Productivity Gap and Asymmetric Trade Relations: The Canada-United States of America Integration Process

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ABSTRACT

The usefulness of the European model of integration is currently subject to debate and the North American integration process has been largely ignored as a comparative framework. The asymmetrical relationship between Canada and the United States began a long time before NAFTA, and the study of this process could shed light on the usual problems faced by Latin American countries. This article attempts to encourage discussion about this topic. Particularly, there is evidence for a substantial and positive change in Canadian productivity at the time of the Canada-US Free Trade Agreement (CUFTA). However, the enactment of the North American Free Trade Agreement (NAFTA) does not seem to have had the same effect as the earlier treaty.

Keywords: economic integration, productivity, development strategies

JEL classification: F15, O47, O51

Brecha en productividad y relaciones comerciales asimétricas: el proceso de integración de Canadá y Estados Unidos de Norteamérica

RESUMEN

La utilidad del modelo europeo de integración es actualmente sujeto de debate, mientras que el proceso de integración norteamericano ha sido largamente ignorado como un marco comparativo. La relación asimétrica entre Canadá y los Estados Unidos empezó hace mucho tiempo antes del NAFTA, y el estudio de este proceso podría dar luces en los problemas usuales enfrentados por países latinoamericanos. Este artículo intenta promover la discusión sobre este asunto. Particularmente, existe evidencia de un cambio positivo y sustancial en la productividad canadiense en el momento del acuerdo comercial entre Canadá y los Estados Unidos (CUFTA). Sin embargo, la promulgación del Acuerdo de Libre Comercio de Norteamérica (NAFTA) no parece que haya tenido el mismo efecto que el tratado anterior.

Palabras clave: integración económica, productividad, estrategias de desarrollo

Clasificación JEL: F15, O47, O51

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1. INTRODUCTION

Frequently, economic integration is cited as a priority for completing Latin America's development process. Major research institutions devote their efforts to this area and regularly publish studies pointing out the economic and political benefits of trade integration[1]. In fact, we have observed frequent attempts made, with differing objectives, political overtones and degrees of success (ALALC, ALADI, MERCOSUR, Andean Community, MCCA, CARICOM, G3 FTA, ALBA, UNASUR/USAN, ALCA/FTAA, etc.[2]). One of the positive results of these initiatives has been the increasing trade and investment flows between regional partners. However, this has been accompanied by a negative aspect: the increasing probability of the contagion of crisis and, in turn, of economic and political instability in the integration project.

Most local governments understand that the best way to deal with globalization is through policy coordination. However, practical approaches lead to the implementation of policies that optimize purely short-term domestic objectives. Escaith and Paunovic (2002) argued that cooperation is not a stable outcome, especially at the beginning of the process when the profits yielded by cooperation are uncertain, and uncertainty grows with the number of countries included in the negotiations. Hence, they emphasize the integration of a reduced number of countries with reasonably homogeneous characteristics. The multitude of economic regions that have been formed since 1960 to date seems to suggest that this step has been accomplished. However, a continental integration project still seems a long way off.

Today, the North American Free Trade Agreement (NAFTA) in the north and the incipient UNASUR in the south seem to be disputing the rest of the continent after the failure of the FTAA. Particularly, UNASUR is introduced as a South-South project even though that characterization conceals significant institutional and structural differences between the economies involved.

The usefulness of the European model of integration is currently subject to debate[3] and the integration process between Canada and the United States of America (USA) has been largely ignored as a comparative framework. Differences between Canada and USA throughout the twentieth century were remarkable in both political and technological terms. The association between these two countries began a long time before NAFTA, and the study of this process could shed light on the usual problems faced by Latin

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[1]   For example, INTAL/BID and its associated networks (RedINT, LAEBA, ELSNIT, REDEALAP), the Trade and Integration Division of ECLAC/UN, the Red MERCOSUR, the CAF of the Andean Community, the Regional Integration Network of LACEA, etc.

[2]   See appendix for abbreviations.

