

Economic Integration, the Business Cycle, and Productivity in North America

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Introduction

Important milestones have been reached this year in the history of bilateral economic relations between Canada and the United States. In particular, 2004 marks the 10th anniversary of the North American Free Trade Agreement (NAFTA) and the 15th anniversary of its precursor, the Canada-US Free Trade Agreement (CUSFTA). These agreements have been exceptionally successful in promoting trade and financial flows between the two countries over the years, yielding one of the world's largest bilateral trade and bilateral direct investment relationships (USTR 2003).

Some observers in Canada have recently called for deeper integration with the United States to eliminate remaining barriers to trade. The most ambitious proposals include calls for a "grand bargain," which would couple security and defence-related policies with deeper trade integration, possibly in the context of a customs union or common market (Dobson 2002). Similarly, some proposals have included calls for a monetary union with the United States (Courchene 2003). There have also been more modest and immediately practical proposals, involving suggestions for greater effort towards harmonizing rules, standards, and regulations, in order to reduce the extent to which these arrangements impede trade and efficiency (Goldfarb 2003).

However, other observers have questioned the merits of these proposals and have argued that further economic integration with the United States might not be in the best interests of Canada. In particular, they claim that increased

economic integration between the Canadian and US economies has not contributed to reducing Canada's dependence on natural resources and to narrowing the labour productivity gap between the two countries (Jackson 2003a, 2003b). Moreover, they argue that a customs union with the United States would imply giving up an independent trade policy, which might have an adverse impact on Canada's broader trade policy priorities.

To shed light on the debate about the future direction of economic integration, we analyze the impact of major Canada-US trade agreements on the dynamics of business cycles and productivity. In particular, we address the following questions: First, what has been the impact of the major trade agreements on trade and financial flows between the two countries? Second, what has been the effect of increased economic linkages on the co-movement of business cycles in Canada and the United States? Third, how has the economic integration affected the labour productivity gap between the two economies?

Canada and the United States have taken important steps to promote economic linkages during the past four decades. Section 1 reviews the key provisions of major trade agreements signed by Canada and the United States. The 1965 Canada-US Auto Pact freed cross-border trade in the sector, and led to a significant growth of the Canadian auto industry. In 1989, CUSFTA expanded the coverage of tariff-free trade to almost all sectors, and in 1994, NAFTA broadened the scope of the CUSFTA by including Mexico. The CUSFTA and NAFTA were groundbreaking, insofar as they covered a broad range of sectors, including services and investment, and introduced a unique dispute settlement mechanism.

Isolating the impact of these agreements on the economies of Canada and the United States is a difficult exercise, as various other major factors have affected these countries over the past two decades. Among these factors are the increases in global trade and finance flows during this period, and the different business cycles and economic policies that were implemented in the two countries. For example, after an unprecedented expansion in the 1990s, the US economy went into a recession in 2001 and remained sluggish until mid-2003. In contrast, Canada has enjoyed a prolonged expansionary period since the late 1990s, after the macroeconomic and structural adjustment earlier in the decade. To account for these factors and to provide for a comprehensive assessment of the effects of the trade agreements on Canadian business cycle and productivity dynamics, we document several stylized facts, employ a variety of econometric methods, and review the results of recent research.

In section 2, we examine the impact of the major agreements on trade and financial flows in Canada.¹ In particular, CUSFTA and NAFTA have been associated with substantial increases in trade and financial flows between the two countries. The inception of CUSFTA also affected the dynamics of national and regional trade flows. With exports to the United States rising much faster than imports, the contribution of net exports to the growth of Canadian gross domestic product (GDP) rose rapidly. In addition, after CUSFTA, the average share of international trade in provincial GDP increased much faster than that of interprovincial trade.

In section 3, we study the extent to which there has been an effect on the comovement of Canada-US business cycles. Increased trade and financial linkages led to significant changes in the dynamics of business cycles in Canada. Canada-US business cycles have become more synchronized, and the rapid growth of intra-industry trade has also contributed to greater cross-country correlations of investment and imports. We also use a dynamic latent factor model to examine the role of common, country-specific, and idiosyncratic factors in driving business cycles in Canada and the United States. The estimation results indicate that, although the common factor has played an increased role in explaining business cycles in Canada and the United States since the early 1980s, country-specific and idiosyncratic factors remain important in Canada.

In section 4, we analyze the impact of economic integration on the labour productivity gap between the two countries. The results indicate that the widening labour productivity gap between the two economies over the 1990s is mainly a reflection of the different evolution of the two countries' industrial structure. However, the negative impact from the different industry specialization between the two countries does not seem to be related to the increased trade integration of Canada and the United States over the 1990s. The increased economic integration with the United States has allowed Canadian firms to benefit from economies of scale and technology transfers, something that appears to have positively contributed to their productivity performance.

In the final section, we conclude with a brief summary of the results and policy implications. The results indicate that economic integration has been associated with a significant increase in business cycle synchronicity, and with convergence in total factor productivity. At the same time, however, the different industrial structure of the two economies implies that they remain subject to substantial country-specific shocks. Differences in industrial

1. Kose, Meredith, and Towe (2004) provide a detailed examination of the impact of NAFTA on the Mexican economy.

structure have also prevented convergence in aggregate labour productivity. Although these findings would seem to weigh against moving towards a monetary union, they also suggest that substantial benefits could be reaped from further reducing the remaining barriers to trade.

1 Trade Agreements Between Canada and the United States

An important step towards promoting Canada-US trade linkages was the 1965 Canada-US Auto Pact. Prior to the Auto Pact, tariffs on cross-border trade in automotive products were high—roughly 7 per cent in Canada and 17 per cent in the United States. The pact eliminated all tariffs faced by producers and led to significant growth in the Canadian auto industry—the industry became highly integrated with the US industry, and transportation equipment became Canada's largest export to the United States (Hummels, Rapoport, and Yi 1998).

The 1989 Canada-US Free Trade Agreement (CUSFTA) introduced free trade in almost all sectors. CUSFTA eliminated most tariffs and other trade barriers in its first ten years, with the average Canadian tariff on manufacturing imports from the United States falling from 3 per cent in 1989 to almost zero in 2001, and the average US tariff on imports from Canada falling from around 4.5 per cent to 0.5 per cent during the same period (Figures 1 and 2). The agreement gave considerable preferential tariff advantage to the other country, since tariffs on imports from third countries remained relatively higher. In addition, CUSFTA substantially reduced non-tariff barriers, provided ground rules covering trade in services and investment, and included various dispute settlement mechanisms (USITC 2003).

The 1994 North American Free Trade Agreement (NAFTA) represented a further milestone.² NAFTA created the world's largest free trade area in terms of total GDP, and it is the second largest, in terms of total trade volume, after the European Union. In 2002, total GDP of NAFTA members was more than 25 per cent larger than that of the European Union. Exports (imports) of the European Union constituted roughly 38 (35) per cent of world exports (imports), while exports (imports) of NAFTA accounted for about 18 (25) per cent (DFAIT 2003). In addition, NAFTA was the first

2. Negotiations for NAFTA formally started in June 1991. Since the member countries had held bilateral discussions earlier, negotiations moved forward quickly and were completed in August 1992. The United States and Mexico passed the NAFTA legislation in November 1993, and Canada did the same in December 1993. Finally, NAFTA entered into force on 1 January 1994.

Figure 1
United States: Average tariffs on imports from Canada and world

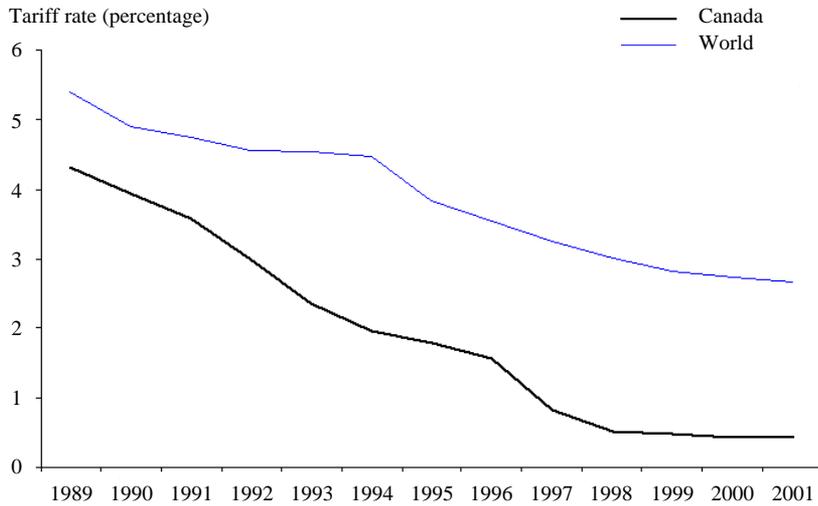
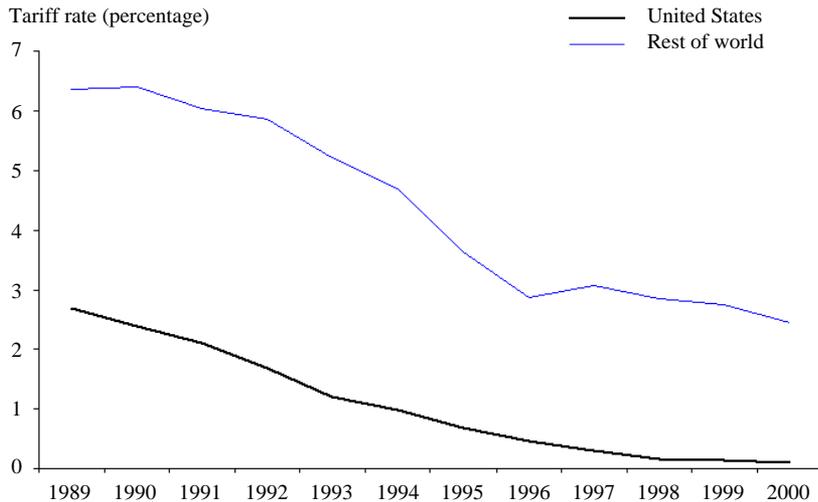


Figure 2
Canada: Average tariffs on manufacturing imports from the United States and rest of world



comprehensive free trade agreement between advanced countries and a developing economy (Mexico).

NAFTA expanded various provisions of CUSFTA and broadened the scope of the agreement by including Mexico.³ It eliminated the majority of tariffs and other trade barriers in its first ten years and will have phased out most remaining tariffs by 2008 (see Hufbauer and Schott 1992; USITC 2003). Moreover, building on the provisions of CUSFTA, NAFTA included various provisions covering investment flows, financial services, government purchases, and protection of intellectual property rights. For example, NAFTA removed many investment barriers and included clauses protecting the rights of direct investors. NAFTA's financial services provisions covered banking, insurance, and securities industries and provided the right of establishment in these industries, subject to some exceptions. Government procurement provisions of NAFTA eliminated "Buy National" restrictions on the majority of non-defence goods and services that were supplied by firms in North America to the federal and state/provincial governments of the member countries. NAFTA also established comprehensive standards for the protection and enforcement of intellectual property rights in the member countries.

In addition, NAFTA introduced unique mechanisms for settlement of disputes and included side agreements covering labour and environmental issues. In particular, NAFTA established processes dealing with various issues, including appeals of anti-dumping and countervailing duty determinations; resolution of investor-state disputes; and private commercial disputes.⁴ NAFTA included two important side agreements: the North American Agreement on Labor Cooperation, aimed at promoting enforcement of domestic labour laws; and the North American Agreement on Environmental Cooperation, established to ensure that trade liberalization and environmental goals were mutually supportive.

However, some sensitive sectors were still protected under NAFTA. For example, NAFTA set out separate agricultural market access requirements between Mexico and the United States, and between Mexico and Canada. When considered in combination with CUSFTA, these provisions established three separate bilateral agreements on agriculture. In addition, NAFTA included comprehensive rules of origin requirements, and products must generally be wholly produced in North America or originate in a

3. CUSFTA is still in force technically, but it has been effectively suspended after the introduction of NAFTA, which has included all the provisions of CUSFTA.

4. The agreement established a Free Trade Commission, which served as the central institution of NAFTA and comprised ministers or similar officials designated by each country.

member country to qualify for NAFTA preferences. Moreover, NAFTA contained safeguard clauses covering import surges from the member countries.

2 Dynamics of Trade and Financial Flows

2.1 Growth of trade flows

Trade flows between Canada and the United States increased significantly after the advent of CUSFTA. Canada's merchandise trade (the sum of exports and imports) to the United States more than doubled in US dollar terms over the period 1988–2002, and trade with the United States, on average, grew more than two times faster than GDP after the inception of CUSFTA (Figure 3a). During the same period, the share of exports to the United States rose from around 30 per cent of GDP to as high as 55 per cent (Figure 3b). By 2002, roughly 90 per cent of Canadian merchandise exports were directed to the United States, a 17 percentage point increase from 1988 (Figure 3c). By contrast, the share of Canadian imports from the United States remained roughly unchanged at around 65 per cent during the same period.

The product mix of Canada-US trade also shifted. Although transportation equipment, along with machinery and electronics, continued to represent a significant fraction of Canada's total trade with the United States, their importance decreased during the period 1989–92 (Table 1). Notably, the share of Canada's exports to the United States associated with primary sectors, including metals and minerals and wood and pulp, also declined somewhat, with sharp increases in apparel and textiles and special transactions (DFAIT 2003). These trends were accompanied by a significant increase in the share of Canada's exports from the agriculture and oil sectors, and to a lesser extent, the manufacturing and service sectors being directed to the United States (Figure 3d).⁵

The inception of CUSFTA also had important national and regional effects in Canada. With exports to the United States rising much faster than imports, the contribution of net exports to GDP growth jumped from about zero during the period 1973–88 to about 0.75 percentage points after the introduction of CUSFTA (Figure 4a). The growth in trade appeared to favour those regions—British Columbia, the Prairies, and the Atlantic region—which previously had relatively weak ties to the US market (Figure 4b). These regions saw a sharp jump in the share of their exports being

5. The information and communication technology (ICT)-producing sector is proxied by the industrial machinery and electrical and electronic product sectors.

