of structural breaks and the dates at which they occur are endogenously determined. Furthermore, it is possible to compute confidence intervals around the dates of the breaks to see whether they encompass known events.

3. Data and econometric estimation

[18] This procedure posits that structural change in a system of equations, occurring at unknown date can affect the regression coefficients, the covariance matrix of the errors, or both. The estimation method is quasi-maximum likelihood based on normal errors, and both conditional heteroskedasticity and autocorrelation are allowed. For more details about the model and the different specifications, reader can look directly the paper.

The Canadian time series used in our analysis come from Statistics Canada and the International Monetary Fund and cover the period 1970-2005.[19] The data for USA are obtained from the US Bureau of Economic Analysis and cover the period 1970-2007. While the translog functional form offers the advantage of being flexible enough to provide a second degree approximation of any technology, this advantage comes at a cost because the number of parameters to be estimated increases rapidly with the numbers of products (*I*) and factors (*J*). This is why most studies about the GNP function have relied on a few broadly-defined products and factors. Following Kohli and Werner (1998) and Kohli (2004), we rely on two factors of production, capital (*K*) and labour (*L*), and three outputs, exports (*X*), domestic sales (*D*) and imports (*M*). Imports are considered as intermediate products, requiring various domestic services such as unloading, transportation, storage, repackaging, marketing and retailing, before being consumed. Because exports must be tailored to suit the specificities of importing countries, they are differentiated from domestic goods. More details about the data are presented in appendix 1, and descriptive statistics are reported in tables 1 and 2.

Figures 1 and 3 illustrate trends in the relative price of imports and exports using the price of domestic goods as the numeraire for Canada and USA. Figure 1 shows some sort of cyclical movement, after an ascending trend during the 1970s, the relative prices of imports and exports followed a downward trend over 10 years before embarking on an another upward trend. In contrast, Figure 2 shows that the relative price of imports and exports was increasing before 1970 and then started a declining trend which could be a consequence of trade liberalization and the tariff cuts.

[19] It was impossible for us to have data staring before 1970 because since 1997, Statistics Canada introduced a big change in the methodology of producing aggregate data for the economy and many series available ended in 1997.

Figures 2 and 4 illustrate trends in capital intensity[20] for Canada and the USA over the sample period. Globally, the two graphs show an upward trend with faster growth for Canada after 1989, when CUSTA came into force, and after 1994, when NAFTA came into force, for the USA.

Tables 1 and 2 present descriptive statistics about key variables. The negative sign associated with the import share is explained by the treatment of imports as inputs requiring at least some transformation before being marketed to consumers (Kohli, 1991, p.62)[21]. According to Table 1, it can be seen that the Canadian economy experienced a notable change in technology particularly in the use of labour and capital. The share of capital increases significantly prior to the period before and after the adoption of the two trade agreements. For the US economy, the share does not significantly change over the different periods. Then, as we can anticipate for a small economy like the Canadian economy, in general, structural change occurred more quickly and deeper than a big economy like the US economy.

We estimated a three-equation system including the *I*-1 product shares and *J*-1 factor shares. We relied on the iterative seemingly-unrelated estimator to account for contemporaneous correlation between the residuals of the three equations. Our main hypothesis is that CUSTA brought about a major structural change that impacted the parameters of Canada's GNP function. This could have occurred through a gradual process whose beginning anticipated CUSTA and lasted several years due to various short run constraints. Preliminary estimations revealed autocorrelation problems that led us to estimate the system of share equations in first differences:

$$\Delta s_i = \sum_{j=1}^{I} \gamma_{ij} \Delta \ln P_j + \sum_{j=1}^{J} \delta_{ij} \Delta \ln V_j \qquad i \in \{M, X, D\} \tag{14}$$

[20]For the specify economy, it is the ratio between the stock of capital and the volume of labour evaluate in terms of total of worked hours.

[21] This hypothesis is more explained and used in recent paper of Kee et al (2008).

$$\Delta s_j = \sum_{h=1}^{J} \phi_{jh} \Delta \ln V_h + \sum_{i=1}^{I} \delta_{ji} \Delta \ln P_i \qquad j \in \{L, K\} \tag{15}$$

Keeping in mind that $y_h = \{s_i, s_j\}, X = \{P_i, V_j\}$, equation (13) becomes:

$$\Delta y_{ht} = \theta_{1,h} \Delta X + \theta_{2,h} \Delta X_{ht} \times F(t, \gamma, \mu) + \Delta \varepsilon_{ht} \tag{16}$$

We can test for a linear specification against the smooth transition regression in two ways. We can test the null hypothesis of linearity by restricting the parameters in $\theta_{2,h}$ to equal zero or alternatively we can restrict the coefficients in such a way as to set F to zero ($\gamma = 0$).

Then, the null hypothesis of linearity for equation (16) can be expressed as :

$H_0 : \gamma = 0$ against $H_0 : \gamma > 0$

Or as $H_0 : \theta_{2h} = 0$ against $H_0 : \theta_{2h} \neq 0$

According to this, we noted that some parameters are not identified under the null hypothesis. For example in the first test, the parameters θ_{2h} and μ are not identified and for the second, γ and μ are not identified either.

Consequently, standard tests like the likelihood ratio test, the Lagrange multiplier test or the Wald test do not follow their standard distribution. To overcome this problem, Luukkonen et al. (1988) proposed a solution which consists of replacing the transition function by a Taylor approximation of an appropriate order. Alternative appeals is a test proposed by Hansen (1996) which consists of approximating the limit distribution by generating p-values through simulation methods. We use a first degree Taylor approximation around $\gamma = 0$ and then replace $F(t, \gamma, \mu)$ by:

$$T_1(t, \gamma, \mu) = \gamma \left. \frac{\partial F(t, \gamma, \mu)}{\partial \gamma} \right|_{\gamma \equiv 0} + R_1(t, \gamma, \mu)$$

where $R_1(t,\gamma,\mu)$ is the remainder term.[22] Substituting $T_1(t,\gamma,\mu)$ for $F(t,\gamma,\mu)$ in (16) and rearranging terms yields the auxiliary model:

$$y_h = \beta_{0,h}X + \beta_{1,h}Xt + \beta_{2,h}Xt^2 + \nu_h \qquad (17)$$

with $\nu_h = \theta_{2,h}X \cdot R_1(t,\gamma,\mu) + \varepsilon_h$, $\beta_{0,h} = \theta_{1,h} + \mu^2\gamma\theta_{2,h}$, $\beta_{1,h} = -2\mu\gamma\theta_{2,h}$ and $\beta_{2,h} = \theta_{2,i}\gamma\theta_{2,h}$.

