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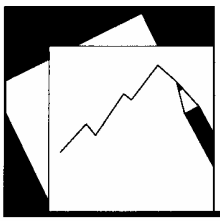

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Economic Integration, Business Cycle, and Productivity in North America

Roberto Cardarelli and M. Ayhan Kose

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Economic Integration, Business Cycle, and Productivity in North America

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Abstract

This paper examines the effect of the major Canada-U.S. trade agreements on the dynamics of business cycles and productivity in Canada. The North American Free Trade Agreement (NAFTA) and its predecessor, the Canada-U.S. Free Trade Agreement (CUSFTA), have led to a substantial expansion of trade flows. Although common factors have played a larger role in explaining business cycles in Canada and the United States since the early 1980s, country-specific and idiosyncratic factors remain important for Canada. At the same time, while increased trade integration seems to have positively contributed to total factor productivity of Canadian industries, the persistence of structural differences between the two countries has prevented convergence of aggregate labor productivity. While these findings seem to weigh against moving toward a monetary union, they also suggest that substantial benefits could be reaped from further reducing remaining barriers to trade.

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Keywords: Canada; United States; Business cycles; Productivity; NAFTA, CUSFTA; Regional Trade

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I. 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-U.S. 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 in order to eliminate remaining barriers to trade. The most ambitious proposals include calls for a "grand bargain," which would couple security and defense-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 some more modest and immediately practical proposals, involving suggestions for greater effort toward 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 argued that further economic integration with the United States might not be in the best interest of Canada. In particular, they claim that increased economic integration between the Canadian and U.S. economies has not contributed to reducing Canada's dependence on natural resources and to narrowing the labor productivity gap between the two countries (Jackson, 2003a and 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.

In order to shed some light on the debate about the future direction of economic integration, this paper analyzes the impact of major Canada-U.S. trade agreements on the dynamics of business cycles and productivity. In particular, the paper addresses 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 comovement of business cycles in Canada and the United States? Third, how has the economic integration affected the labor productivity gap between the two economies?

Canada and the Unites States have taken important steps to promote economic linkages during the past four decades. Section II reviews the key provisions of major trade agreements signed by Canada and the Unites States. The 1965 Canada-U.S. auto pact freed cross-border trade in the sector, and led to a significant growth of 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, in so far 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 U.S. 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. In order 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, the paper documents several stylized facts, employs a variety of econometric methods, and reviews the results of recent research.

Section III examines the impact of the major agreements on trade and financial flows in Canada.[2] In particular, the 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 Canadian GDP growth 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 IV, the extent to which there has been an effect on the comovement of Canada-U.S. business cycles is studied. Increased trade and financial linkages led to significant changes in the dynamics of business cycles in Canada. Canada-U.S. 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. This section also employs 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.

Section V analyzes the impact of economic integration on the labor productivity gap between the two countries. The results indicate that the widening labor 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.

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

Section 6 concludes 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 structure also have prevented convergence in aggregate labor productivity. Although these findings would seem to weigh against moving toward a monetary union, they also suggest that substantial benefits could be reaped from further reducing the remaining barriers to trade.

II. Trade Agreements Between Canada and the United States

An important step toward promoting Canada-U.S. trade linkages was the 1965 Canada-U.S. auto pact. Prior to the auto pact, tariffs on cross-border trade in automotive products were high—roughly 7½ percent in Canada and 17½ percent in the United States. The pact eliminated all tariffs faced by producers and led to a significant growth in the Canadian auto industry—the industry became highly integrated with the U.S. industry and transportation equipment became Canada's largest export to the United States (Hummels, Rapaport, and Yi, 1998).

The 1989 Canada-U.S. 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 percent in 1989 to almost zero in 2001, and the average U.S. tariff on imports from Canada falling from around 4.5 percent to 0.5 percent 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 nontariff 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.[3] NAFTA created the world's largest free trade area in terms of total gross domestic product (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 percent larger than that of the European Union. Exports (imports) of the European Union constituted roughly 38 (35) percent of world exports (imports) while exports (imports) of NAFTA accounted for about 18 (25) percent (DFAIT, 2003). In addition, NAFTA was the first comprehensive free trade agreement between advanced countries and a developing economy (Mexico).

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[3] 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 in January 1, 1994.

` NAFTA expanded various provisions of CUSFTA and broadened the scope of the agreement by including Mexico.[4] 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, and 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 nondefense goods and services that were supplied by firms in North America to the federal and state 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 labor and environmental issues. In particular, NAFTA established processes dealing with various issues including appeals of antidumping and countervailing duty determinations; resolution of investor-state disputes; and private commercial disputes.[5] NAFTA included two important side agreements: the North American Agreement on Labor Cooperation, aimed at promoting enforcement of domestic labor laws; and the North American Agreement on Environmental Cooperation, established to ensure that trade liberalization and environment 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 the 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 member country to qualify for NAFTA preferences. Moreover, NAFTA contained safeguard clauses covering import surges from the member countries.

[4] 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.

[5] The agreement established a Free Trade Commission, which served as the central institution of NAFTA comprising ministers or similar officials designed by each country.

III. Dynamics of Trade and Financial Flows

A. 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 U.S. 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 percent of GDP to as high as 55 percent of GDP (Figure 3b). By 2002, roughly 90 percent 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 percent during the same period.

The product mix of Canada-U.S. 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).[6]

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 favor those regions—British Columbia, the Prairies, and the Atlantic region—which previously had relatively weak ties to the U.S. market (Figure 4b). These regions saw a sharp jump in the share of their exports being 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 percent in 1991 to 75 percent in 2000 (Courchene, 2003). For Quebec and Ontario especially, the relative importance of international trade rose

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

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 percent of its GDP in 1989 to almost 50 percent in 2001.

Some 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 which accounts for the effects associated with market size and distance. They document that regional trade flows with the United States rose by 6.7 percent per year for Ontario, 5.3 percent for Quebec, 5 percent for the Prairies, and 4.7 percent for Atlantic Canada during this period.

Recent research also confirms the significant impact of CUSFTA on Canada-U.S. 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) employs a gravity framework and finds that NAFTA accounts for roughly 50 percent of the increase in the exports of Canada to the United States and approximately 25 percent of the increase in Canadian imports from the United States. Clausing (2001) concludes that the agreement did not result in any sizeable trade diversion, i.e., the expansion of trade was not at the expense of other countries, while Romalis (2002) and Wall (2003) 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 percent and by only 64 percent 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 that there has been a substantial increase in trade flows between Canada and the United States after NAFTA.

B. Changes in the Nature of Trade

Canada's trade appears to have become more geared toward manufactured goods as a result of the boom in Canada-U.S. trade linkages. The share of manufactures in total exports rose from less than 33 percent in 1960 to roughly 63 percent 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 percent in 1960 to roughly

83 percent 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 the changes in the dynamics of sectoral trade flows between the two countries. For example, Gu and Sawchuk (2001) study the 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 vehicles 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 fast growth of the two high-tech industries explained more than 50 percent of the increase while the rest was attributable to the increased trade intensity in these industries. In addition, they report that although the contribution of the resource and resource-based industries was relatively small to the growth of trade flows between the two countries, they still accounted for roughly 20 percent of the increase in aggregate trade flows.[7]

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) 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, Rapaport, and Yi (1998) conclude that the 1965 U.S.-Canada Auto Agreement led to a substantial increase in vertical trade in the auto industry.

Intra-industry trade between Canada and the United States also has risen over time. Intra-industry trade plays a major role in Canada's trade with the United States as it accounts for most of the trade in almost all industries.[8] The importance of intra-industry trade between the two countries rose in several industries, including metal products, machinery, and motor vehicles, after the inception of CUSFTA. For example, the share of intra-industry trade rose from 62 percent in 1990 to 67 percent 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; and Acharya, Sharma, and Rao, 2003).

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[7] These industries include all primary industries and food, beverages, tobacco, leather, wood, paper and allied, primary metal, nonmetallic minerals and refined petroleum.

[8] OECD (2002) 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 percent over the period 1988–91 to 76.2 percent during 1996–2000.

C. 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 percent 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-mergers (DFAIT 2003).[9] As a result, the average share of FDI inflows in Canada's domestic gross fixed capital formation (investment) rose from 6 percent in the 1986–88 period to 26 percent 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, and Globerman and Shapiro, 2003).

IV. Economic Integration and the Dynamics of Business Cycles

A. A Brief Survey of the Literature

In theory, increased trade linkages have ambiguous effects on the comovement 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 comovement, if industry-specific shocks are important in driving business cycles. However, the degree of comovement 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 comovement of consumption across countries (Kalemli-Ozcan, Sorensen, and Yosha, 2003).

These competing factors complicate evaluations of the impact of trade agreements on Canada-U.S. 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

[9] Although there was a significant increase in the volume of FDI flows from the United States to Canada in the period 1989–2002, the U.S. share of Canadian FDI stock remained quite stable at around 65 percent.

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 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 (1973Q1–1986:2), 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 periods than those in the BW period. Kose, Otrok, Whiteman (2004) 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 over time.

Some 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 U.S. business cycle has become less correlated with the aggregate cycle of Europe, Canada, and Japan since the 1960s.

B. How Did the Free Trade Agreements Change the Business Cycle in Canada?

Inspection of simple correlations suggests an increase in the comovement 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 U.S. business cycles have become less correlated with cycles in other G-3 countries (Germany and Japan).

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 comovement. First, cross-country correlations capture only the contemporaneous comovement in macroeconomic variables, and do not account for common fluctuations associated with "leads" and "lags." Second, correlations can account for the degree of comovement 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 comovement.

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, 2004) allows estimation of the extent to which common or country-specific factors explain the changes in the comovement, and also help take into account potentially important contemporaneous, as well as temporal, covariation among different macroeconomic variables.

The model focuses on the dynamic comovement 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,…,12, and t=1960Q1-2002Q4. Thus, for observable i:

$$y_{it} = a_i + b_i^{common} f_t^{common} + b_i^{country} f_{n,t}^{country} + \varepsilon_{i,t} \qquad E\varepsilon_{i,t}\varepsilon_{j,t-s} = 0 \qquad for \quad i \neq j, \quad (1)$$

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 behavior 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 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 U.S. country factor captures some of the NBER 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 U.S. 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: (1) a common factor that is common across all variables/countries; (2) country-specific factors, which are common across the main aggregates within a country; and (3) 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 percent 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 percent 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 percent to roughly 40 percent (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.

Nonetheless, country-specific and idiosyncratic factors remain important in Canada. The country-specific factor still accounted for more than 10 percent 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 percent 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 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 exchange rate regime. Arora and Jeanne (2001) argue that exchange rate flexibility has not

slowed the pace of Canada-U.S. economic integration, and has been useful in isolating the Canadian economy from asymmetric external shocks.[10]

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). Debb (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 U.S. real GDP growth has also declined significantly since the mid-1980s, which has been true for the rest of the G-7, except for Japan, where output volatility has increased in the past decade. Explanations for the increased stability of Canadian and U.S. output have centered 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 (Debb, 2001, and Blanchard and Simon, 2001).

V. Economic Integration and Productivity

A. A Brief Survey of the Literature

Despite the close integration between the Canadian and U.S. economies, the labor productivity gap between the two countries has widened over the last two decades (Figure 11). While a greater utilization of labor 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 labor 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 Information and Communication Technologies (ICT)-producing sector: Some studies have attributed most of the post-1995 acceleration of labor productivity in the United States to the exceptional total factor productivity 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 (2002) show that the size of Canada's ICT-producing sector increased from around 2½ percent of GDP in 1981 to around 4 percent of GDP on average over the second half of the 1990s, but remained below the U.S. share, which was around 6 percent of GDP over this period.

[10] 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.

