Session 5:
Real Linkages:
Canada and the United States

Regional and Industrial Business Cycle Fluctuations in Canada: A North American Perspective

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Introduction

Conventional wisdom holds that the globalization of markets has had a significant impact on the co-movement or transmission of international business cycles. It is by now widely accepted that a "world" factor contributes importantly to business cycle fluctuations in most countries. Moreover, consistent with the increase in regional integration in Europe and North America, there is evidence of increased synchronization of business cycles within some regions of the world. In North America, this tendency was already well under way prior to the implementation of the Canada-US Free Trade Agreement (FTA) in 1989. The growing linkages between these two economies are often analyzed in the literature in one of two ways: by looking at trends in bilateral trade flows at the regional and sectoral levels, or by analyzing correlations or commonalities in aggregate business cycle fluctuations. In this paper, we combine the two approaches. By formally examining Canadian and US business cycles at the industry and region levels, we provide a rich analysis of the extent to which expansions and recessions in the two economies are linked.

We address this question by analyzing a unique data set of sectoral output for US and Canadian subnational regions. Specifically, we investigate the extent to which disaggregate Canadian business cycle fluctuations are influenced by North American, Canadian, and region-specific variations in sectoral output. To do so, we identify factors that are common to each

industry from North American, Canadian, and regional perspectives, using a state-space approach. We then use the results of this factorization to perform variance decompositions and examine the temporal dimension of our findings.

Dynamic factor models have been popular in the recent literature on business cycle linkages, since they capture every possible dynamic correlation from the data. However, the extracted factors that factor models provide cannot be easily interpreted. Our approach has the advantage of being more intuitive in that the estimated dynamic unobservable components from the state-space approach are derived from structural identifying restrictions.

Six major results emerge from our empirical analysis:

(i) Over the period 1963–2001, the common North American, common Canadian, and region-specific components were all important determinants of business cycle fluctuations in Canada's regions and industries.

(ii) On average, the contribution of the common Canadian component is dominant.

(iii) The share of the variance in Canadian cycles that is common with the United States increased over the sample.

(iv) This increase was at the expense of region-specific shocks, indicating that economic integration could have led to a reduction in cyclical asymmetries across Canada's regions.

(v) Interestingly, the common Canadian component in the manufacturing sector rose, suggesting a Canada-wide increase in specialization in that industry.

(vi) Industrial composition matters: some sectors are much more exposed to North American developments (manufacturing and wholesale and retail trade), others to Canadian developments (other services, construction, and transportation), and others to idiosyncratic shocks (mining; utilities; and agriculture, fishing, and forestry).

Given these findings, the principal policy recommendation resulting from our work stresses economic flexibility, in terms of the structure of the economy, such as factor mobility, but also in terms of the tools used in macroeconomic stabilization policy. In that context, an independent monetary policy framework, characterized by exchange rate flexibility, seems best suited to ensure efficient economic outcomes in Canada.

The first section of this paper reviews recent findings on the importance of the international transmission of business cycles. The second section reviews trends in the Canada-US trading relationship. The third section

presents our data set and empirical methodology, and the fourth discusses our key findings. Before concluding, the final section identifies the main policy implications of our findings.

1 Literature Review

A number of studies have found evidence of a world business cycle. Kose, Otrok, and Whiteman (2003) find that a global cyclical element contributes importantly to output-growth fluctuations in a broad cross-section of industrial and developing countries. Canova, Ciccarelli, and Ortega (2004) obtain similar results for the G-7 industrial economies. Within this group, international business cycles appear to be the most important for the US, Canadian, and UK economies (IMF 2001).

The increase in regional integration has led to the emergence of common cycles within some regions of the world. Evidence for a European business cycle is mixed. Bordo and Helbling (2003) and Stock and Watson (2003) find that there is a tendency towards increased synchronization of business cycles in the Euro-zone economies. However, Kose, Otrok, and Whiteman (2003), as well as Canova, Ciccarelli, and Ortega (2004), do not find evidence of a Euro-area-specific cycle. On the other hand, evidence of a distinct North American business cycle is ample (Stock and Watson 2003; Bordo and Helbling 2003; and others).

Close linkages between the Canadian and US business cycles are widely documented (Ambler, Cardia, and Zimmermann 2004; Helbling and Bayoumi 2003; Otto, Voss, and Willard 2001; Kose, Prasad, and Terrones 2003; Cardarelli and Kose 2004). Bergman, Bordo, and Jonung (1998) find that the correlations of the business cycles of these two countries have been high for over a century. This finding is consistent with other evidence that many countries share a common cycle with their major trading partner (Anderson, Kwark, and Vahid 1999). Bordo and Helbling (2003) find that the correlation of aggregate supply or permanent shocks has risen steadily for the United States and Canada. As well, the share of Canada's output variance explained by a common cyclical factor with the United States is estimated to have tripled between the period from 1960 to 1980 and the subsequent period since the early 1980s (Cardarelli and Kose 2004). On the other hand, Doyle and Faust (2003) show that there has been no statistically significant change in the correlation between Canadian and US real GDP growth since the 1960s. Similar results were found by Helbling and Bayoumi (2003). Overall, the relative importance of common global factors for Canada is generally high in the literature. Table 1 presents ballpark figures from the recent literature for the importance of common and specific

Table 1
Components for Canadian output fluctuations (percentage)

Studies	Common	Specific
Kose, Otrok, and Whiteman (2003)	72	28
Cardarelli and Kose (2004)	10	90
Canova, Ciccarelli, and Ortega (2004)	30	70
Helbling and Bayoumi (2003)	60	40
Bordo and Helbling (2003)	50	50
Stock and Watson (2003)	65	35

components for Canadian output fluctuations, based on samples starting in the early 1960s.

While it is clear that there are tight cyclical linkages between close trading partners, such as the United States and Canada, there is an ongoing debate concerning the key factors that explain these linkages. Frankel and Rose (1998) provide evidence that stronger international trade linkages should lead to increased business cycle correlations.[1] Baxter and Kouparitsas (2004) found a robust relationship between bilateral trade and business cycle co-movements, employing a data set of over 100 countries. However, there remains considerable skepticism among researchers as to whether trade linkages are sufficient in and of themselves to generate the observed output correlations among countries (Bordo and Helbling 2003; Doyle and Faust 2003; IMF 2001). For instance, the similarity of sectoral economic structures may be as important as trade intensity in contributing to the synchronization of business cycles across countries in the OECD (Imbs 2001, 2003).[2] As well, the degree of financial market integration, as explained by such variables as bilateral exchange rate stability and the extent of integration of either equity or bond markets, also seems to contribute to increased bilateral business cycle correlations (Otto, Voss, and Willard 2003). Finally, the similarity of accounting standards and the speed of adoption of new information and communications technologies appear to be important influences on bilateral output-growth correlations (Otto, Voss, and Willard 2001).

1. A more recent study suggests that Frankel and Rose may have considerably overstated the magnitude of this effect (Gruben, Koo, and Millis 2002). Another study supporting a positive and significant link between trade intensity and business cycle correlations is Kose, Prasad, and Terrones (2003).

2. On the other hand, Baxter and Kouparitsas (2004) found in their cross-country study that the similarity of industrial structure was not a robust determinant of business cycle co-movements.

The geographical and sectoral dimensions of fluctuations in economic activity are also important in understanding business cycles, both nationally and internationally. For instance, shocks that significantly affect the allocation of labour and capital across regions and sectors appear to contribute importantly to aggregate economic fluctuations (Schuh and Triest 1998; Davis and Haltiwanger 1999). In the case of the United States, there is evidence that shocks to state economic activity are important in explaining output movements at the national level (Ghosh and Wolf 1997). As well, Horvath (1998, 2000) has concluded that sector-specific shocks, especially those affecting sectors acting as key suppliers of inputs, have accounted for most of the volatility in US GDP growth. Consistent with this result, Barillas and Schleicher (2003) find that manufacturing, the primary industries, and construction are important sources of fluctuations for the Canadian economy. In a study of seven European countries and the United States, it was found that industry-specific and nation-specific shocks contributed significantly to explaining volatility in industrial output growth rates (Stockman 1988). It has been suggested that policies to reduce the economic effects of national borders would likely increase the importance of cross-country and industry-specific shocks relative to that of nation-specific shocks as sources of cyclical fluctuations in economic activity at the national level (Clark and Shin 2000).