Figure 3a
Trade with the United States
and GDP

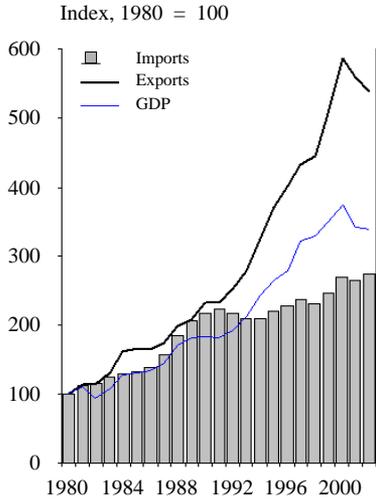


Figure 3b
Trade with the United States
as a share of GDP

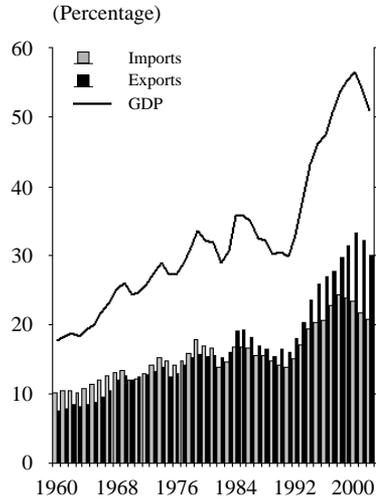


Figure 3c
Trade with the United States
as a share of total



Figure 3d
Canada: Sectoral exports to
the United States

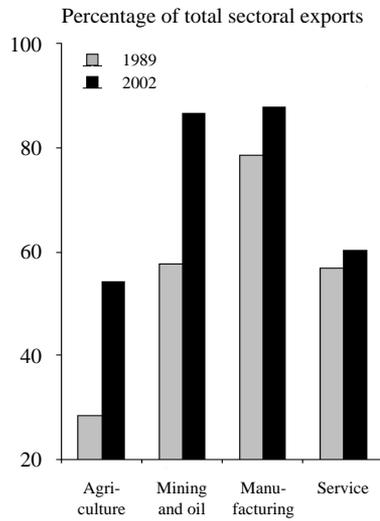


Figure 4a
Contributions to GDP growth

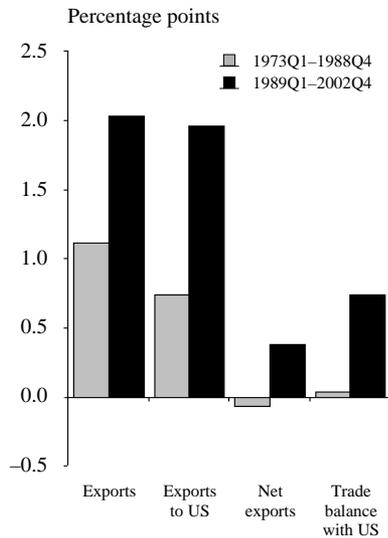


Figure 4b
Exports to the United States by region

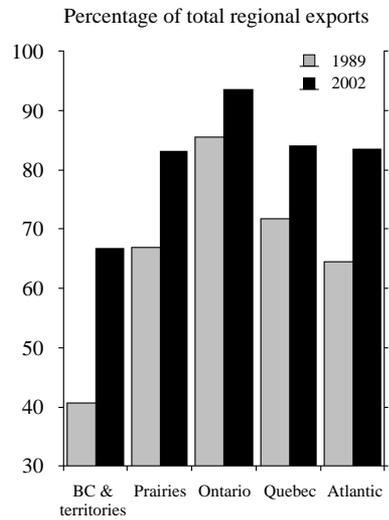


Figure 4c
Regional exports to the United States

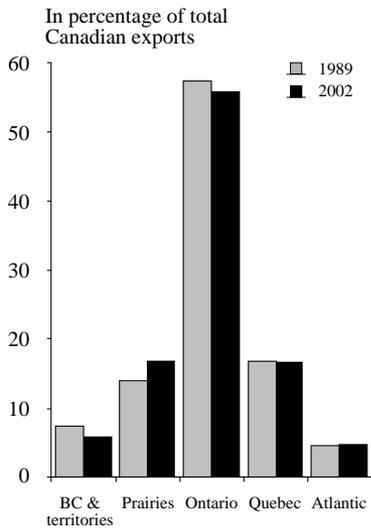


Figure 4d
Vertical specialization

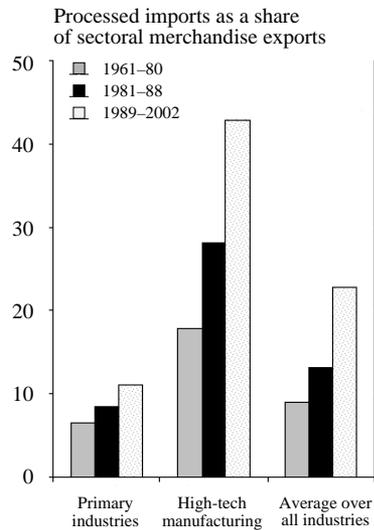


Table 1
Canada: Merchandise trade with the United States
 (Share of total exports and imports, percentage)

Exports	1989	2002	Change (1989–2002)
Transportation equipment	32.8	27.0	–5.8
Machinery and electronics	14.6	13.7	–0.9
Metals and minerals	21.3	21.7	0.4
Wood and pulp	15.0	10.5	–4.5
All others	16.4	27.1	10.7
Imports			
Transportation equipment	28.1	25.6	–2.5
Machinery and electronics	33.6	30.6	–3.0
Metals and minerals	11.3	10.9	–0.4
Chemicals and plastic and rubber	10.0	14.8	4.8
All others	17.0	18.2	1.2

Source: DFAIT (2003).

directed to the United States, narrowing the gap with Ontario and Quebec, which had already enjoyed strong trade links to the United States (Figure 4c).

The importance of geographical change in Canadian trade patterns from the traditional east-west trading axis to the international north-south trading one is also emphasized by recent research. In particular, the average share of international trade in provincial GDP increased much faster than that of interprovincial trade after the inception of CUSFTA, and rose from 42 per cent in 1991 to 75 per cent in 2000 (Courchene 2003). For Quebec and Ontario especially, the relative importance of international trade rose tremendously during the 1990s as the United States market became increasingly more important. In particular, Ontario's exports to the United States rose from 25 per cent of its GDP in 1989 to almost 50 per cent in 2001.

A number of recent studies examine the changes in the dynamics of regional trade flows using various gravity models. For example, Wall (2003) studies bilateral trade flows among the NAFTA members using a gravity model. He concludes that NAFTA resulted in a large increase in the trade volume between Central Canada (Ontario and Quebec) and the United States during the 1993–97 period. However, his results also suggest that NAFTA led to a decrease in the amount of trade between Eastern Canada (New Brunswick, Newfoundland, Nova Scotia, and Prince Edward Island), while its impact on the trade flows from Western Canada (Alberta, British Columbia, Manitoba, and Saskatchewan) to the United States was relatively minor. Gu and Sawchuk (2001) study the changes in regional trade flows between Canada

and the United States over the period 1990–98, employing a gravity model that accounts for the effects associated with market size and distance. They document that regional trade flows with the United States rose by 6.7 per cent per year for Ontario, 5.3 per cent for Quebec, 5 per cent for the Prairies, and 4.7 per cent for Atlantic Canada during this period.

Recent research also confirms the significant impact of CUSFTA on Canada-US trade flows. Clausing (2001) analyzes the effect of CUSFTA on commodity-level tariff rates and concludes that more than half of the increase in Canada's exports to the United States during 1989–94 was due to the agreement. Romalis (2002) examines the impact of tariff preference associated with CUSFTA and NAFTA on the trade flows between the member countries and confirms that CUSFTA has had a large impact on Canada's trade share with the United States. Wall (2003) uses a gravity framework and finds that NAFTA accounts for roughly 50 per cent of the increase in the exports of Canada to the United States and approximately 25 per cent of the increase in Canadian imports from the United States. Clausing (2001) concludes that the agreement did not result in any sizable trade diversion, i.e., the expansion of trade was not at the expense of other countries, while Romalis and Wall argue that the agreements induced trade diversion. Schwanen (1997) compares trade in sectors that were liberalized after CUSFTA and NAFTA with others and concludes that exports of Canada to the United States in these sectors rose by 139 per cent and by only 64 per cent in other sectors. Trefler (2001) and Head and Reis (2003) find that CUSFTA appeared to have a positive impact on trade flows. Krueger (1999, 2000) also documents a substantial increase in trade flows between Canada and the United States after NAFTA.

2.2 Changes in the nature of trade

Canada's trade appears to have become more geared towards manufactured goods as a result of the boom in Canada-US trade linkages. The share of manufactures in total exports rose from less than 33 per cent in 1960 to roughly 63 per cent in 2001, with a correspondingly less prominent role played by agriculture and fuels (Table 2). The share of manufacturing imports also increased from less than 70 per cent in 1960 to roughly 83 per cent in 2001. Moreover, over the second half of the 1990s, Canada's tradable sector seems to have evolved rapidly in the direction of high-tech-producing sectors. In particular, while it remains lower than in the United States, Canada's ICT-producing sector has increased its share of aggregate GDP over this period (Table 3).

Recent research analyzes changes in the dynamics of sectoral trade flows between the two countries. For example, Gu and Sawchuk (2001) study the

Table 2
Canada: Composition of trade
 (Share of total exports and imports, percentage)

	Exports			Imports		
	1960	1980	2001	1960	1980	2001
Manufactures	32.5	48.1	62.4	69.0	71.7	82.9
Agriculture and food	36.5	23.4	13.0	16.2	9.6	7.0
Fuel and ores	30.4	28.1	18.5	12.3	17.2	7.9

Source: World Bank, *World Development Indicators*.

Table 3
Canada and the United States: Value-added, shares of total
 (Percentage)

	Canada		United States	
	1981–95	1995–2000	1981–95	1995–2000
Agriculture	3.2	2.5	2.3	1.8
Mining	6.9	5.6	2.5	1.5
Construction	8.5	6.9	5.3	5.3
Manufacturing	24.0	25.1	22.4	19.5
<i>of which</i>				
Industrial machineries and electrical and electronic equipment	2.7	2.9	5.0	4.4
Transportation	5.5	5.2	4.0	3.8
Communications	3.9	3.7	3.1	3.1
Utilities	4.5	4.5	3.2	2.6
Trade	14.7	14.3	16.4	16.0
FIRE	12.8	14.3	19.0	21.1
Other services	15.9	18.0	21.9	25.3

Note: FIRE = finance, insurance, and real estate.

Source: International Monetary Fund staff estimates.

contributions of various sectors to the increase in trade flows between Canada and the United States. They find that the two high-tech industries, i.e., electronic equipment and industrial machinery, along with the motor vehicle industry, accounted for half of the increase in Canada's trade flows with the United States during the period 1990–98. Their results also indicate that the rapid growth of the two high-tech industries explained more than 50 per cent of the increase, while the rest was attributable to the increased trade intensity in these industries. In addition, Gu and Sawchuk report that although the contribution of the resource and resource-based industries was

relatively small compared with the growth of trade flows between the two countries, these industries still accounted for roughly 20 per cent of the increase in aggregate trade flows.⁶

Trade liberalization has also spurred cross-border vertical integration. For example, the share of Canada's exports based on vertical trade—i.e., the share of export value that is due to the processing of imports at an earlier stage of production—rose by twofold since the inception of CUSFTA (Figure 4d). Dion (1999–2000) finds that there has been a dramatic increase in vertical specialization across manufacturing industries, especially since the late 1980s (which coincides with the inception of CUSFTA). Hummels, Rapoport, and Yi (1998) conclude that the 1965 US-Canada Auto Pact led to a substantial increase in vertical trade in the auto industry.

Intra-industry trade between Canada and the United States has also risen over time. Intra-industry trade plays a major role in Canada's trade with the United States, since it accounts for most of the trade in almost all industries.⁷ After the inception of CUSFTA, the importance of intra-industry trade between the two countries rose in several industries, including metal products, machinery, and motor vehicles. For example, the share of intra-industry trade rose from 62 per cent in 1990 to 67 per cent in 1998 in machinery industry (Sawchuk and Sydor 2003). Recent research is unable to establish a clear link between CUSFTA/NAFTA and the increase in intra-industry trade between the two countries during the 1990s (Trefler 2001; Acharya, Sharma, and Rao 2003).

2.3 Growth of financial flows

Trade liberalization has been associated with a significant increase in foreign direct investment (FDI) flows between Canada and the United States. Gross FDI flows increased by more than sevenfold between 1989 and 2002, with similar increases in both directions (Figure 5a). The bulk of the FDI inflows to Canada came from the United States as the average share of inflows from the United States accounted for 68 per cent of total inflows over the period 1989–2002. A tremendous increase in FDI flows occurred after the inception of NAFTA, associated with a small number of mega-

6. These industries include all primary industries and food, beverages, tobacco, leather, wood, paper and allied products, primary metal, non-metallic minerals, and refined petroleum.

7. Schreyer (2001) documents that the extent of manufacturing intra-industry trade of Canada has been high and relatively stable over time. Manufacturing intra-industry trade as a fraction of total manufacturing trade rose from 73.5 per cent over the period 1988–91 to 76.2 per cent during 1996–2000.

Figure 5a
Canada-US FDI flows

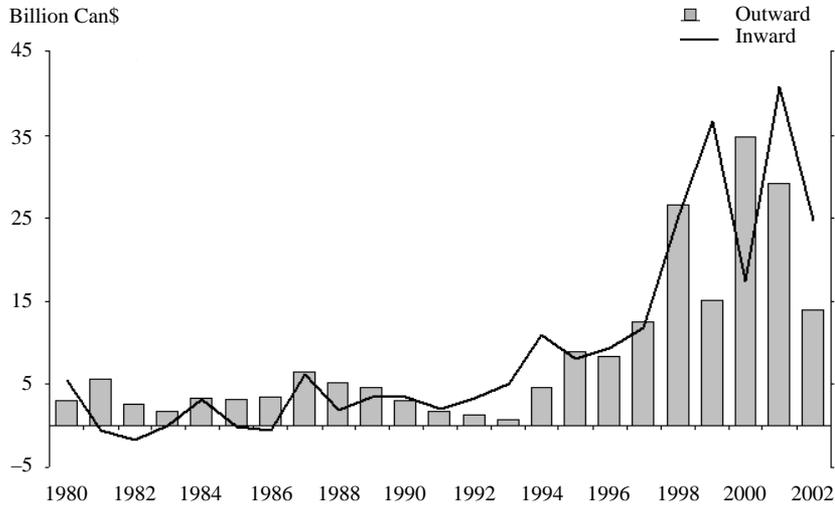
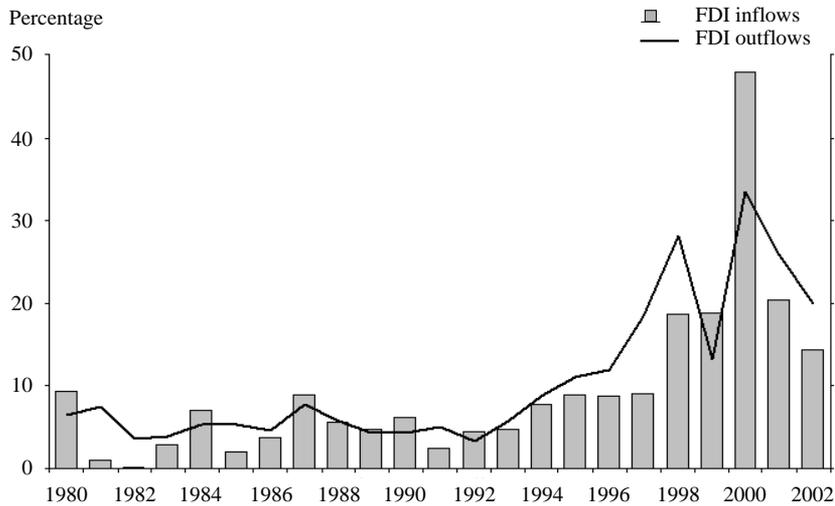


Figure 5b
Canada: FDI flows as a fraction of domestic investment



mergers (DFAIT 2003).⁸ As a result, the average share of FDI inflows in Canada's domestic gross fixed capital formation (investment) rose from 6 per cent in the 1986–88 period to 26 per cent over the 2000–02 period (Figure 5b). However, recent research is unable to show that CUSFTA/NAFTA has had any discernible impact on FDI flows between the two countries (Schwanen 1997; Globerman and Shapiro 2003).