- Different contribution from ICT capital accumulation: The widespread adoption of ICT capital assets has been regarded as a key factor behind the strong labor productivity growth in the United States.[11] 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 (Table 5).[12] Nonetheless, the contribution from ICT capital deepening to labor 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.[13]

- 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 percent of total manufacturing employment, compared to around 60 percent in the United States in 1997. Not only has the weight of SMEs in the Canadian economy increased over the last two decades, but some studies have found these firms to be less productive relative to their U.S. counterparts. For example, Baldwin and Tang (2003) show that around ¼ percentage point of the labor productivity gap in the manufacturing sector in 1997 was due to the larger share of SMEs in Canada compared to the United States, and ½ percentage point to the lower productivity of SMEs in Canada.

- Differences in the share and income of self-employed: The difference in labor-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 still remain, the methodology used by national statistical agencies to measure labor and total factor productivity has been converging. In particular, both the U.S. Bureau of Labor Statistics and Statistics Canada now use hedonic prices and include purchase of computer software in the national account measures of investment.

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[11] See, for example, Oliner and Sichel (2002) and Jorgenson, Ho, and Stiroh (2004).

[12] 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 BLS. 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).

[13] See Khan and Santos (2002), Harchaoui and Tarkhani (2002), Armstrong, and others (2002), and Ho, Rao, and Tang (2003). Both Armstrong, *et al*. and Harchaoui and Tarkhani find that ICT-capital deepening has contributed around ¼ percent to the average annual labor 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 ½ percent (Oliner and Sichel, 2002) and ⅔ percent (Jorgenson, Ho, and Stiroh, 2004).

- Differences in the regulatory burden in labor and product markets: Gust and Marquez (2004) find that countries with a more burdensome regulatory framework tend to have lower total factor productivity 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 labor and product market legislation and institutions.[14]

The role of trade linkages and of different industrial structures in driving the labor productivity gap is explored in this section by conducting level and growth accounting at a sectoral level. Using industry data allows assessing: a) whether the lack of aggregate convergence is masking significant variation in sectoral productivity dynamics; and b) 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.

B. Sectoral Growth Accounting

The analysis below uses a traditional growth accounting framework. This approach attributes labor productivity growth (value added per hours worked, y_t) to the contribution of three factors: the improvement in labor quality (H_t), weighted by the labor 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 total factor productivity (TFP, denoted by A_t):[15]

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

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:

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

where Canadian value added and capital stock are expressed in U.S. dollars using industry specific conversion rates derived from Tang and Lee (2001).[16]

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[14] Based on the regulatory variables they use, Canada is lagging the United States according to the OECD employment protection legislation index, but is leading the United States according to the World Economic Forum's regulatory burden index.

[15] The dot over the variables denotes percentage growth rates. For a more detailed discussion of the methodology see Jorgenson, Ho, and Stiroh (2004).

[16] Tang and Lee (2001) estimated relative Canada-U.S. TFP levels for 1993. As the real GDP and capital stock data in equation (3) are expressed in 1996 (Fisher chain weighted) dollars, the Tang and

(continued…)

Labor and capital inputs for both Canada and the United States are adjusted for quality changes using the same methodology. In particular, labor quality (H_t) is the difference between the growth of hours worked and the growth of labor input, obtained by weighting the hours of different types of labor (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 labor and capital inputs capture the effect of substituting toward inputs with a higher marginal productivity (e.g., ICT capital and higher educated labor). 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 U.S. industries' average labor productivity growth, and the contribution from the three proximate causes. The results are shown separately for the period 1981–2000, as well as the pre- and post-1995 period. The table also shows average labor productivity growth for the entire business sector, aggregated over the 23 sectors considered.[17]

There are two major results:

- Canadian aggregate labor productivity grew by an average annual 0.3 percentage points less than in the United States over the whole period, but the gap in growth rates widened to an average 0.8 percentage points in the post-1995 period. These estimates are broadly consistent with the estimates obtained by conducting growth accounting at an aggregate level (Macklem, 2003).[18]

- In the post-1995 period, the labor productivity gap between the two countries widened not only in the ICT-producing sector, but also in sectors that intensively

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Lee industry conversion rates are updated to 1996 using growth differentials in industries' value added deflators.

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

[18] Recent data revisions by Statistics Canada suggest that the aggregate labor productivity growth gap between Canada and the United States in the 1995–2000 period has been smaller, about ½ percent, than what suggested by the data used in this paper.

used ICT capital.[19] Canada's non–ICT producing manufacturing industries appear to have performed as well, if not better, than their U.S. counterparts. However, a gap emerged in sectors that have been most intensively using new technologies, like the trade and FIRE (Financial, Insurance, and Real Estate) sectors. In particular, labor 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.

C. How Did The Free Trade Agreements Affect Productivity Growth in Canada?

The persistence of the labor productivity gap in the face of the dramatic increase in trade linkages between Canada and the United States has puzzled many observers.[20] Recent works 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 Hecksher-Ohlin framework predict a reallocation of resources towards sectors where a country has comparative advantages. 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 Canadian industry TFP growth is plotted against (1) the degree of vertical specialization and (2) the degree of trade exposure of Canadian sectors.[21] 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

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

[20] See the exchange of ideas between McCallum (1999) and Jackson (1999) on the occasion of the 10th anniversary of the FTA.

[21] 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: the share of an industry's exports in its gross output (capturing its degree of export orientation); the share of an industry's imported intermediate inputs in its gross output (capturing the exposure of an industry on the cost side); and 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). The data, originally up to 1996, have been extrapolated to 2000.

since the inception of the free trade agreement with the United States. In particular, the ICT-producing and transportation equipment sectors seem to have most benefited from exposure to trade and intra-industry specialization over this period.

Moreover, free trade agreements seem to have contributed to convergence in TFP between the two countries. To assess the impact of free trade agreements on the TFP convergence between Canada and the United States, an autoregressive model is estimated, which contains both industry and time specific effects and a structural change in the autoregressive coefficient:[22]

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

where i is the index for industries (i=1..23), t is the index for time (t=1...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_{CUSTA} is a dummy that controls for the impact of CUSTA (from 1990). Table 7 reports the results from the Arellano and Bond (1991) generalized method of moment (GMM) applied to equation (3) in first differences.[23] 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. Further, the estimated negative value of δ (significant at a 10 percent level) indicates that the rate of convergence has increased in the 1990s after the Canada-U.S. 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 the Canada-U.S. Free Trade Agreement on productivity in the manufacturing sector, Sawchuk and Trefler (2002) find that, over the 1989–95 period, tariff cuts raised labor productivity by 3¼ percent per year in the most affected industries, and by ½ percent 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 Canada's manufacturing sector's specialization has hardly changed under the free trade agreement (Head and Reis, 2003).

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[22] Easterly, Fiess, and Lederman (2002) adopt this methodology to assess the impact of NAFTA on the Mexico-U.S. productivity convergence.

[23] As it is well known, the presence of a lagged dependent variable in a fixed-effect model generates biased OLS 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.

D. The Impact of Industrial Structure on the Aggregate Labor Productivity Gap

The evidence showed so far suggest that factors other than trade linkages with the United States have been likely to be at work in driving the Canada-U.S. labor productivity gap. Conducting growth accounting at a sectoral level allows quantifying the role played by the differences in industrial structures between the two economies. This is done by decomposing the aggregate labor 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 labor 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 labor productivity growth;
- and a "reallocation factor," that reflects the different ability of the two economies to direct labor resources (hours worked, h_i) toward sectors with a value-added share that exceeds the labor compensation share (ls_i) (that is, toward sectors with higher-than-average labor productivity level):[24]

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

This decomposition shows that a significant part of the widening labor 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 become a negative contributor in the post-1995 period. This seems to suggest that the widening of the Canada-U.S. labor productivity gap over the second half of

[24] See Faruqui, and others (2002) for a similar decomposition formula. Their conclusion is that most of the business sector labor 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 (4 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.

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 toward high-productivity sectors.

The widening of the aggregate labor productivity gap between Canada and the United States over the second half of the 1990s has been mainly driven by the ICT-producing sector and two major service sectors, trade and FIRE. Figure 13 shows the industries' contribution to the aggregate labor productivity growth gap in the two sub periods, 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 labor productivity growth, whereas the negative contribution from the FIRE sector was largely the result of the lower relative size of the sector in Canada.[25]

VI. Concluding Remarks

The results above illustrate that while free trade has helped promote the integration of the U.S. 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 percent 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 favor of a Canada-U.S. 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.

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[25] 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 U.S. 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.

The paper also shows that the widening labor productivity gap between the two economies over the 1990s is a reflection of the differences in the two countries' industrial structure. 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 lagging in some industries that have been intensively using ICT capital, especially in the service sector. In this paper, the industries' contribution to the aggregate labor productivity gap is weighted through their relative value added shares, and also reflects the economy's ability to reallocate resources from lower towards more productive sectors. From this perspective, the United States have been able to take a much larger benefit from the dramatic acceleration of labor 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, something that appears to have contributed positively to their TFP performance over the last 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 MFN tariffs—which is under discussion among the NAFTA partners—could boost NAFTA's GDP by as much as 2–3 percent (Policy Research Initiative, 2003).[26]

[26] 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 Estevardeordal 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, labor 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 a NAICS industry classification (starting from 1997).

Comparing the 1997 industries' value added based on the two industry classifications shows that the difference is generally around 15 percent, except for "other manufacturing sector" and "furniture and fixture," for which the difference is around 30 percent. 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 follows 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" by industry (GPO). As these figures are on a market-price basis, value-added data at basic prices were obtained by subtracting the indirect business tax and nontax liability from GPO.

GDP by industry is obtained from industries components of domestic income which, as it is well known, tend to falls 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, labor input and capital services were obtained from Jorgenson, Ho, and Stiroh (2004), 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 Unites States by aggregating four subsectors (namely, metal mining, coal mining petroleum and gas and nonmetallic mining).

The aggregation was needed also 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 the sake of comparison, the two sectors were aggregated into one large sector, which is taken as a proxy for the ICT-producing sector in the paper.

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

Despite following these aggregation procedures allows to obtain reasonably comparable sectors for the two countries, some minor differences still persist, particularly in the service sectors. In addition to the different treatment of eating and drinking places (see footnote 25 in the text), another difference which is worth mentioning regards postal services, which are placed in the Communication 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 (Calgary: The University of Calgary Press).

Arellano, M. and S.R. Bond, 1991, "Some Tests of Specification for Panel Data: Monte Carlo Evidence and An Application to Employment Equations," *Review of Economic Studies*, Vol. 58, 277-97

Arora, V., and O. Jeanne, 2001, "Economic Integration and the Exchange Rate Regime: Some Lessons from Canada," IMF Policy Discussion Paper No. 01/1 (Washington).

Armstrong, P., T. Harchaoui, C. Jackson, and F. Tarkhani, 2002, "A Comparison of Canada-US Economic Growth in the Information Age, 1981–2000," Statistics Canada Research Paper Series, No. 001 (Ottawa).

Baldwin, J. and J. Chowhan, 2003, "The Impact of Self-Employment on Productivity Growth in Canada and the US," in *Canadian Economic Observer*, August, Vol. 16, No. 08.

Baldwin, J. 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 Annual Meeting of the Canadian Economics Association, Carleton University, Ottawa, Canada, May 30–June 1, 2003.

Bayoumi, T., and B. Eichengreen, 1994, "Monetary and Exchange Rate Arrangements for NAFTA," *Journal of Development Economics,* Vol. 43, pp. 125–65.

Blanchard, O. and J. Simon, 2001, "The Long and Large Decline in U.S. Output Volatility," *Brookings Papers on Economic Activity*, Vol. 1, pp. 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 Financ*e, Vol. 13, pp. 21–39.

Clausing, K.A., 2001, "Trade creation and trade diversion in the Canada-United States Free Trade Agreement," *Canadian Journal of Economics*, Vol. 34, pp. 677–96.

Courchene, T., 2003, "FTA at 15, NAFTA at 10: a Canadian perspective on North American Integration," *North American Journal of Economics and Financ*e, Vol. 14, pp. 263–85.