In research on the factors influencing cyclical fluctuations in the major Canadian regions, including shocks originating in the United States, DeSerres and Lalonde (1994) find that shocks to Canadian regions are more closely linked to a common Canadian component than to a common component with the United States. Bayoumi and Eichengreen (1993) found that a large share of shocks in Canadian regions are asymmetric relative to those in the United States. (See Dupasquier, St-Amant, and Lalonde (1997) for similar results.) On the other hand, Racette and Raynauld (1994) found evidence that US national economic shocks were particularly important as a source of aggregate output variation in British Columbia, while the economies of Ontario and the Atlantic region were especially sensitive to Canadian national economic shocks. They also found that US regional shocks tended to be more important than shocks originating in other Canadian regions as a source of real variation in a given Canadian region, reflecting the importance of north-south international trade linkages. More recent evidence suggests that real growth in Ontario and Quebec is most highly correlated with that of the US regions and that growth in the US Great Lakes region is the most highly correlated with that of the Canadian regions (Michelis 2004).

While Canada-US business cycle linkages have been analyzed at length from a regional perspective, to our knowledge, there is no study on these

linkages at the sectoral level. This paper extends the existing literature on cross-country economic linkages by focusing on both the sectoral and regional dimensions of the Canada-US economic relationship. Our approach has the advantage of measuring the relative degree of North American integration at the industry level in Canadian regions. Before turning to the empirical analysis, the next section reviews the stylized facts of the Canada-US international trade linkages, with emphasis on developments at the sectoral and regional levels.

2 Canada-US International Trade Linkages: Stylized Facts

Canada's international trade, relative to GDP, has risen markedly since the early 1960s (Figure A1.1, Appendix 1). Moreover, the exposure of the Canadian economy to international trade has surged since the late 1980s, following the implementation of the Canada-US FTA. The substantial rise in the export orientation of the Canadian economy has been limited largely to the United States, as exports to non-US countries (relative to GDP), overall, were little changed in the 1961–2001 period (Figure A1.2). In contrast, the increase in Canadian import market penetration has been more geographically diversified. For instance, the US share of Canada's imports of goods and services has been relatively stable since the early 1960s (Table A1.1).

The increasing orientation of Canada's exports towards the US market, already well under way prior to the implementation of the FTA, has continued since the late 1980s. The rise in the US share of total exports since 1989, while broadly based by product category, has been particularly strong for agricultural products, metals and minerals, and apparel and textiles (Table A1.2). In a few cases (such as transportation equipment), there was little room for further increases in orientation towards the American market, since a very high percentage of Canadian exports was already being shipped to the United States prior to 1989. In contrast, the changes in the US shares of Canada's merchandise imports by product categories since 1989 were generally more modest. There was, however, a marked rise in the US share of Canadian imports of food and beverages over this period.

The rise in the US share of Canadian merchandise exports since 1989 has been evident in all of the major Canadian regions. These increases in US export orientation were largest for British Columbia and the Territories, the Prairie provinces, and the Atlantic region, since these regions had previously had a smaller US export orientation than either Ontario or Quebec (Tables A1.3–A1.7). By major product category and region, the largest

increases in US export orientation were for selected resource-based products: metals and minerals and wood and paper products for British Columbia and the Territories and the Atlantic region, and agricultural products for the Prairie region.

Canada's trade with the United States has tended to be oriented towards particular US regions. For instance, close to half of Canada's international trade with the United States has been concentrated in the Midwest region (Acharya, Sharma, and Rao 2003). Between the 1980–89 and 1995–2000 periods, there was a substantial rise in the share of Canada's merchandise trade with the US South region, concentrated in exports from Canada's Atlantic and Prairie regions and Quebec. On the other hand, over the same period, the share of Canada's goods trade with the US Northeast region decreased markedly, concentrated in exports from the Atlantic region and Ontario.

Part of the increase in international trade exposure represents growing two-way trade in similar products among industrial countries, as well as the increasing importance of imported inputs in the production of exportable products (Acharya, Sharma, and Rao 2003; Dion 1999–2000). Even so, there has been a tendency for the net export intensity of Canadian industries to rise over time (Acharya, Sharma, and Rao 2003; Campa and Goldberg 1997).

3 Data and Methodology

Our goal is to examine the cyclical linkages between the Canadian and US economies at the industrial and regional levels. To do so, we estimate a state-space model in which sectoral business cycle fluctuations are decomposed into a common North American component shared by Canada and the United States, a Canadian component common to all provinces, and an idiosyncratic regional component. A similar approach was used by Chamie, DeSerres, and Lalonde (1994) to examine optimal currency areas in Europe and the United States.

To estimate the model, we use data on regional output at the sector level. For Canada, we use Conference Board data on provincial GDP, while for the United States, we use Bureau of Economic Analysis (BEA) data on gross state product. Our data set is annual and spans from 1963 to 2001. It covers the following 10 sectors: agriculture, fishing, and forestry (AF); mining (MI); manufacturing (MF); construction (CN); transportation and communications (TC); utilities (UT); wholesale and retail trade (WR); finance, insurance, and real estate (FI); other services (SE); and government (GV). Canadian provinces were grouped into five regions: Atlantic (AT),

Quebec (QC), Ontario (ON), Prairies (PR), and British Columbia (BC); US states were grouped into eight economic regions, as in Crone (2003): Northeast (NE), Mid-Atlantic (MA), South (SO), Great Lakes (GL), Plains (PL), Mountains (MN), Southwest (SW), and Far West (FW).[3]

For each of the 10 industries, the measurement equation is specified as follows:

$$\begin{bmatrix} Y_t^{NE} \\ Y_t^{MA} \\ Y_t^{SO} \\ Y_t^{GL} \\ Y_t^{PL} \\ Y_t^{MN} \\ Y_t^{SW} \\ Y_t^{FW} \\ Y_t^{AT} \\ Y_t^{QC} \\ Y_t^{ON} \\ Y_t^{PR} \\ Y_t^{BC} \end{bmatrix} = \begin{bmatrix} h_{1,1} & 0 \\ h_{2,1} & 0 \\ h_{3,1} & 0 \\ h_{4,1} & 0 \\ h_{5,1} & 0 \\ h_{6,1} & 0 \\ h_{7,1} & 0 \\ h_{8,1} & 0 \\ h_{9,1} & h_{9,2} \\ h_{10,1} & h_{10,2} \\ h_{11,1} & h_{11,2} \\ h_{12,1} & h_{12,2} \\ h_{13,1} & h_{13,2} \end{bmatrix} I_{13x13} \begin{bmatrix} Z_t^{NA} \\ Z_t^{CAN} \\ Z_t^{NE} \\ Z_t^{MA} \\ Z_t^{SO} \\ Z_t^{GL} \\ Z_t^{PL} \\ Z_t^{MN} \\ Z_t^{SW} \\ Z_t^{FW} \\ Z_t^{AT} \\ Z_t^{QC} \\ Z_t^{ON} \\ Z_t^{PR} \\ Z_t^{BC} \end{bmatrix}, \quad (1)$$

where the vector *Y* contains the HP-filtered cyclical component of each region's output, and the vector *Z* contains the orthogonal unobservable common North American and Canadian components, as well as 13 region-specific components. The coefficients in the state matrix *H* provide a measure of how strongly regional business cycles are related to the common

3. See Appendix 5 for additional details on the construction of this data set, as well as descriptive statistics.

components. Given that our focus is on Canadian regions, we do not attempt to identify a distinct common US component. Such a variable would likely be redundant given the disproportionate importance of the US economy in North America.