[3]   An early essay of Sunkel (1998) outlines the integration difficulties that Latin America historically faced and highlights substantial differences with the European integration process.

American countries—principally, as regards asymmetric trade relations and how they affect economic performance in the long term.

This paper provides a summary of Canadian productivity performance and analyzes the development of the integration process. I present evidence that integration agreements with the USA are not the primary source of the deterioration in multifactor productivity in the twentieth century. Furthermore, the enactment of the Canada-US Free Trade Agreement (CUFTA) may even have had a favorable effect on the use of technology that allowed the growing gap with USA to be temporarily reversed.

This study involves two stages; the first is of a descriptive nature, namely an exploration of the historical process of the Canada-US integration process (Section 2). The second stage is of an empirical nature, involving the specifications of the development accounting framework and the application of this framework to the Canadian-American experience. Then, I introduce a decomposition of the product gap and an evaluation of the possible impact of integration on productivity (Section 3). Finally, there is the conclusion in Section 4.

2. CANADIAN AND USA INTEGRATION PROCESS

The first antecedent of integration was the Canadian-American Reciprocity or Elgin-Marcy Treaty (1854), with political rather than economical connotations (Rapoport, 1994). There is agreement on understanding it as a defensive response against American expansion instead of an opportunity for development. On the other hand, the National Policy of Tariff was the principal instrument of economic policy of the Conservative party after the federal election of 1878. The party's electoral success was due to its explicit opposition to the Canadian-American reciprocity treaties after the failure of the 1871 Washington Act.

The National Policy of Tariff was devised to stimulate import substitution industrialization. However, the government and the business community tried to protect the Canadian market and reach equilibrium in the balance of payments rather than create conditions to promote industrialization (Lucchini, 2002). Di Tella (2007) further develops this idea, stating that tariffs were needed for the railroad and the railroad was essential to Canada. This policy was considered positive and its general acceptance compelled the Liberal party to accept it, despite a tradition of upholding the reciprocity treaties for years before.

Lucchini (2006) argues that the Canadian industrial sector was constituted by poorly integrated activities. These were conducted by local businessmen with scarce foreign capital until 1870. The positive impact of the new economic program came about through significant technological renewal. The technological progress is explained by the exploitation of economies of scale, the early expansion of hydroelectricity, and the increasing share of American capital in domestic firms that took advantage of

a protected market. Notwithstanding this early industrial development, the agricultural sector maintained its leading role.

The period between 1901 and 1911 was characterized by a boom in Canadian wheat exports and is considered by many scholars as being critical to Canada's economic development (Altman, 2003). After 1911, trade policy in Canada became even more protectionist and was also discriminatory against the USA (Whalley, 1992, p. 135).

The Import Duties Act (1919) and Imperial Preference (1932) lowered duties on production of British imperial origin and products that came from the Commonwealth, respectively. Industrial businessmen who were united in the Canadian Manufacturers' Association—to a large extent, these men worked for subsidiaries of US companies— proposed an Imperial import substitution policy similar to the Canadian one. Preferential treatment was given by the British Crown to a substantial number of Canadian manufacturers from 1919 onwards. During the years of the Great Depression, the United Kingdom hardened its stance in response to the trade policies of the USA and Continental Europe, and Canada was obliged to make an effort to keep the British market. As a result, Imperial Preference was agreed upon at the 1932 Ottawa Conference, and the Canadian government saw it as "a means of putting pressure on the USA to reverse its 1930 tariff increases" (Pomfret, 2000, p. 118). However, one of the indirect effects of this policy was the growth of American investment in Canada with positive and far-reaching implications on Canadian manufacturing exports.