The null hypothesis of linearity can be summarized as $H_0 : \beta_{l,h} = 0; l = 1,2; h = i, j$ and it is equivalent to $H_0' : \theta_{2,h} = 0$ or $H_0'' : \gamma = 0$. We notice that $\nu_h = \varepsilon_h$ under the null hypothesis. A Lagrange multiplier test distributed with $p = 6 \times 2 = 12$ degrees of freedom can then be computed to ascertain the reasonableness of the restrictions under the null hypothesis. To avoid the problem of spurious rejection of linearity due to heteroskedasticity of an unknown form, we use heteroskedastic-consistent standard errors.

For Canada, the LM statistic for the nonlinearity test is 26.25 and it exceeds the corresponding 5% (or 10%) critical value of 21.03(18.55). As a result, we reject the null hypothesis of linearity and consider from this point on that Canada's GNP function has undergone a process of gradual structural change. Table 2 reports the estimated parameters and the fit of the model. The coefficient of determination for the model is high (R^2 = 0.78)[23] and many parameters are significant. The two parameters linked to the transition function are significant and we have $\gamma = 3.52$ for the speed of adjustment and $\mu = 0.07$ for the threshold, corresponding to the year 1997[24]. As illustrated by the graph of the transition function in Figure 3, the structural break started around the year

[22] Refering to Escribano and Jorda (1999), a second order approximation should be more accurate, but as noticed by Van Dijk et al. (2002), there is a trade-off because the extra variables in the auxiliary regression mean more parameters to estimate. Furthermore, tests based on first order approximations have as much power as tests based on second order approximations.

[23] The system R^2 is computed by the method proposed by McElroy (1977) for the SURE model.

[24] We have to mention that to overcome some difficulties at the estimation stage, we normalized the time trend and price variables to their 1997 value.

1984 and continued until 2005. The estimated changes occur symmetrically in around 1997. In other words, the structural change takes place gradually from the first regime to the second regime in 1997, and then switched progressively back to the first regime. This result is reminiscent of the results reported in Magee (2008) and Baier and Bergstrand (2007) who found that bilateral trade flows had begun adjusting prior to the implementation of CUSTA and kept on adjusting for years afterward.

We can divide our sample to focus on the regimes prior to and after the transition period. We can now go back to Table 1 to compare the average over regime I and regime II. The reduction of labour's share in the economy from the first to the second regime is most visible and so is the increasing share of capital.

For the USA, the LM statistic for the nonlinearity test is 8.17 and it does not exceed the corresponding 10% critical value of 18.55. As a result, we cannot reject the null hypothesis of linearity and gradual structural change cannot be considered in this case. Then, an alternative is to consider one or more abrupt changes . As mentioned before, we can implement the procedure proposed by Qu and Perron (2007)[25] to obtain the date(s) of structural change(s). We can then conduct Chow tests around the structural change date(s) suggested by the Qu and Perron (2007) procedure. Before presenting these results, it is insightful to glance at the results obtained with the gradual switching regression and see how they relate to the results under the abrupt change assumption. Table 4 reports the parameters estimates and the fit of the model. The coefficient of determination for the model is high (R^2 = 0.80) and many parameters are significant. The two parameters linked to the transition function are significant and we have $\gamma = 0.082$ for the speed of adjustment and $\mu = 1.091$ for the threshold.· Not surprisingly, the value of the speed of adjustment gamma is superior to the estimated speed for Canada. We can see

[25] Qu and Perron (2007) propose a procedure of studying (estimation, inference and computation) of multiple structural change occurring at unknown dates in a linear multivariate regression models estimated with a quasi maximum likelihood based on normal errors.

then in the graph of transition function (Figure 6) that the structural break might have started in 1995 and did not last long. This suggests that structural change might be easier to identify with a procedure that search for abrupt changes, like the method of Qu and Perron (2007) combined to a classical Chow test. The estimated date of break is the year 1995 and the 90% confidence interval for the break date is 1991 and 1999 (i.e, ± 4 years), which includes the date at which NAFTA came into force. We divided our sample into two sub periods around 1995. The estimation results conducted over these two subsamples and the full sample are presented in Table 5. Most of the parameters are statistically significant and quite different across samples. The fit measured by the system's R^2 is quite good. To implement the Chow test, we use the likelihood ratio test $LR = 2\left(LLF_u - LLF_c\right) \sim \chi_k^2$, where LLF_u and LLF_c are the log likelihood functions for the unconstrained and constrained models and k = 6 is the number of parameters to be estimated in the constrained model. We obtained a LR statistic of 11.13 that exceeds the corresponding 10% critical value of 10.64. As a result, we must reject the null hypothesis that the parameters before 1995 and the parameters after 1995 periods are the same. We are confident that NAFTA, not CUSTA, had a significant impact on the USA.

Canada and the USA have responded differently to regional integration initiatives. Canada's structural change occurred around the adoption of CUSTA and lasted several years whereas the USA experienced an abrupt structural change only after NAFTA came into force. This suggests that the US economy is more flexible than the Canadian economy and/or that a small economy must undergo more drastic changes that take longer to put in place. This is not surprising because terms of trade changes induced by trade liberalization should have a relatively larger impact on the smaller country.[26]

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[26] Country size matters as argued by Syropoulos (2002). Starting from a Nash tariff equilibrium, moving to free trade makes the small (large) country better (worse) off. In a simple Ricardian setting, the large country remains incompletely specialized while the small country becomes completely specialized when moving from autarky to

4. Goods and Factors Linkages: When Friends become Enemies and Enemies become Friends

The Stolper-Samuelson, Rybczynski, output and factor demand elasticities presented in Tables 6 and 7 are estimated at the mean of each subsample (for one regime or for one period). Confidence intervals computed using the method proposed by Krinski and Robb (1986)[27] are also reported. The simulated empirical distributions of the elasticities are based on 1000 draws.