The transition equation specifies the dynamic behaviour of the unobservable variables (Z). Assuming that these variables follow an AR(1) process, we have:

$$Z_t = FZ_{t-1} + e_t, \text{ where}$$

$$E(e_t e_t') = Q = \begin{bmatrix} 1 & & & & & \\ & 1 & & & & \\ & & Q_{3,3} & & & \\ & & & . & & \\ & & & & . & \\ & & & & & . \\ & & & & & Q_{13,13} \end{bmatrix}. \quad (2)$$

For purposes of identification, the unobservable components are assumed to be uncorrelated. The scale of the variables is standardized by setting the variance of the common North American and Canadian components to unity.[4] A total of 10 state-space models are estimated, one for each industry. The unobservable components, Z, are generated by the Kalman filter with estimates of H, F, and Q given by maximum likelihood using the integrated EM/scoring algorithms.[5]

We then assess the relative importance of the common and specific factors by carrying out variance decompositions of regional business cycles. The decomposition is calculated from the estimated variance of shocks affecting each of the 13 regions (i). From equations (1) and (2), it follows that

$$Y_t^i = H_{i,1} Z_t^{NA} + H_{i,2} Z_t^{CAN} + Z_t^i$$

and that

4. This standardization is used only to simplify the calculations. It is neutral on the variance decompositions, since the unrestricted h coefficients (columns 1 and 2) simply adjust accordingly.

5. With an all-industry North American state-space model containing all 130 series, we would be able to identify industry-specific shocks. However, such a model would contain a very large number of parameters (many hundreds), which would complicate the estimation process greatly.

$$var(Y_t^i) = \frac{H_{i,1}^{\ 2}}{1 - F_{1,1}^{\ 2}} + \frac{H_{i,2}^{\ 2}}{1 - F_{2,2}^{\ 2}} + \frac{Q_{i+2,i+2}^{\ 2}}{1 - F_{i+2,i+2}^{\ 2}}.$$

The first element of this sum represents the contribution of the North American factor to total business cycle variance in region *i*. The second term measures the contribution of the Canadian component, while the third term captures the contribution of region-specific factors. It is worth noting that we do not attempt to identify the source or nature of shocks. Rather, the purpose of the model is to perform a geographical classification of disturbances as affecting either all North American regions, all Canadian regions, or only one region. Before turning to results, we review the possible interpretations for each of these components.

The North American factor measures the component of the business cycle that Canada shares with the United States.[6] A strong North American component in terms of variance decomposition has two possible interpretations: (i) a high degree of North American market integration; or (ii) a similar reaction/exposure to common shocks. It is important to note that this component may not be specific to the North American region, since it can also reflect a common response of Canada and the United States to global disturbances.[7] For example, an oil-price shock could be captured by the North American component.

The Canadian factor captures the portion of the regions' business cycles that is entirely Canadian, i.e., common to all Canadian regions for the industry under examination and orthogonal to the United States. Industries affected by a common national regulation or provinces requiring higher federal transfers will increase the importance of the common Canadian component. This component also has the same two interpretations as the North American component, but at the Canadian level. For example, a fiscal-policy shock at the federal level could be captured by the Canadian component.

The regional factor measures the component of the cycle that is specific to a region. Important regional elements have two possible explanations: (i) the industry under study is highly concentrated in that region (specialization); or (ii) region-specific shocks occurred frequently over the sample (e.g., bad weather, strikes, provincial government policies, immigration). For

6. For the US series, this factor captures both US-specific national factors, as well as North American factors.

7. This is not likely, however, given the results of Kose, Otrok, and Whiteman (2003) and Stock and Watson (2003), who find an important North American regional factor in a broader context.

example, a sudden decline in fish stocks on the west coast will be captured by the component relating to British Columbia.

4 Empirical Results

Summary tables for the variance decompositions are presented in Appendixes 2 and 3 for Canada and the United States, respectively. We present results based on a regional and industrial aggregation.[8] This aggregation is a complex combination involving weights based on both the relative levels of the output series as well as the relative variances of cyclical components. Thus, although a given sector can represent only a small share of output, its contribution will be large if the relative variance of its business cycle is large.

Over the period 1963–2001, our results show that the common North American, Canadian, and region-specific components were important determinants of sectoral cyclical variations in Canada. Our findings generally confirm the results obtained in previous studies suggesting that external disturbances are an important determinant of Canadian business cycle fluctuations. On average, these shocks explain about 32 per cent of regional business cycle variations in Canada. As previously identified, this component captures developments in the economy at large, whether they are North American or not.[9] This result is consistent with results of Gregory, Head, and Raynauld (1997); Chamie, DeSerres, and Lalonde (1994); Canova, Ciccarelli, and Ortega (2003); and Cardarelli and Kose (2004). However, our findings diverge somewhat from recent studies by Kose, Otrock, and Whiteman (2003) and Helbling and Bayoumi (2003) that suggest that external factors account for a much larger share of cyclical variations in Canada (see section 2). On a regional basis, not surprisingly, it is in Quebec and Ontario that the North American factor is the most important, with shares of 24 and 37 per cent, respectively. Ontario is the only province where common North American disturbances dominate. At the other extreme, only 4.1 per cent of cyclical fluctuations in the Prairies region are common with the United States. On a sectoral basis, again not surprisingly, it is in the manufacturing and trade sectors that the common North American factor is the highest, with shares of 52 and 33 per cent, respectively. The utilities and primary sectors are the least integrated with the United States.

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8. See Appendix 4 for the complete results at the industry-region level in Canada. Detailed results for the United States are available from the authors.
9. The identifying assumption is that this component is orthogonal to all other factors, including the Canadian sector-specific element.

Common Canadian disturbances are the most important contributors to cyclical variations in Canada. With an average share of 38 per cent, this component is important in all Canadian regions. It is the highest in the "other services" sector, which is not surprising, given that this sector is mostly public. On an industry basis, except for the agriculture, fishing, and forestry sector, the large share for the common Canadian component is broad-based. It is highest in the "other services" and finance, insurance, and real estate (FIRE) sectors and lowest in the utilities and primary sectors.

We find that idiosyncratic disturbances account for a non-negligible proportion of 30 per cent of the total variation in provincial business cycles. From both a Canadian and North American persective, the Atlantic, Prairies, and BC regions are the least economically integrated, since most of the variance of the business cycle in these regions is explained by idiosyncratic shocks. This result is attributable mainly to the agriculture, fishing, and forestry sector. As expected, cycles in the utilities and primary sectors are the most idiosyncratic. The results for the agriculture, fishing, and forestry sector, in which almost 93 per cent of the variance is idiosyncratic, may appear at odds with one's priors, given the tradable nature of these goods. This probably reflects weather-related supply shocks. Another explanation could be the segmented nature of agricultural markets in Canada. These markets were characterized by federal and provincial supply-management programs over most of our sample period.[10] In many respects, the same logic applies to the utilities sector, since one would expect that utility output would be highly regional in nature, reflecting the segmented structure of the industry.[11] These results highlight the importance of accounting for regional and sectoral differences in business cycle dynamics.

To evaluate the impact of the tendency towards economic integration over the sample, we re-estimate the models over the period 1982–2001. These results indicate an increase in the average contribution of the common North American component from 32 to 38 per cent. While broad-based, the increase is most evident in the Atlantic and BC regions. This is consistent with the stylized facts suggesting a convergence in trade openness towards the Ontario and Quebec levels. Ontario is still the only province where common North American disturbances dominate. From a sectoral perspective, the increase of the North American factor is broad-based. The only

10. See Palda (1994) for a review of Canadian interprovincial barriers to trade.

11. In Canada, utilities are generally owned, and all regulated, by provincial authorities, with limited interprovincial trading abilities. Consequently, excess capacity in one province has little effect on neighbouring provinces.

exception is the manufacturing sector, where the contribution of this factor fell by 10 percentage points.[12]

The reduction in North American synchronization of cycles in the manufacturing sector since 1982 could be due to outsourcing activities from the manufacturing sector towards the wholesale and retail trade sector. It could also be explained by an increase in specialization in Canada's regions following the expansion in trade openness with the United States. It is important to note, however, that it is the common Canadian component—and not the regional components—that benefited from this reduction. Consequently, for this explanation to hold, the increase in manufacturing specialization must have been similar across all Canadian regions. Also, results show that the increase in the contribution of the common Canadian component is not due to a rise in the exposure of manufacturing cycles to this component (the h coefficients). Rather, it is explained by an increase in the relative persistence of common Canadian cycles (the F coefficient). This suggests a slower speed of adjustment in the manufacturing sector since 1982. Is this due to an increase in price or wage rigidity or to a slow adjustment in the industrial structure of this sector following globalization?[13] We leave this to future research.