3 Economic Integration and the Dynamics of Business Cycles

3.1 A brief survey of the literature

In theory, increased trade linkages have ambiguous effects on the co-movement of business cycles. Stronger trade linkages can result in more highly correlated business cycles by increasing demand- and supply-side spillovers. Increased intra-industry specialization across countries can also increase cyclical co-movement, if industry-specific shocks are important in driving business cycles. However, the degree of co-movement might fall if inter-industry (rather than intra-industry) trade linkages are spurred and industry-specific shocks are important in driving business cycles (Kose and Yi 2001).

The effect of financial flows on business cycle correlations also depends on the nature of shocks and specialization patterns. For example, stronger financial linkages could generate higher cross-country synchronization of output by allowing easier spillovers of demand-side shocks. However, financial linkages could help facilitate investment and specialization of production, thereby increasing countries' exposure to industry- or country-specific shocks. This could lead to a decrease in the degree of output correlations, while inducing stronger co-movement of consumption across countries (Kalemli-Ozcan, Sørensen, and Yosha 2003).

These competing factors complicate evaluations of the impact of trade agreements on Canada-US business cycles. The increase in vertical specialization and intra-industry trade between Canada and the United States would typically be expected to strengthen business cycle linkages over time. However, inter-industry trade and differences in industrial structure are still considerable, implying that sector-specific shocks could lead to divergence of cycles. For example, the fact that Canada experienced a shallower downturn and a relatively stronger recovery from the 2000

8. Although there was a significant increase in the volume of FDI flows from the United States to Canada in the period 1989–2002, the US share of Canadian FDI stock remained quite stable at around 65 per cent.

recession than the United States has often been ascribed to Canada's smaller ICT sector, as well as to the effects of a relatively depreciated exchange rate and the improvement in global commodity prices.

Recent empirical studies are inconclusive regarding the extent to which business cycles in the two countries have become more synchronized. Some of these studies argue that there has been an increase in the extent of synchronization of business cycles in Canada and the United States. For example, Kose, Prasad, and Terrones (2004) study cross-country correlations of business cycle fluctuations in several macroeconomic aggregates of the G-7 countries over the three different periods: the Bretton Woods (BW) period of fixed exchange rates (1960Q1–1972Q4); the common-shocks period, during which the world economy was buffeted by severe shocks to oil prices and subsequent disinflation (1973Q1–1986Q2); and the globalization period (1986Q3–2002Q4), which coincided with dramatic increases in the volume of international trade and financial flows. They report that correlations of output and consumption fluctuations in Canada and the United States were higher in the globalization period than in the BW period. Kose, Otrok, and Whiteman (2003) and Stock and Watson (2003) find that the importance of global factors in explaining business cycles in both countries has risen since the 1980s and conclude that business cycle linkages between Canada and the United States have become stronger.

Others conclude that there has been no major change in the degree of synchronization of business cycles in the two countries. Doyle and Faust (2003) show that there has been no statistically significant change in the correlations of the growth rates of GDP of Canada and the United States since the 1960s, with similar results reported by Helbling and Bayoumi (2003). Heathcote and Perri (2003) show that the US business cycle has become less correlated with the aggregate cycle of Europe, Canada, and Japan since the 1960s.

3.2 How did the free trade agreements change the business cycle in Canada?

Inspection of simple correlations suggests an increase in the co-movement of business cycles in Canada and the United States. For example, an increase is clearly evident in the 20-year rolling correlations in cyclical deviations of Canada's output, consumption, and investment and cyclical deviations in the United States, with a particularly sharp increase in the case of investment and imports after the inception of CUSFTA (Figures 6 and 7). At the same time, the Canadian and US business cycles have become less correlated with cycles in other G-3 countries (Germany and Japan).

Figure 6
Canada and the United States: Co-movement of economic variables

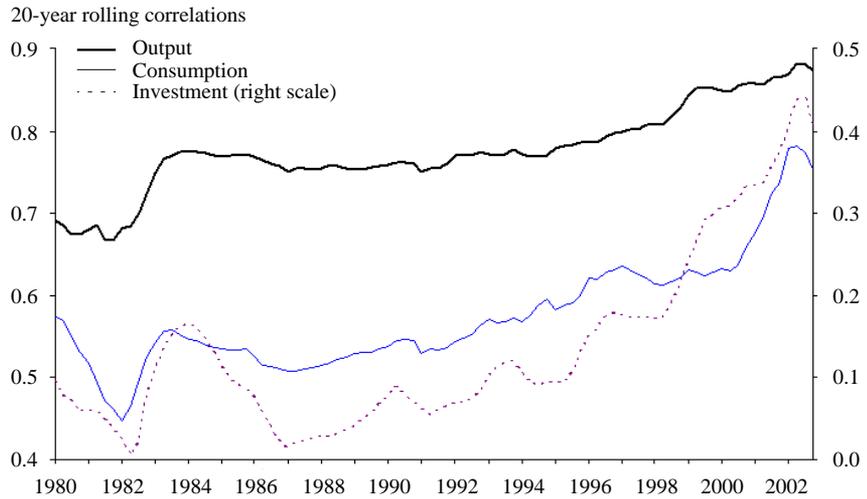
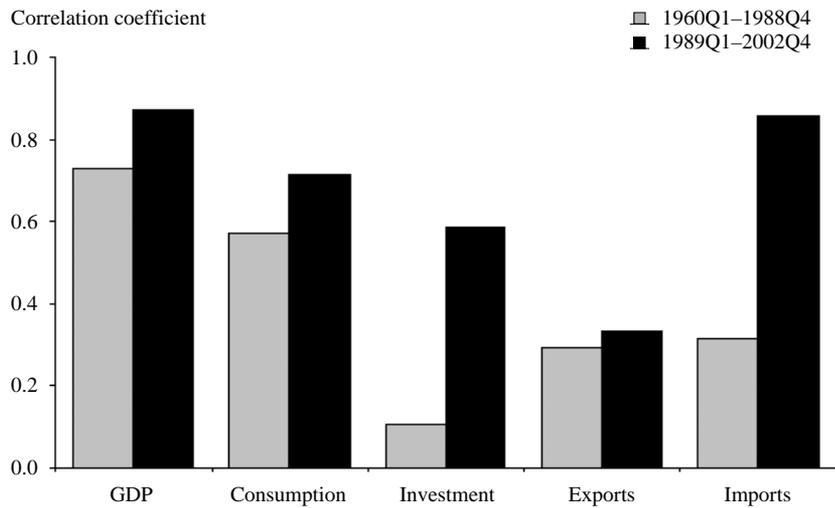


Figure 7
Canada and the United States: Co-movement of economic variables



While they are useful in describing some general patterns, simple correlations do not allow conclusive statements about the changes in the degree of business cycle co-movement. First, cross-country correlations capture only the contemporaneous co-movement in macroeconomic variables, and do not account for common fluctuations associated with “leads” and “lags.” Second, correlations can account for the degree of co-movement in only a single macroeconomic variable. Moreover, correlations are not helpful to analyze the relative importance of different types of factors and/or shocks in explaining business cycle co-movement.

A dynamic latent factor model is estimated to further analyze the sources of the apparent increase in convergence of business cycles in Canada and the United States. The model (employed in Kose, Otrok, and Whiteman 2003) allows estimation of the extent to which common or country-specific factors explain the changes in the co-movement, and also helps take into account potentially important contemporaneous, as well as temporal, covariation among different macroeconomic variables.

The model focuses on the dynamic co-movement of output, consumption, and investment across Canada and the G-3 countries. It decomposes macroeconomic fluctuations into (i) a “common” factor that is common across all variables/countries; (ii) “country-specific” factors, which are common across the main aggregates within a country; and (iii) “idiosyncratic” factors, which are specific to total output, consumption, and investment (idiosyncratic errors). In particular, there are three types of factors in the model: the common factor (f^{common}), four country-specific factors ($f_i^{country}$, one per country), and 12 factors specific to each variable ($\varepsilon_{i,t}$, the “unexplained” idiosyncratic errors). Observable variables are denoted by $y_{i,t}$, for $i = 1, \dots, 12$, and $t = 1960Q1-2002Q4$. Thus, for observable i :

$$y_{it} = a_i + b_i^{common} f_t^{common} + b_i^{country} f_{n,t}^{country} + \varepsilon_{i,t}$$

$$E\varepsilon_{i,t}\varepsilon_{j,t-s} = 0 \quad \text{for } i \neq j, \quad (1)$$

where n denotes the country number. Output, consumption, and investment data for each of four countries are used as observables, so there are 12 time series to be “explained” by the five factors and 12 “regression” equations to be estimated.

The estimated factors capture some of the major economic events since 1960. In particular, casual observation suggests that the common factor has been an important force behind most of the major business cycle episodes of the past 40 years. In particular, the behaviour of the common factor is consistent with the steady expansionary period of the 1960s; the boom of the

early 1970s; the recessions of the mid-1970s, the early 1980s, and the 1990s; the expansionary period of the late 1980s; and the global downturn of 2001–02 (Figure 8a). At the same time, the Canada-specific country factor was also important in explaining some of Canada's major cyclical episodes, including the recessions of 1982 and 1991, the economic slowdown in 2001, and the booms of the 1960s and the second half of the 1990s (Figure 8b). The estimated US country factor captures some of the National Bureau of Economic Research reference cycle dates including the recessions of 1970, 1975, 1980, and 1982, and the booms of 1973, 1980, and 1981 (Figure 8c). Both the common and US country factors capture the highly synchronized and severe downturn in 2000.

The importance of the common factor in driving business cycles is analyzed using variance decompositions. To measure the relative contributions of the common, country, and idiosyncratic factors to variations in aggregate variables in each country, the variance of each macroeconomic aggregate is decomposed into the fraction that is due to each of the two factors and the idiosyncratic component in three different time periods. Specifically, the fraction of variance of each macroeconomic aggregate explained by the following factors is computed: (i) a common factor that is common across all variables/countries; (ii) country-specific factors, which are common across the main aggregates within a country; and (iii) factors specific to each variable.

During the period 1960Q1–2002Q4, all three factors have played major roles in accounting for business cycle fluctuations in Canada. Indeed, while the common factor has been important, it explains only about 10 per cent of Canada's output volatility, with the country and idiosyncratic factors explaining the bulk of the volatility for the period 1960Q1–2002Q4 (Figure 9a). By contrast, the common factor is relatively more important in Germany and Japan, explaining more than 25 per cent of output volatility in Japan.

However, the common factor has played an increased role in explaining business cycles in Canada and the United States since the early 1980s. Comparing estimates of the model calculated over two separate sub-periods—1960Q1–1981Q2 and 1981Q3–2002Q4—shows that the share of Canada's output variance explained by the common factor roughly tripled in the later period (Figure 9b). Moreover, the share of investment due to the common factor rose by fourfold during the second period, and the role of the common factor in explaining consumption variance increased from less than 5 per cent to roughly 40 per cent (Figures 9c and 9d). Although the importance of the common factor also increased for the United States, the increase was smaller than that for Canada.

Figure 8a
World factor

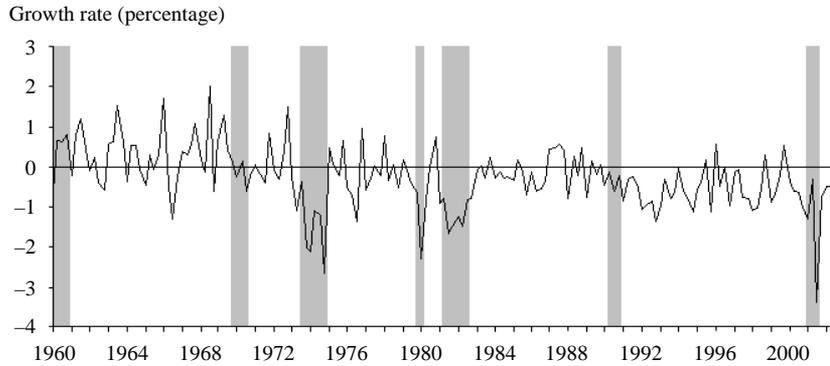


Figure 8b
Canada: Country factor and GDP

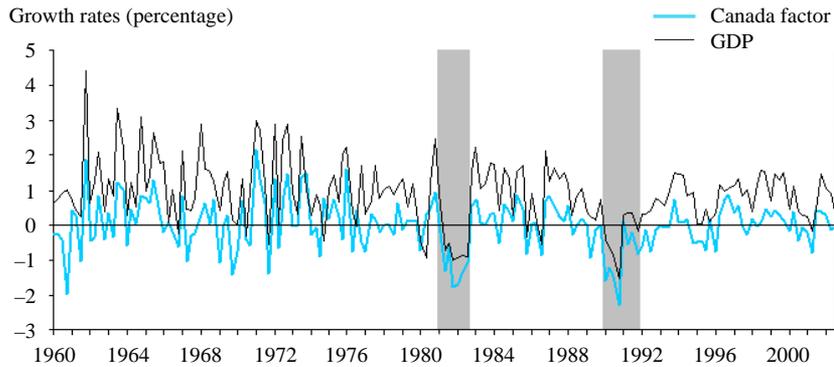


Figure 8c
United States: Country factor and GDP

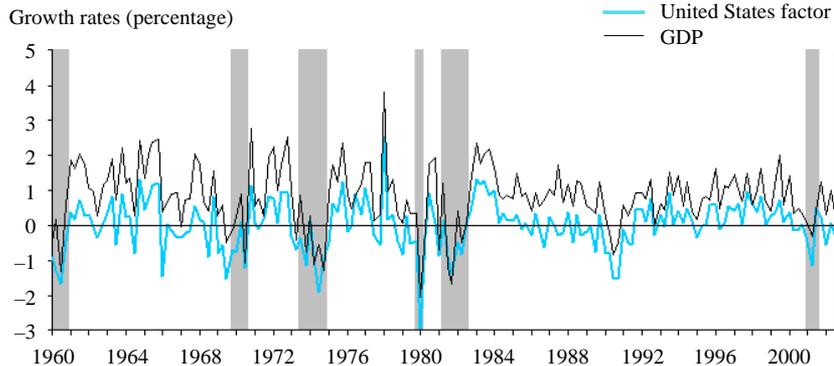


Figure 9a
Variance of output explained
by each factor (1960Q1–2002Q4)
 Fraction of variance (percentage)