Before going more profoundly into the analysis of those results, we will make some comments about the context of our paper. The point is that, we are not in the classic two countries, two goods and two factors HOS classical models and then, the four main theorems do not necessary hold, particularly the R and SS ones. Therefore, some of our R and SS elasticities that may be seen sometimes puzzling are not. The justification of those results is the departure from the classical assumptions; in our model, we have three goods and two factors. The theoretical analysis of this type of model is not the scope of our paper particularly because the discussion, concerning the higher dimensional issues in the HOS model, is extensively documented in the literature. For example, we can refere to the first three chapters of the handbook of international trade (volume 1), by Choi and Harrigan (2003), from where we borrowed this meaningful citation:

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free trade. As a result, all of the trade gains accrue to the small country. Feenstra (2004, p.151) also relates the magnitude of border effects to the size of countries.

[27] A simulation method is implemented to derive the empirical distributions of the elasticities. Denoting a vector of parameter estimates by M and the corresponding variance-covariance matrix by V, we take random drawings for vector of parameters from a multivariate normal distribution defined by M and V. For each draw, we compute the elasticities and from a large enough number of draws we can generate an empirical distribution for each elasticity.

"There is not much virtue in simplicity if a result that holds in a model of two countries, two commodities, and two factors does not generalize in any meaningful way to higher dimensions." John Chipman (1987, p. 922)[28].

Finally, as indicated by Feenstra (2004, p.71), the Rybcynski theorem does not hold when there are more factors than goods while a generalized version of the Stolper-Samuelson theorem continues to hold.

The point estimates for elasticities in the two regimes for Canada or the two periods for the USA are generally consistent with those reported in the literature and most of them are significantly different from zero. We can notice in comparing results across regimes that there are two main effects that emerge in the description of the evolution of the elasticities. Firstly, there is a sign reversal effect which implies that goods that were friends to a particular factor have become enemies of that factor and, conversely, that enemies have become friends. Secondly, there is a scale effect that inflates the absolute value of import demand, export supply and inverse factor demand elasticities. According to the objective of the paper, SS and R elasticities are the focus of this analysis, and our comment of the other elasticities are very brief.

Let us start with the results concerning the Canadian economy, which are reported in Table 6. The Stolper-Samuelson elasticities reported for the first regime indicate that an increase in the price of exports had a negative effect on the price of labour, and that an increase in the price of imports decreased the price of capital. In contrast, wages tend to rise in response to raises in the price of imports and in the price of domestic goods. The price of capital increased following increases in the prices of exports and domestic goods. Given that trade liberalization typically induces higher export prices and lower import prices that combine to create improvements in the terms of trade, labour unions had reasons to be sceptical about the alleged benefits of CUSTA

[28] Choi, E. Kwan, "Implications of many commodities in the Heckscher-Ohlin model," Choi and Harrigan (eds.), Handbook of International Trade, Volume 1. Blackwell Publishing (2003).

for their members as opposed to owners of capital who were generally pro-CUSTA. These results are consistent with Beaulieu's (2002) analysis of survey data in the year preceding the implementation of CUSTA. The elasticities for the period following the transition are quite different. In the second regime, the price of labour reacted negatively (positively) to increases in the price of imports (exports) while the opposite can be said about the price of capital. However, insofar as imports and exports prices have declined following the implementation of CUSTA, the net combined effect on the price of labour is positive, confirming the results of Trefler (2004). Because the price of capital has increased in the post-transition period, we can infer from the simultaneous reductions in imports and exports prices that export price reductions ended up having a stronger positive effect on the price of capital. Finally, over the two regimes, our estimates show that increases in the price of domestic goods tended to boost prices of labour and capital. This result is consistent with those of the literature, especially Kohli and Werner (1998).

Turning our attention to the US Stolper-Samuelson elasticities, which are reported in first part of Table 7. We can see that during the first period an increase in the price of imports had a negative effect on the prices of labour and capital. This means that imports were enemies of labour and capital. If we consider imports as intermediate inputs, we can say that they were substitutes for labour and capital in the USA before 1995. In contrast, exports and domestic goods are friends of the two inputs. The elasticities pertaining to the inverse factor demand of labour vary substantially across regimes. We can observe sign reversals as imports became a friend of labour and exports became an enemy. In contrast, the inverse labour demand for domestic goods did not change. As for the SS effects on the price of capital, the signs remain the same across regime, but the elasticities have increased in the second period for the three goods. Following the terminology of Jones and Scheinkman (1977), domestic and export goods are friends of capital.

In the case of Canada, for the period preceding the CUSTA transition, Rybcynski elasticities indicate that an increase in labour endowment had a significant positive effect on domestic sales, but a negative effect on imports and exports. An increase in capital endowment had a significant positive effect on imports, exports and domestic sales. As illustrated in figure 2, the Canadian economy experienced large increases in its capital-labour ratio during the transition years, which increased the production capacity of the Canadian economy. Comparing the "before" and "after" regimes, we observe a sign reversal in the R elasticities for imports and exports. In regime II, labour favours all three GNP components, but capital hurts imports and exports. Knowing that the amount of capital has increased significantly during the transition period, we can conclude that observed endowment changes supported consumption of domestic products at the expense of imports and exports as in Kohli and Werner's (1998) study about South Korea. Still, both South Korea and Canada experienced rapid growth in imports and exports. In the case of Canada, the evolution of import, domestic and export prices ended up offsetting the effects of structural change.