Consistent with the stylized facts, we find that the contribution of the North American factor increases in the trade and primary sectors. Interestingly, the contribution of the North American component also increased in sectors with little or no tradable content. In the case of the FIRE sector, the rise probably reflects the increasing integration of Canadian and US financial markets. The increase in the construction sector could be explained by a greater symmetry in interest rate movements on both sides of the border. With respect to cycles in the utilities sector, the greater share of the North American component is concentrated in Quebec. This may be due to the increasing importance of electricity exports.

On average, results indicate that symmetry in Canadian regional cycles remains high, with a contribution of the common Canadian component of 40 per cent. This component rose in all regions but the Prairies. In that region, business cycles have become mostly idiosyncratic, and this is mainly due to the mining sector. Region-specific shocks decreased significantly in British Columbia and the Atlantic region. The average contribution of

12. Otherwise, the common North American component would have increased significantly more, given the importance of the manufacturing industry in the variance of the cycle in total output.

13. Beine and Coulombe (2004) find that industrial concentration ratios are roughly unchanged over the past twenty years. This might suggest that the manufacturing sector has been relatively sluggish in its response to open borders compared with other industries.

regional factors fell from 30.4 to 21.6 per cent. Roughly three quarters of this reduction translates into an increase in the share of the North American factor. With the exception of the mining sector, results show a significant reduction in the regional component in most industries.[14]

Given that we do not identify a distinct common US component, the cyclical variations in the US regions are decomposed into a common North American component as well as into region-specific elements. From a US perspective, therefore, the North American factor is the common US component. Results for the United States show that cyclical variations are largely symmetric across regions and industries. On average, 68.3 per cent of the variance of US business cycles is due to the North American component. The least integrated regions are the Northeast and the Mountains, while the most integrated are the Great Lakes and the South. At the industry level, the cycles in the manufacturing, mining, and government sectors are largely symmetric, while the utilities and FIRE sectors are mostly idiosyncratic. Results for the post-1982 period show that the average decomposition for the United States as a whole is virtually unchanged. Economic integration has led to a significant increase in the share of the North American component only in the Northeast, Mid-Atlantic, and Far West regions. An increase in region-specific shocks, probably due to specialization, occurred in the other regions. With the exception of the FIRE sector, variance decompositions are essentially unchanged at the industry level.

5 Policy Implications

Given our findings, which suggest that North American, Canadian, and region-specific shocks are all important determinants of provincial business cycles, our main policy recommendation stresses economic flexibility, both in terms of the actual economic structure of the economy, such as factor mobility, but also in terms of the tools used in macroeconomic stabilization policy.

Our finding of a sizable common Canadian factor in both regional and industrial business cycle variations argues forcefully in favour of an independent Canadian monetary policy characterized by a flexible exchange rate. A flexible exchange rate buffers external shocks, allowing the economy to adjust more easily to disturbances. Almost equally important, the real exchange rate is also a measure of the relative price of tradables to non-tradables. Allowing it to float sends signals to economic agents about the

14. The result for the mining sector probably relates to the growing importance of natural gas production over this period. This sector is highly influenced by weather shocks.

relative health of their industries, and thus encourages a more efficient allocation of resources.

Note that the importance of region- and/or sector-specific disturbances poses a challenge for monetary policy. Over the full sample, idiosyncratic shocks account for about 30 per cent of cyclical variations. However, we find that the Canadian factor has remained significant, and the idiosyncratic effect has become less important in the more recent sample. Thus, there is evidence that Canada satisfies the optimal currency-area criteria more so now than in the past, although the Canadian economy continues to importantly share a common cycle with its trading partners.

The relative importance of region- and sector-specific factors in explaining provincial business cycle fluctuations necessitates a delicate balance between regional fiscal stabilization policies and those that promote factor mobility. In Canada, fiscal stabilization policies operate at both the federal and provincial levels. The federal equalization program, which transfers fiscal resources from wealthier provinces to those in need, reduces the vulnerability of provincial finances to idiosyncratic shocks (Bayoumi and Masson 1995), while providing a continuity of resources to fund health and education. The federal government also administers the employment insurance system, which provides extended benefits to workers in some seasonal industries, such as fishing. At the provincial level, Canadian provinces can run countercyclical fiscal policies to offset region-specific economic disturbances.

On the other hand, idiosyncratic shocks also argue strongly in favour of policies that promote factor mobility. Two such impediments are inter-provincial trade restrictions and disincentives to labour mobility. Barriers to interprovincial trade are well documented in Canada (Palda 1994). Not only have they tended to insulate Canadian provinces from shocks in other provinces, but they have also acted to slow the transfer of capital resources from one sector to another. In addition, the federal transfer system, which ensures equal access to essential services across Canada, has likely reduced the opportunity costs of remaining in a region or industry that is under-performing.[15] As well, the Canadian employment insurance system affects labour mobility by discouraging workers in contracting and/or seasonal industries from seeking employment in other regions.[16] Our results suggest that policies aimed at facilitating the transfer of resources from contracting

15. The rationale for the federal equalization program is not purely economic. To a large degree, the program is motivated by a desire for social cohesion among all Canadian regions.

16. Clearly, some of these factors have structural dimensions that may not necessarily be captured in the cyclical position of the economy, as is used in this paper.

to expanding industries may lead to a reduction in business cycle variations at the regional and national levels, particularly in an era of increasing globalization.

On this note, our results are somewhat encouraging. Structural reforms have been put in place in the past decade (the employment insurance legislation of 1996, which made payments a function of the intensity of use, and the 1995 Agreement on Internal Trade) that have increased the Canadian economy's ability to respond to shocks. Such reforms may underlie our finding that the idiosyncratic component of regional business cycles is significantly lower in the most recent sample than over the full period. The significant reduction in region-specific shocks in the 1982–2001 period argues less forcefully in favour of regional stabilization policies.[17]

Conclusion

This paper investigates the regional dimension of business cycle variations, using a unique data set of sector- and region-specific output series for North America. Common industrial factors are identified at the North American, Canadian, and regional levels, using a state-space approach. Six major results emerge from our empirical analysis:

(i) Over the period 1963–2001, the common North American, common Canadian, and region-specific components were all important determinants of business cycle fluctuations in Canada's regions and industries.

(ii) On average, the contribution of the common Canadian component is dominant.

(iii) The share of the variance in Canadian cycles that is common with the US increased over the sample.

(iv) This increase was at the expense of region-specific shocks, indicating that economic integration could have led to a reduction in cyclical asymmetries across Canada's regions.

(v) Interestingly, the common Canadian component in the manufacturing sector rose, suggesting a Canada-wide increase in specialization in that industry.

(vi) Industrial composition matters: some sectors are much more exposed to North American developments (manufacturing and wholesale and retail trade), others to Canadian developments (other services, construction,

17. Of course, the direction of causality is unclear. Are regional shocks less important because regional diversification and stabilization policies work? Or are these shocks simply becoming less important? Further research is needed to determine the answer.

and transportation), and others to idiosyncratic shocks (mining; utilities; and agriculture, fishing, and forestry).

Our findings are best interpreted qualitatively, given uncertainty around the estimated variance decompositions. Future work will focus on comparing our post-1982 findings with pre-1982 results, calculating confidence bands on the estimated decompositions, as well as performing additional robustness checks. An additional avenue for future research is examining regional linkages, such as the north-south dimension. Nevertheless, based on our results, the principal policy prescription is to encourage economic flexibility, both in the economy's ability to respond to macroeconomic shocks through fiscal and monetary policies, but also by reducing impediments to factor mobility. In addition, our results provide evidence that the Canadian economy may better satisfy the requirements for an optimal currency area in the 1982–2001 period, since idiosyncratic shocks have become significantly less important determinants of regional business cycles.