In the early 20th century, Canada had an economy with diversified production and less dependence on primary exports. Moreover, the division of land into smallholdings and the early industrialization process ensured that manufacturing was the most powerful interest group (Lucchini, 2006), and its principal objective was to maintain economic links with the USA without losing the advantages that came of being a member of the Commonwealth. Promfret (2000) mentions that "at Confederation in 1867 Britain supplied 60 per cent and the USA 32 per cent of Canada's imports, but by 1938, despite Imperial Preference, the shares were 18 per cent from Britain and 63 per cent from the USA. The reorientation was reinforced during the 1920s by a sharp change in the source of capital inflows. In 1920, 53 per cent of the foreign capital in Canada was British and 44 per cent from the USA, but by 1926 these proportions had been reversed and in 1930, 36 per cent was from Britain and 60 per cent from the USA" (pp. 116-117).

Although US policy had toughened considerably and Ottawa's response had reduced the trade between both countries dramatically, the enactment of the Reciprocal Trade Agreements Act (1934) and the new trade agreements of 1935 and 1938 -the latter with the inclusion of United Kingdom- went some way towards restoring the commerce relationship. Finally, the alignment with the USA during WWII reinforced the political relationship so that economic links were stronger than ever. After 1947, Canada followed the lead of these countries, and principally the USA, by embracing multilateralism.

Stewart Stokes (1993) said that the 1959 and 1965 agreements were specialized in scope and technical in nature but had extraordinary effects on Canada's imports and exports, especially the latter; for instance, through the Canada-US Automotive Products Agreement. During the 1980s, bilateral trade accounted for 70% of Canadian trade. According to Stewart Stokes the majority of Canadian exports were concentrated on resources with relatively low levels of processing or automotive products.

While the Canada-US Free Trade Agreement (CUFTA) of 1987/8 marked the abandonment of the National Policy, the formation of the North American Free Trade Agreement (NAFTA) in 1994 constituted the institutional framework for the consolidation of an integrationist path. We could summarize the strategic implications of NAFTA for Canada with this phrase: "Canada is heavily dependent on trade with the United States and thus increasingly vulnerable to US protectionism" (Hart, 1991, p. 87).

According to Whalley (1992), "the average tariff on Canadian exports to the United States prior to the agreement was approximately 1 per cent; nearly 80 per cent of Canadian trade with the United States was already duty free…" (p. 134). So what explains the change in the Canadian position? "By the early 1980s, the view in Canada was that GATT negotiations were increasingly being slowed by a form of lowest common denominator outcome. The argument was that if Canada had 80 per cent of her trade with one country, why negotiate simultaneously with 80 or more countries multilaterally when one country defined Canada´s dominant trade interest, and also it was possible to move farther and faster down the bilateral rather than the multilateral route" (pp. 135-6). The objective in negotiating trade arrangements was to secure the country's access to the larger US market not only before increases in US barriers occurred, but also before other smaller countries entered into similar access negotiations.

The confirmation of the move towards a market-oriented trade policy blocked the path to greater protection by the USA, at least in relation to Canada. And by participating in NAFTA, Canada prevented the bilateral agreement between the USA and Mexico from eroding some of the benefits obtained with the CUFTA. Instead, Miller (1990) argued that the "fear factor" was not well-founded. While a protectionist impulse existed, it was severely contained Canada had been unable to reach other markets, and this "dependency syndrome" was explained, in his opinion, by the set of institutional, corporate and government factors that bind Canada and the USA in terms of technological development products and markets and investment planning ("subsidiary companies" controlled by US companies).

3. IMPACT OF INTEGRATION BETWEEN CANADA AND USA ON THE PRODUCTIVITY GAP

Rao and Sharpe (2004) introduce their book by saying that productivity growth is the fundamental driver of improvement in real incomes and living standards in the long term. Moreover, "the economic well-being and quality of life of a country's citizens depend on many factors besides productivity growth. But, by increasing the economic pie, improvements in productivity offer more choices to government and its citizens to invest additional resources in areas such as health, education, the environment and public security and infrastructure, and to alleviate poverty and economic inequalities. By contrast, in an era of stagnant real incomes, it is extremely difficult to devote more resources to these areas (p. 3)". These factors are sufficient for studying the impact of the integration process on the productivity of the Canadian economy.