Concerning the Rybczynski elasticities for the USA, the second part of Table 7, estimates show that over the two periods changes occurred only for imports and exports. There is a sign reversal in the impact of labour endowment on the demand of import and the production of exports goods. In the first period, an increase in labour endowment induced increases in imports and exports. However, in the second period, the result is opposite as the production of traded goods fell in response to increases in labour endowment. Comparing, we see that the impact of an increase in the stock of capital had a stronger positive effect on the production of traded goods after NAFTA came into force. We find no evidence of change in the quantity elasticities of domestic goods when we compare the two periods. The non-trading sector in the USA is very large and this might explain why it was seemingly oblivious to NAFTA.

Looking at the Canadian import demand and output supply prices elasticities, table 6 shows that the export and domestic supplies are inelastic ($\varepsilon^{I}{}_{XX} = 0.72$, $\varepsilon^{I}_{DD} = 0.33$) while the import demand elasticity has the wrong sign, but is not statistically different from zero in regime I. However, the import demand elasticity ($\varepsilon^{II}{}_{MM} = -2.05$) has the right sign and is significantly different from zero in regime II. Prior to the transition, the higher price of imports increased exports, thus mimicking the effects of a currency devaluation, and decreased domestic production which suggests that the latter relies on foreign inputs. In regime II, an increase in export prices triggers increases in imports and in domestic production, which suggests that imports are increasingly used as inputs in export manufacturing and that exports and domestic goods are complements in production. In the case of the USA, import demand and output supplies are inelastic. In the first period, the demand for imports is sensitive to the prices of the three goods. The supply of export goods is sensitive to changes in the price of imports and exports, but the price elasticities for domestic goods are near zero. The demand for imports decreases when the price of imports goes up and increases when the price of exports goes up. The production of export goods reacts negatively to increases in the domestic price and positively with the price of imports and exports. The most notable change appears for the cross price elasticities between exports and domestic goods. In the first period, this elasticity is near zero and in the second period, it becomes inferior to minus one. This means that after 1995, exports and domestic goods became complementary goods.

In terms of Canadian factor demands, the own-price elasticities for labour and capital have the expected negative signs before and after the CUSTA transition period.

However, we notice sizeable scale effects that render these demands more elastic over time ($\varepsilon^{I}{}_{KK} = -0.31, \varepsilon^{II}{}_{KK} = -0.72, \varepsilon^{I}{}_{LL} = -0.22, \varepsilon^{II}{}_{LL} = -0.73$). The elasticities for the USA have the same signs as the Canadian ones, but their size differ as well as their changes across regimes ($\varepsilon^{I}{}_{KK} = -0.57, \varepsilon^{II}{}_{KK} = -0.65, \varepsilon^{I}{}_{LL} = -1.09, \varepsilon^{II}{}_{LL} = -1.04$).

5- Conclusion

Baier and Bergstrand (2007) argue that free trade agreements on average double the volume of trade between two members after 10 years. Using plant-level data, Tybout (1991, 2003) and Trefler (2004) among others found that free trade agreements induce gains in productivity and technical efficiency at the firm level. These effects are universally perceived as positive changes, yet there is much opposition to regional initiatives in developed and developing countries alike. Part of the opposition is motivated by the expected effects of output price variations on factor prices -the so-called Stolper-Samuelson (SS) effects. For example, Beaulieu (2002) used survey data collected prior to the implementation of the Canada-US Trade Agreement (CUSTA) and found that support or opposition to the proposed regional initiative could be explained by a large extent by the SS theorem. SS and Rybczinsky (R) elasticities are a by-product of the Gross National Product function, a powerful theoretical concept that has provided the foundation for many empirical analyses. However, we are not aware of any empirical study using a Multivariate Smooth Transition Regression framework or the Qu and Perron (2007) endogenous structural change approach to analyze the impact on R and SS elasticities of regional trade agreements through a GNP function.

We use a GNP function with endogenous structural change to investigate the impact of CUSTA and NAFTA. We were particularly interested in: 1) finding which of CUSTA or NAFTA had the largest impact on Canada and the United States; 2) characterizing the transition phase between regimes; and 3) assessing the nature and magnitude of changes in SS and R, and other elasticities of interest for the Canadian and US economies. Carrère (2006) and Freund and McLaren (1999) show that there is dynamic pattern in the effect of RTA for countries members. Magee's (2008) results show that bilateral trade flows began adjusting to CUSTA prior to CUSTA's implementation. As in Baier and Bergstrand (2007), Magee also showed that the effects of CUSTA were not instantaneous. Accordingly, we allowed for a smooth transition beginning and ending at endogenously determined dates in the estimation of our Gross National Production function. The bulk of the changes occurred over the 1985-1996 period, that is, two years before the implementation of CUSTA and two years after NAFTA. Then, our result is consistent with recent papers studying the effects of trade agreements which take into account dynamic aspects.

For the US economy, the test of gradual transition was not conclusive. Nevertheless, the procedure of Qu and Perron (2007) revealed that an abrupt structural change happened a year after the adoption of NAFTA. The contrasts in the nature and timing of the structural changes in the USA and in Canada suggest that the US economy is more flexible (particularly its labour market) and that country size matters. The adjustments are relatively more important for smaller countries. We also found sign reversals in SS and R elasticities. Prior to CUSTA, imports were friends of Canadian workers while exports were enemies. Results from survey data in Beaulieu (2002) support a similar conclusion and hence justify the opposition of Canadian labour unions to CUSTA prior to its implementation. However, after the 11-year transition period, Canadian exports have turned into friends and imports into enemies while the opposite holds for the USA.

Though our paper extends the literature about the effects of a regional trade agreement on the economy by testing for structural change and assessing its impact on key economic elasticities, there are some directions in which further research are possible. Specially, two extensions are possible by working at a disaggregated level. First, it would be interesting to work with more disaggregated variables such as investments goods, governments expenditures or consumption goods in place of domestic demand, or dividing labour by unskilled and skilled labour, etc. We can also think about the estimation of our model with data of firms or plants instead of national level; this could offer the possibility of introducing data from Mexico.

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Appendix: Data construction

The variables were constructed as in most empirical studies using GNP functions and following some recommendations from Kohli (1991, chap 8).