Appendix 1
Stylized Facts

Figure A1.1
Canada's international trade as a percentage of GDP

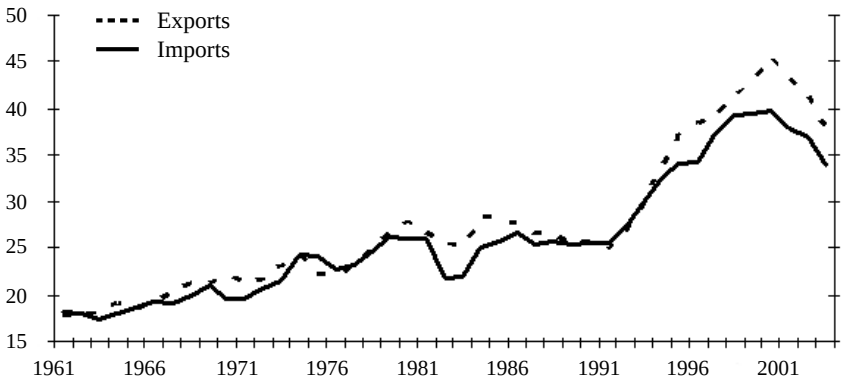

Figure A1.2
Canada's exports as a percentage of GDP

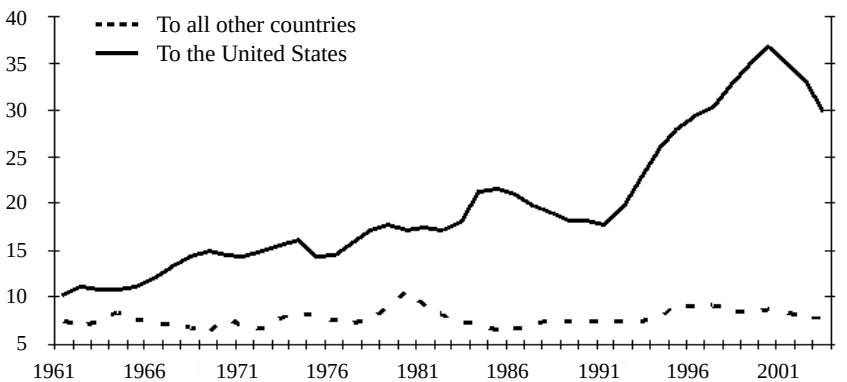

Table A1.1
Canada's bilateral trade with the United States

	1961	1975	1988	2003
US share of Canadian exports of goods and services (%)	58.0	64.7	71.8	79.7
US share of Canadian imports of good and services (%)	67.1	66.3	68.3	68.4
Canadian exports to US relative to total GDP (%)	10.3	14.4	19.1	30.0
Canadian imports from US relative to total GDP (%)	12.2	16.0	17.7	23.0

Source: Statistics Canada, National Income and Expenditure Accounts, balance of payments.

Table A1.2
US share of Canada's merchandise trade for major product categories

	Exports		Imports	
	1989	2002	1989	2002
Agriculture	35.2	59.4	62.6	61.4
Food and beverages	75.0	91.2	42.4	62.1
Metals and minerals	69.4	90.1	53.6	50.7
Chemicals	66.7	78.7	64.8	64.7
Plastics and rubber products	81.5	94.8	77.0	80.7
Apparel and textiles	56.3	87.1	27.5	31.8
Wood and paper	65.0	80.8	83.0	81.7
Machinery and electronics	78.6	83.2	67.3	61.3
Transportation equipment	95.1	94.4	78.8	72.9
Miscellaneous manufactures	90.2	94.3	48.3	43.1

Sources: Statistics Canada, customs basis.
Department of Foreign Affairs and International Trade (Canada),
NAFTA @ 1: A Preliminary Report.

Table A1.3
US share of merchandise trade,
British Columbia and Territories (percentage)

	1989	2002
Total exports	40.8	66.7
Selected products		
Metals and minerals	24.5	60.9
Wood and paper	45.1	65.7
Machinery and electronics	74.3	78.6
Total imports	43.1	37.6
Selected products		
Metals and minerals	51.6	52.4
Machinery and electronics	50.7	37.8
Transportation equipment	26.7	18.9

Sources: Statistics Canada, customs basis.
Department of Foreign Affairs and International Trade (Canada),
NAFTA @ 10: A Preliminary Report.

Table A1.4
US share of merchandise trade, Prairie region (percentage)

	1989	2002
Total exports	66.8	83.1
Selected products		
Agriculture	22.8	47.4
Metals and minerals	89.2	97.1
Machinery and electronics	80.8	75.6
Total imports	84.3	75.6
Selected products		
Metals and minerals	85.9	84.5
Machinery and electronics	85.8	73.9
Transportation equipment	97.7	67.7

Sources: Statistics Canada, customs basis.
Department of Foreign Affairs and International Trade (Canada), *NAFTA @ 10: A Preliminary Report*.

Table A1.5
US share of merchandise trade, Ontario (percentage)

	1989	2002
Total exports	85.5	93.5
Selected products		
Metals and minerals	75.1	88.5
Plastics and rubber	80.4	94.9
Wood and paper	94.5	96.3
Machinery and electronics	82.0	86.4
Transportation equipment	97.0	96.8
Total imports	76.0	72.5
Selected products		
Metals and minerals	78.3	78.5
Chemicals	72.1	69.6
Plastics and rubber	85.7	86.7
Machinery and electronics	71.2	63.8
Transportation equipment	92.7	86.7

Sources: Statistics Canada, customs basis.
Department of Foreign Affairs and International Trade (Canada), *NAFTA @ 10: A Preliminary Report*.

Table A1.6
US share of merchandise trade,
Quebec (percentage)

	1989	2002
Total exports	71.7	84.0
Selected products		
Metals and minerals	67.9	85.8
Wood and paper	79.0	88.4
Machinery and electronics	69.4	78.4
Transportation equipment	83.9	80.0
Total imports	45.0	37.2
Selected products		
Chemicals	50.9	43.5
Machinery and electronics	54.8	52.5
Transportation equipment	77.7	53.4

Sources: Statistics Canada, custom basis.
Department of Foreign Affairs and International Trade (Canada), *NAFTA @ 10: A Preliminary Report*.

Table A1.7
US share of merchandise trade,
Atlantic region (percentage)

	1989	2002
Total exports	64.6	83.5
Selected products		
Agriculture	69.0	68.4
Metals and minerals	71.3	91.3
Wood and paper	53.4	76.2
Total imports	25.5	22.7
Selected products		
Agriculture	34.5	55.3
Metals and minerals	8.2	8.2
Machinery and electronics	45.2	45.6

Sources: Statistics Canada, customs basis.
NAFTA @ 10: A Preliminary Report.

Appendix 2
Summary of Results for Canada[1]

Table A2.1
Canadian variance decomposition: by region
(percentage of total variance)

	North America	Canada	Regional	North America	Canada	Regional
		1963–2001			1982–2001	
Atlantic	8.2	19.7	72.1	26.8	36.4	36.8
Quebec	23.5	55.7	20.8	27.7	60.8	11.5
Ontario	37.3	35.7	26.9	46.1	38.4	15.6
Prairies	4.1	35.8	60.1	8.3	24.0	67.8
British Columbia	12.3	30.7	57.0	26.0	37.7	36.2
Weighted average	31.6	38.0	30.4	38.0	40.4	21.6

Table A2.2
Canadian variance decomposition: by industry
(percentage of total variance)

	North America	Canada	Regional	North America	Canada	Regional
		1963–2001			1982–2001	
Manufacturing	51.6	26.6	21.8	41.8	43.6	14.6
Other services	11.3	58.0	30.7	24.3	59.0	16.6
Wholesale and retail trade	33.2	45.8	21.0	55.1	30.9	14.0
Finance, insurance, and real estate	7.7	47.1	45.2	38.8	28.7	32.5
Transportation and communications	11.3	43.8	44.9	9.9	68.9	21.1
Mining	3.4	44.2	52.4	14.1	0.0	85.9
Agriculture, fishing, and forestry	1.5	6.0	92.5	3.9	4.9	91.3
Utilities	1.6	30.0	68.3	9.5	26.8	63.7
Construction	9.1	54.6	36.3	33.2	28.9	37.9
Government	12.0	48.8	39.2	35.9	36.2	28.0
Weighted average	31.6	38.0	30.4	38.0	40.4	21.6

1. Results in this appendix are based on weighted averages of variance decompositions at the region and sector levels (based on disaggregate results from Appendix 4). These averages are a function of the relative size of each sector and region in terms of both levels and variances.