According to Diewert (2004), both countries experienced a "golden era" of productivity growth during the years 1960s and a period of "dismal years" between 1974 and 1991. Energy shocks, high inflation rates and a worldwide recession seem to be the reasons for the poor performance during this latter sub-period. Finally, a "new economy era" began in 1992 with productivity growth rates below those achieved in the pre-1973 period. Diewert found that for all time periods, the USA "appears to have had faster rates of productivity growth than Canada" (p. 37). Figure 1 shows three estimations of the relative total (or multi-) factor productivity, taking the USA as the benchmark.

Figure 1. Relative Total Factor Productivity, Canada-USA. Some sources, 1961-2010
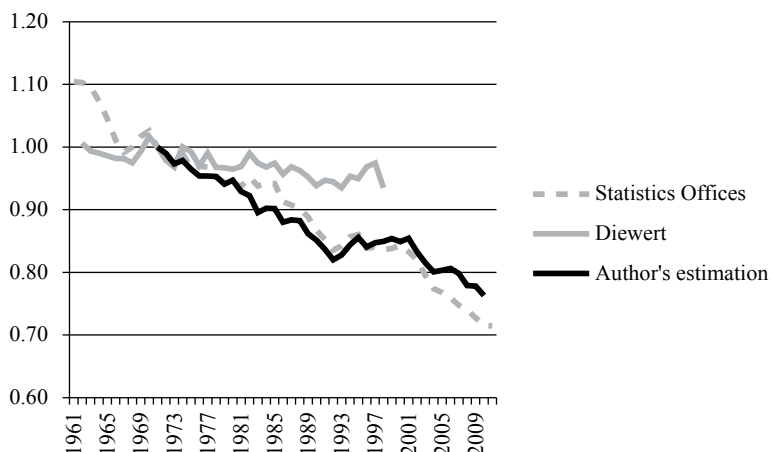
Sources: Diewert (2004), Statistics Canada and BLS. For Author´s estimation, see main text.

Studies of Canadian productivity trends agree that there was a deterioration in performance and an erosion over time of the catch-up effect with the USA after mid-1980s. Gu and Ho (2004) and Lee and Tang (2004) found that during those years the total factor productivity grew more slowly and the gap increased.

According to the integration literature[4], the association with a bigger economy allows the realization of economies of scale, and the intensification of international trade and investment facilitate the spread of technological advances. Given that one of the supposed benefits of integration with the USA was improved productivity, at least one relevant question arises: are the bilateral agreements responsible for the increasing gap in productivity?

To answer that question it is necessary to take into account two issues related to the timing of integration effects. First, the effects may occur immediately or after a delay. Second, the effects can create breaks in the relevant variables or be expanded over time. We can assume that it is almost impossible for the integration effects on productivity to occur contemporaneously with the entry into force of the agreement. For example, companies should invest in machines to enhance their scale and supply the new market. Even before that happens, this move should generate the necessary conditions for the expansion of business. That involves elements that cannot be directly influenced by governments or that need time for adjustment, particularly in terms of agents' expectations and preferences.

Next I will create a framework for productivity level comparisons and establish whether there was at least one structural break in Canadian total factor productivity after the Oil Crisis that can be associated with the process of integration with the USA.

As usual, I begin with a Cobb-Douglas function that contains three productive factors and a TFP variable, which represents the residual of the production function. I assume that both Canada and the USA can be explained by the same model. Hence, the residual contains all the possible structural differences.

The product Y is represented in the following expression[5]:

$$(1) \quad Y_i = K_i^\alpha H_i^\beta (A_i L_i)^{1-\alpha-\beta}$$

where i indicates the country, while α and β are the shares of physical and human capital, K and H, in the product, with $(\alpha + \beta < 1)$. The human capital stock is the product of the average human capital level, h, and the workers, L ($H_i = h_i \times L_i$). Variable A represents multifactor productivity.