Working at an aggregate level, to evaluate domestic production or GNP, we used the income and expenditure approaches. According to the income approach, the gross national product is equal to the sum of the value of exports and national expenditures minus imports. Imports and exports are evaluated net of foreign transfers. The volumes of imports and exports were extracted from StatCan's CANSIM II database and related prices. The volume of national expenditures was extracted from CANSIM II and the prices associated with the consumption aggregate are the Canadian national consumer price index.

In the implementation of the second approach, we assume that the gross national product can be calculated like the sum of the factors' remuneration. This relation gives us an estimate of the remuneration of capital for the economy. After approximating the remuneration of labour by the total of salary paid per year in the economy, we obtain the amount of the remuneration of the capital by simple deduction. Then, with the volume (or stock) of capital obtained from the StatCan's database, we can estimate the price of capital. The price of labour was computed by dividing the remuneration of labour by the volume of work. The latter is defined as the product of the employment level and the hours worked per week.

Table 1: Descriptive statistics of output shares and input shares for Canada

	Full Sample (1970-2005)		Pre-CUSTA (1970-1989)		Post-CUSTA (1989-2005)		Regime I (1970-1984)		Regime II (1985-2005)	
	Mean	Std Dev	Mean	Std Dev	Mean	Std Dev	Mean	Std Dev	Mean	Std Dev
Output shares										
Imports	-0.195	0.077	-0.133	0.031	-0.265	0.045	-0.119	0.019	-0.300	0.012
Exports	0.258	0.081	0.201	0.031	0.324	0.069	0.192	0.028	0.376	0.029
Consumption	0.936	0.022	0.931	0.014	0.941	0.029	0.928	0.013	0.925	0.024
Input shares										
Labour	0.545	0.042	0.578	0.026	0.510	0.024	0.587	0.022	0.492	0.010
Capital	0.454	0.042	0.422	0.026	0.490	0.024	0.413	0.022	0.508	0.010

Table 2: Descriptive statistics of output shares and input shares for USA

	Full Sample		Pre-CUSTA		Post-CUSTA		Regime I (1970-1995)		Regime II (1996-2007)	
	Mean	Std Dev	Mean	Std Dev	Mean	Std Dev	Mean	Std Dev	Mean	Std Dev
Output shares										
Imports	-0,123	0,032	-0,099	0,020	-0,148	0,022	-0,106	0,021	-0,160	0,017
Exports	0,103	0,018	0,088	0,014	0,117	0,008	0,095	0,017	0,119	0,009
Consumption	1,021	0,020	1,011	0,014	1,031	0,021	1,011	0,012	1,042	0,018
Input shares										
Capital	0,356	0,032	0,350	0,014	0,362	0,042	0,342	0,019	0,387	0,032
Labour	0,644	0,032	0,650	0,014	0,638	0,042	0,658	0,019	0,613	0,032

Figure 1: Terms of trade from 1970 to 2005 for Canada

PXR : Relative price of exports; PMR : Relative price of imports.