Appendix 3
Summary of Results for the United States

Table A3.1
US variance decomposition: by region
(percentage of total variance)

	North America	Regional	North America	Regional
	1963–2001		1982–2001	
Northeast	40.9	59.1	75.2	24.8
Mid-Atlantic	49.1	50.9	86.7	13.3
South	82.8	17.2	86.9	13.1
Great Lakes	88.3	11.7	79.9	20.1
Plains	74.1	25.9	69.2	30.8
Mountains	47.5	52.5	49.8	50.2
Southwest	67.8	32.2	53.1	46.9
Far West	49.9	50.1	68.5	31.5
Weighted average	68.3	31.7	68.3	31.7

Table A3.2
US variance decomposition: by industry
(percentage of total variance)

	North America	Regional	North America	Regional
	1963–2001		1982–2001	
Manufacturing	79.9	20.1	76.2	23.8
Other services	63.9	36.1	70.5	29.5
Wholesale and retail trade	63.8	36.2	62.1	37.9
Finance, insurance, and real estate	21.9	78.1	42.9	57.1
Transportation and communications	59.1	40.9	59.6	40.4
Mining	91.7	8.3	91.7	8.3
Agriculture, fishing, and forestry	70.3	29.7	71.0	29.0
Utilities	44.0	56.0	40.5	59.5
Construction	54.6	45.4	52.3	47.7
Government	91.1	8.9	90.5	9.5
Weighted average	68.3	31.7	68.3	31.7

Appendix 4
Complete Results for Canada[1]

Table A4.1
Manufacturing variance decomposition (percentage)

	North America	Canada	Regional	North America	Canada	Regional
	1963–2001			1982–2001		
Atlantic	24.0	57.2	18.8	11.7	79.9	8.4
Quebec	34.4	59.9	5.7	23.0	69.2	7.9
Ontario	55.3	20.5	24.2	46.2	38.3	15.4
Prairies	22.3	28.3	49.4	24.5	16.8	58.7
British Columbia	27.3	57.5	15.2	18.5	70.8	10.7

Table A4.2
Other services variance decomposition (percentage)

	North America	Canada	Regional	North America	Canada	Regional
	1963–2001			1982–2001		
Atlantic	3.8	56.7	39.5	22.0	49.4	28.6
Quebec	17.2	45.2	37.6	32.1	56.3	11.6
Ontario	11.9	66.5	21.6	29.3	63.7	6.9
Prairies	0.1	40.2	59.7	1.6	80.6	17.8
British Columbia	0.6	11.9	87.4	2.2	1.4	96.5

Table A4.3
Wholesale and retail trade variance decomposition (percentage)

	North America	Canada	Regional	North America	Canada	Regional
	1963–2001			1982–2001		
Atlantic	32.7	59.0	8.4	53.3	37.4	9.3
Quebec	41.4	55.0	3.6	48.0	49.9	2.1
Ontario	35.2	48.5	16.3	63.9	29.7	6.4
Prairies	10.5	15.6	73.9	23.2	0.0	76.8
British Columbia	11.6	22.6	65.8	29.3	0.0	70.7

1. Complete results for the US regions are available from the authors.

Table A4.4
Finance, insurance, and real estate variance decomposition (percentage)

	North America	Canada	Regional	North America	Canada	Regional
	1963–2001			1982–2001		
Atlantic	2.7	74.7	22.6	5.1	59.8	35.1
Quebec	0.7	63.4	36.0	0.6	67.7	31.7
Ontario	11.0	53.2	35.8	48.8	26.7	24.5
Prairies	1.5	15.1	83.4	9.1	11.6	79.2
British Columbia	0.1	15.5	84.4	53.4	26.7	19.9

Table A4.5
Transportation and communications variance decomposition (percentage)

	North America	Canada	Regional	North America	Canada	Regional
	1963–2001			1982–2001		
Atlantic	5.6	66.9	27.5	9.5	83.3	7.2
Quebec	17.8	59.9	22.3	13.1	71.1	15.8
Ontario	8.8	44.1	47.0	5.3	84.5	10.1
Prairies	8.2	23.6	68.2	6.1	25.1	68.8
British Columbia	22.4	22.0	55.6	34.3	23.9	41.8

Table A4.6
Mining variance decomposition (percentage)

	North America	Canada	Regional	North America	Canada	Regional
	1963–2001			1982–2001		
Atlantic	3.8	14.9	81.3	20.0	0.0	80.0
Quebec	0.1	35.5	64.4	27.7	0.0	72.3
Ontario	1.0	32.6	66.4	0.3	0.0	99.7
Prairies	4.1	47.6	48.3	15.1	0.0	84.9
British Columbia	6.9	64.0	29.1	1.4	0.0	98.6

Table A4.7
Agriculture, fishing, and forestry variance decomposition (percentage)

	North America	Canada	Regional	North America	Canada	Regional
	1963–2001			1982–2001		
Atlantic	1.6	82.1	16.2	0.8	87.2	12.0
Quebec	0.0	58.1	41.9	0.0	51.1	48.9
Ontario	0.0	0.0	100.0	6.4	0.0	93.6
Prairies	2.0	1.6	96.4	2.7	0.2	97.1
British Columbia	0.4	0.1	99.5	7.0	4.6	88.5

Table A4.8
Utilities variance decomposition (percentage)

	North America	Canada	Regional	North America	Canada	Regional
	1963–2001			1982–2001		
Atlantic	7.4	37.4	55.2	21.7	10.6	67.6
Quebec	0.8	37.0	62.2	36.3	67.7	4.0
Ontario	1.2	11.5	87.3	0.9	19.7	79.4
Prairies	2.0	37.5	60.5	4.1	18.4	77.5
British Columbia	1.2	40.3	58.5	11.9	9.7	78.4

Table A4.9
Construction variance decomposition (percentage)

	North America	Canada	Regional	North America	Canada	Regional
	1963–2001			1982–2001		
Atlantic	4.9	0.0	95.1	30.6	23.1	46.3
Quebec	2.6	49.0	48.4	41.1	29.5	29.4
Ontario	11.0	58.9	30.1	74.2	11.1	14.7
Prairies	0.2	55.6	44.2	0.1	45.4	54.5
British Columbia	6.6	8.3	85.1	38.2	13.9	47.9

Table A4.10
Government variance decomposition (percentage)

	North America	Canada	Regional	North America	Canada	Regional
	1963–2001			1982–2001		
Atlantic	1.4	53.4	45.2	20.7	52.5	26.8
Quebec	0.2	49.3	50.5	36.0	51.4	12.6
Ontario	17.0	48.4	34.6	44.0	28.9	27.1
Prairies	11.1	49.2	39.6	5.8	29.8	64.4
British Columbia	4.3	50.2	45.5	1.5	52.5	46.0

Appendix 5
Data Set Construction and Descriptive Statistics

To construct the 1963–2001 gross state product (GSP) data set, two different BEA series were used. 1977–2001 data were obtained directly from the BEA (<http://www.bea.gov/bea/regional/gsp>), 1963–1986 data, although also generated by the BEA, were obtained from the RAND Corporation (<http://www.rand.org/labor/aging/dataprod/cdl/listdata.html>). The BEA had removed these data from their website, because "GSP estimates (for years before 1977) were based upon data and methodologies that make them inconsistent with the current GSP series." Since the two series overlapped for nine years (1977–1986), however, they could be compared and spliced together. For each industry, a regression (with intercept 0) was used to predict the "new series" GSP numbers for each state during this nine-year period, using only the "old series" GSP numbers. The following statistics were obtained:

Name	SIC	Coefficient	R-squared
Agriculture, forestry, fishing	10000	0.8986337	0.9940058
Mining	30000	1.0786877	0.9921311
Construction	40000	1.0052937	0.9890694
Manufacturing	50000	0.9986042	0.9963753
Transportation	62000	0.9882547	0.9873658
Communications	64000	1.0296502	0.9981840
Utilities	66000	0.9931251	0.9920840
Wholesale	70000	1.0210251	0.9993343
Retail	80000	1.0173764	0.9995911
FIRE	90000	1.1260956	0.9861843
Other services	100000	1.0240287	0.9999258
Government	110000	1.1450106	0.9994801

Several of the coefficients are statistically different from 1, but the very high R-squared values show that while the older series may not be identical to the newer series, it is measuring essentially the same values. To calculate values for the overall 1963–2001 series, the following method was used:

1963–1976: Values from the "old series" were multiplied by the appropriate coefficient from the above table.

1977–1986: Values from the "new series" were given a weight of 1 in 1977, 2 in 1978, and so on up to 10 in 1986. Values from the "old series" were given a weight of 10 in 1977, 9 in 1978, and so on down to 1 in 1986.