Denoting P_i as the population of the country i, equation (2) contains per capita product and its components:

$$(2) \quad \frac{Y_i}{P_i} = \frac{L_i}{P_i} \left(\frac{K_i}{Y_i} \right)^{\frac{\alpha}{1-\alpha-\beta}} \left(\frac{H_i}{Y_i} \right)^{\frac{\beta}{1-\alpha-\beta}} A_i$$

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[4] For a comprehensive presentation of the effects of integration, see Jovanovic (2006) and Robson (1998).

[5] Equation (1) can be reached from a three sectors model; one of them produces final goods and the others are composed by j firms that produce physical and human capital, respectively. A benchmark in this approach is Romer´s model. In turn, this expression of the production function is used by Mankiw *et al.* (1992), and Klenow and Rodriguez-Claire (1997).

where L/P is the labor participation rate, and K/Y and H/Y indicate the intensity of physical and human capital in the product.

Then, I define the relative per capita product and its components as:

$$(3) \quad \varphi_{ij}^{Y/P} \equiv \frac{Y_i}{P_i} \bigg/ \frac{Y_j}{P_j} = \varphi_{ij}^{L/P} \varphi_{ij}^{K/Y} \varphi_{ij}^{H/Y} \varphi_{ij}^{A};$$

$$\varphi_{ij}^{L/P} \equiv \left(\frac{L_i}{P_i} \bigg/ \frac{L_j}{P_j} \right); \quad \varphi_{ij}^{K/Y} \equiv \left(\frac{K_i}{Y_i} \bigg/ \frac{K_j}{Y_j} \right)^{\frac{\alpha}{1-\alpha-\beta}};$$

$$\varphi_{ij}^{H/Y} \equiv \left(\frac{H_i}{Y_i} \bigg/ \frac{H_j}{Y_j} \right)^{\frac{\beta}{1-\alpha-\beta}}; \quad \varphi_{ij}^{A} \equiv \left(A_i / A_j \right) = \frac{\varphi_{ij}^{Y/P}}{\varphi_{ij}^{L/P} \varphi_{ij}^{K/Y} \varphi_{ij}^{H/Y}}$$

Multifactor productivity depends on two factors. The first is called "technological capabilities", and represents a complex set of human abilities, technological knowledge and organizational structure which are required to operate technology efficiently as well as to reach a process of technological change (Llal, 1992). The second factor captures the leaps in the production possibility frontier, i.e. changes in technology due to learning processes prompted by endogenous factors or incorporated from the rest of the world (by means of imports of goods or technology, foreign investment, immigration, etc.). These changes need to be relevant, so that they can strongly modify the "real costs of production" (Harberger, 1998).

Following that categorization, the multifactor productivity can be decomposed as follows:

$$(4) \quad A_{it} \equiv X_{it} E_i T_t$$

where it represents an economy i in the period t, so that X_{it} shows specific effects in i and t, and it refers to technological capabilities. E_i captures the effects that are specific in i and invariant in t (for example, the effect of the productive structure on multifactor productivity). In turn, T_t is related to the effects that are invariant in i and specific to t (for example, a widespread technological shock). Given a technological shock, this component captures the average effect on the economies, while X_{it} captures the differences between them.

Therefore, from (2) and (4) we can estimate X_{it}, E_i and T_t, as follows:

$$(5) \quad \hat{X}_{it} = \frac{\hat{A}_{it}}{\hat{E}_i \hat{T}_t}$$

$$(6) \quad \hat{E}_{i\psi} = \frac{\left(\overline{Y/P}\right)_{i\psi}}{\left(\overline{K/Y}\right)_{i\psi}^{\frac{\alpha}{1-\alpha-\beta}} \left(\overline{H/Y}\right)_{i\psi}^{\frac{\beta}{1-\alpha-\beta}} \left(\overline{L/P}\right)_{i\psi}}$$

$$(7) \quad \hat{T}_{t} = \frac{\left(\overline{Y/P}\right)_{t}}{\left(\overline{K/Y}\right)_{t}^{\frac{\alpha}{1-\alpha-\beta}} \left(\overline{H/Y}\right)_{t}^{\frac{\beta}{1-\alpha-\beta}} \left(\overline{L/P}\right)_{t}}.$$

where ψ represents a sub-period of time, $\wedge$ denotes estimated values of the variables, and the symbol ‾ denotes the average value. Equations (6) and (7) are extracted from the expression (2) averaging the variables in t and i, respectively.