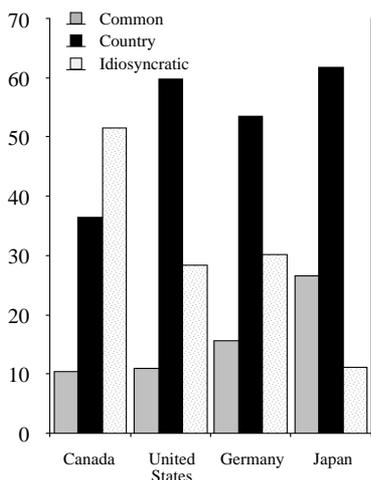


Figure 9b
Variance of output explained
by the common factor
 Fraction of variance (percentage)

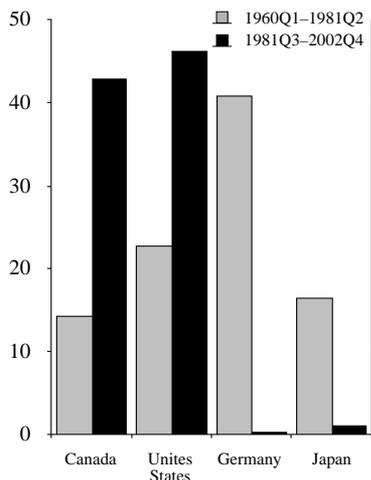


Figure 9c
Variance of consumption explained
by the common factor
 Fraction of variance (percentage)

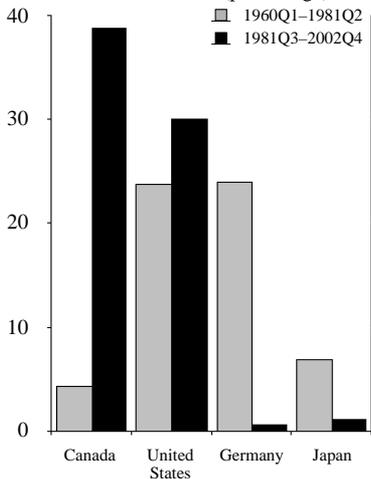
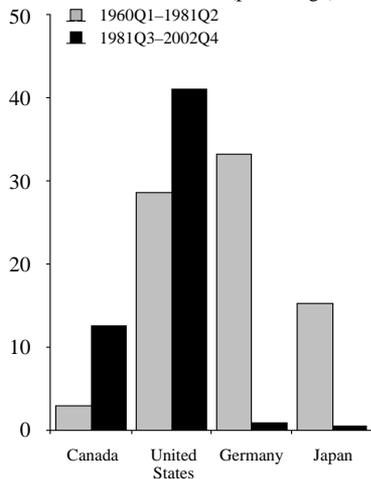


Figure 9d
Variance of investment explained
by the common factor
 Fraction of variance (percentage)



Nonetheless, country-specific and idiosyncratic factors remain important in Canada. The country-specific factor still accounted for more than 10 per cent of volatility of each variable in the second period, and the majority of business cycle variation is still attributed to the idiosyncratic factor (Table 4). The country-specific and idiosyncratic factors also explained over 50 per cent of business cycle variation in the United States.

By contrast, the common factor became less important in explaining output volatility in Germany and Japan during the period 1981Q3–2002Q4. This likely reflects the relative importance of domestic forces that have swamped the importance of increased trade and financial linkages during the past two decades. The Japanese economy has been struggling with a variety of structural problems as it has suffered from a sharp fall in asset prices and a severe banking crisis since the early 1990s. The German economy has been affected by the aftershocks of unification during the same period. In addition, the share of trade with these two countries has decreased in both Canada and the United States during the 1990s.

The important role played by country-specific and idiosyncratic factors in explaining Canadian business cycles suggests that there are significant benefits associated with exchange rate flexibility. This result is consistent with the findings in some recent studies. For example, Murray, Schembri, and St-Amant (2003) document that Canada and the United States are subjected to asymmetric shocks and a flexible exchange rate regime plays a critical role in insulating the Canadian economy from the adverse impact of such shocks. Carr and Floyd (2002) also find that asymmetric real shocks account for a substantial fraction of exchange rate variation in Canada, suggesting that there are benefits from having a flexible regime. Arora and Jeanne (2001) argue that exchange rate flexibility has not slowed the pace of Canada-US economic integration and has been useful in isolating the Canadian economy from asymmetric external shocks.⁹

There have also been important changes in the dynamics of volatility of business cycles in Canada after the inception of CUSFTA. For example, the volatility of business cycle fluctuations in Canada has become less volatile during the 1990s (Figure 10). Debs (2001) finds that there was a structural break in the volatility of Canadian real GDP growth in the first quarter of 1991. The standard deviation of US real GDP growth has also declined significantly since the mid-1980s, and this has been the case for the rest of the G-7, except for Japan, where output volatility has increased in the past

9. Murray (2000) and Bayoumi and Eichengreen (1994) also conclude that the flexible exchange rate regime is beneficial to Canada. Lafrance and St-Amant (1999) provide a review of recent studies about optimal currency areas.

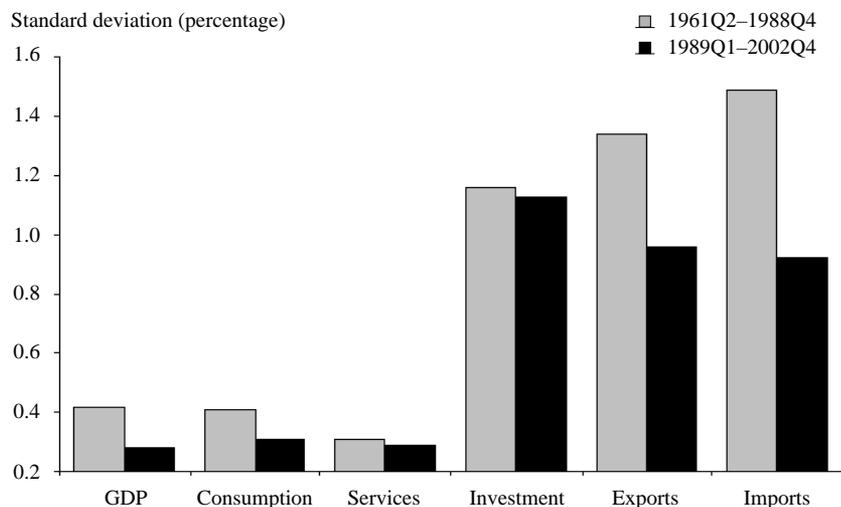
Table 4
Variance decompositions
 (Percentage)

Factors/ Periods	Output			Consumption			Investment		
	33%	median	66%	33%	median	66%	33%	median	66%
Canada									
1960Q1–1981Q2									
Common	10.98	14.29	17.93	2.70	4.28	6.25	1.58	2.83	4.49
Country	13.64	17.96	22.49	15.06	19.65	24.56	16.95	22.13	28.01
Idiosyncratic	61.60	65.95	70.36	70.68	75.06	79.19	68.56	73.88	79.32
1981Q3–2002Q4									
Common	36.94	42.92	48.11	33.36	38.78	43.38	9.36	12.59	15.88
Country	6.34	10.60	15.39	8.13	13.08	18.91	5.04	10.30	15.92
Idiosyncratic	41.67	45.26	49.32	43.28	46.98	50.69	70.75	75.97	79.91
United States									
1960Q1–1981Q2									
Common	18.54	22.65	27.37	19.78	23.72	28.36	24.55	28.60	32.76
Country	40.46	46.17	51.30	23.66	28.56	33.09	37.90	42.41	46.83
Idiosyncratic	28.15	30.55	33.17	44.70	47.25	49.49	25.91	28.59	31.51
1981Q3–2002Q4									
Common	40.18	46.18	51.48	25.80	29.97	33.64	35.83	41.07	46.44
Country	4.81	9.65	14.99	4.03	7.87	12.22	8.50	15.15	22.24
Idiosyncratic	39.69	42.88	46.00	58.32	61.09	63.84	38.13	42.39	46.90

Note: 33 per cent and 66 per cent refer to the confidence intervals of the median.

Source: International Monetary Fund staff calculations.

Figure 10
Canada: Volatility of business cycles



decade. Explanations for the increased stability of Canadian and US output have centred on the increasing importance of the “new economy,” the declining importance of industrial versus service sector activity, the employment of improved inventory management techniques, and increased effectiveness of monetary policy (Debs 2001; Blanchard and Simon 2001).

4 Economic Integration and Productivity

4.1 A brief survey of the literature

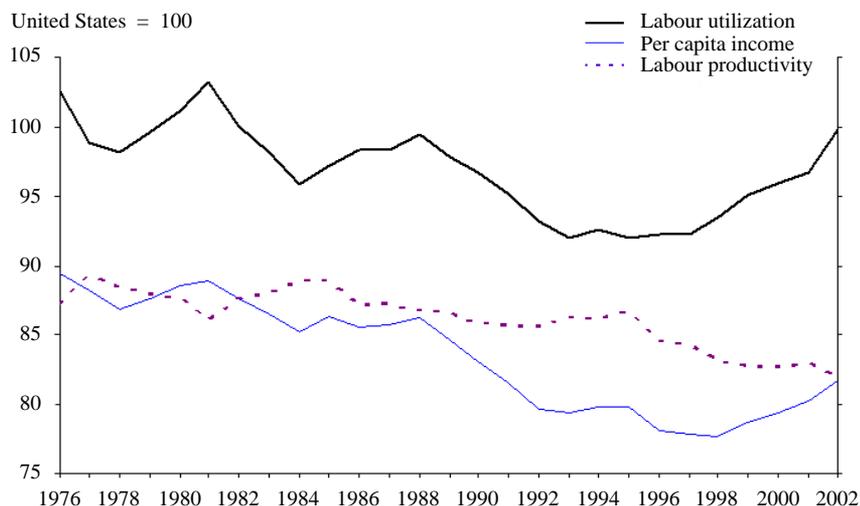
Despite the close integration between the Canadian and US economies, the labour productivity gap between the two countries has widened over the past two decades (Figure 11). While a greater use of labour resources has allowed Canada to narrow the gap with the United States in terms of per capita income from the mid-1990s, convergence has been held back by the more modest pace of Canadian labour productivity growth.

A copious number of studies have sought to analyze the factors behind the productivity gap between Canada and the United States (see Crawford 2002 and Macklem 2003). Among the explanations offered are the following:

- Different size of the ICT-producing sector: Some studies have attributed most of the post-1995 acceleration of labour productivity in the United States to the exceptional total factor productivity (TFP) performance of the ICT-producing sector (e.g., Gordon 2003 and Harchaoui and Tarkhani 2002). Given its smaller ICT-producing sector, these studies suggest that Canada is at a relative disadvantage in reaping the benefit of the ICT productivity wave. For example, Harchaoui and Tarkhani show that the size of Canada’s ICT-producing sector increased from around 2 per cent of GDP in 1981 to around 4 per cent of GDP on average over the second half of the 1990s, but remained below the US share, which was around 6 per cent of GDP over this period.
- Different contribution from ICT capital accumulation: The widespread adoption of ICT capital assets has been regarded as a key factor behind the strong labour productivity growth in the United States.¹⁰ Harchaoui and Tarkhani (2002) show that Canada’s business sector also experienced solid growth in ICT capital services over the 1981–2000 period, at levels comparable to if not higher than the United States

10. See, for example, Oliner and Sichel (2002) and Jorgenson, Ho, and Stiroh (2005).

Figure 11
United States and Canada: Income and productivity indicators



(Table 5).¹¹ Nonetheless, the contribution from ICT capital deepening to labour productivity growth is generally estimated to be lower in Canada than in the United States, mainly reflecting the lower estimated marginal productivity of ICT capital and the lower ICT capital intensity in Canada.¹²

- Differences in the share and productivity performance of small and medium-size enterprises (SMEs): In the Canadian manufacturing sector, SMEs (i.e., firms with less than 500 employees) accounted for 75 per cent of total manufacturing employment, compared to around 60 per cent in the United States in 1997. Not only has the weight of SMEs in the Canadian economy increased over the past two decades, but some studies have found these firms to be less productive relative to their US

11. The faster growth in ICT capital services in Canada might be partly explained by differences in the capital-asset depreciation rates used by Statistics Canada and the Bureau of Labor Statistics. In particular, Statistics Canada uses higher depreciation rates for ICT assets, something that might lead to a faster growth of their capital services (see Ho, Rao, and Tang, 2003).

12. See Khan and Santos (2002); Harchaoui and Tarkhani (2002); Armstrong et al. (2002); and Ho, Rao, and Tang (2003). Both Armstrong et al. and Harchaoui and Tarkhani find that ICT capital deepening has contributed around 1/4 per cent to the average annual labour productivity growth in Canada over the 1995–2000 period, up only slightly compared to the 1981–2000 period. The equivalent figure for the United States is estimated between 1/2 per cent (Oliner and Sichel 2002) and 2/3 per cent (Jorgenson, Ho, and Stiroh 2005).

Table 5
Canada and the United States: ICT capital accumulation
 (Percentage)

	1981–95		1995–2001	
	Canada	United States	Canada	United States
Investment (average rate of growth) ^a				
Computers	25.8	28.0	39.8	39.3
Software	19.2	16.6	10.2	19.8
Communications	4.5	4.8	17.9	12.2
Capital services (average rate of growth) ^b				
All assets	3.0	3.4	4.3	5.4
ICT	16.9	14.9	18.4	21.3
Computers	27.1	23.9	32.9	41.8
Software	14.5	15.0	7.2	16.4
Communications	7.4	6.3	12.2	8.5
ICT share of capital income ^b	6.3	10.9	8.3	15.3
ICT share of capital stock ^c	3.9	7.0	6.4	11.7

a. Source: Haver Analytics.

b. Source: Harchaoui and Tarkhani (2002).

c. Sources: Armstrong et al. (2002) for Canada and the Bureau of Economic Analysis for the United States.

Note: Values are for 1981 and 2000.

counterparts. For example, Baldwin and Tang (2003) show that around 0.25 percentage point of the labour productivity gap in the manufacturing sector in 1997 was due to the larger share of SMEs in Canada compared to the United States, and 0.5 percentage point to the lower productivity of SMEs in Canada.