Crawford, A., 2002, "Trends in Productivity Growth in Canada," *Bank of Canada Review*, Spring (Ottawa).

Debb, A., 2001, "Testing for a Structural Break in the volatility of Real GDP Growth in Canada," Bank of Canada Working Paper, No. 2001–9 (Ottawa).

Department of Foreign Affairs and International Trade (DFAIT), 2003, "NAFTA @ 10– A Preliminary Report," Minister of Public Works and Government Services Canada, 2003, ISBN 0-662-67423-5, Catalogue number: E2-487/2003 (Ottawa).

Dion, R., 1999, "Trends in Canada's Merchandise Trade," *Bank of Canada Review*, Winter 1999–2000 (Ottawa).

Dobson, W., 2002, "Shaping the future of the North American Economic Space: A Framework for Action," C.D. Howe Institute Commentary, No. 162 (Toronto).

Doyle, B., and J. Faust, 2003, "Breaks in the Variability and Comovement of G-7 Economic Growth," Federal Reserve Board International Finance Discussion Papers Series, No. 2003/786 (Washington: Federal Reserve Board).

Easterly, W., N. Fiess, and D. Lederman, 2002, "NAFTA and Convergence in North America: High Expectations, Big Events, and Little Time," Working Paper, World Bank (Washington).

Estevadeordal, A., and K. Suominen, 2004, "Rules of Origin: A World Map and Trade Effects," unpublished paper, Inter-American Development Bank (Washington).

Faruqui, U., M. Laroche, M. Woollat, W. Gu, J.P. Maynard, and M. Kaci, 2002, "Differences in Productivity Growth: Canadian-U. S. Business Sector, 1987–2000," *Monthly Labor Review*, April, pp. 16–29.

Ghosh, M., and S. Rao, 2004, "Economic Impacts of a Possible Canada-U.S. Customs Union: A Dynamic CGE Model Analysis," Industry Canada Working Paper, No. 0508 (Ottawa).

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 (Calgary: University of Calgary Press).

Goldfarb, D., 2003, "Beyond Labels: Comparing Proposals for Closer Canada-U. S. Economic Relations," C. D. Howe Institute Backgrounder, No. 76 (Toronto).

Gordon, R., 2003, "High Tech Innovation and Productivity Growth: Does Supply Create its Own Demand?," NBER Working Papers, No. 9437 (Cambridge).

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*, Vol. 12, 283–300.

Gust, C. and J. Marquez, 2004, "International Comparison of Productivity Growth: the Role of Information Technology and Regulatory Practices," *Labour Economics,* Vol. 11, No. 1, pp. 33–58.

Hall, R.E. and C.I. Jones, 1996, "The Productivity of Nations," NBER Working Paper, No. 5812 (Cambridge).

Harchaoui, T. and F. Tarkhani, 2002, "Information Technology and Productivity Growth in Canada and the United States: a Comprehensive Examination," unpublished paper, Statistics Canada (Ottawa).

Harris, R. 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).

Heathcote, J. and F. Perri, 2003, "Why Has the U.S. Economy Become Less Correlated with the Rest of the World?" *American Economic Review*, Papers and Proceedings, Vol. 69, No. 2, pp. 63–69.

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 (Calgary: University of Calgary Press).

Helbling, T., and T. Bayoumi, 2003, "Are They All in the Same Boat? The 2000–01 Growth Slowdown and the G-7 Business Cycle Linkages," IMF Working Paper, No. 03/46 (Washington).

Ho, M., S. Rao, and J. Tang, 2003, "Sources of Output Growth in Canadian and U.S. Industries in the Information Age," unpublished paper, Industry Canada (Ottawa).

Hufbauer, G.C., and J.J. Schott, 1992, "North American Free Trade: Issues and Recommendations," Institute for International Economics, (Washington).

Hummels, D., D. Rapaport, K. Yi, 1998, "Vertical Specialization and the Changing Nature of World Trade," *Economic Policy Review*, June, pp. 79–99.

Jackson, A., 1999, "From Leaps of Faith to Lapses of Logic," *Policy Options*, Institute for Research on Public Policy, June (Montreal).

———, 2003a, "Why the Big Idea is a Bad Idea: A Critical Perspective of Deeper Economic Integration With the United States," Canadian Labor Congress Research Paper, No. 20 (Ottawa)

———, 2003b, "From Leaps of Faith to Hard Landings: Fifteen Years of "Free Trade," Canadian Labor Congress Research Paper, No.28 (Ottawa).

Jorgenson, D., M. Ho, and K. Stiroh, 2004, "Growth of U.S. Industries and Investments in Information Technology and Higher Education", in Measuring Capital in a New Economy edited by C. Corrado, C. Hulten, and D. Sichel (Chicago: University of Chicago Press).

Kalemli-Ozcan, S., B. Sorensen, and O. Yosha, 2003, "Risk Sharing and Industrial Specialization: Regional and International Evidence," *American Economic Review*, Vol. 93, pp. 903–18.

Khan, H. and M. Santos, 2002, "Contribution of ICT Use to Output and Labor Productivity Growth in Canada," Bank of Canada Working Paper, No. 2002–7 (Ottawa).

Kose, M.A., G. Meredith, and C. Towe, 2004, "How Has NAFTA Affected the Mexican Economy?," IMF Working Paper, No. 04/59 (Washington).

Kose, M.A., C. Otrok, and C. Whiteman, 2003, "International Business Cycles: World, Region, and Country Specific Factors," *American Economic Review*, Vol. 93, pp. 1216–39

———, 2004, "Understanding the Evolution of World Business Cycles," forthcoming in IMF Working Paper Series (Washington).

Kose, M. A., E.S. Prasad, and M. Terrones, 2003, "How Does Globalization Affect the Synchronization of Business Cycles?" *American Economic Review,* Papers and Proceedings, Vol. 93, pp. 57–62.

———, 2004, "Volatility and Comovement in a Globalized World Economy: An Empirical Exploration," in *Macroeconomic Policies in the World Economy*, edited by Horst Siebert, forthcoming (Berlin: Springer-Verlag).

Kose, M.A. and K. Yi, 2001, "International Trade and Business Cycles: Is Vertical Specialization the Missing Link?" *American Economic Review*, Papers and Proceedings, Vol. 91, pp. 371–75.

Krueger, A.O., 1999, "Trade Creation and Trade Diversion under NAFTA," NBER Working Paper, No. 7429 (Cambridge).

———, 2000, "NAFTA's Effects: A Preliminary Assessment," *The World Economy*, Vol. 23, No. 6, pp. 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 (Ottawa).

Leung, D. 2004, "The Effect of Adjustment Costs and Organizational Change on Productivity in Canada: Evidence from Aggregate Data," Bank of Canada Working Paper, No. 2004–1 (Ottawa).

Macklem, T., 2003, "Future Productivity Growth in Canada: Comparing to the United States," *International Productivity Monitor*, No.7, Fall.

McCallum, J., 1999, "Two Cheers for the FTA," *Policy Options*, Institute for Research on Public Policy, June (Montreal).

McMahon, F., M. Curtis, and A.O. Adegoke, 2003, "The Unseen Wall: The Fraser's Institute's 2003 Trade Survey," Fraser Institute Public Policy Sources, No.76 (Vancouver).

Mirus, R., and K. Hoffmann, 2004, "Estimating Potential Savings from Streamlining Tariffs Among NAFTA Partners: An Alberta Perspective," unpublished paper.

Murray, J., 2000, "Why Canada Needs a Flexible Exchange Rate Regime?" *North American Journal of Economics and Finance*, Vol. 11, pp. 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*, Vol. 14, pp. 107–240.

Organization of Economic Cooperation and Development (OECD), 2001, "OECD Productivity Manual: a Guide to the Measurement of Industry-Level and Aggregate Productivity Growth" (Paris).

Oliner, S.D. and D. E. Sichel, 2002, "Information Technology and Productivity: Where Are We Now and Where Are We Going?" *Economic Review*, Federal Reserve Bank of Atlanta, Vol. 87, No. 3, pp. 15–44.

Policy Research Initiative, 2003, "The North American Linkages Project: Focusing the Research Agenda," Policy Research Initiative, Privy Council Office (Ottawa). Available online at www.policyresearch.gc.ca.

Robidoux, B., 2003, "Future Productivity Growth in Canada: The Role of Service Sector," *International Productivity Monitor*, No.7, Fall.

Romalis, J., 2002, "NAFTA's and CUSFTA's Impact on North American Trade," unplished paper, University of Chicago, July. Available online at 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, 117-79, in *North American Linkages: Opportunities and Challenges for Canada*, edited by R. G. Harris (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 (Calgary: University of Calgary Press).

Schwanen, D., 1997, "Trading Up: The Impact of Increased Continental Integration on Trade, Investment, and Jobs in Canada," C. D. Howe Institute Commentary (Toronto).

Stock, J. H., and M.W. Watson, 2003, "Understanding Changes in International Business Cycle Dynamics," NBER Working Paper, No. 9859 (Cambridge).

Tang, F. and J. Lee, 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 Dale Jorgenson and Franck Lee, Industry Canada Research Volume (Ottawa).

Trefler, D., 2001, "The Long and Short of the Canada-U.S. Free Trade Agreement," NBER Working Paper No. 8923 (Cambridge).

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 3621 (Washington).

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*, No. 85(2): 13–26.

Table 1: Canada: Merchandise Trade with the United States
(Share of Total Exports and Imports in percent)

Exports	1989	2002	Change (1989-2002)
Transportation Equipment	32.8	27.0	-5.8
Machinery & Electronics	14.6	13.7	-0.9
Metals & Minerals	21.3	21.7	0.4
Wood & 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 & Electronics	33.6	30.6	-3.0
Metals & Minerals	11.3	10.9	-0.4
Chemicals & Plastic & Rubber	10.0	14.8	4.8
All Others	17.0	18.2	1.2

Source: DFAIT (2003).

Table 2. Canada: Composition of Trade
(Share of Total Exports and Imports in Percent)

	Exports			Imports		
	1960	1980	2001	1960	1980	2001
Manufactures	32.5	48.1	62.4	69.0	71.7	82.9
Agriculture & Food	36.5	23.4	13.0	16.2	9.6	7.0
Fuel & 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
(In percent)

	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
of which				
Industrial Machineries and Electrical and Electronic equip.	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

Source: Fund staff estimates.

Table 4. Variance Decompositions

(In percent)

Factors/Periods	Output 33%	Output Median	Output 66%	Consumption 33%	Consumption Median	Consumption 66%	Investment 33%	Investment Median	Investment 66%
				Canada					
60:1-81:2									
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
81:3-02:4									
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					
60:1-81:2									
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
81:3-02:4									
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

Notes: 33 percent and 66 percent refer to the confidence intervals of the median.
Source: Fund staff calculations.

Table 5. Canada and the United States: ICT Capital Accumulation

(In percent)

	1981-95		1995-2001	
	Canada	United States	Canada	United States
Investment (average rate of growth) 1/				
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) 2/				
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 2/	6.3	10.9	8.3	15.3
ICT share of capital stock 3/	3.9	7.0	6.4	11.7

1/ Source: Haver Analytics.
2/ Source: Harchaoui and Tarkhani (2002).
3/ Sources: Armstrong et al. (2002) for Canada and BEA for the United States.
Values are for 1981 and 2000.