The annual data utilized were obtained from the Centre for the Study of Living Standards and the World Databank. The time period used for our analysis was 1971-2010. All values were converted from CAD$ to USD$ using exchange rates supplied by CSLS. Calibration was done by taking as reference the average wage share of income from Bernanke and Gürkaynak (2001) and using appropriate values for alpha and beta[6].

Figure 2 shows the long-run path of the components of the relative per capita product. The multifactor productivity slowdown is the key variable in determining the path of relative per capita product between the 1970s and 1980s. However, this is not a sufficient explanation for the "new economy era". Differences in the labor participation rate are important in explaining the relative economic development in the region. Product decomposition allows us to observe that since the late 1990s, the increase in the ratio between labor force participation rates has offset the fall in relative multifactor productivity. However, the difference in slopes between the curves of output per capita and the rate of participation marks out a problem of low labor productivity in Canada. This finding is consistent with the analyses of Baldwin and Gu (2007, 2009) who have found a slowdown in labor productivity almost entirely explained by factors that determine the growth of multifactor productivity (innovation, organization of firms, economies of scale and use of capacity).

[6] See appendix for more details about data and estimation procedure.

Figure 2. Relative per capita product and its components, Canada-USA. 1961-2010
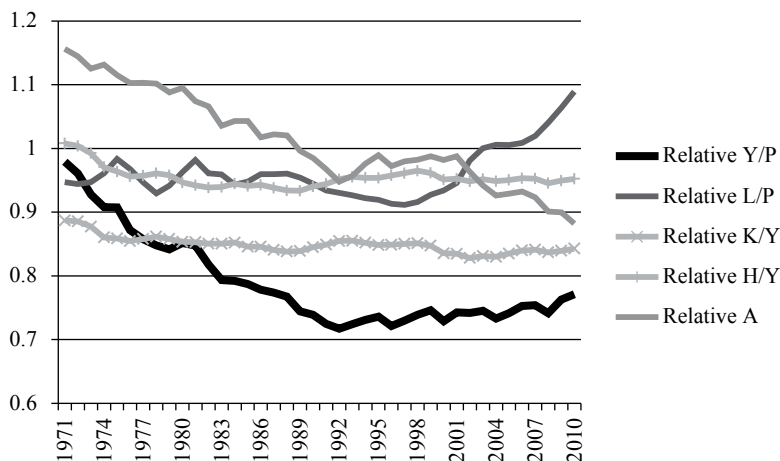
Sources: Author's estimation. For more details, see main text.

The evolution of the relative A shows clear evidence of improved US productivity performance: Starting from a gap in favor of Canada in the 1970s but with a bias toward closure, and ending with a growing gap in favor of the USA—except for a period of stability during the 1990s. Figure 3 shows that during the years 1970s the structural factors (summarized in E) favored more assimilation of technological developments in Canada than in the USA. However, that advantage disappeared with time and in the 1990s the situation was reversed (i.e. relative E value below 1). This was partially offset by better use of technological capabilities in Canada between 1991 and 1995. However, this could not be sustained beyond 2001 and further ratio decline was halted only by the effects of the US crisis.