The final value was computed as ((new_series * new_series_weight) + (coefficient * old_series * old_series_weight)) / 11.

1987–2001: Values from the "new series" were used directly.

Next, industries were selected from the data so that the resulting series would cover the same industries in both the United States and Canada:

ID	**Name**
AF	Agriculture, fishing, and forestry
MI	Mining (including oil and natural gas extraction)
CN	Construction
TC	Transportation and communications
UT	Utilities
WR	Wholesale and retail trade
FI	Finance, insurance, and real estate
SE	Other services (including education and health services)
GV	Government (public administration and defence)

Finally, provinces were grouped as follows:

ID	**Provinces**
AT	Newfoundland, Prince Edward Island, Nova Scotia, New Brunswick
PQ	Quebec
ON	Ontario
PR	Manitoba, Saskatchewan, Alberta
BC	British Columbia

and US states were grouped into the economic regions developed by Crone (2003):

Note: SIC (Standard Industrial Classification) code.

ID	States
NE	ME, NH, VT, MA, RI, CT
MA	NY, NJ, PA, DE, MD
SO	VA, NC, SC, GA, FL, KY, TN, AL, MS, AR
GL	WV, MI, OH, IN, IL, WI, MN
PL	MO, KS, NE, IA
MN	SD, ND, MT, ID
SW	LA, WY, UT, CO, TX, OK, NM
FW	AZ, CA, NV, WA, OR

Table A5.1
Industry shares (percentage)

	Canada		United States	
	1963	**2001**	**1963**	**2001**
MI	5.4	3.5	2.4	1.4
MF	18.2	18.1	27.7	14.4
CN	8.7	5.3	4.8	4.8
AF	6.3	2.2	3.3	1.4
TC	5.5	8.8	6.5	6.0
WR	8.1	11.2	16.5	16.3
FI	13.3	19.8	16.1	20.9
SE	23.0	22.7	10.7	22.5
GV	9.3	5.6	12.0	12.3
UT	2.1	2.7	2.6	2.2

Table A5.2
Industry shares (percentage of provincial output, 1963–2001)

	AF	**MI**	**MF**	**CN**	**UT**	**TC**	**WR**	**FI**	**SE**	**GV**
AT	6.0	3.0	11.9	7.2	2.6	6.7	10.0	16.4	23.5	12.5
QC	2.6	1.1	21.8	7.1	3.7	7.6	9.7	14.3	24.9	7.0
ON	1.9	2.0	21.8	6.4	3.2	6.4	9.7	18.2	23.2	7.0
PR	6.1	16.7	8.4	7.6	2.4	6.8	9.0	15.5	21.0	6.4
BC	6.4	2.7	14.3	6.7	2.3	8.1	9.7	19.9	23.2	6.6

Table A5.3
Region shares (percentage)

	1963	**2001**
AT	6.8	5.6
QC	24.4	21.6
ON	39.6	42.0
PR	18.5	18.7
BC	10.7	12.1
NE	5.9	5.9
MA	23.2	18.7
SO	14.4	20.0
GL	24.6	17.4
PL	5.4	4.1
MN	1.2	1.0
SW	9.9	13.0
FW	15.4	20.0

References

Acharya, R.C., P. Sharma, and S. Rao. 2003. "Canada-US Trade and Foreign Direct Investment Patterns." In *North American Linkages: Opportunities and Challenges for Canada*, edited by R.G. Harris, 13–88. The Industry Canada Research Series. University of Calgary Press.

Ambler, S., E. Cardia, and C. Zimmermann. 2004. "International Business Cycles: What Are the Facts?" *Journal of Monetary Economics* 51 (2): 257–76.

Anderson, H.M., N.-S. Kwark, and F. Vahid. 1999. "Does International Trade Synchronize Business Cycles?" Monash University Department of Econometrics and Business Statistics Working Paper No. 8/99.

Barillas, F. and C. Schleicher. 2003. "Common Trends and Common Cycles in Canadian Sectoral Output." Bank of Canada Working Paper No. 2003–44.

Baxter, M. and M. Kouparitsas. 2004. "Determinants of Business Cycle Comovement: A Robust Analysis." National Bureau of Economic Research Working Paper No. 10725.

Bayoumi, T.A. and B.J. Eichengreen. 1993. "Monetary and Exchange Rate Arrangements for NAFTA." International Monetary Fund Working Paper No. 93/20.

Bayoumi, T. and P.R. Masson. 1995. "Fiscal Flows in the United States and Canada: Lessons for Monetary Union in Europe." *European Economic Review* 39 (2): 253–74.

Beine, M. and S. Coulombe. 2004. "Economic Integration and Regional Industrial Specialization: Evidence from the Canadian-US FTA Experience." University of Ottawa Working Paper No. 0408E.

Bergman, U.M., M.D. Bordo, and L. Jonung. 1998. "Historical Evidence on Business Cycles: The International Experience." In *Beyond Shocks: What Causes Business Cycles?*, edited by J.C. Fuhrer and S. Schuh, 65–113. Federal Reserve Bank of Boston Conference Series No. 42.

Bordo, M.D. and T. Helbling. 2003. "Have National Business Cycles Become More Synchronized?" National Bureau of Economic Research Working Paper No. 10130.

Campa, J. and L.S. Goldberg. 1997. "The Evolving External Orientation of Manufacturing: A Profile of Four Countries." Federal Reserve Bank of New York *Economic Policy Review* 3 (2): 53–81.

Canova, F., M. Ciccarelli, and E. Ortega. 2004. "Similarities and Convergence in G-7 Cycles." European Central Bank Working Paper No. 312.

Cardarelli, R. and M.A. Kose. 2004. "Economic Integration, Business Cycle, and Productivity in North America." International Monetary Fund Working Paper No. 04/138.

Chamie, N., A. DeSerres, and R. Lalonde. 1994. "Optimum Currency Areas and Shock Asymmetry: A Comparison of Europe and the United States." Bank of Canada Working Paper No. 1994–1.

Clark, T.E. and K. Shin. 2000. "The Sources of Fluctuations Within and Across Countries." In *Intranational Macroeconomics*, edited by G.D. Hess and E. van Wincoop, 189–217. Cambridge University Press.

Crone, T.M. 2003. "An Alternative Definition of Economic Regions in the U.S. based on Similarities in State Business Cycles." Federal Reserve Bank of Philadelphia Working Paper No. 03–23.

Davis, S.J. and J. Haltiwanger. 1999. "Gross Job Flows." In *Handbook of Labor Economics*, edited by O. Ashenfelter and D. Card, 2711–805. Amsterdam: North Holland.

Department of Foreign Affairs and International Trade (Canada). 2003. *NAFTA @ 10: A Preliminary Report*. <http://www.dfait.maeci.gc.ca/eet/pdf/NAFTA@10-2003-en.pdf>.

DeSerres, A. and R. Lalonde. 1994. "Symétrie des chocs touchant les régions canadiennes et choix d'un régime de change." Bank of Canada Working Paper No. 1994–9.

Dion, R. 1999–2000. "Trends in Canada's Merchandise Trade." *Bank of Canada Review* (Winter): 29–41.

Doyle, B.M. and J. Faust. 2003. "Breaks in the Variability and Co-Movement of G-7 Economic Growth." Federal Reserve Board International Finance Discussion Paper No. 786.

Dupasquier, C., R. Lalonde, and P. St-Amant. 1997. "Optimum Currency Areas as Applied to Canada and the United States." In *Exchange Rates and Monetary Policy*, 131–71. Proceedings of a conference held by the Bank of Canada, October 1996. Ottawa: Bank of Canada.

Frankel, J.A. and A.K. Rose. 1998. "The Endogeneity of the Optimum Currency Area Criteria." *Economic Journal* 108 (449): 1009–25.

Ghosh, A.R. and H.C. Wolf. 1997. "Geographical and Sectoral Shocks in the US Business Cycle." National Bureau of Economic Research Working Paper No. 6180.

Gregory, A.W., A.C. Head, and J. Raynauld. 1997. "Measuring World Business Cycles." *International Economic Review* 38 (3): 677–701.

Gruben, W.C., J. Koo, and E. Millis. 2002. "How Much Does International Trade Affect Business Cycle Synchronization?" Federal Reserve Bank of Dallas Working Paper No. 203.