Table 6. Canada and the United States: Productivity Growth, 1982-2000
(In percent)

	Canada				United States			
		Contribution from:				Contribution from:		
	Labor productivity	Capital	Labor quality	TFP	Labor productivity	Capital	Labor quality	TFP
Agriculture	3.7	0.1	0.5	3.1	4.3	0.3	0.3	3.7
Mining	2.2	2.1	0.2	-0.1	4.3	2.9	0.2	1.2
Construction	-0.6	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	0.6	0.9	0.2	-0.5
Rubber and Plastic	2.2	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	3.0	1.0	0.5	1.5
Lumber and Wood	2.0	0.3	0.4	1.3	0.1	-0.6	0.4	0.2
Furniture and fixture	1.3	-0.5	0.2	1.7	1.0	0.3	0.6	0.2
Paper and allied products	3.2	1.9	0.2	1.1	1.5	1.0	0.3	0.2
Printing and publishing	-0.7	0.3	0.3	-1.3	-1.0	1.1	0.3	-2.3
Primary metal	5.2	0.7	0.3	4.3	2.1	0.7	0.4	1.0
Fabricated metal	1.5	-0.4	0.2	1.6	2.2	0.4	0.4	1.3
Ind. Mach. & Elect. Equipment	5.8	1.3	0.3	4.2	11.0	1.3	0.5	9.2
Transportation equipment	4.2	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	2.2	0.3	0.4	1.5
Chemical and chemical products	4.1	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	5.7	1.1	0.4	4.2
Transportation	2.3	0.5	0.4	1.4	1.7	-0.1	0.3	1.5
Communications	3.1	1.8	0.8	0.5	3.9	2.8	0.2	0.9
Utilities	1.3	0.1	0.1	1.1	3.1	2.0	0.1	0.9
Trade	2.4	0.5	0.5	1.3	3.5	1.2	0.2	2.0
FIRE	1.7	1.5	0.5	-0.3	1.2	1.5	0.2	-0.5
Other Services	-0.2	0.8	0.7	-1.7	-0.2	0.6	0.2	-1.1
Total	1.6	0.8	0.4	0.6	2.0	1.1	0.3	0.8

Canada and the United States: Productivity Growth, 1982-95
(In percent)

	Canada				United States			
		Contribution from:				Contribution from:		
	Labor productivity	Capital	Labor quality	TFP	Labor productivity	Capital	Labor quality	TFP
Agriculture	3.0	-0.7	0.6	3.1	3.7	0.1	0.4	3.2
Mining	3.3	1.8	0.2	1.2	5.7	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 fixture	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. & 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
Chemical 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

Table 6 (cont.). Canada and the United States: Productivity Growth, 1995-2000
(In percent)

	Canada				United States			
	Labor productivity	Contribution from:			Labor productivity	Contribution from:		
		Capital	Labor quality	TFP		Capital	Labor quality	TFP
Agriculture	5.3	2.2	0.3	2.8	3.2	0.6	0.2	2.4
Mining	-0.8	2.5	0.1	-3.4	1.2	1.9	0.0	-0.7
Construction	-0.4	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	-0.7	1.3	0.1	-2.2
Rubber and Plastic	-0.6	-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	2.5	1.7	0.2	0.6
Lumber and Wood	1.5	1.3	0.3	0.0	0.2	0.5	0.2	-0.5
Furniture and fixture	2.6	-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	-1.2	1.1	0.2	-2.4
Printing and publishing	0.4	0.1	0.0	0.3	-0.3	1.5	0.2	-2.0
Primary metal	2.8	0.2	-0.1	2.7	1.8	0.7	0.2	0.9
Fabricated metal	1.9	-1.0	0.0	2.9	1.4	0.6	0.3	0.5
Ind. Mach. & Elect. Equipment	7.4	1.5	-0.4	6.3	16.9	2.3	0.4	14.2
Transportation equipment	3.7	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	1.3	1.3	0.3	-0.2
Chemical and chemical products	3.9	-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	6.2	1.3	0.4	4.5
Transportation	1.7	0.8	0.3	0.6	1.7	0.9	0.2	0.5
Communications	3.3	2.7	2.0	-1.3	2.3	2.2	0.1	0.1
Utilities	3.3	-1.0	-0.2	4.5	4.0	2.6	0.1	1.4
Trade	3.0	0.8	0.6	1.6	5.4	1.7	0.1	3.6
FIRE	2.7	1.3	0.2	1.2	2.8	2.0	0.2	0.6
Other Services	0.6	0.5	0.7	-0.7	0.0	1.0	0.3	-1.3
Total	1.8	0.8	0.3	0.9	2.6	1.5	0.2	1.1

Source: Fund staff estimates.

Table 7. Estimation of TFP Convergence Equation 1/

	All sectors	Manufacturing
TFP^{Can-US} (-1)	0.79	0.69
	(0.00)	(0.00)
D_{CUSTA}*TFP^{Can-US} (-1)	-0.06	-0.11
	(0.09)	(0.14)
D_{CUSTA}	-0.04	-0.06
	(0.00)	(0.00)
no. of observations	414	252
Sargan test (p-value)	0.74	0.34
AR(2) test (p-value)	0.59	0.21

1/ Dependent variable: log-TFP differential (Canada minus United States)
Yearly data, covering 23 industries for the period 1981-2000.
Year dummies are not reported. Numbers in brackets are p-values,
based on heteroskedastic robust standard errors.

Table 8. Canada - U.S. Labor Productivity Growth Gap

(In percent)

Contribution from:	1982-2000	1982-95	1995-2000
Direct Effect	-0.4	-0.3	-0.5
of which:			
Industrial Mach. and Electrical and Electronic equip.	-0.2	-0.2	-0.4
Transportation equipment	0.1	0.0	0.1
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: Fund staff estimates.

Figure 1. United States: Average Tariffs on Imports from Canada and World

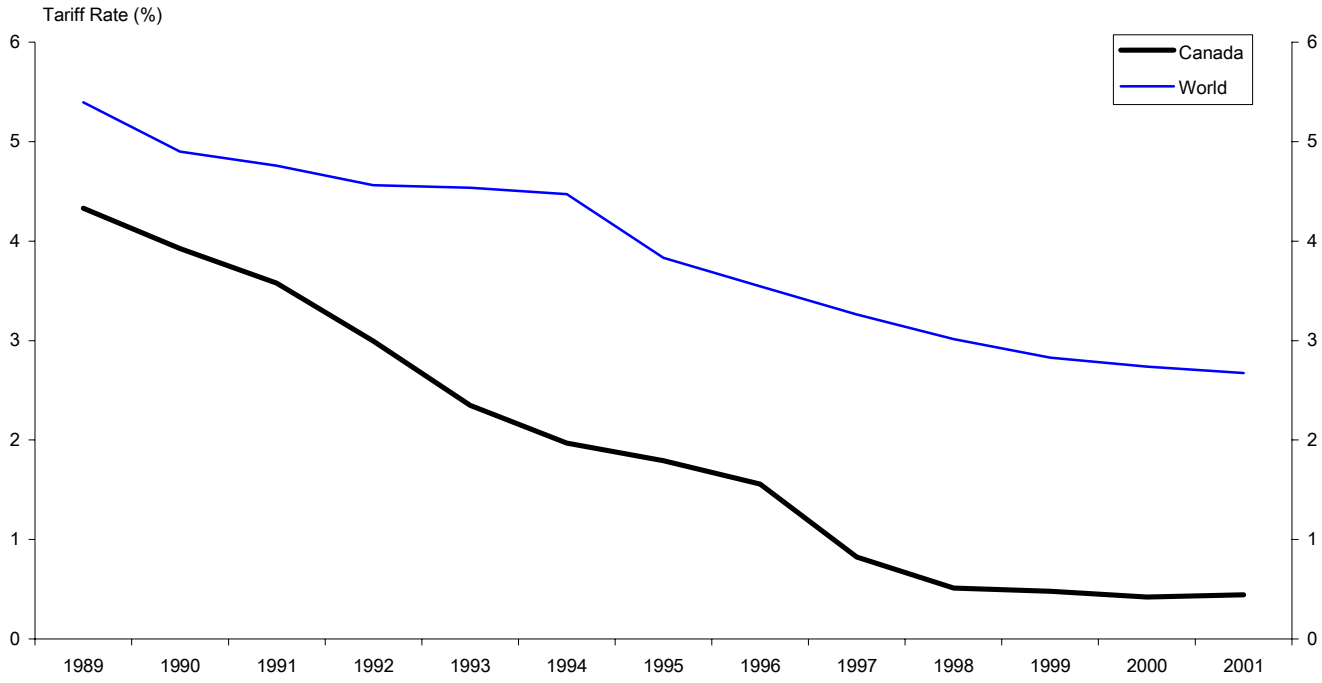

Figure 2. Canada: Average Tariffs on Manufacturing Imports from the U.S. and Rest of World