- Differences in the share and income of self-employed: The difference in labour-productivity growth between Canada and the United States in the 1990s has also been attributed to the faster growth of self-employment in Canada and the poorer income performance of this group compared with the United States (Baldwin and Chowhan 2003).

Less relevant factors include:

- Differences in national accounts statistics: While differences remain, the methodology used by national statistical agencies to measure labour and TFP has been converging. In particular, both the US Bureau of Labor Statistics and Statistics Canada now use hedonic prices and include purchase of computer software in the national account measures of investment.
- Differences in the regulatory burden in labour and product markets: Gust and Marquez (2004) find that countries with a more burdensome regulatory framework tend to have lower TFP growth. However,

notwithstanding the difficulties in building comparable indexes of regulatory burden across countries, empirical evidence does not reveal a large difference between Canada and the United States in terms of labour and product market legislation and institutions.¹³

The role of trade linkages and of different industrial structures in driving the labour productivity gap is explored in this section by conducting level and growth accounting at a sectoral level. Using industry data allows assessing: i) whether the lack of aggregate convergence is masking significant variation in sectoral productivity dynamics; and ii) the extent to which the productivity differences between the two countries reflect differences in their industrial structure and/or in the performance of specific industries.

4.2 Sectoral growth accounting

The analysis below uses a traditional growth accounting framework. This approach attributes labour productivity growth (value added per hours worked, y_t) to the contribution of three factors: the improvement in labour quality (H_t), weighted by the labour income share of value added (β_t); capital deepening (proxied by the flow of capital services per hours worked, k_t), weighted by the capital income share of value added (α_t); and TFP (denoted by A_t):¹⁴

$$\dot{y}_t = \alpha_t \dot{k}_t + \beta_t \dot{H}_t + \dot{A}_t. \quad (2)$$

Following Hall and Jones (1996), the log-TFP differential between Canada and the United States for industry i is obtained by subtracting the weighted average of the log-difference in human and physical capital inputs from the log-difference in value added:

$$\ln\left(\frac{TFP_{i,t}^{Can}}{TFP_{i,t}^{US}}\right) = \ln\left(\frac{y_{i,t}^{Can}}{y_{i,t}^{US}}\right) - \left[\frac{1}{2}(\alpha_{k,i,t}^{Can} + \alpha_{k,i,t}^{US}) \ln\left(\frac{k_{i,t}^{Can}}{k_{i,t}^{US}}\right) + \frac{1}{2}(\alpha_{h,i,t}^{Can} + \alpha_{h,i,t}^{US}) \ln\left(\frac{H_{i,t}^{Can}}{H_{i,t}^{US}}\right) \right], \quad (3)$$

13. Based on the regulatory variables they use, Canada is lagging the United States according to the Organisation for Economic Co-operation and Development (OECD) employment protection legislation index, but is leading the United States according to the World Economic Forum's regulatory burden index.

14. The dot over the variables denotes percentage growth rates. For a more detailed discussion of the methodology, see Jorgenson, Ho, and Stiroh (2005).

where Canadian value added and capital stock are expressed in US dollars using industry-specific conversion rates derived from Lee and Tang (2001).¹⁵

Labour and capital inputs for both Canada and the United States are adjusted for quality changes using the same methodology. In particular, labour quality (Ht) is the difference between the growth of hours worked and the growth of labour input, obtained by weighting the hours of different types of labour (in terms of educational attainment, age, and gender) by their marginal productivity (proxied by their relative compensation). Similarly, capital services are obtained by weighting the growth rates of different capital assets, using their estimated marginal productivity (proxied by rental prices) as weights. Within this framework, the estimates of labour and capital inputs capture the effect of substituting towards inputs with a higher marginal productivity (e.g., ICT capital and higher educated labour). In turn, this allows the estimates of TFP to better proxy the impact of technical and organizational changes on productivity.

Table 6 shows Canadian and US industries' average labour productivity growth, and the contribution from the three proximate causes. The results are shown separately for the period 1982–2000, as well as the pre- and post-1995 period. The table also shows average labour productivity growth for the entire business sector, aggregated over the 23 sectors considered.¹⁶

There are two major results:

- Canadian aggregate labour productivity grew by an average annual 0.3 percentage point less than in the United States over the whole period, but the gap in growth rates widened to an average 0.8 percentage point in the post-1995 period. These estimates are broadly consistent with the

15. Lee and Tang (2001) estimated relative Canada-US TFP levels for 1993. As the real GDP and capital stock data in equation (3) are expressed in 1996 (Fisher-chain-weighted) dollars, the Lee and Tang industry conversion rates are updated to 1996 using growth differentials in industries' value-added deflators.

16. Consistent with Schreyer (2001), total labour productivity growth is obtained as the weighted average of labour productivities across industries using value-added shares as weights, plus a reallocation term that reflects the economy's ability to move labour resources to those sectors with a higher-than-average level of labour productivity. Given that aggregate TFP and contributions from labour quality and capital deepening are obtained as weighted averages of industries figures using value-added shares as weights, their sum is different than total labour productivity, the difference being the reallocation factor.

Table 6
Canada and the United States: Productivity growth, 1982–2000
 (Percentage)

	Canada						United States					
	Labour productivity			Contribution from:			Labour productivity			Contribution from:		
	productivity	Capital	Labour quality	TFP	Capital	Labour quality	TFP	productivity	Capital	Labour quality	TFP	
Agriculture	3.7	0.1	0.5	3.1	0.1	0.5	3.1	4.3	0.3	0.3	3.7	
Mining	2.2	2.1	0.2	-0.1	2.1	0.2	-0.1	1.8	2.9	0.2	-1.3	
Construction	-0.6	0.1	0.3	-1.0	0.1	0.3	-1.0	-0.1	-0.1	0.4	-0.4	
Food, beverage, and tobacco	1.3	0.5	0.1	0.7	0.5	0.1	0.7	0.6	0.9	0.2	-0.5	
Rubber and plastic	2.2	0.0	0.1	2.1	0.0	0.1	2.1	4.3	0.6	0.3	3.3	
Textiles, apparel, and leather	2.5	0.5	0.5	1.5	0.5	0.5	1.5	3.0	1.0	0.5	1.5	
Lumber and wood	2.0	0.3	0.4	1.3	0.3	0.4	1.3	0.1	-0.6	0.4	0.2	
Furniture and fixtures	1.3	-0.5	0.2	1.7	0.2	0.2	1.7	1.0	0.3	0.6	0.2	
Paper and allied products	3.2	1.9	0.2	1.1	1.9	0.2	1.1	1.5	1.0	0.3	0.2	
Printing and publishing	-0.7	0.3	0.3	-1.3	0.3	0.3	-1.3	-1.0	1.1	0.3	-2.3	
Primary metal	5.2	0.7	0.3	4.3	0.7	0.3	4.3	2.1	0.7	0.4	1.0	
Fabricated metal	1.5	-0.4	0.2	1.6	-0.4	0.2	1.6	2.2	0.4	0.4	1.3	
Ind. mach. and elect. equipment	5.8	1.3	0.3	4.2	1.3	0.3	4.2	11.0	1.3	0.5	9.2	
Transportation equipment	4.2	1.1	0.1	3.0	1.1	0.1	3.0	2.2	0.5	0.2	1.5	
Non-metallic mineral products	2.2	-0.4	0.2	2.4	-0.4	0.2	2.4	2.2	0.3	0.4	1.5	
Chemicals and chemical products	4.1	0.1	0.2	3.8	0.1	0.2	3.8	3.7	1.4	0.3	2.0	
Other manufacturing industries	1.4	0.4	0.3	0.7	0.4	0.3	0.7	5.7	1.1	0.4	4.2	
Transportation	2.3	0.5	0.4	1.4	0.5	0.4	1.4	1.7	-0.1	0.3	1.5	
Communications	3.1	1.8	0.8	0.5	1.8	0.8	0.5	3.9	2.8	0.2	0.9	
Utilities	1.3	0.1	0.1	1.1	0.1	0.1	1.1	3.1	2.0	0.1	0.9	
Trade	2.4	0.5	0.5	1.3	0.5	0.5	1.3	3.5	1.2	0.2	2.0	
FIRE	1.7	1.5	0.5	-0.3	1.5	0.5	-0.3	1.2	1.5	0.2	-0.5	
Other services	-0.2	0.8	0.7	-1.7	0.8	0.7	-1.7	-0.2	0.6	0.2	-1.1	
Total	1.6	0.8	0.4	0.6	0.8	0.4	0.6	1.9	1.1	0.3	0.8	

(cont'd)

Table 6 (cont'd)
Canada and the United States: Productivity growth, 1982–1995
 (Percentage)

	Canada						United States					
	Labour productivity	Contribution from:			TFP		Labour productivity	Contribution from:			TFP	
		Capital	Labour quality	TFP				Capital	Labour quality	TFP		
Agriculture	3.0	-0.7	0.6	3.1		3.7	0.1	0.4	3.2			
Mining	3.3	1.8	0.21	1.2		3.0	3.1	0.3	2.2			
Construction	-0.6	0.2	0.3	-1.1		-0.1	-0.3	0.5	-0.3			
Food, beverage, and tobacco	1.6	0.3	0.3	1.0		2.5	0.7	0.2	1.5			
Rubber and plastic	3.2	0.5	0.3	2.4		4.1	0.3	0.4	3.4			
Textiles, apparel, and leather	2.5	0.6	0.6	1.3		3.1	0.7	0.6	1.8			
Lumber and wood	1.9	0.2	0.4	1.3		0.5	-0.9	0.5	0.9			
Furniture and fixtures	0.8	-0.1	0.3	0.6		0.9	0.2	0.7	0.0			
Paper and allied products	3.1	1.8	0.4	0.9		1.5	0.9	0.4	0.2			
Printing and publishing	-1.2	0.4	0.4	-2.0		-1.4	0.8	0.3	-2.6			
Primary metal	5.8	0.7	0.4	4.6		1.9	0.7	0.4	0.8			
Fabricated metal	1.3	-0.1	0.3	1.0		2.5	0.4	0.4	1.7			
Ind. mach. and elect. equipment	5.4	1.1	0.7	3.6		9.0	0.9	0.5	7.6			
Transportation equipment	4.1	0.8	0.3	3.0		2.2	0.4	0.2	1.5			
Non-metallic mineral products	1.3	-0.2	0.3	1.2		2.6	-0.1	0.4	2.2			
Chemicals and chemical products	4.2	0.1	0.3	3.8		4.2	1.2	0.3	2.7			
Other manufacturing industries	1.6	0.7	0.4	0.4		5.3	1.0	0.4	4.0			
Transportation	2.5	0.4	0.5	1.7		1.5	-0.6	0.3	1.7			
Communications	2.9	1.3	0.3	1.2		4.5	3.0	0.2	1.3			
Utilities	0.5	0.4	0.2	-0.1		3.0	1.8	0.2	1.1			
Trade	1.9	0.4	0.5	1.0		2.3	1.0	0.3	1.0			
FIRE	1.4	1.6	0.6	-0.8		0.7	1.3	0.2	-0.9			
Other services	-0.4	0.9	0.7	-1.9		-0.4	0.5	0.2	-1.0			
Total	1.6	0.8	0.5	0.5		1.6	0.9	0.3	0.7			

(cont'd)

Table 6 (cont'd)
Canada and the United States: Productivity growth, 1995–2000
 (Percentage)

	Canada						United States					
	Labour productivity			Contribution from:			Labour productivity			Contribution from:		
	productivity	Capital	Labour quality	TFP	Capital	Labour quality	TFP	productivity	Capital	Labour quality	TFP	
Agriculture	5.3	2.2	0.3	2.8	2.2	0.3	2.8	3.2	0.6	0.2	2.4	
Mining	-0.8	2.5	0.1	-3.4	2.5	0.1	-3.4	-1.0	1.9	0.0	-2.9	
Construction	-0.4	0.0	0.2	-0.6	0.0	0.2	-0.6	-0.5	0.5	0.2	-1.2	
Food, beverage, and tobacco	0.7	1.0	-0.4	0.1	1.0	-0.4	0.1	-0.7	1.3	0.1	-2.2	
Rubber and plastic	-0.6	-1.1	-0.3	0.8	-1.1	-0.3	0.8	4.3	1.4	0.2	2.8	
Textiles, apparel, and leather	2.9	0.0	0.1	2.8	0.0	0.1	2.8	2.5	1.7	0.2	0.6	
Lumber and wood	1.5	1.3	0.3	0.0	1.3	0.3	0.0	0.2	0.5	0.2	-0.5	
Furniture and fixtures	2.6	-1.4	-0.2	4.2	-1.4	-0.2	4.2	1.6	0.5	0.3	0.9	
Paper and allied products	2.2	1.9	-0.2	0.5	1.9	-0.2	0.5	-1.2	1.1	0.2	-2.4	
Printing and publishing	0.4	0.1	0.0	0.3	0.1	0.0	0.3	-0.3	1.5	0.2	-2.0	
Primary metal	2.8	0.2	-0.1	2.7	0.2	-0.1	2.7	1.8	0.7	0.2	0.9	
Fabricated metal	1.9	-1.0	0.0	2.9	-1.0	0.0	2.9	1.4	0.6	0.3	0.5	
Ind. mach. and elect. equipment	7.4	1.5	-0.4	6.3	1.5	-0.4	6.3	16.9	2.3	0.4	14.2	
Transportation equipment	3.7	1.8	-0.3	2.2	1.8	-0.3	2.2	2.0	0.8	0.1	1.1	
Non-metallic mineral products	3.0	-1.2	-0.1	4.3	-1.2	-0.1	4.3	1.3	1.3	0.3	-0.2	
Chemicals and chemical products	3.9	-0.2	-0.1	4.1	-0.2	-0.1	4.1	2.3	1.9	0.2	0.2	
Other manufacturing industries	1.0	-0.8	0.0	1.7	-0.8	0.0	1.7	6.2	1.3	0.4	4.5	
Transportation	1.7	0.8	0.3	0.6	0.8	0.3	0.6	1.7	0.9	0.2	0.5	
Communications	3.3	2.7	2.0	-1.3	2.7	2.0	-1.3	2.3	2.2	0.1	0.1	
Utilities	3.3	-1.0	-0.2	4.5	-1.0	-0.2	4.5	4.0	2.6	0.1	1.4	
Trade	3.0	0.8	0.6	1.6	0.8	0.6	1.6	5.4	1.7	0.1	3.6	
FIRE	2.7	1.3	0.2	1.2	1.3	0.2	1.2	2.8	2.0	0.2	0.6	
Other services	0.6	0.5	0.7	-0.7	0.5	0.7	-0.7	0.0	1.0	0.3	-1.3	
Total	1.8	0.8	0.3	0.9	0.8	0.3	0.9	2.6	1.5	0.2	1.1	

Source: International Monetary Fund staff estimates.

estimates obtained by conducting growth accounting at an aggregate level (Macklem 2003).¹⁷

- In the post-1995 period, the labour productivity gap between the two countries widened not only in the ICT-producing sector, but also in sectors that intensively used ICT capital.¹⁸ Canada's non-ICT-producing manufacturing industries appear to have performed as well as, if not better than, their US counterparts. However, a gap emerged in sectors that have been most intensively using new technologies, such as the trade and FIRE (financial, insurance, and real estate) sectors. In particular, labour productivity growth in Canada's trade sector was well below that in the United States, reflecting shortfalls in both TFP and capital deepening. A gap also opened in the FIRE sector, reflecting a smaller contribution of capital deepening than in the United States.