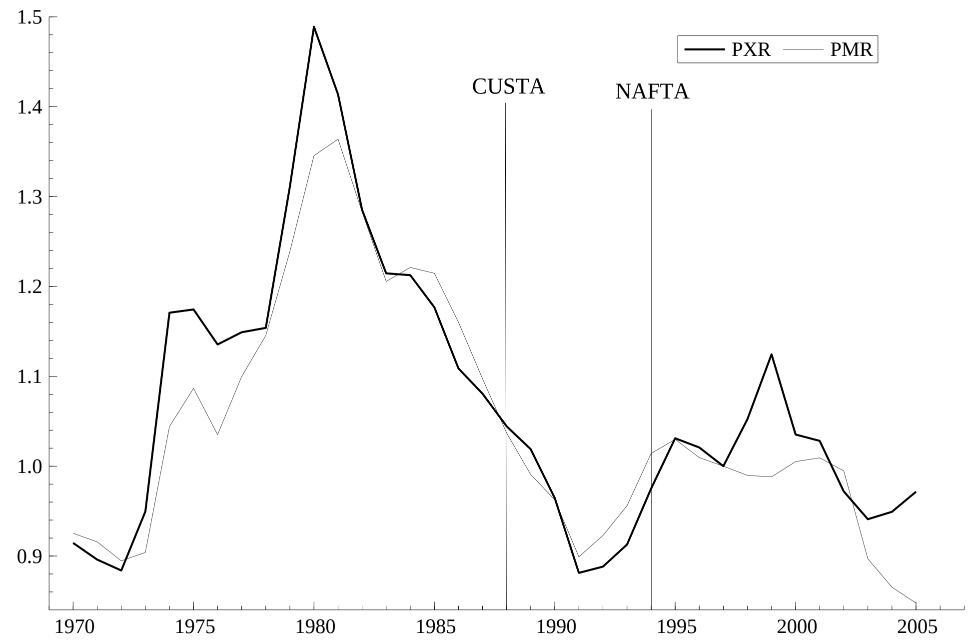

Figure 2: Capital-labour endowment ratio from 1970-to 2005 for Canada

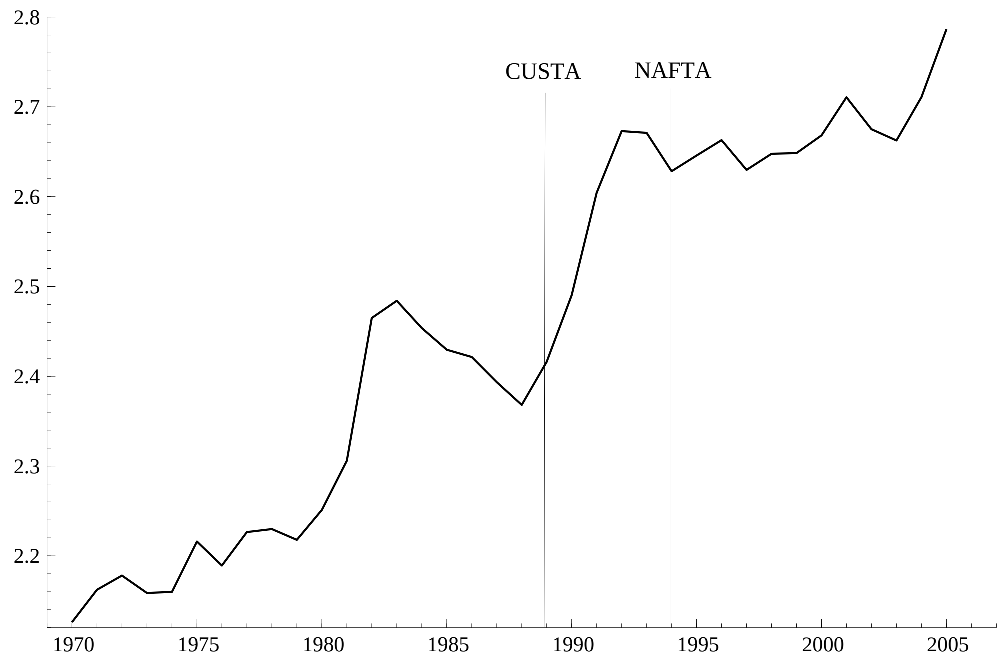

Figure 3: Terms of trade from 1970 to 2007 for USA

PXR : Relative price of exports; PMR : Relative price of imports.

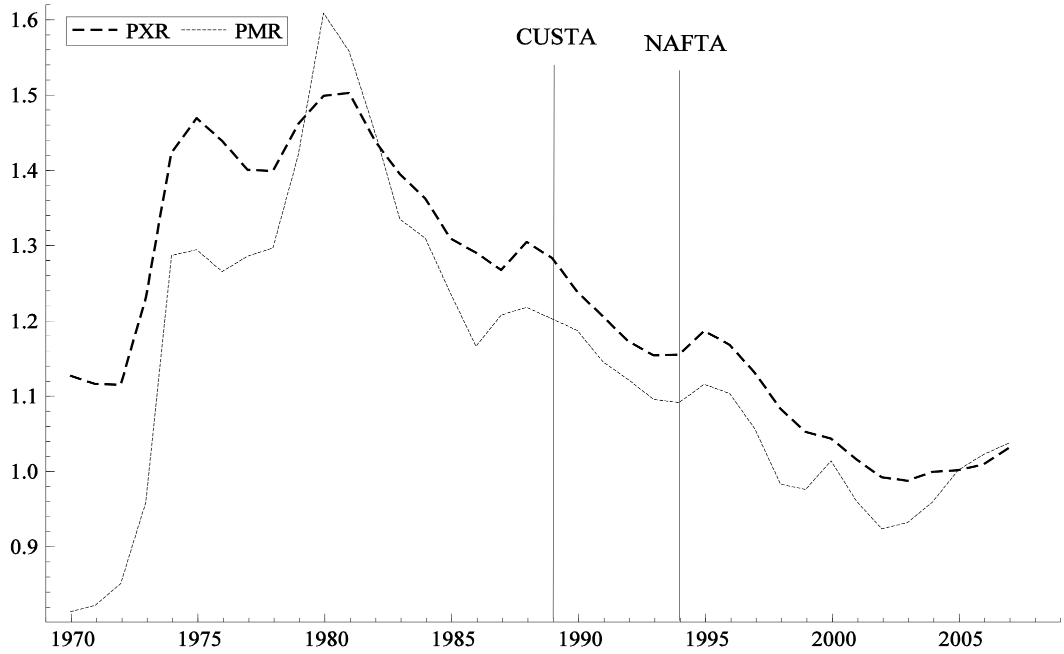

Figure 4: Capital intensity from 1970 to 2007 for USA

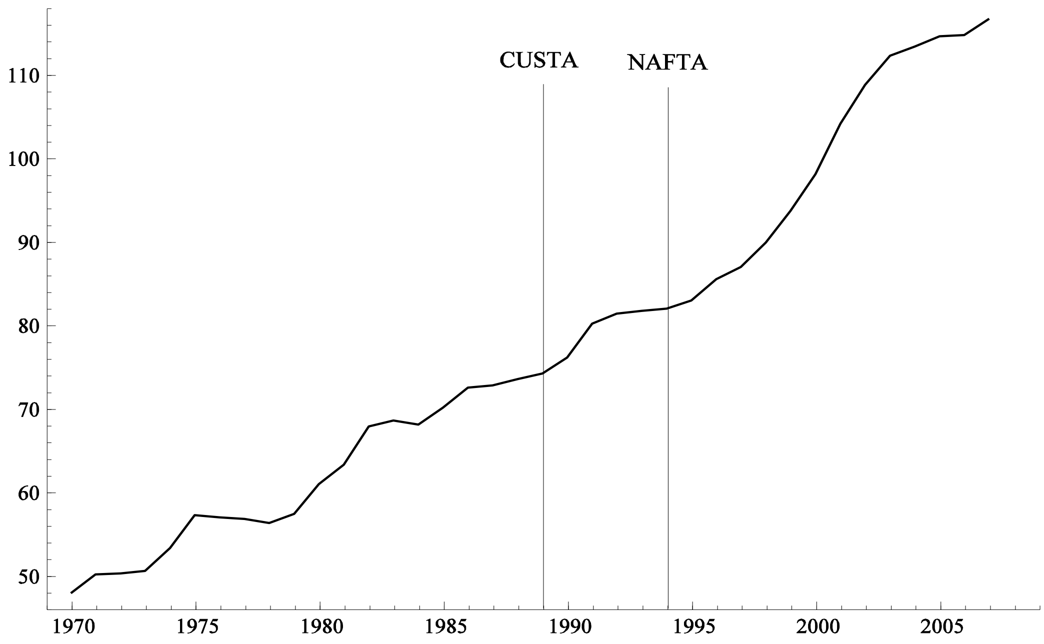

Table 3: Smooth Transition Regression model for Canada

Parameters	Regime I (1970-1984)		Regime II (1985-2005)	
	Estimate	Standard Errors	Estimate	Standard Errors
γ_{MM}	-0.228***	0.066	0.218*	0.114
γ_{MX}	0.166**	0.069	-0.212**	0.093
δ_{ML}	0.162***	0.051	-0.266**	0.123
γ_{XX}	0.277***	0.095	-0.191*	0.116
δ_{XL}	-0.252***	0.022	0.333***	0.082
ϕ_{LL}	0.115	0.087	-0.116	0.161
Gamma	0,007**	0,003		
Mu	3.517**	1.479		
System Fit : R^2		0.777		
Number of observations :		*T= 35*		