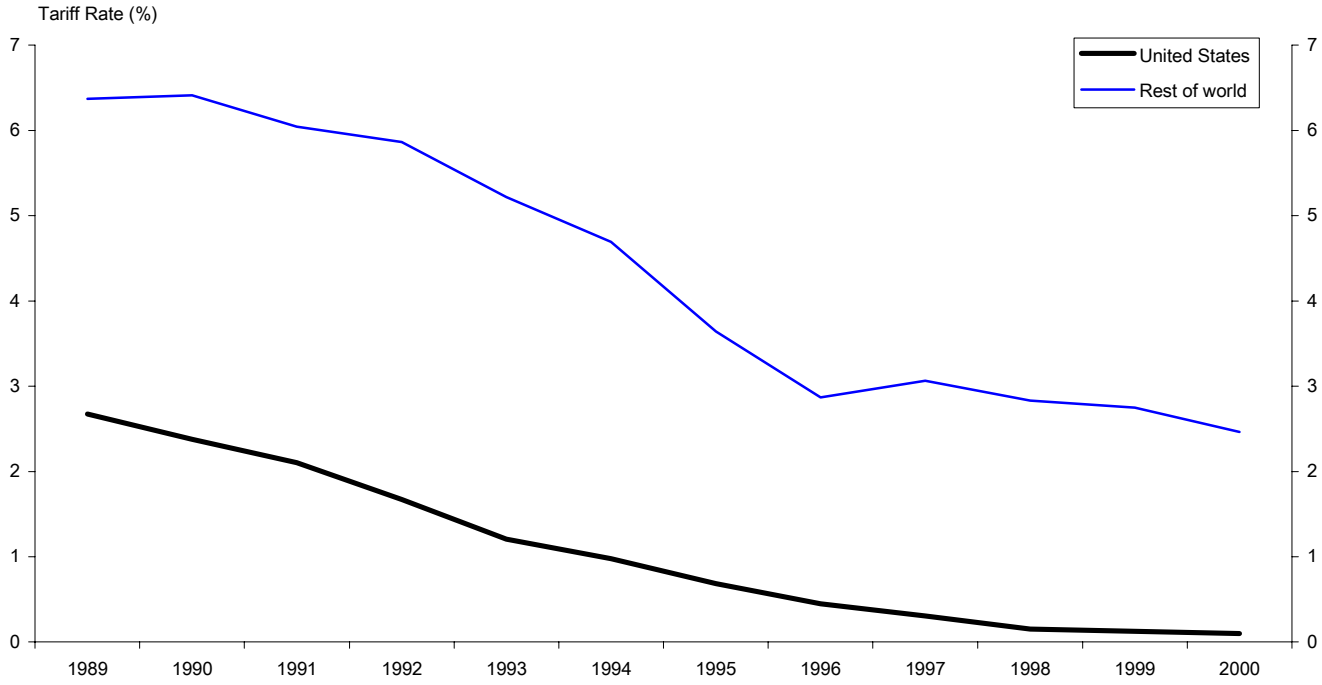

Figure 3a. Trade with the U.S. and GDP

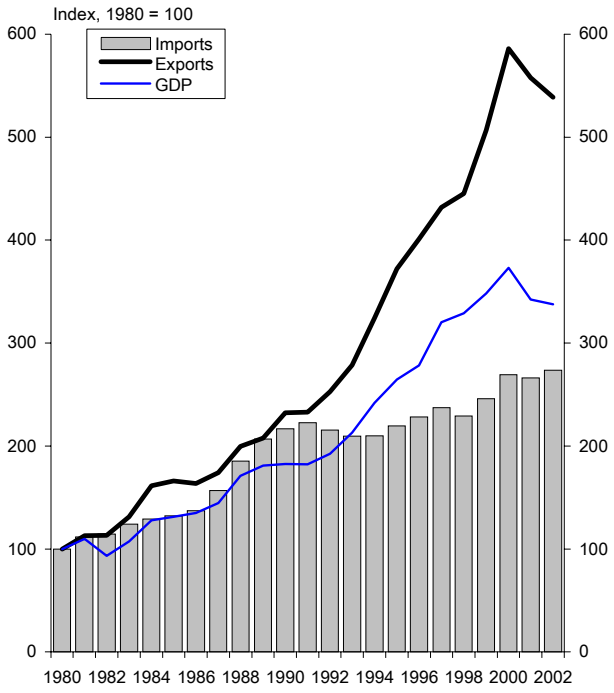

Figure 3b. Trade with the U.S. as a Share of GDP

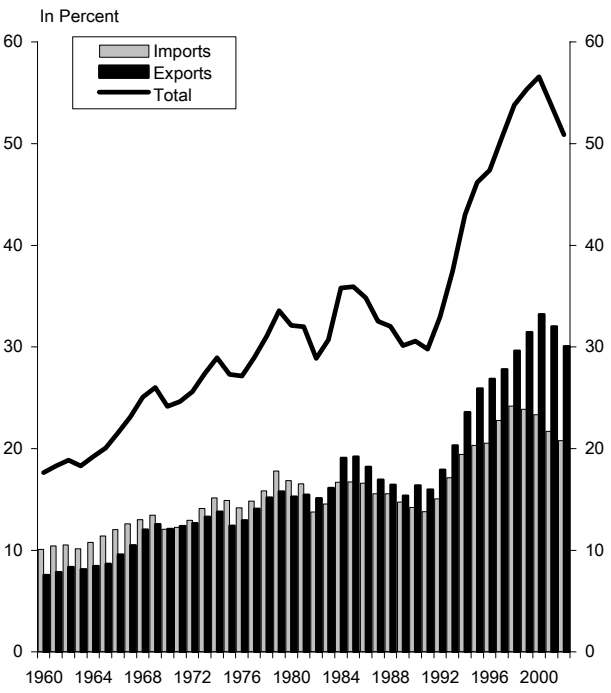

Figure 3c. Trade with the U.S. as a Share of Total

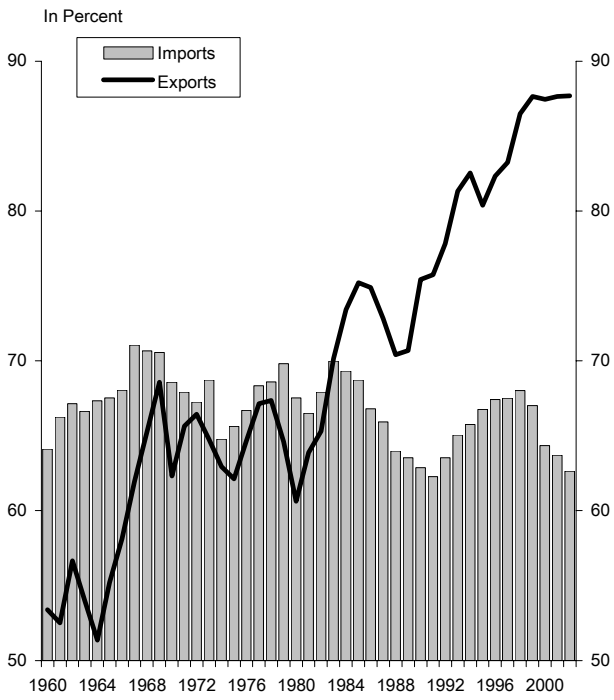

Figure 3d. Canada: Sectoral Exports to the U.S.

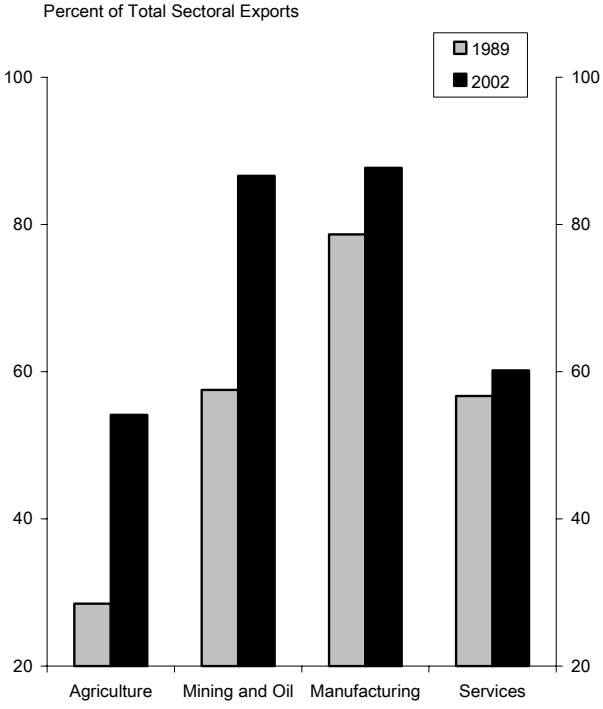

Figure 4a. Contributions to GDP Growth

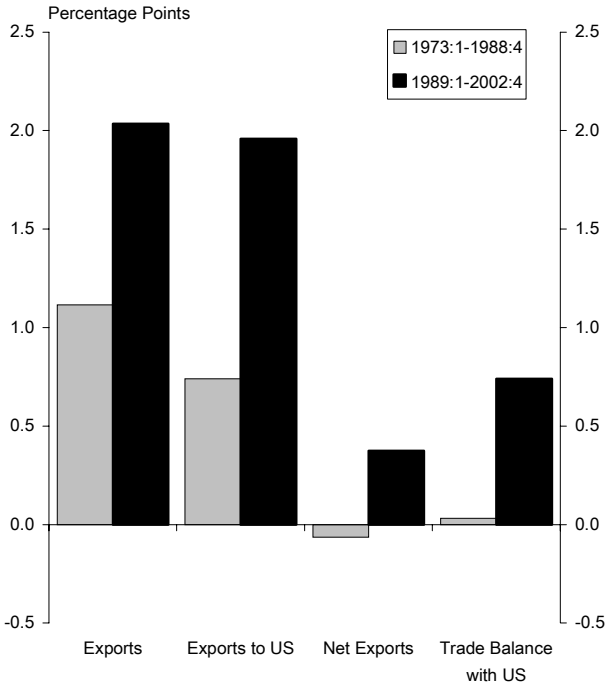

Figure 4b. Exports to the U.S. by Region

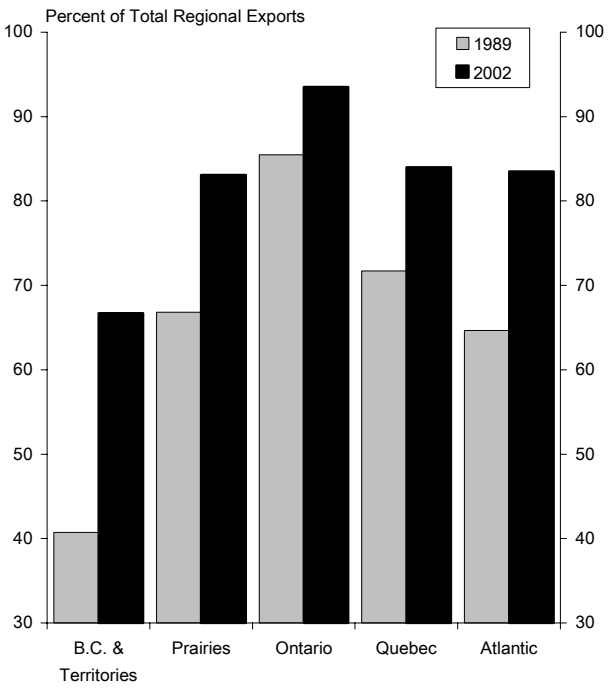

Figure 4c. Regional Exports to the U.S.