4.3 How did the free trade agreements affect productivity growth in Canada?

The persistence of the labour productivity gap in the face of the dramatic increase in trade linkages between Canada and the United States has puzzled many observers.¹⁹ Recent studies in growth literature have highlighted a variety of mechanisms through which increased trade would affect productivity growth. In particular, trade would facilitate the transfer of knowledge, increase scale and specialization, and, by increasing exposure to competition, induce a reallocation of resources from less to more efficient firms within industries. At the same time, traditional trade theories, as embodied in a Heckscher-Ohlin framework, predict a reallocation of resources towards sectors where a country has comparative advantage. To the extent that Canada's comparative advantage lies in sectors less exposed to the dynamic gains from trade, such as the natural resource and resource-based manufacturing sectors, the inter-industry resource reallocation induced by trade may have hindered the productivity gap with the United States from closing (Jackson 2003a).

The fact that Canadian trade has increased mainly in two-way trade in similar products suggests that Canadian firms are likely to have benefited greatly from the dynamic gains of trade. To assess this hypothesis, average

17. Recent data revisions by Statistics Canada suggest that the aggregate labour productivity growth gap between Canada and the United States in the 1995–2000 period has been smaller, about 1/2 per cent, than what is suggested by the data used in this paper.

18. The ICT-producing sector is proxied by the industrial machinery and electrical and electronic product sectors.

19. See the exchange of ideas between McCallum (1999) and Jackson (1999) on the occasion of the 10th anniversary of NAFTA.

Canadian industry TFP growth is plotted against (i) the degree of vertical specialization, and (ii) the degree of trade exposure of Canadian sectors.²⁰ Figure 12 shows that the average TFP growth is positively correlated with both measures of openness to trade, and the extent of the correlation has increased since the inception of the free trade agreements with the United States. In particular, the ICT-producing and transportation equipment sectors seem to have benefited most from exposure to trade and intra-industry specialization over this period.

Moreover, the free trade agreements seem to have contributed to convergence in TFP between the two countries. To assess the impact of the agreements on the TFP convergence between Canada and the United States, an autoregressive model is estimated; it contains both industry and time-specific effects and a structural change in the autoregressive coefficient:²¹

$$TFP_{i,t}^{Can-US} = \beta TFP_{i,t-1}^{Can-US} + \gamma D_{CUSFTA} + \delta \bar{D}_{CUSFTA} * TFP_{i,t-1}^{Can-US} + \alpha_i + \lambda_t + \varepsilon_{i,t}, \quad (4)$$

where i is the index for industries ($i = 1 \dots 23$), t is the index for time ($t = 1 \dots 20$), $TFP_{i,t}^{Can-US}$ is the log-TFP differential between Canada and the United States for industry i derived from equation (2), and D_{CUSFTA} is a dummy that controls for the impact of CUSFTA (from 1990). Table 7 reports the results from the Arellano and Bond (1991) generalized method of moments (GMM) applied to equation (3) in first differences.²² The estimated value of β is significantly less than 1, suggesting convergence in TFP levels between Canada and the United States over the period considered. Furthermore, the estimated negative value of δ (significant at a

20. The degree of vertical specialization measures the extent to which an industry's trade is accounted for by inputs that are imported and embodied in exports. The degree of trade exposure is the algebraic sum of three different indicators: (i) the share of an industry's exports in its gross output (capturing its degree of export orientation); (ii) the share of an industry's imported intermediate inputs in its gross output (capturing the exposure of an industry on the cost side); and (iii) the share of an industry's competing imports in the domestic markets for its core products (measuring the exposure to foreign penetration of the domestic market). Both indexes of openness to trade are from Dion (1999–2000). The data, originally up to 1996, have been extrapolated to 2000.

21. Easterly, Fiess, and Lederman (2003) adopt this methodology to assess the impact of NAFTA on the Mexico-US productivity convergence.

22. As is well known, the presence of a lagged dependent variable in a fixed-effect model generates biased ordinary least squares estimates. The Arellano-Bond technique allows to obtain unbiased and consistent estimates by moving to a specification in first differences and instrumenting the lagged changes of the dependent variables with its lagged ($t-2$ and earlier) levels.

Figure 12a
Trade exposure and TFP growth

Average 1981–2000

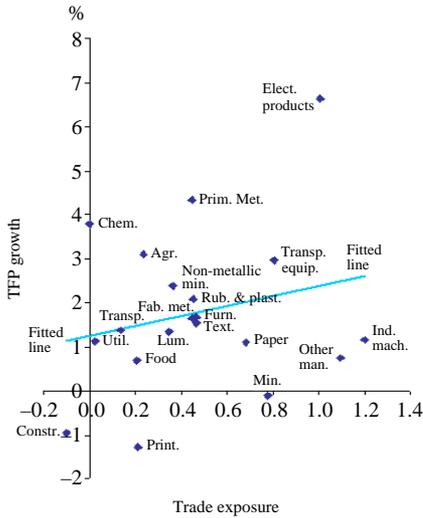


Figure 12b
Trade exposure and TFP growth

Average 1990–2000

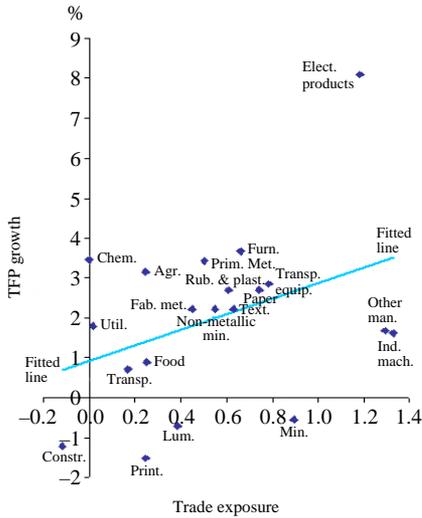


Figure 12c
Vertical integration and TFP growth

Average 1981–2000

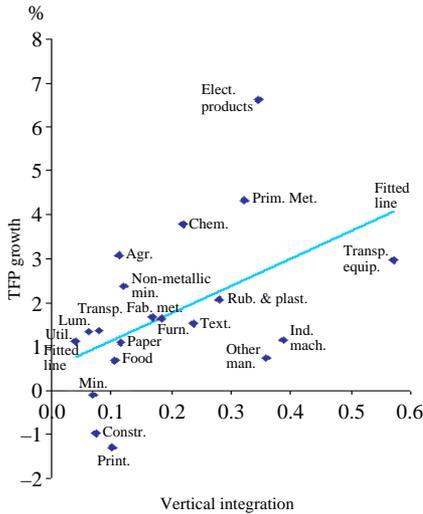


Figure 12d
Vertical integration and TFP growth

Average 1990–2000

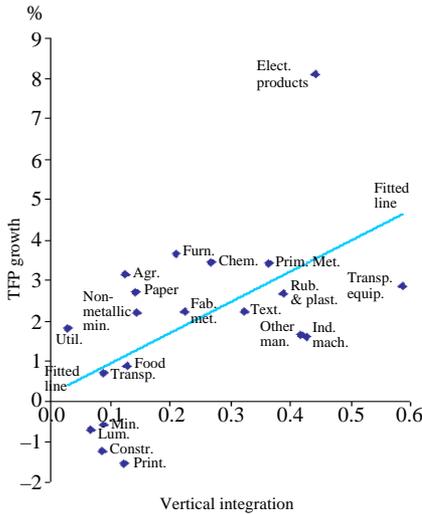


Table 7
Estimation of TFP convergence equation^a

	All sectors	Manufacturing
TFP ^{Can-US} (-1)	0.79 (0.00)	0.69 (0.00)
D _{CUSFTA} *TFP ^{Can-US} (-1)	-0.06 (0.09)	-0.11 (0.14)
D _{CUSFTA}	-0.04 (0.00)	-0.06 (0.00)
No. of observations	414	252
Sargan test (<i>p</i> -value)	0.74	0.34
AR(2) test (<i>p</i> -value)	0.59	0.21

Notes:

a. Dependent variable: log-TFP differential (Canada minus United States).

Yearly data, covering 23 industries for the period 1982–2000.

Year dummies are not reported. Numbers in parentheses are *p*-values, based on heteroscedastic robust standard errors.

10 per cent level) indicates that the rate of convergence has increased in the 1990s after the Canada-US free trade agreement. The role of trade is confirmed by the fact that convergence has been even faster in the manufacturing sector, as shown by the lower coefficients in the second column.

These results are consistent with those of other papers about the impact on productivity of increased trade linkages between Canada and the United States. For example, examining the impact of CUSFTA on productivity in the manufacturing sector, Sawchuk and Treffer (2002) find that, over the 1989–95 period, tariff cuts raised labour productivity by 3.25 per cent per year in the most affected industries, and by 0.5 per cent per year in the overall manufacturing sector. On the other hand, empirical research has failed to identify a positive link between trade specialization and TFP growth in Canada (Harris and Kherfi 2000) and noticed that the specialization of Canada's manufacturing sector has hardly changed under the free trade agreement (Head and Reis 2003).

4.4 The impact of industrial structure on the aggregate labour productivity gap

The evidence thus far suggests that factors other than trade linkages with the United States have likely been at work in driving the Canada-US labour productivity gap. Conducting growth accounting at a sectoral level allows for quantifying the role played by the differences in industrial structures between the two economies. This is done by decomposing the aggregate

labour productivity growth gap between Canada and the United States into three components, which correspond to the three terms on the right-hand side of equation (5):

- a “direct” effect, which reflects the contribution from industry i 's different labour productivity growth performance, weighted by its average value-added share (va_i);
- a “structural” effect, which reflects the contribution from the industry i 's different relative size across the two countries, weighted by its average labour productivity growth;
- and a “reallocation factor,” which reflects the different ability of the two economies to direct labour resources (hours worked, h_i) towards sectors with a value-added share that exceeds the labour compensation share (ls_i) (that is, towards sectors with a higher-than-average labour productivity level):²³

$$\begin{aligned} \dot{y}_{Can} - \dot{y}_{US} = & \sum_i \left(\frac{va_{i, Can} + va_{i, US}}{2} \right) (\dot{y}_{i, Can} - \dot{y}_{i, US}) \\ & + \sum_i \left(\frac{\dot{y}_{i, Can} + \dot{y}_{i, US}}{2} \right) (va_{i, Can} - va_{i, US}) \\ & + \left[\sum_i (va_{i, Can} - ls_{i, Can}) \dot{h}_{i, Can} \right. \\ & \left. - \sum_i (va_{i, US} - ls_{i, US}) \dot{h}_{i, US} \right]. \end{aligned} \quad (5)$$

This decomposition shows that a significant part of the widening labour productivity gap between Canada and the United States over the post-1995 period is explained by structural differences between the two economies. Table 8 shows that the negative contribution from the “direct” effect has increased slightly over the two periods, whereas the other two effects have

23. See Faruqui et al. (2003) for a similar decomposition formula. Their conclusion is that most of the business sector labour productivity growth gap between Canada and the United States in the 1987–2000 period is explained by the direct effect. Moreover, the manufacturing sector is the main contributor to the aggregate gap in the post-1996 period, while the service sector is more relevant in the period 1987–96. However, these results are obtained at a rather coarse level of disaggregation (four large sectors are identified, namely, primary, manufacturing, construction, and services), something that (as admitted by the same authors) might conceal the contribution from the structural and reallocation effects.

Table 8
Canada-US labour productivity growth gap
 (Percentage)

Contribution from:	1982–2000	1982–95	1995–2000
Direct effect	-0.2	-0.1	-0.2
<i>of which:</i>			
Industrial machinery and electrical and electronic equipment	-0.1	-0.1	-0.2
Transportation equipment	0.1	0.0	0.1
Other manufacturing industries	0.0	0.0	-0.1
Communications	0.0	0.0	0.0
Utilities	-0.1	0.0	0.0
Trade	-0.2	0.0	-0.4
FIRE	0.1	-0.1	0.0
Other services	0.0	0.0	0.1
Structure effect	0.0	0.1	-0.2
Reallocation effect	0.0	0.1	-0.2

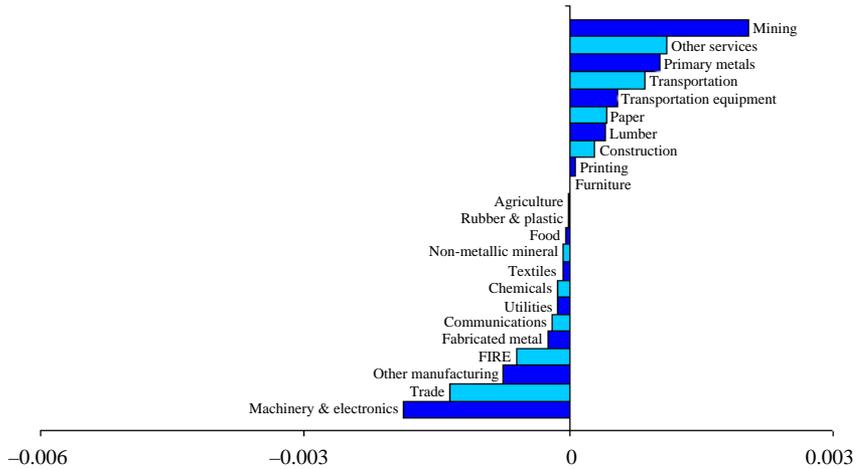
Source: International Monetary Fund staff estimates.

become a negative contributor in the post-1995 period. This seems to suggest that the widening of the Canada-US labour productivity gap over the second half of the 1990s was mostly due to a shift in the relative pattern of industry specialization. In other words, rather than having become less productive than the United States, Canada has tended to be less successful in directing resources towards high-productivity sectors.