*Note: ***, **,* Parameters significant at 1%, 5%, 10% level, respectively*

Table 4: Smooth Transition Regression model for USA

Parameters	Regime I (1970-1995)		Regime II (1996-2007)	
	Estimate	Std Errors	Estimate	Std Errors
γ_{MM}	-0.363***	0.075	0.265	0.078
γ_{MX}	0.057	0.049	0.011	0.059
δ_{ML}	0.142**	0.062	-0.149	0.070
γ_{XX}	0.508**	0.217	-0.489	0.229
δ_{XL}	-0.100	0.068	0.073	0.074
ϕ_{LL}	0.166*	0.091	-0.394	0.140
Gamma	0.083*	0,031		
Mu	1.091**	0.526		
System Fit : R^2		0.800		
Number of observations :		*T= 37*		

*Note: ***,**,* Parameters significant at 1%, 5%, 10% level, respectively*

Table 5: Regression model with abrupt structural change

Parameters	All sample		Period 1		Period 2	
	Estimate	Std Errors	Estimate	Std Errors	Estimate	Std Errors
γ_{MM}	-0,113***	0,016	-0,106***	0,016	-0,271***	0,037
γ_{MX}	0,075***	0,022	0,068***	0,024	0,100***	0,030
δML	0,000	0,025	-0,008	0,026	0,106***	0,036
γ_{XX}	0,025	0,037	0,025	0,041	0,157	0,121
δXL	-0,011	0,022	-0,016	0,026	-0,053	0,049
ϕ_{LL}	-0,159**	0,084	-0,150**	0,070	-0,164	0,202
System Fit : R^2	0,670		0,740		0,790	
Log likelihood	394,500		277,950		127,680	
T	38		26		12	