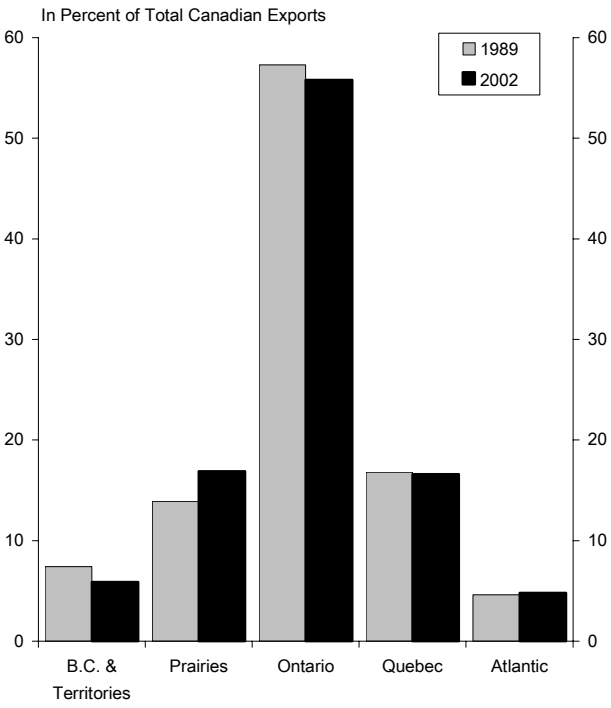

Figure 4d. Vertical Specialization

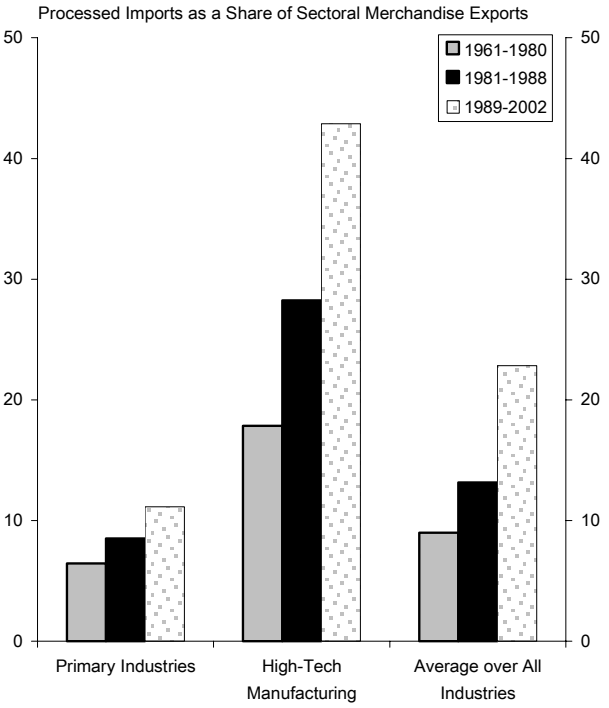

Figure 5a. Canada-U.S. FDI Flows

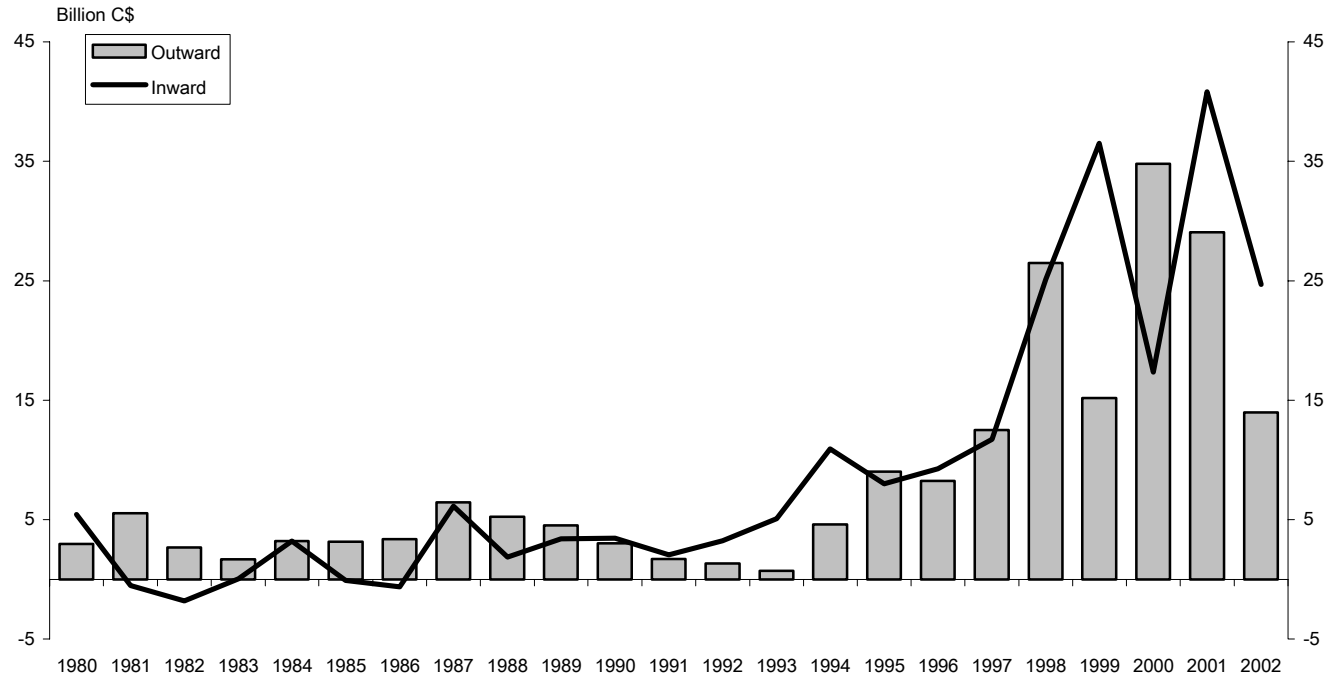

Figure 5b. Canada: FDI Flows as a Fraction of Domestic Investment

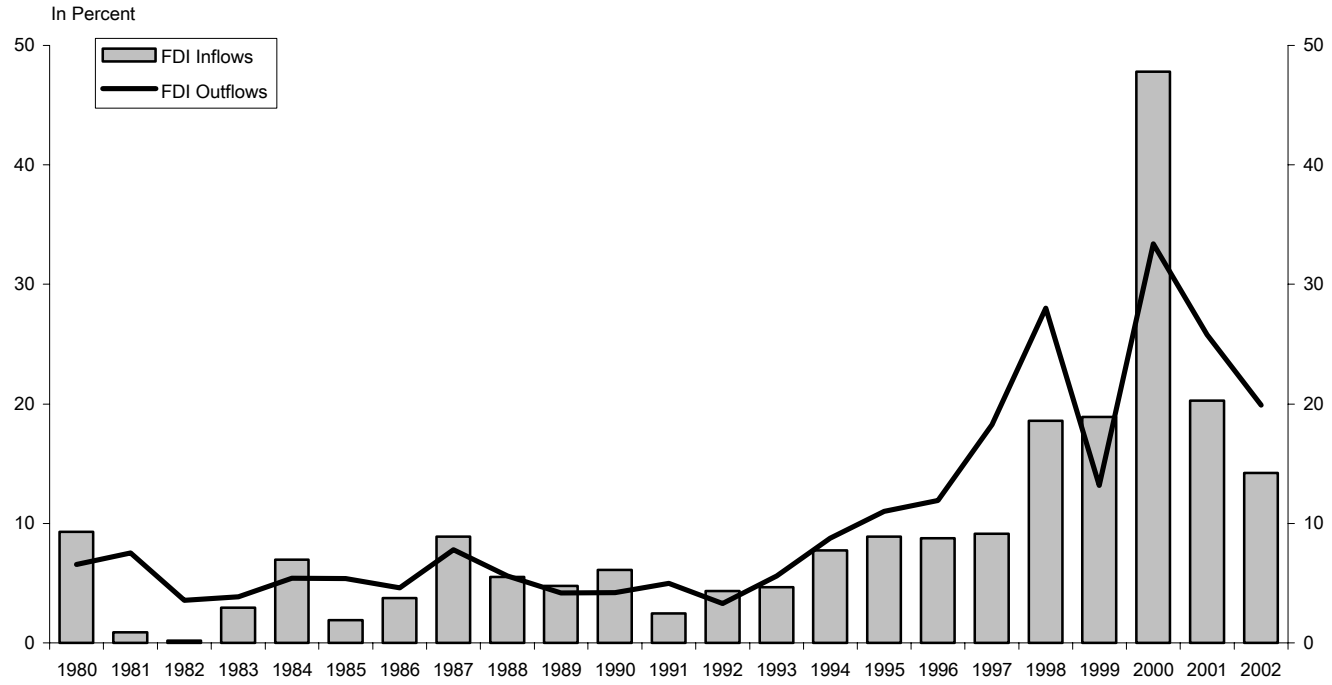

Figure 6. Canada and the United States: Comovement of Economic Variables

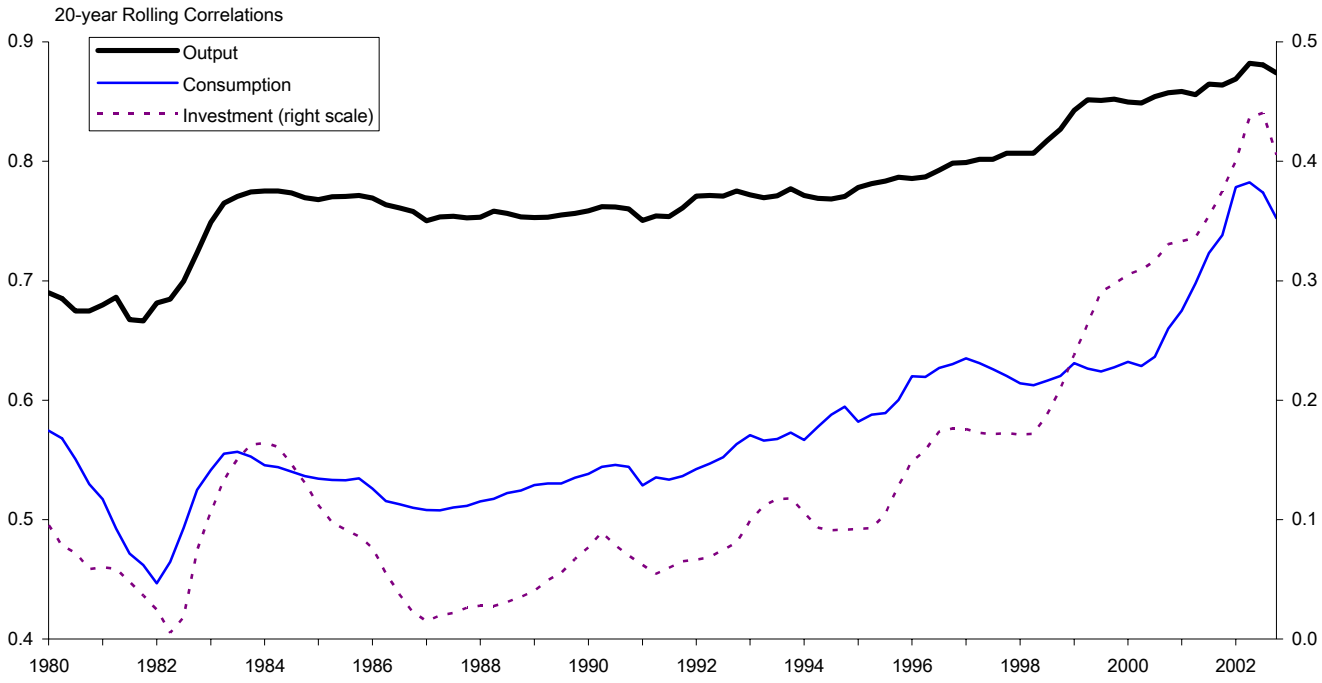