Figure 3. Components of Relative A, Canada-USA. 1961-2010
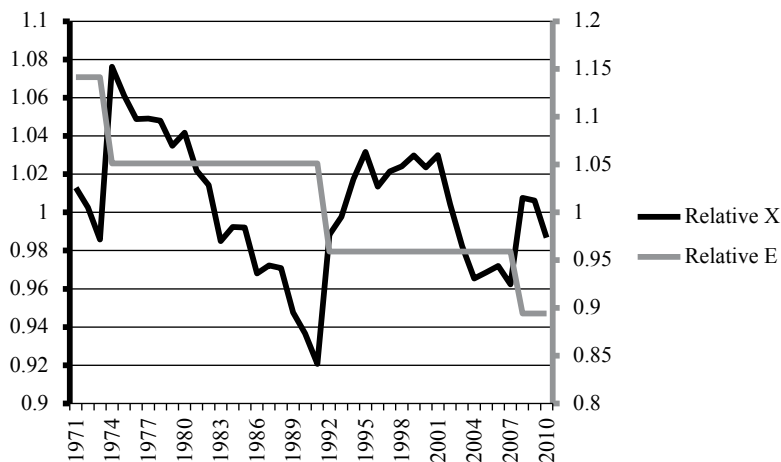
Sources: Author's estimation. For more details, see main text.
Note: For the computation of E were utilized the sub-periods 1971-73, 1974-91, 1992-2007 according to Diewert (2004), and 2008-10.

While the substantial improvement in technological capabilities observed between 1991 and 1995 could be associated with the CUSTA enactment, the stable path between 1996 and 2001 could be interpreted as a weakening of the driving force of technological improvements that could not be reversed with NAFTA. This interpretation is consistent with Cardarelli and Kose (2004) and, partially, with Sawchuk and Trefler (2002).

In order to complete the analysis of the total factor productivity I have performed a test of structural breaks. The selected techniques show whether that variable has undergone significant changes that could have been consequences of the entry into force of the integration agreements. Three alternative tests have been used: Zivot and Andrews (1992), Kim and Perron (2009), and Bai and Perron (1998, 2003). Different specifications were used for each of them. Table 1 shows the results of the three tests with the suggested break dates.

Table 1. Results of the time series analysis. Suggested break years

	Canadian productivity		Relative A
	level	difference	Level
ZA			
Intercept	1991		1984
Trend	1997		1994
both	1989		1994
KP			
Intercept	1996	1980	1992
Trend	2007	2006	1992
both	2007	2006	1992
BP			
1 break	1996	1990	1985
2 breaks	1984-1997	1990-1999	1982-2002
3 breaks	1983-1993-1998	1990-1999-2004	1980-1988-2002

Sources: Author's estimation. For more details, see main text.

Not all cases are statistically significant. Therefore, it can be concluded that we are witnessing a process of technological advance without any exogenous structural breaks. However, if we take into account all the specifications, we can observe that possible breaks accumulate in the first half of the 1990s. The years 1990 and 1992 have a higher frequency (See Figure 4).

Figure 4. Canadian total factor productivity. Suggested breaks years. 1961-2010
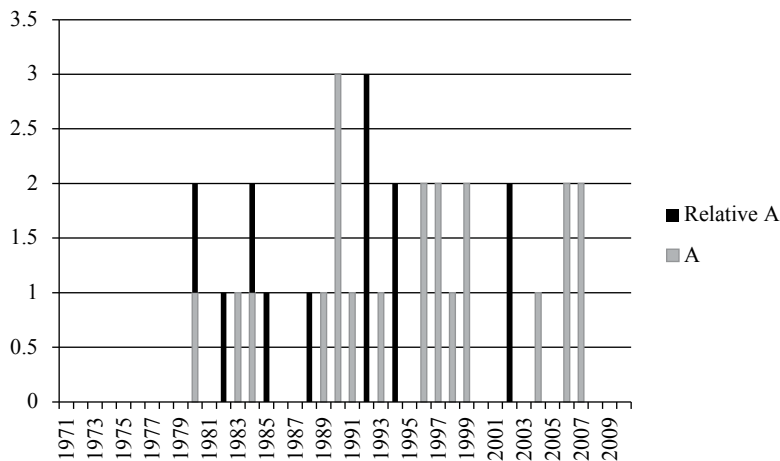
Sources: Author's estimation. For more details, see main text.