Helbling, T. and T. Bayoumi. 2003. "Are They All in the Same Boat? The 2000–2001 Growth Slowdown and the G-7 Business Cycle Linkages." International Monetary Fund Working Paper No. WP/03/46.

Horvath, M. 1998. "Cyclicality and Sectoral Linkages: Aggregate Fluctuations from Independent Sectoral Shocks." *Review of Economic Dynamics* 1 (4): 781–808.

———. 2000. "Sectoral Shocks and Aggregate Fluctuations." *Journal of Monetary Economics* 45 (1): 69–106.

Imbs, J. 2001. "Sectors and the OECD Business Cycle." London Business School. Photocopy.

———. 2003. "Co-Fluctuations." Centre for Economic Policy Research Discussion Paper No. 2267 (old version).

International Monetary Fund. 2001. "International Linkages: Three Perspectives." *World Economic Outlook* (October): 65–104.

Kose, M.A., C. Otrok, and C.H. Whiteman. 2003. "International Business Cycles: World, Region, and Country-Specific Factors." *American Economic Review* 93 (4): 1216–39.

Kose, M.A., E.S. Prasad, and M.E. Terrones. 2003. "Volatility and Comovement in a Globalized World Economy: An Empirical Exploration." International Monetary Fund Working Paper No. WP/03/246.

Michelis, L. 2004. "Prospects of a Monetary Union in North America: An Empirical Investigation." In *Exchange Rates, Economic Integration and the International Economy,* edited by L. Michelis and M. Lovewell, 114–35. Toronto: APF Press.

Otto, G., G. Voss, and L. Willard. 2001. "Understanding OECD Output Correlations." University of New South Wales School of Economics Research Discussion Paper No. 2001–05.

———. 2003. "A Cross Section Study of the International Transmission of Business Cycles." Photocopy.

Palda, F. 1994. "Provincial Trade Wars: Why the Blockade Must End." The Fraser Institute.

Racette, D. and J. Raynauld. 1994. "BVAR Models with Economic Priors: An Application to the Propagation of US Regional Cycles to Canada." *Empirical Economics* 19 (4): 675–90.

Schuh, S. and R.K. Triest. 1998. "Job Reallocation and the Business Cycle: New Facts for an Old Debate." In *Beyond Shocks: What Causes Business Cycles?,* edited by J.C. Fuhrer and S. Schuh, 271–337. Federal Reserve Bank of Boston Conference Series No. 42.

Stock, J.H. and M.W. Watson. 2003. "Understanding Changes in International Business Cycle Dynamics." National Bureau of Economic Research Working Paper No. 9859.

Stockman, A.C. 1988. "Sectoral and National Aggregate Disturbances to Industrial Output in Seven European Countries." *Journal of Monetary Economics* 21 (2/3): 387–409.

Discussion

Tamin Bayoumi

Like most good papers, the study by Gosselin et al. comes from a very simple but powerful insight—with real GDP by sector of origin for US states and Canadian provinces (using a relatively consistent methodological approach), it is possible to create a data set describing activity across two dimensions—location and industry—for industrialized North America. The authors construct such a data set and use factor analysis to examine the relative contribution for Canada of idiosyncratic disturbances to those at the provincial/state level, the national level, and at the North American level. The latter is identified as a US shock on the assumption that Canada is a small open economy that does not affect, but is affected by, its southern neighbour.

Results and Policy Conclusions

This clear and well-written paper finds three main results:

- Common Canadian shocks are the most important contributors to the Canadian cycle. Hence, there appears to be a Canadian cycle that is relatively important and that is not dominated by idiosyncratic, provincial, or North American disturbances.
- These shocks have become more important over time compared to idiosyncratic shocks. There seems to be a trend for Canada to become more of a national economy over time.

- The importance of North American (identified as US) disturbances has also risen, particularly in those sectors most exposed to trade, including primary products. This finding corresponds to evidence of increasing ties with the United States after the passage of the Free Trade Agreement (FTA) and the North American Free Trade Agreement (NATFA). Indeed, given the strong evidence of closer ties with the United States over this period, it could be seen as being closer to a model validation check, since not finding this result would have led one to question the methodology.

Based on these results, the authors support three policy conclusions:

- Economic flexibility is important in an economy such as Canada. This is a statement I can wholeheartedly support.
- Canada has a strong business cycle and hence needs its own currency, and the case for a separate currency has been growing stronger over time. I find this assertion less persuasive, since there is no comparison with other regions (most obviously, with the euro area or the United States). Without comparison with other currency unions, I cannot see how these results allow the authors to make such an assertion.
- There is a role for countercyclical fiscal policy at the provincial level. I am extremely skeptical about this conclusion, for two reasons. Provinces are generally highly open to trade, meaning that a large proportion of any addition to aggregate demand does not flow into provincial activity. In addition, Ricardian effects diminish the effect of aggregate demand at a provincial level, whereas (to the extent that provincial cycles are offsetting in terms of the national deficit) this does not occur at the national level (Bayoumi and Masson 1998).

Analytic Approach

I have two main comments regarding the authors' analytic approach. First, they do not compare changes in Canadian behaviour over time with those for another country. Since the type of analysis of variance decomposition used here does not lend itself to formal statistical tests, the authors provide no formal statistics on the likelihood that the trends being identified are important. However, this limitation puts a premium on other forms of comparison to ensure that change in (say) the proportion of shocks attributed to the Canadian cycle does not reflect a change in the nature of the shocks hitting all economies. For example, large idiosyncratic shocks over the 1960–81 period could simply reflect the oil shocks of the 1970s. The most obvious way of checking that the trends identified in the Canadian economy over time do not reflect "global" trends is to compare these results with those of other countries. Given that the data set includes Canada and the

United States, it would seem sensible to compare the statistics found for Canada with the experience of the United States (as noted, a comparison with the euro area would also be helpful).[1]

Second, the authors do not identify industry-specific disturbances, which is surprising, since the basic data cover both location and industry of origin. Normally, if the panel has two dimensions, they can be added to the factor model. Including sectoral shocks (possibly at the cost of a slightly simpler estimation procedure) would help answer the question of whether the increase in Canadian and North American shocks largely reflects an increase in the importance of industry-specific shocks as barriers to trade have fallen and intra-industry trade has increased, or indeed whether it reflects increasingly national disturbances, as argued in the paper.

My suggestions for the analysis would be to (i) include industry-specific shocks, and (ii) compare the Canadian results with those from the United States (at the least) to account for "global" trends in the nature of the shocks over time.

Finally, the International Monetary Fund has been examining the nature of Canadian cycles from a more macroeconomic point of view, looking at which variables explain the evolution of Canadian regional domestic products. As can be seen in Table 1, the results suggest that oil-price hikes and exchange rate movements have differential effects across regions, supporting activity in Canada's Prairie provinces, while having a large impact on the industrial centre of the country. The US cycle is more important for the Prairies/central provinces than for the coastal regions, which have larger links with the rest of the world. These conclusions indicate that Canada, possibly to a somewhat greater extent than many other countries, remains a conglomeration of regional economies.

1. Using Hodrick-Prescott filters to detrend a series can interfere with the natural pattern of correlations, although I suspect that is not an important concern in this paper.

Table 1
Relative output growth across regions

	British Columbia	Prairie provinces	Central provinces	Atlantic provinces
Regional output growth[1]	0.15	0.07	0.18*	0.37**
	(0.17)	(0.18)	(0.09)	(0.14)
US GDP growth	0.63**	0.80**	0.79**	0.45**
	(0.17)	(0.14)	(0.11)	(0.13)
Real exchange rate change[1]	–0.13	–0.06	–0.16**	–0.11**
	(0.09)	(0.08)	(0.06)	(0.05)
Oil-price change[1]	0.00	0.04**	–0.02*	–0.02*
	(0.02)	(0.01)	(0.01)	(0.01)

Notes: Standard errors in parentheses; (*) significance at 10 per cent, (**) at 5 per cent.
Newey-West heteroscedasticity-consistent standard errors and covariance.
1. Lagged variables.

Reference

Bayoumi, T. and P.R. Masson. 1998. "Liability-Creating versus Non-Liability-Creating Fiscal Stabilisation Policies: Ricardian Equivalence, Fiscal Stabilisation, and EMU." *Economic Journal* 108 (449): 1026–45.