Figure 7. Canada and the United States: Comovement of Economic Variables

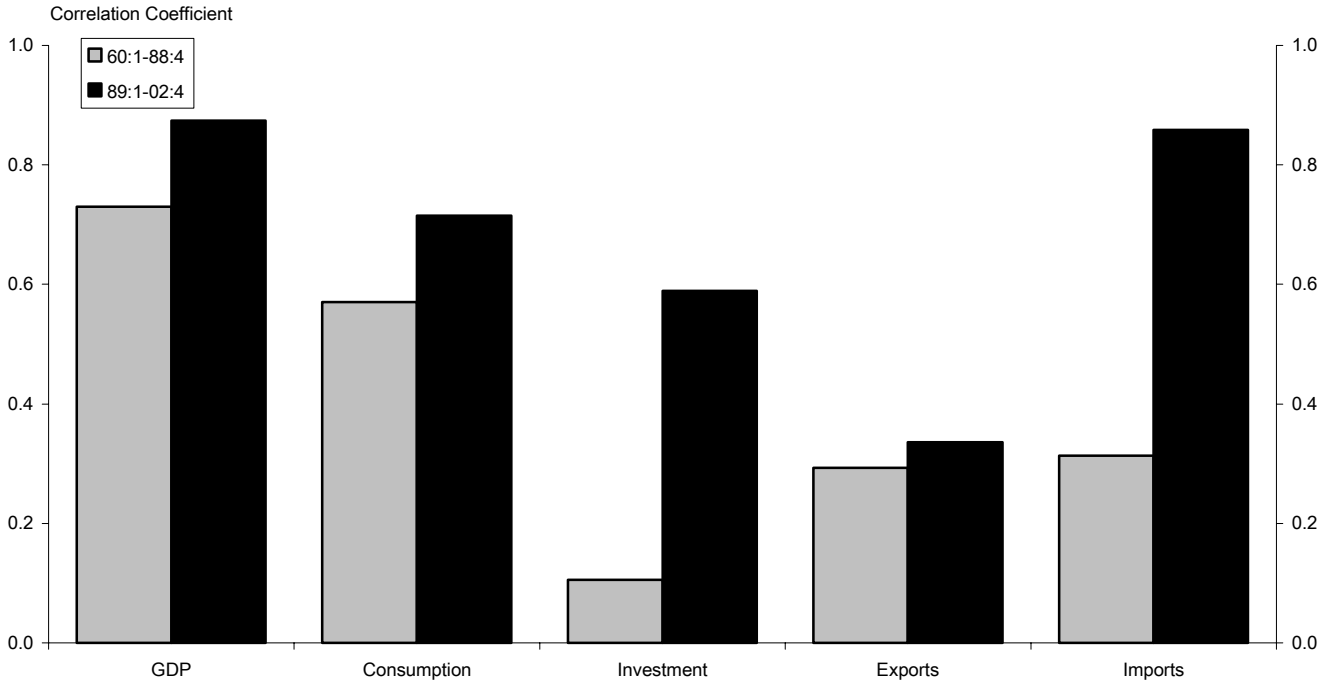

Figure 8a. World Factor

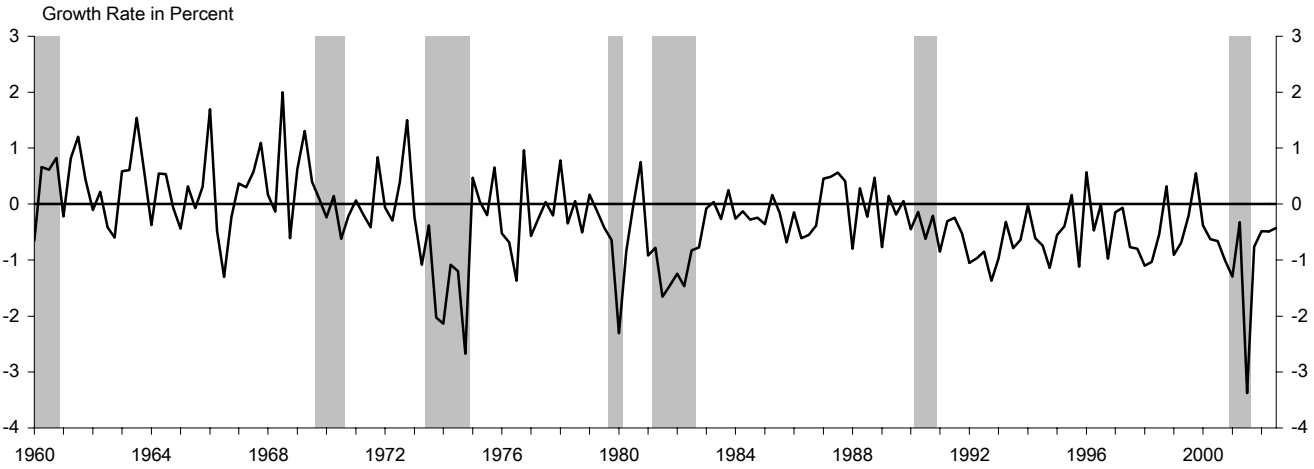

Figure 8b. Canada: Country Factor and GDP

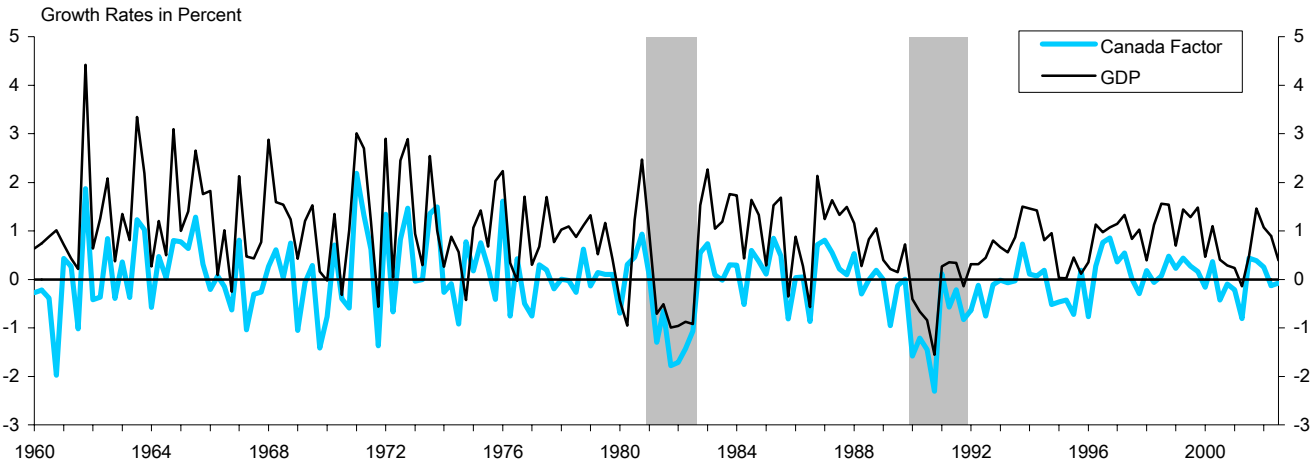

Figure 8c. United States: Country Factor and GDP

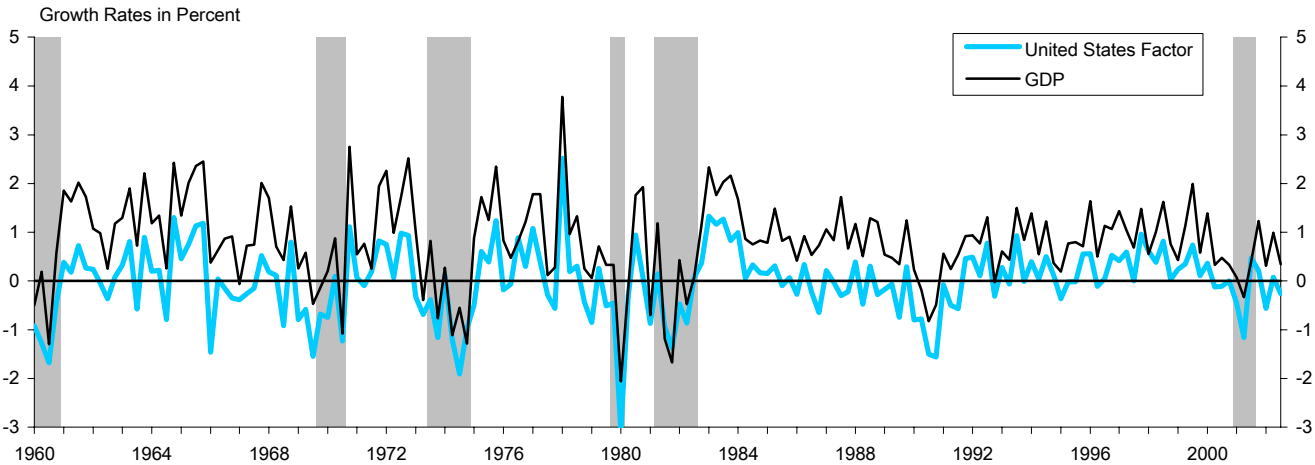

Figure 9a. Variance of Output Explained by Each Factor (60:1-02:4)