4. FINAL CONSIDERATIONS

There seems to be consensus that economic relations with the USA have had a significant impact on post-Confederation economic history. While the discussion on the net effect on Canadian development is still under debate, there is no doubt that Canada has one of the highest standards of living in the world, and productivity growth is essential for improvement. Hence the relevance of the study of the effects of integration on Canadian productivity arises naturally. After a synthesis of the integration process, I have described the evolution of the productivity performance and presented a development accounting exercise for the estimation and decomposition of the productivity gap between Canada and the USA.

There is evidence for a substantial change in productivity that is contemporaneous with CUFTA. However, this did not occur once but has took at least three years of adjustment of the production structure and technological capabilities. The effect on multifactor productivity appears to have been positive and allowed a temporarily reverse in the growing trend of a productivity gap with USA. However, the enactment of the NAFTA does not seem to have had the same effect as the earlier treaty. Finally, the intensification of the integration process does not seem to be the source of the increasing productivity gap between Canada and the USA.

Some questions arise. First, is it possible to use the Canadian development process as a benchmark for less developed Latin American countries? This article attempts to stimulate discussion in that regard. The topic is controversial, but the economic development of some Latin American economies could have several features in common with the Canadian case. For example, over the twentieth century and into this present

one, Uruguay and Paraguay have constituted economies with strong bonds with bigger economies, Brazil and Argentina.

Second, is it possible to take advantage of the support of a larger economy while avoiding "dependency syndrome"? Studies mention the leadership potential of Brazil in MERCOSUR, or Colombia in the Andean Community. Currently the USA has an important role in MCCA and CARICOM. Although the differences are obvious and inherent to the development processes, what is relevant is the similarity in the fact that there are pronounced asymmetries between the main trading partners. The comparative approach in the study of integration processes can shed light on that aspect.

ANNEX

Abbreviations

ALADI: Asociación Latinoamericana de Integración

ALALC: Asociación Latinoamericana de Libre Comercio

ALBA-TCP: Alianza Bolivariana para los Pueblos de Nuestra América - Tratado de Comercio de los Pueblos

ALCA/FTAA: Area de Libre Comercio de las Américas/Free Trade Area of the Americas

CARICOM: Caribbean Community

CUFTA: Canada-U.S. Free Trade Agreement

G3 FTA: Colombia, México and Venezuela Free Trade Agreement

MERCOSUR: Mercado Común del Sur

MCCA: Mercado Común Centroamericano

NAFTA: North American Free Trade Agreement

UNASUR: Unión de Naciones Suramericanas

Data and sources

Sources

Centre for the Study of Living Standards (CSLS), Aggregate income and productivity trends, Canada vs. United States Database, Tables 4, 5 and 7. www.csls.ca/data.asp (last access: 06/12/2013).

The World Bank (TWB), World DataBank, World Development Indicators http://databank.worldbank.org/data/views/variableSelection/selectvariables.aspx?source=world-development-indicators (last access: 06/12/2013)

Variables

For Canada: GDP at market prices (millions 2002 CAD$), Numbers of jobs (thousands) and Geom. End-year Net Capital Stock (million 2002 CAD$), Table 4. GDP PPP exchange rate USD$/CAD$, Table 7, CSLS. Population (total and ages 15-64), and Secondary education (pupils), TWB.

For USA: GDP at market prices (billions 2005 USD$), Numbers of jobs (millions) and Geom. End-year Net Capital Stock (Billions 2005 USD$), Table 5. Population (total and ages 15-64), and Secondary education (pupils), TWB.

Human Capital estimation methodology

I used Mankiw et al. (1992)'s methodology for the estimation of human capital intensity in steady state:

$$(8) \quad \frac{H}{Y} = \frac{I_H/Y}{n + g_{st} + \delta}$$

and the perpetual inventory method for computing the complete series. In (8) the numerator is the human capital investment rate proxied by the ratio between the secondary enrolment population and working- ge population (ages 15-64). For the steady state, I used the average for all periods. Parameters: average population growth rate for all periods, average human capital investment rate for all periods, and depreciation rate=0,0458.

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