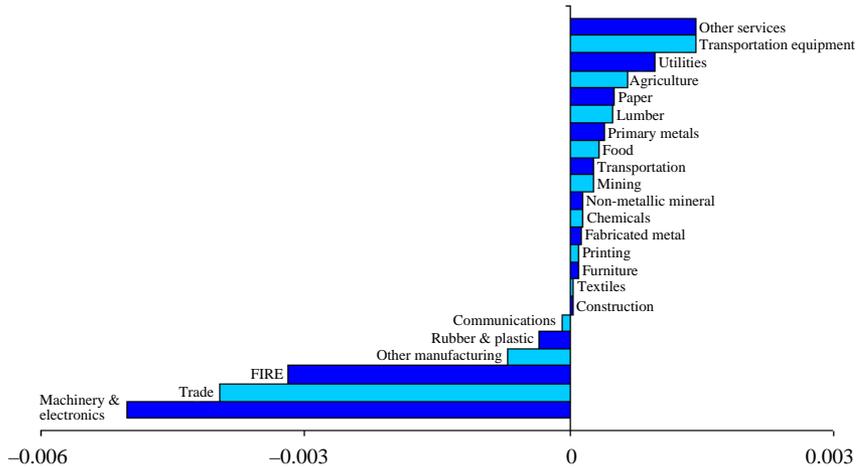
The widening of the aggregate labour productivity gap between Canada and the United States over the second half of the 1990s has been driven mainly by the ICT-producing sector and two major service sectors, trade and FIRE. Figure 13 shows the industries' contribution to the aggregate labour productivity growth gap in the two subperiods, 1981–95 and 1995–2000. Each industry's contribution is given by the sum of its contribution to the "direct," "structure," and "reallocation" effects. While the ICT-producing sector has remained the major contributor to the aggregate gap over the whole period, the negative contribution from the trade and FIRE sectors rose significantly in the second half of the 1990s. The negative contribution from the ICT-producing manufacturing and trade sectors mainly reflected lower labour productivity growth, whereas the negative contribution from the

Figure 13
Sectoral contributions to the Canada-US
aggregate labour productivity growth gap
 (Percentage)

1981–95



1995–2000



FIRE sector was largely the result of the lower relative size of the sector in Canada.²⁴

Conclusion

The results above illustrate that while free trade has helped promote the integration of the US and Canadian economies, significant differences remain. Business cycles in Canada and the United States have certainly become more synchronized, and the importance of common factors in explaining business cycles in the two countries has increased, likely reflecting the significant increase in trade based on vertical specialization. Nonetheless, significant structural differences between the two economies remain evident. Primary goods still account for more than 30 per cent of Canada's total exports, and the analysis above shows that country-specific and idiosyncratic factors remain very important in explaining the Canadian business cycle.

The continued importance of country-specific and idiosyncratic factors in driving business cycles in Canada also confirms the benefits of exchange rate flexibility. Although there remain those in Canada who argue in favour of a Canada-US monetary union, the significant differences in industrial structure and composition of trade between the two countries suggest that there could be important costs to Canada from giving up its ability to insulate itself from country-specific and other shocks.

The paper also shows that the widening labour productivity gap between the two economies over the 1990s is a reflection of the differences in the industrial structure of the two countries. Industry growth accounting shows that Canada has done as well, if not better, than the United States in many (non-ICT-producing) manufacturing sectors, while it has lagged in some industries that have been intensively using ICT capital, especially in the service sector. In this paper, the industries' contribution to the aggregate labour productivity gap is weighted through their relative value-added shares, and it also reflects the economy's ability to reallocate resources from less productive to more productive sectors. From this perspective, the United States has been able to take a much larger benefit from the dramatic

24. The comparison between the trade sectors in the two countries may be blurred by the fact that eating and drinking places are included in the US trade sector, while they are part of the "other service" sector for Canada (as they are in the "accommodation, food, and beverage" sector). However, the results do not change substantially when the Canadian trade sector is adjusted to include that fraction of the "accommodation, food, and beverage" sector that can be attributed to eating and drinking places.

acceleration of labour productivity growth in the service sectors, owing to the larger share of these sectors in their economy compared to Canada.

The negative impact from the difference in industry specialization between the two countries does not seem to be related to the increased trade integration of Canada over the 1990s. Much of the increased trade occurred within industries, as shown by the increased degree of vertical specialization of many Canadian sectors (in particular, transport equipment and ICT-producing sectors). This has allowed Canadian firms to benefit from economies of scale and technology transfers, which appear to have contributed positively to their TFP performance over the past decades.

These findings suggest that there could be gains from further steps to deepen economic linkages. The CUSFTA/NAFTA experience illustrates the significant benefits accruing to both countries from free trade, but important barriers remain. For example, differences in regulatory frameworks impede trade and investment flows; security concerns, which have become critically important during the past two years, slow cross-border flows of goods; and rules-of-origin requirements also restrict trade flows (McMahon, Curtis, and Adegoke 2003). Recent research suggests that the removal of rules-of-origin requirements and the harmonization of most favoured nation (MFN) tariffs—which is under discussion among the NAFTA partners—could boost NAFTA's GDP by as much as 2 to 3 per cent (Policy Research Initiative 2003).²⁵

25. NAFTA partners have recently decided to establish study groups to analyze avenues for harmonization of MFN tariffs and rules-of-origin requirements, and to improve rules governing investment flows. In addition, recognizing the importance of secure and continuous access to each other's markets, Canada and the United States have recently placed an emphasis on border security. For example, a Smart Border Action Plan has been implemented, which includes a Free and Secure Trade (FAST) program to harmonize procedures for clearing cross-border shipments. For an extensive discussion of the impact of rules-of-origin requirements, see Estevadeordal and Suominen (2004). Mirus and Hoffman (2004) and Ghosh and Rao (2004) argue that there are large gains associated with the harmonization of MFN tariffs and the liberalization of NAFTA's rules of origin.

Appendix 1

Data Sources

Data for Canada

Real (chain-Fisher-weighted) value added, hours worked, labour input, and capital services data were obtained from Statistics Canada and were based on a SIC-80 industry classification.

For the manufacturing sectors, however, the data ended in 1997. They were extrapolated to 2000 using the growth rates from the KLEMS input and output database, which follows the North American Industry Classification System (starting from 1997).

Comparing the 1997 industries' value added based on the two industry classifications shows that the difference is generally around 15 per cent, except for "other manufacturing sector" and "furniture and fixture," for which the difference is around 30 per cent. The results for these sectors should then be interpreted with greater caution than others.

Data for the United States

Industry data for the United States follow the US SIC-87 industry classification.

Real (chain-Fisher-weighted) value-added industry data for the United States were obtained from Bureau of Economic Analysis's "gross product originating" (GPO) by industry. As these figures are on a market-price basis, value-added data at basic prices were obtained by subtracting the indirect business tax and non-tax liability from GPO.

GDP by industry is obtained from industries' components of domestic income which, as is well known, tend to fall short of GDP measured on an expenditure basis. The difference is named "statistical discrepancy," and is attributed to the industries based on their share of total GDP.

Hours worked, labour input, and capital services were obtained from Jorgenson, Ho, and Stiroh (2005) and are based on methodologies that are largely comparable with those adopted by Statistics Canada.

Industry classification

To obtain the same level of industry classification for the two countries, a number of subsectors were aggregated into larger sectors. As an example, a "mining" sector was obtained for the United States by aggregating four subsectors (namely, metal mining, coal mining, petroleum and gas, and non-metallic mining).

The aggregation was also needed to obtain comparable sectors for the two countries. For example, US SIC-87 classification places computers and office equipment in “industrial machinery,” while Canada SIC-80 classification places it in the “electrical and electronic” equipment. For comparison, the two sectors were aggregated into one large sector, which was taken as a proxy for the ICT-producing sector in the paper.

The following aggregation criteria were used: subindustries value added were aggregated using value-added shares as weights; labour and capital inputs were aggregated using relative shares in aggregate labour compensation and capital income, respectively, as weights; and hours worked were aggregated through the unweighted sum.

Despite following these aggregation procedures to obtain reasonably comparable sectors for the two countries, minor differences still persist, particularly in the service sectors. In addition to the different treatment of eating and drinking places (see footnote 24 in the main text), another difference that is worth mentioning relates to postal services, which are placed in the “communications” sector for Canada but in the “transportation” sector for the United States.

References

- Acharya, R., P. Sharma, and S. Rao. 2003. "Canada-U.S. Trade and Foreign Direct Investment Patterns." In *North American Linkages: Opportunities and Challenges for Canada*, edited by R.G. Harris, 13–88. Calgary: University of Calgary Press.
- Arellano, M. and S. Bond. 1991. "Some Tests of Specification for Panel Data: Monte Carlo Evidence and an Application to Employment Equations." *Review of Economic Studies* 58 (2): 277–97.
- Armstrong, P., T. Harchaoui, C. Jackson, and F. Tarkhani. 2002. "A Comparison of Canada-U.S. Economic Growth in the Information Age, 1981–2000." Statistics Canada Economic Analysis Research Paper No. 001.
- Arora, V. and O. Jeanne. 2001. "Economic Integration and the Exchange Rate Regime: Some Lessons from Canada." International Monetary Fund Policy Discussion Paper No. 01/1.
- Baldwin, J. and J. Chowhan. 2003. "The Impact of Self-Employment on Productivity Growth in Canada and the US." *Canadian Economic Observer* 16 (8).
- Baldwin, J.R. and J. Tang. 2003. "The Contribution of Small and Medium Sized Producers to the Productivity Gap between the Manufacturing Sectors of Canada and the United States." Paper presented at the 37th Annual Meeting of the Canadian Economics Association, Carleton University, Ottawa, 30 May–1 June 2003.
- Bayoumi, T. and B. Eichengreen. 1994. "Monetary and Exchange Rate Arrangements for NAFTA." *Journal of Development Economics* 43 (1): 125–65.
- Blanchard, O. and J. Simon. 2001. "The Long and Large Decline in U.S. Output Volatility." *Brookings Papers on Economic Activity* 1: 135–74.
- Carr, J.L. and J.E. Floyd. 2002. "Real and Monetary Shocks to the Canadian Dollar: Do Canada and the United States Form an Optimal Currency Area?" *North American Journal of Economics and Finance* 13 (1): 21–39.
- Clausing, K.A. 2001. "Trade Creation and Trade Diversion in the Canada-United States Free Trade Agreement." *Canadian Journal of Economics* 34 (3): 677–96.
- Courchene, T.J. 2003. "FTA at 15, NAFTA at 10: A Canadian Perspective on North American Integration." *North American Journal of Economics and Finance* 14 (2): 263–85.
- Crawford, A. 2002. "Trends in Productivity Growth in Canada." *Bank of Canada Review* (Spring): 19–32.

- Debs, A. 2001. "Testing for a Structural Break in the Volatility of Real GDP Growth in Canada." Bank of Canada Working Paper No. 2001-9.
- Department of Foreign Affairs and International Trade (DFAIT). 2003. "NAFTA @ 10: A Preliminary Report."
- Dion, R. 1999-2000. "Trends in Canada's Merchandise Trade." *Bank of Canada Review* (Winter): 29-41.
- Dobson, W. 2002. "Shaping the Future of the North American Economic Space: A Framework for Action." C.D. Howe Institute Commentary No. 162.
- Doyle, B.M. and J. Faust. 2003. "Breaks in the Variability and Co-movement of G-7 Economic Growth." Board of Governors of the Federal Reserve System International Finance Discussion Paper No. 786.
- Easterly, W., N. Fiess, and D. Lederman. 2003. "NAFTA and Convergence in North America: High Expectations, Big Events, and Little Time." *Economica* 4 (1): 1-40.
- Estevadeordal, A. and K. Suominen. 2004. "Rules of Origin: A World Map and Trade Effects." Inter-American Development Bank. Washington. Unpublished.
- Faruqi, U., W. Gu, M. Kaci, M. Laroche, and J.-P. Maynard. 2003. "Differences in Productivity Growth: Canadian-U.S. Business Sectors, 1987-2000." *Monthly Labor Review* April 126 (4): 16-29.
- Ghosh, M. and S. Rao. 2004. "Economic Impacts of a Possible Canada-U.S. Customs Union: Simulation Results from a Dynamic CGE Model." Industry Canada. Photocopy.
- Globerman, S. and D. Shapiro. 2003. "Assessing Recent Patterns of Foreign Direct Investment in Canada and the United States." In *North American Linkages: Opportunities and Challenges for Canada*, edited by R.G. Harris, 281-310. Calgary: University of Calgary Press.
- Goldfarb, D. 2003. "Beyond Labels: Comparing Proposals for Closer Canada-U.S. Economic Relations." C.D. Howe Institute *Backgrounders*, No. 76.
- Gordon, R.J. 2003. "High-Tech Innovation and Productivity Growth: Does Supply Create Its Own Demand?" National Bureau of Economic Research Working Paper No. 9437.
- Gu, W. and G. Sawchuk. 2001. "Canada's Growing Market Integration with the U.S.—With a Focus on Trade." *North American Journal of Economics and Finance* 12 (3): 283-300.
- Gust, C. and J. Marquez. 2004. "International Comparison of Productivity Growth: The Role of Information Technology and Regulatory Practices." *Labour Economics* 11 (1): 33-58.

- Hall, R.E. and C.I. Jones. 1996. "The Productivity of Nations." National Bureau of Economic Research Working Paper No. 5812.
- Harchaoui, T. and F. Tarkhani. 2002. "Information Technology and Productivity Growth in Canada and the United States: A Comprehensive Examination." Statistics Canada. Unpublished.
- Harris, R.G. and S. Kherfi. 2000. "Productivity Growth and Trade Specialization." Paper presented at the Centre for the Study of Living Standards conference on *The Canada-U.S. Manufacturing Productivity Gap*. Ottawa.
- Head, K. and J. Reis. 2003. "Free Trade and Canadian Economic Performance: Which Theories Does the Evidence Support?" In *North American Linkages: Opportunities and Challenges for Canada*, edited by R.G. Harris, 181–205. Calgary: University of Calgary Press.
- Heathcote, J. and F. Perri. 2003. "Why Has the U.S. Economy Become Less Correlated with the Rest of the World?" *American Economic Review* 93 (2): 63–9.
- Helbling, T. and T. Bayoumi. 2003. "Are They All in the Same Boat? The 2000–2001 Growth Slowdown and the G-7 Business Cycle Linkages." International Monetary Fund Working Paper No. 03/46.
- Ho, M.S., S. Rao, and J. Tang. 2003. "Sources of Output Growth in Canadian and U.S. Industries in the Information Age." Industry Canada Research Monograph.
- Hufbauer, G.C. and J.J. Schott. 1992. "North American Free Trade: Issues and Recommendations." Washington: Institute for International Economics.
- Hummels, D., D. Rapoport, and K.-M. Yi. 1998. "Vertical Specialization and the Changing Nature of World Trade." *Economic Policy Review* 4 (2): 79–99.
- Jackson, A. 1999. "From Leaps of Faith to Lapses of Logic." *Policy Options* 20 (5): 12–18.
- . 2003a. "Why the 'Big Idea' Is a Bad Idea: A Critical Perspective on Deeper Economic Integration with the United States." Canadian Labour Congress Research Paper No. 20.
- . 2003b. "From Leaps of Faith to Hard Landings: Fifteen Years of 'Free Trade'." Canadian Labour Congress Research Paper No. 28.
- Jorgenson, D.W., M.S. Ho, and K.J. Stiroh. 2005. "Growth of U.S. Industries and Investments in Information Technology and Higher Education." In *Measuring Capital in the New Economy*, edited by C. Corrado, J. Haltiwanger, and D. Sichel. National Bureau of Economic Research Studies in Income and Wealth.