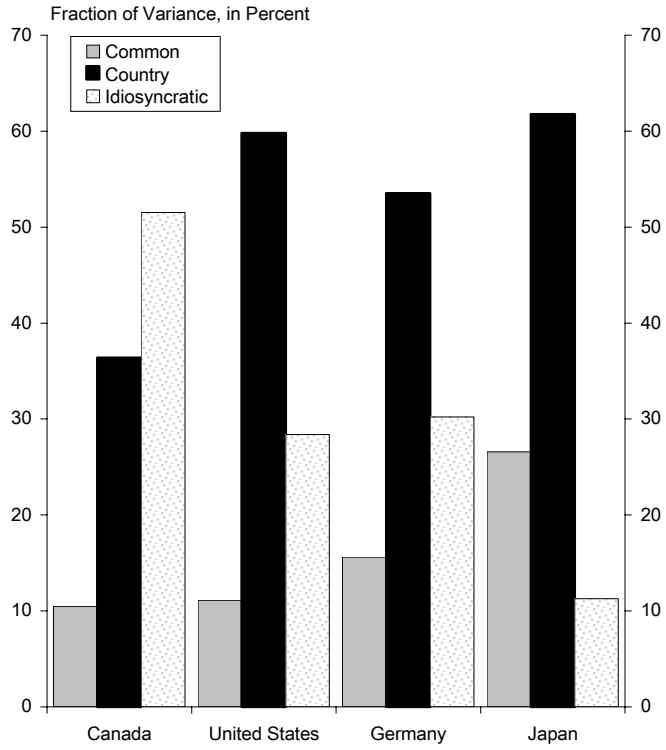

Figure 9b. Variance of Output Explained by the Common Factor

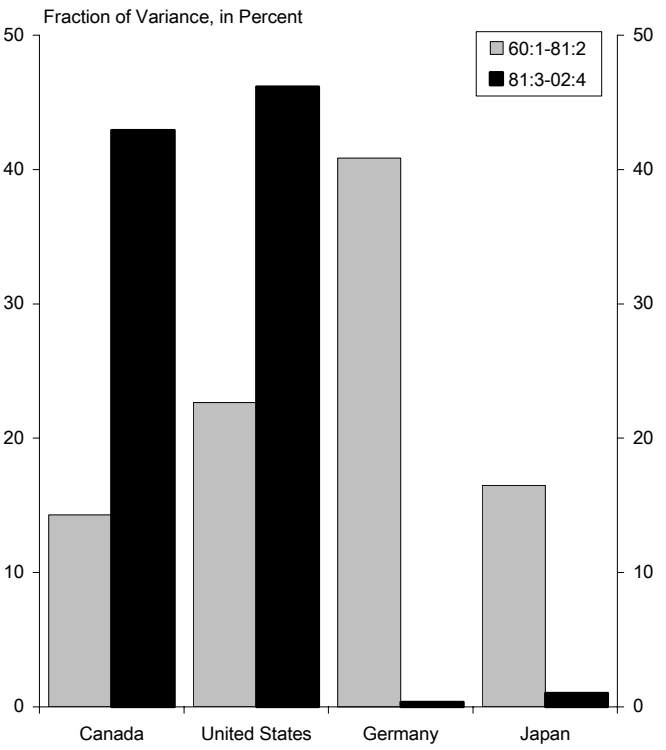

Figure 9c. Variance of Consumption Explained by the Common Factor

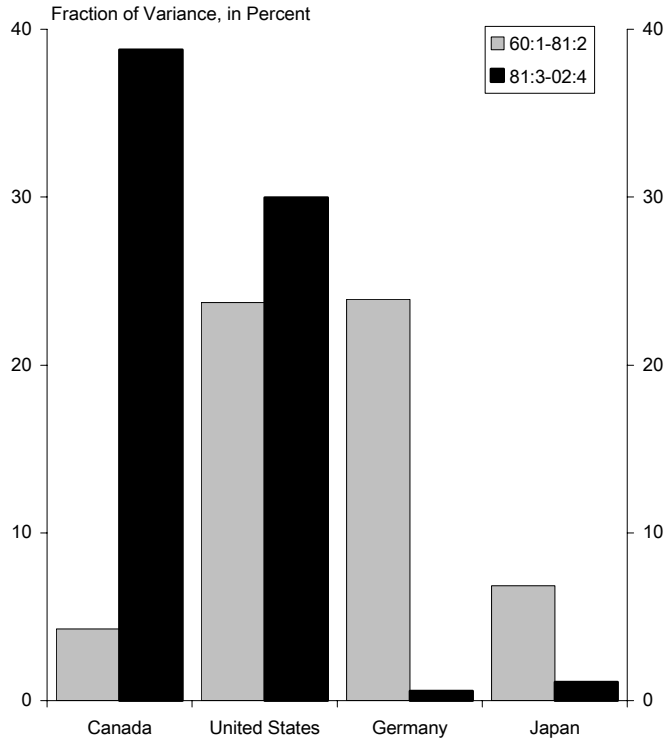

Figure 9d. Variance of Investment Explained by the Common Factor

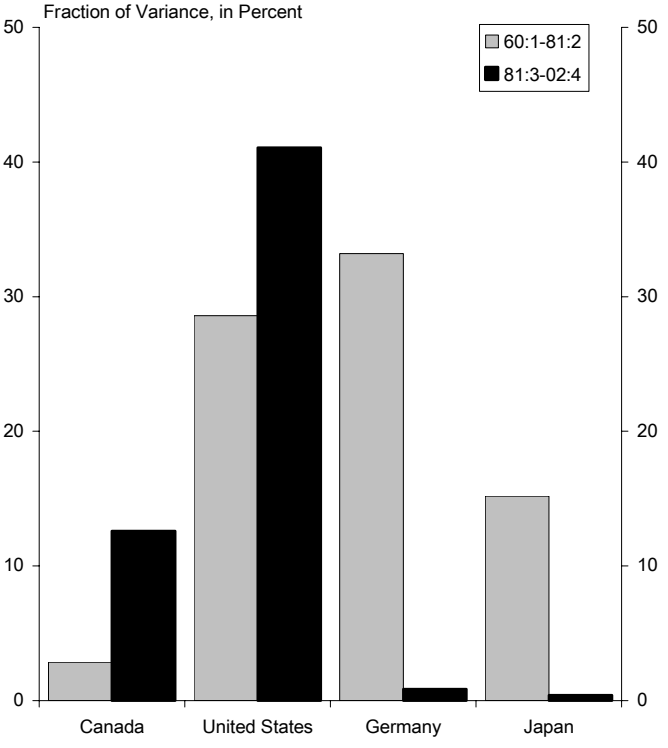

Figure 10. Canada: Volatility of Business Cycles

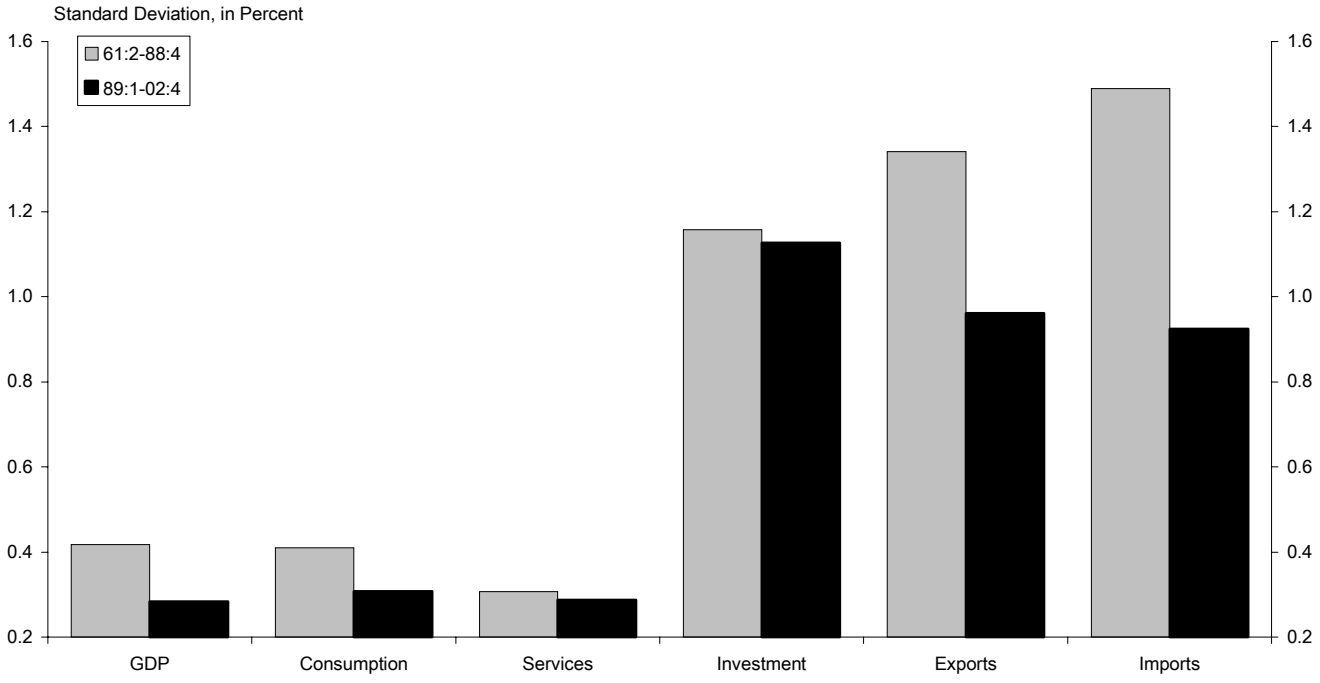

Figure 11. United States and Canada: Income and Productivity Indicators

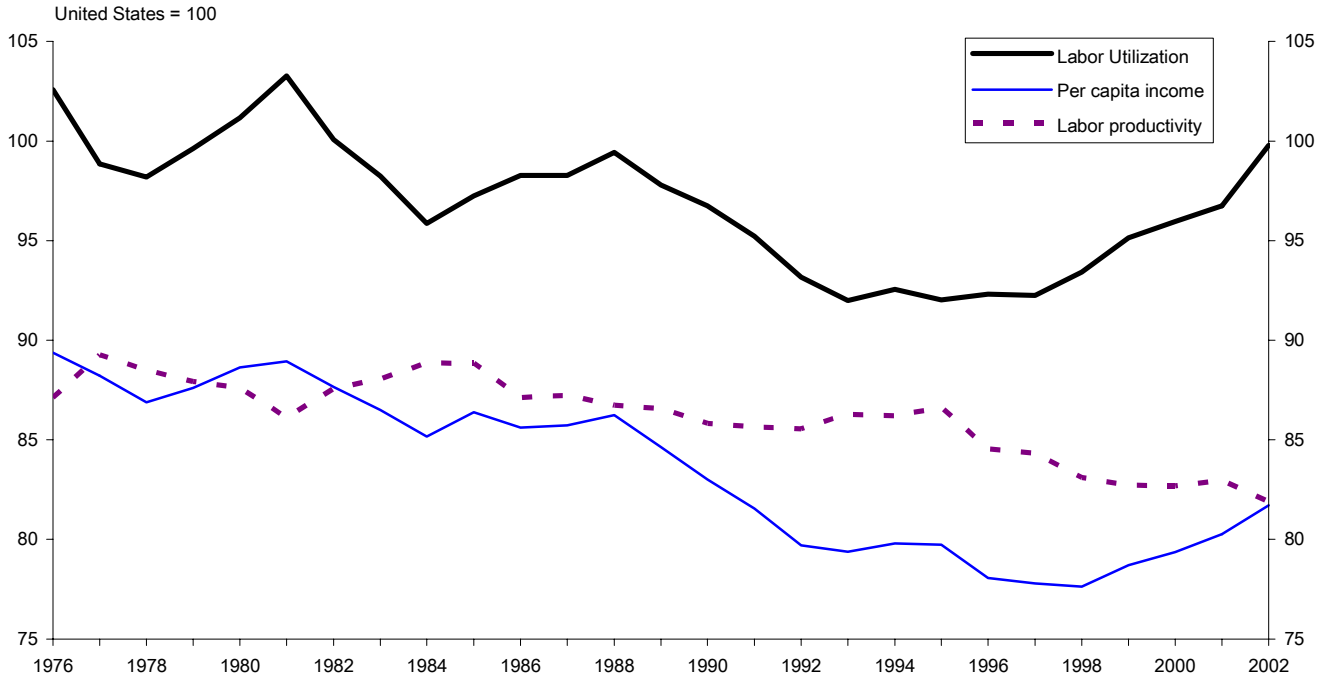

Figure 12a. Trade Exposure and TFP Growth

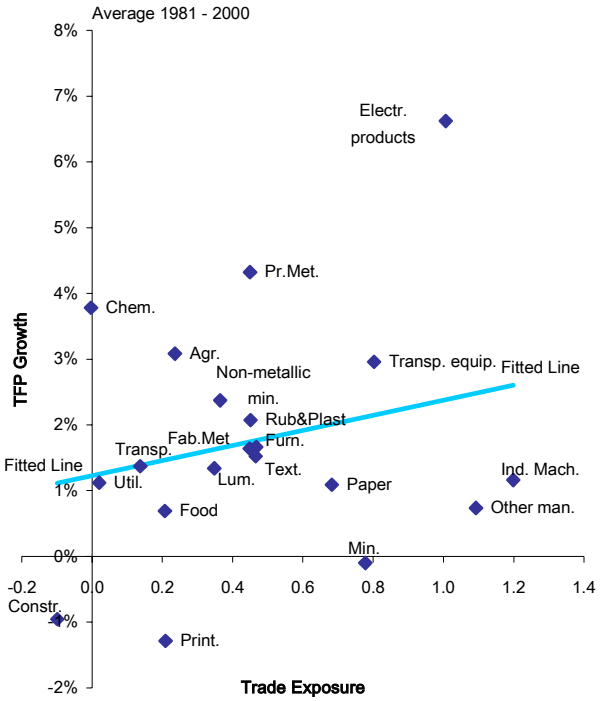

Figure 12b. Trade Exposure and TFP Growth

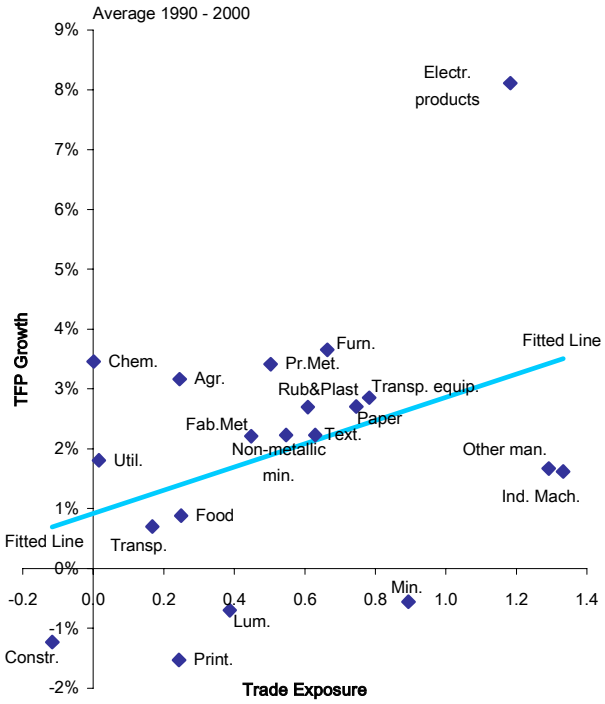

Figure 12c. Vertical Integration and TFP Growth

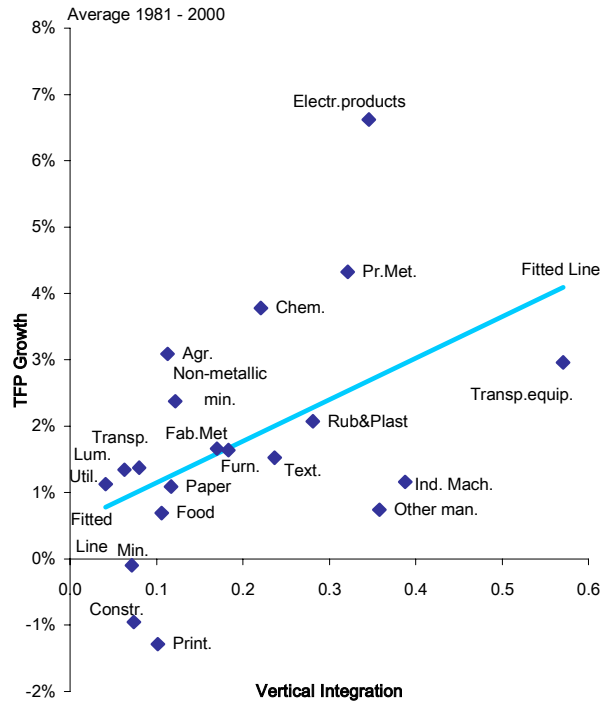

Figure 12d. Vertical Integration and TFP Growth

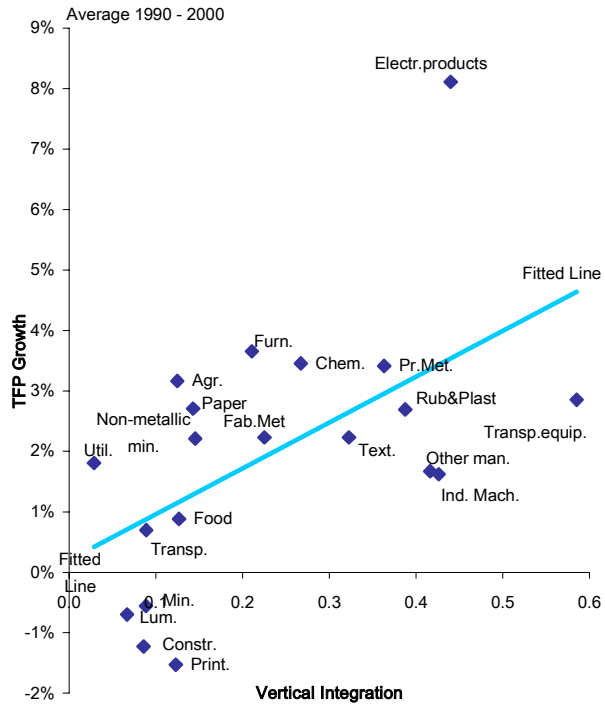

Figure 13. Sectoral Contributions to the Canada - U.S. Aggregate Labor Productivity Growth Gap

(In percent)