*Note: ***, ** Parameters significant at 1%, 5% level, respectively*

Figure 5: Timing and Speed of the Transition between Regimes for Canada

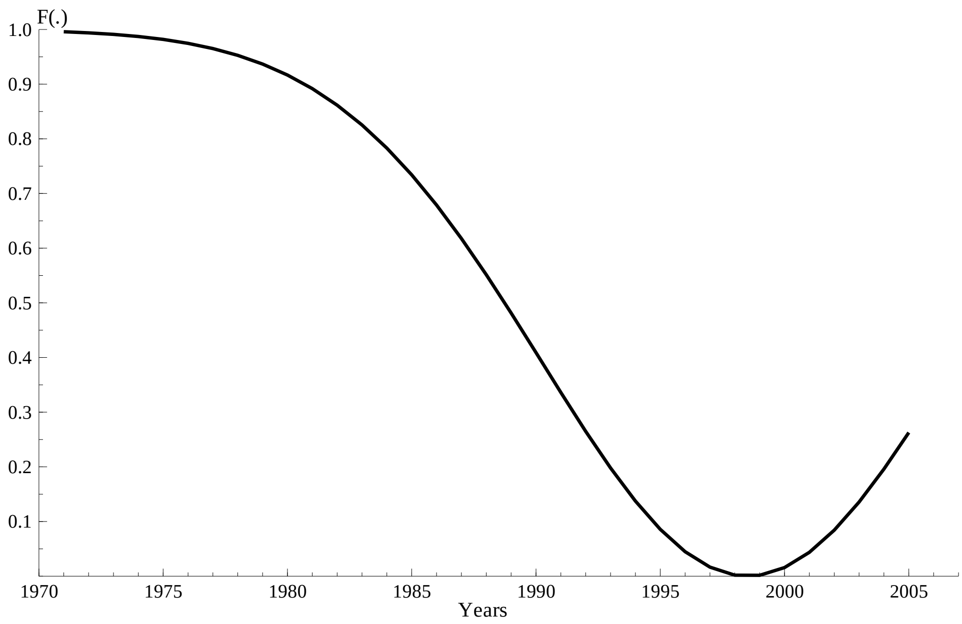

Figure 6: Timing and Speed of the Transition between Regimes for USA

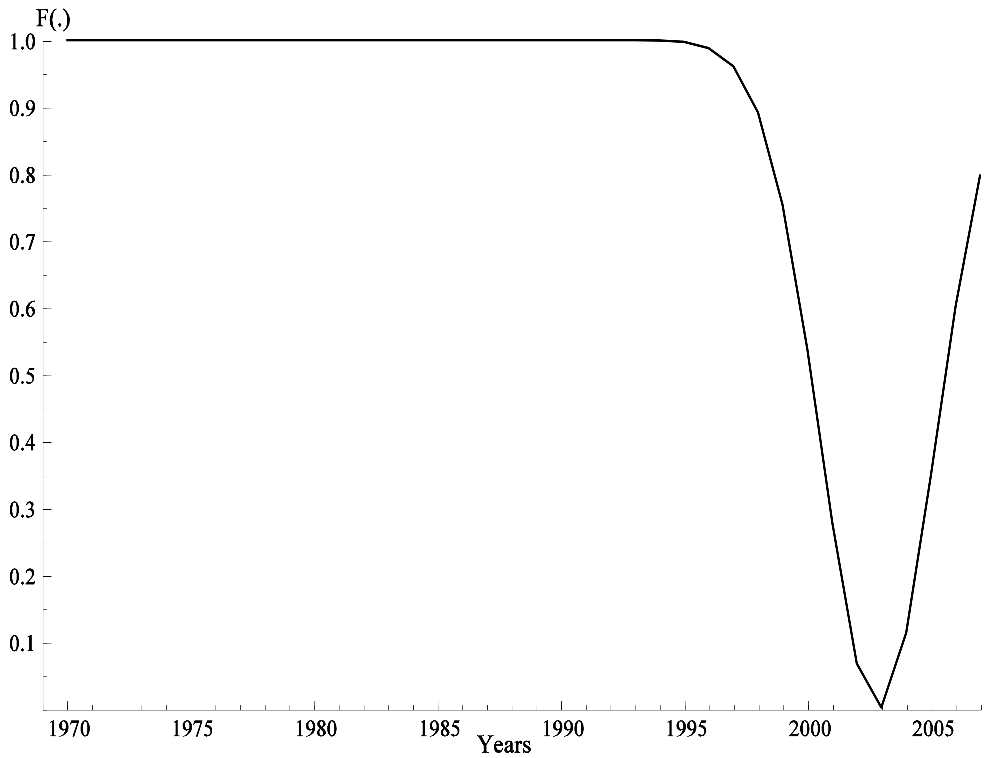

Table 6 : Elasticities Before and After the CUSTA Transition (Canada)

	Regime I			Regime II		
	Estimate	90% Confidence Interval*		*Estimate*	90% Confidence Interval*	
		Lower bound	*Upper bound*		*Lower bound*	*Upper bound*
i) Price elasticities of inverse factor demands - Stolper-Samuelson elasticities						
LM	0,160	0,014	0,298	-0,827	-1,223	-0,414
LX	-0,250	-0,314	-0,187	1,026	0,753	1,298
LD	1,089	0,966	1,217	0,801	0,527	1,049
KM	-0,509	-0,706	-0,302	0,235	-0,165	0,617
KX	0,792	0,702	0,883	-0,307	-0,571	-0,046
KD	0,717	0,535	0,892	1,071	0,831	1,333
ii) Quantity elasticities of outputs supplies - Rybczynski elasticities						
ML	-0,814	-1,516	-0,076	1,416	0,708	2,089
MK	1,814	1,071	2,515	-0,416	-1,093	0,291
XL	-0,815	-1,026	-0,611	1,446	1,062	1,830
XK	1,815	1,611	2,026	-0,446	-0,830	-0,067
DL	0,684	0,606	0,764	0,420	0,276	0,550
DK	0,316	0,236	0,394	0,580	0,450	0,722
iii) Price elasticities of import demand and output supply						
MM	0,852	-0,065	1,816	-2,045	-2,705	-1,416
MX	-1,251	-2,283	-0,244	1,087	0,543	1,631
MD	0,399	-0,262	1,046	0,958	0,532	1,384
XM	0,805	0,155	1,466	-0,895	-1,344	-0,450
XX	0,721	-0,182	1,590	-1,198	-1,760	-0,656
XD	-1,526	-1,867	-1,178	2,094	1,847	2,338
DM	-0,049	-0,130	0,030	-0,294	-0,425	-0,164
DX	-0,293	-0,359	-0,226	0,779	0,687	0,870
DD	0,343	0,259	0,426	-0,485	-0,582	-0,385
iv) Quantity elasticities of inverse factor demands						
LL	-0,216	-0,449	0,040	-0,743	-1,279	-0,263
LK	0,216	-0,041	0,446	0,743	0,261	1,279
KL	0,308	-0,058	0,635	0,720	0,253	1,239
KK	-0,308	-0,638	0,057	-0,720	-1,240	-0,254

*Note: *Confidence Intervals are computed using the method proposed by Krinski and Robb (1986);*

Table 7 : Elasticities at the sample mean according to the abrupt structural change (USA)

	Regime I			Regime II		
	Estimate	90% Confidence Interval*		Estimate	90% Confidence Interval*	
		Lower bound	Upper bound		Lower bound	Upper bound
i) Price elasticities of inverse factor demands-Stolper-Samuelson elasticities						
LM	-0,131	-0,254	-0,008	0,114	-0,041	0,260
LX	0,048	-0,077	0,179	-0,018	-0,227	0,189
LD	1,083	0,946	1,215	0,905	0,705	1,114
KM	-0,094	-0,157	-0,030	-0,333	-0,427	-0,236
KX	0,120	0,051	0,184	0,205	0,074	0,336
KD	0,974	0,905	1,045	1,128	0,996	1,254
ii) Quantity elasticities of outputs supplies-Rybczynski elasticities						
ML	0,421	0,026	0,817	-0,274	-0,633	0,097
MK	0,579	0,183	0,974	1,274	0,901	1,629
XL	0,171	-0,276	0,642	-0,060	-0,743	0,616
XK	0,829	0,353	1,275	1,060	0,381	1,740
DL	0,366	0,320	0,411	0,336	0,262	0,414
DK	0,634	0,589	0,680	0,664	0,586	0,738
iii) Price elasticities of import demand and output supply						
MM	-0,111	-0,342	0,126	0,528	0,144	0,907
MX	-0,540	-0,878	-0,174	-0,504	-0,818	-0,199
MD	0,651	0,435	0,852	-0,024	-0,361	0,316
XM	0,603	0,190	0,981	0,683	0,269	1,105
XX	-0,643	-1,318	0,066	0,443	-1,326	2,169
XD	0,040	-0,386	0,460	-1,126	-2,547	0,263
DM	-0,068	-0,090	-0,046	0,004	-0,049	0,055
DX	0,004	-0,036	0,043	-0,128	-0,290	0,030
DD	0,065	0,023	0,105	0,124	0,005	0,245
iv) Quantity elasticities of inverse factor demands						
LL	-1,097	-1,435	-0,755	-1,038	-1,885	-0,195
LK	1,097	0,752	1,435	1,038	0,193	1,879
KL	0,570	0,390	0,745	0,655	0,122	1,187
KK	-0,570	-0,745	-0,392	-0,655	-1,190	-0,123

*Note: *Confidence Intervals are computed using the method proposed by Krinski and Robb (1986);*