- Kalemli-Ozcan, S., B.E. Sørensen, and O. Yosha. 2003. "Risk Sharing and Industrial Specialization: Regional and International Evidence." *American Economic Review* 93 (3): 903–18.
- Khan, H. and M. Santos. 2002. "Contribution of ICT Use to Output and Labour-Productivity Growth in Canada." Bank of Canada Working Paper No. 2002–7.
- Kose, M.A., G.M. Meredith, and C.M. Towe. 2004. "How Has NAFTA Affected the Mexican Economy? Review and Evidence." International Monetary Fund Working Paper No. 04/59.
- Kose, M.A., C. Otrok, and C.H. Whiteman. 2003. "International Business Cycles: World, Region, and Country-Specific Factors." *American Economic Review* 93 (4): 1216–39.
- . 2004. "Understanding the Evolution of World Business Cycles." International Monetary Fund Working Paper. Forthcoming.
- Kose, M.A., E.S. Prasad, and M.E. Terrones. 2004. "Volatility and Comovement in a Globalized World Economy: An Empirical Exploration." In *Macroeconomic Policies in the World Economy*, edited by H. Siebert, 89–122. Berlin: Springer-Verlag.
- Kose, M.A. and K.-M. Yi. 2001. "International Trade and Business Cycles: Is Vertical Specialization the Missing Link?" *American Economic Review* 91 (2): 371–75.
- Krueger, A.O. 1999. "Trade Creation and Trade Diversion under NAFTA." National Bureau of Economic Research Working Paper No. 7429.
- . 2000. "NAFTA's Effects: A Preliminary Assessment." *World Economy* 23 (6): 761–75.
- Lafrance, R. and P. St-Amant. 1999. "Optimal Currency Areas: A Review of the Recent Literature." Bank of Canada Working Paper No. 1999–16.
- Lee, F.C. and J. Tang. 2001. "Productivity Levels and International Competitiveness Between Canada and the United States." In *Industry-level Productivity and International Competitiveness Between Canada and the United States*, edited by D.W. Jorgenson and F.C. Lee, 155–79: Industry Canada Research Monograph.
- Macklem, T. 2003. "Future Productivity Growth in Canada: Comparing to the United States." *International Productivity Monitor* 7 (Fall): 50–7.
- McCallum, J. 1999. "Two Cheers for the FTA." *Policy Options* 20 (5): 6–11.
- McMahon, F., M. Curtis, and A.O. Adegoke. 2003. "The Unseen Wall: The Fraser Institute's 2003 Trade Survey." Fraser Institute Public Policy Sources No. 76.
- Mirus, R. and K. Hoffman. 2004. "Estimating Potential Savings from Streamlining Tariffs Among NAFTA Partners: An Alberta Perspective." Unpublished.

- Murray, J. 2000. "Why Canada Needs a Flexible Exchange Rate." *North American Journal of Economics and Finance* 11 (1): 41–60.
- Murray, J., L. Schembri, and P. St-Amant. 2003. "Revisiting the Case for Flexible Exchange Rates in North America." *North American Journal of Economics and Finance* 14 (2): 207–40.
- Oliner, S.D. and D.E. Sichel. 2002. "Information Technology and Productivity: Where Are We Now and Where Are We Going?" Federal Reserve Bank of Atlanta *Economic Review* 87 (3): 15–44.
- Policy Research Initiative. 2003. "The North American Linkages Project: Focusing the Research Agenda." Policy Research Initiative, Privy Council Office (Ottawa). <www.policyresearch.gc.ca>.
- Romalis, J. 2002. "NAFTA's and CUSFTA's Impact on North American Trade." University of Chicago. Unpublished paper. <<http://gsbwww.uchicago.edu/fac/john.romalis/research/naftapaper.pdf>>.
- Sawchuk, G. and A. Sydor. 2003. "Mexico and Canada: Changing Specializations in Trade with the United States." In *North American Linkages: Opportunities and Challenges for Canada*, edited by R.G. Harris, 117–79. Calgary: University of Calgary Press.
- Sawchuk, G. and D. Trefler. 2002. "A Time to Sow, a Time to Reap: The FTA and Its Impact on Productivity and Employment." In *Productivity Issues in Canada*, edited by S. Rao and A. Sharpe, 537–69. Calgary: University of Calgary Press.
- Schreyer, P. 2001. "The OECD Productivity Manual: A Guide to the Measurement of Industry-Level and Aggregate Productivity." *International Productivity Monitor* 0 (2): 37–51.
- Schwanen, D. 1997. "Trading Up: The Impact of Increased Continental Integration on Trade, Investment, and Jobs in Canada." C.D. Howe Institute Commentary No. 89.
- Stock, J.H. and M.W. Watson. 2003. "Understanding Changes in International Business Cycle Dynamics." National Bureau of Economic Research Working Paper No. 9859.
- Trefler, D. 2001. "The Long and Short of the Canada-U.S. Free Trade Agreement." National Bureau of Economic Research Working Paper No. 8293.
- United States International Trade Commission (USITC). 2003. "The Impact of Trade Agreements: Effect of the Tokyo Round, U.S.-Israel FTA, U.S.-Canada FTA, NAFTA, and the Uruguay Round on the U.S. Economy." Publication No. 3621. Washington, DC.
- United States Trade Representative (USTR). 2003. *National Trade Estimate Report on Foreign Trade Barriers*. Washington.
- Wall, H.J. 2003. "NAFTA and the Geography of North American Trade." *Federal Reserve Bank of St. Louis Review* 85 (2): 13–26.

Discussion

Eva Ortega

This paper offers an extensive and comprehensive review of real macroeconomic links between Canada and the United States. It discusses the foundations of the debate on whether or not the trade agreements between the two countries in the past decades have been beneficial for Canada, in particular for the dynamics of its business cycle and productivity.

My interpretation of the paper's main points is the following. First, trade with the United States accelerated in Canada since the Canada-United States Free Trade Agreement (CUSFTA) at both the national and regional levels. This acceleration was especially evident in the manufacturing sector, which increased cross-border vertical integration. Second, the higher business cycle synchronicity observed over time between Canada and the United States may not necessarily be due to trade intensification. Cardarelli and Kose find that the biggest source of Canadian business cycle fluctuations are idiosyncratic factors, which contribute strongly to the case for flexible exchange rates. Third, the widened gap of labour productivity between the United States and Canada since the mid-1990s is shown to be linked to poorer performance of the information and communication technologies (ICT) sector in Canada. Trade intensification indeed reduced the total factor productivity (TFP) differential across countries but did not bring about convergence.

I will focus on three aspects of the paper: (i) the measurement and interpretation of business cycle synchronicity; (ii) the evidence and conclusions on the productivity gap; and (iii) whether Canada-US real macroeconomic links represent a story of trade.

Business Cycle Synchronicity

As highlighted by the authors, evidence of higher trade and vertical specialization would result in a more common business cycle. However, section 4 of their paper shows evidence of different production structures in Canada and the United States, which would cause more country-specific cyclical fluctuations. Which effect dominates is unclear, both theoretically and empirically. The authors choose a dynamic factor model for output, consumption, and investment in Canada and the G-3 and find that idiosyncratic factors are the main source of the business cycle fluctuations of Canadian variables.

A frequent criticism of factor models is that they do not provide a clear economic interpretation of the various factors. The authors' Table 4 shows the variance decomposition¹ results and finds that for the United States, the dominant role of the country-specific factor in the 1960s and 1970s is replaced by that of the common factor in the past two decades. How do we interpret the common factor in this case? Did the United States become the common factor for the G-3 and Canada business cycles in the past two decades? If so, the higher role that the paper finds for the common factor in Canadian fluctuations in the 1980s and 1990s could then be interpreted as a deeper economic integration with the United States.

On a different note, this higher significance of common fluctuations found in the latter period (1981–2002) is compatible with the maintained or increased role for country-specific or idiosyncratic fluctuations and has been highlighted elsewhere (see, for example, Canova, Ciccarelli, and Ortega 2004). The main reason behind both findings is that macroeconomic fluctuations were less volatile in the G-7 countries in recent periods, especially during the 1990s. Lower volatility causes less uncertainty around estimated common cycles as well as country-specific cycles, which were often non-significant before the 1990s because of wide standard errors. Determining whether the recent lower business cycle volatility is due to increased integration or to other causes, for example, smaller shocks, would require a structural model rather than a reduced-form model like the one in this paper.

1. The variance decomposition is shown for two periods (1960–81 and 1981–2002), and the coefficients are kept fixed. Since the break is not linked to a particular change in trade agreements, differences across subperiods cannot, unfortunately, be linked to trade intensification.

The Canada-US Productivity Gap

The authors show how the convergence of Canadian per capita income with that of the United States has been held back since the mid-1990s as a result of the widening of the gap in labour productivity. The common explanation for this indicates a smaller and less productive ICT sector in Canada, together with a lower ICT capital deepening in Canadian firms. Cardarelli and Kose use industry data to look for possible sectoral dynamics behind the gap and for a possible link with trade intensity. This is an ambitious and demanding task.

The accounting exercise for growth in sectoral labour productivity yields an estimate of -0.8 per cent for the Canada-US labour productivity gap in the 1995–2000 period versus 0.9 per cent in 1982–95. The contributing factors found for that change confirm the consensus story above and are: (i) the significantly smaller TFP growth in the ICT sector in Canada, despite the reduction of the Canada-US TFP gap in general; and (ii) the far lower capital deepening in Canada than earlier.

The results for the 1995–2000 period should be considered with caution, since the authors extrapolate the database for manufactures after 1997 using a different industry definition. Indeed, the authors acknowledge that recent estimates show a Canada-US labour productivity gap in 1995–2000 of around -0.4 per cent.

A volume edited by Dale Jorgenson examines this productivity gap, using the new KLEMS (capital, labour, energy, material, and service) database. In this publication, Ho, Rao, and Tang (2004) find that FIRE (financial, insurance, and real estate services) and retail trade, followed by communications, agriculture, and other services, contributed most to aggregate labour productivity growth in Canada in 1995–2000. More productive ICT-producing industries contributed less because of their small size. Consistent with this new evidence, Cardarelli and Kose report an important contribution of services to the productivity gap in 1995–2000, which they find is not so much due to big differences in productivity but rather to the fact that rapidly improving sectors, such as the FIRE services, are larger in the United States (the “structure effect”).

The authors also analyze the effect of trade agreements on productivity. Informal evidence is found of higher TFP growth in Canada after CUSFTA, linked to greater vertical specialization and trade exposure. In terms of the Canada-US gap, the authors find that trade intensification reduced the TFP

level differential,² although it did not lead to convergence. It would have been interesting to see an analysis related to the labour productivity gap or even to TFP growth.

Cardarelli and Kose conclude by arguing that the main reason behind the increased gap in labour productivity growth between Canada and the United States is the reallocation and industry structure differences; that Canada has been less successful in redirecting resources to sectors of high productivity. However promising, their analysis could be extended by reporting, for example, the size of the reallocation factor for each country. It may also be worth exploring the reallocation effect using other sectoral information, such as capital reallocation and the entry and exit of firms from high-productivity sectors. But is this reallocation effect linked to higher trade intensity or is it linked to different investment patterns in the two countries?

A Story of Trade?

Trade agreements between Canada and the United States do not seem to have clearly affected either the business cycle synchronicity or the evolution of productivity growth in the two countries. Thus, have Canada-US real macroeconomic links been governed by trade? Or are they determined more importantly by their differing economic structures or by aggregate and sectoral investment patterns?

If the different structures or investment behaviour matter most, then perhaps domestic policies rather than international trade agreements should be emphasized and encouraged.

The extensive information conveyed in Cardarelli and Kose's work provides challenging evidence that stimulates interesting and important further investigation. Their Table 5, for example, reports a remarkably slower growth of the use of ICT capital services by Canadian firms than by their US counterparts. What can explain this difference?

2. The TFP gap is calculated assuming equal input shares across countries. This assumption leads to erroneously interpreting the cross-country differences in input income shares in value added as TFP differential.

References

- Canova, F., M. Ciccarelli, and E. Ortega. 2004. "Similarities and Convergence in G-7 Cycles." Europe Central Bank Working Paper No. 312.
- Ho, M.S., S. Rao, and J. Tang. 2004. "Sources of Output Growth in Canadian and U.S. Industries in the Information Age." In *Economic Growth in Canada and the United States in the Information Age*, edited by D.W. Jorgenson, 83–165. Industry Canada Research Monograph.

General Discussion*

Graham Voss, in response to comments, pointed out that his results seemed conclusive, but that more work should be done to try to reconcile the lack of a border effect according to the sectoral data in his paper and the strong Canadian component that was found in the Gosselin et al. paper. In response to Ortega's comments, Ayhan Kose made four points. First, while using fixed coefficients over the two sample periods was debatable, their paper was not trying to link the cyclical convergence with trade agreements. Going forward, rolling regressions and structural break tests may be useful in this context. Second, the common factor is not the US economic cycle. The output data are not weighted and the United States is not the main driver of the common factor. Third, neither is decreasing volatility of shocks. Fourth, given the fact that data revisions have tended to lessen the Canada-US productivity gap in recent years, measurement of productivity across countries remains a challenge.

In the general discussion that followed, Raphael Solomon asked Kose if it was not too soon to evaluate the effects of NAFTA, given that tariffs were to be phased out over time, up to ten years for certain categories of goods. Kose agreed it would be useful to look at this again in 2010. Gregor Smith asked if researchers could provide confidence intervals, since observed differences across different time periods might not be statistically significant. Moreover, shock decompositions can be interpreted for exogenous variables, but not for endogenous variables, as reported in the papers. Kose replied that confidence intervals can be found in the paper. Nicholas Rowe cautioned against using correlations evidence to assess optimal currency areas. For

* Prepared by Robert Lafrance.

instance, if the Bank of Canada could perfectly offset the common Canadian shock in these models, then we would conclude that Canada was not an optimal currency area (since only the international and regional shocks would be in evidence). What the correlations show is the failures of central banks to offset shocks. Kose agreed, but noted that a flexible exchange rate regime is still valuable for Canada despite its growing integration into the US economy.