Regional Perspectives on Dollarization in Canada*

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Abstract: In this paper, we investigate whether it is preferable for Canadian regions to individually adopt the US dollar or to remain with the current currency arrangement. The empirical analysis focuses on the cross-correlations of various business cycle measures of Canadian regions, of Canada, and of the United States. The business cycle investigation is completed by the analysis of two other important criteria for optimum currency areas, i.e., industrial specialization and trade interdependence. Our results highlight a significant heterogeneity across Canadian provinces. In particular, it transpires that it could be economically advantageous for the central provinces of Ontario and Quebec and to a lesser extent British Columbia to adopt the US dollar. By contrast, it is not as clear what the other regions should do, the final answer depending obviously on the path the larger three provinces take.

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1. INTRODUCTION

The exchange rate system has been an important economic policy issue in Canada for decades. At the time when industrialized countries were pegging their currencies within the Bretton Woods system, in 1950 Canada floated its dollar, a float that would last throughout the decade. It appeared at the time that floating the Canadian dollar was necessary to alleviate the effects of commodity price adjustments. After a forced return to the fixed exchange rate system in 1962, Canada was again among the first to leave the prevailing order when it allowed its currency to float in June 1970. Since then, the Canadian dollar has floated more or less freely against the currencies of its most important trading partners including, in particular, the US dollar.

Recently, with the introduction of the euro in 1999, the debate about the exchange rate among academic economists, and to some extent the business community, has taken a new direction. A North American currency union or a simple dollarization is increasingly considered a credible alternative to the current flexible exchange rate regime (Courchene and Harris 1999). As Bank of Canada Governor David Dodge mentioned, “In recent months, the debate over Canada’s exchange rate system has heated up and calls for the adoption of a common currency with the United States have attracted a lot of attention” (Dodge 2001, 1).

Basically, the opponents of the prevailing flexible exchange rate regime have emphasized the degree of openness of the Canadian economy, with more than 40 per cent of its output now being exported. Furthermore, they underline the sharp increase since the early 1980s in north-south international trade (more than 80 per cent of which is with the United States) compared with the east-west interprovincial trade (Courchene and Harris 1999). Consequently, the adoption of a single currency could generate important economies of transaction costs. Another point mentioned by Harris (2000) focuses on the significant divergence between labor productivity in Canada and the United States. In general, the opponents of the flexible exchange rate regime advocate the adoption of the US dollar rather than a fixed and adjustable exchange rate system, pointing out the numerous significant crises faced by the European Monetary System in 1993 and 1994.

In contrast, researchers at the Bank of Canada who defend the prevailing exchange rate regime (Djouad et al. 2000; Macklem et al. 2000) have emphasized the stabilizing properties provided by exchange rate adjustments and the related independence of domestic monetary policy. This argument of course comes directly from the Mundellian view of the optimum currency area (OCA) theory (Mundell 1961). The
OCA theory balances the stabilization costs of a single currency against its benefits. The Mundellian argument was used in 2000 as the main line of defense by former Bank of Canada Governor Gordon Thiessen in a speech entitled “Why a Floating Exchange Rate Regime Makes Sense for Canada.” The argument has been re-stated recently by the Bank of Canada, as illustrated by the following quote from a speech given by Governor Dodge:

The real value of a floating currency for Canada lies in helping our economy to absorb some of the impact of external shocks. A classic example would be a sharp movement in the value of our exports relative to our imports, such as occurred in 1997–98, when world commodity prices plummeted in the wake of the Asian crisis (Dodge 2001, p. 4).

In this paper, we reconsider the issue of the exchange rate regime between Canada and the United States. Unlike the main thrust of the literature, however, our focus is on regional dynamics and showing why and how Canada as a whole is not an OCA. We use the traditional criteria that define such an OCA: business cycle synchronization (Mundell 1961), trade independence (Mc Kinnon 1963), and the degree of industrial specialization (Kenen 1969). It may thus be expected that the incentives for choosing a single currency with the United States will differ significantly across the Canadian regions. This point might be relevant from a public choice point of view. Canada is well known for having segmented regional political preferences, the autonomous ambitions of Quebec being a good example. We show that arguments in favor of currency union with the United States tend to increase over time for Quebec and Ontario. Since these two provinces account for almost two-thirds of the Canadian GDP, this may call into question the future political sustainability of the Canadian currency. The importance of political will in choosing a common currency has been shown clearly with the recent monetary integration in Europe.

This paper provides a systematic investigation of Canadian provincial business cycles using the perspective of an optimal monetary zone with the United States. We consider various measures of the business cycle and analyze the relations between Canadian provinces and the US economy. Our results suggest that the Canadian business cycle differs from that of the United States mainly because of the dynamics of the peripheral Canadian regions. In other words, it is shown that on the basis of the Mundellian criterion of asymmetric shocks, the central provinces (i.e., Quebec and Ontario) and perhaps British Columbia would be better off adopting the US dollar, while the other provinces should keep a flexible Canadian dollar. For these latter provinces however, as the OCA approach yields an over optimistic role for the exchange rate, the final decision regarding the exchange rate regime is far from
obvious. The business cycle analysis is completed by the investigation of two important criteria for optimum currency areas (OCA): industrial specialization (Kenen, 1969) and trade interdependence (McKinnon, 1963).\textsuperscript{5}

The paper is organized as follows. Section two contains a short survey of relevant studies of the Canadian case. The third section is an empirical analysis, comparing correlations of various measures of the Canadian regional and the US business cycles. The fourth section provides a deeper analysis, aiming at a greater understanding of these results. Section five focuses on the currency options of an independent Quebec and section six concludes.

2. REVIEWING THE LITERATURE
Regional aspects of the Canadian economy were taken as an example in Mundell’s (1961) seminal contribution on OCA. According to Mundell, Canada might not be an OCA because of the asymmetry in the economic structures of eastern and western Canada.

During the two referendums in the 1970s and the 1990s regarding the secession of Quebec from the Canadian federation, Quebec economists discussed the desirability of using the Canadian dollar as opposed to the US dollar (Fortin 1991; Courchene and Laberge 2000). The prevailing view in the Quebec debate was that a sovereign Quebec would be better off keeping the Canadian dollar, given Quebec’s close trade links with the rest of the Canadian economy and its willingness to preserve the economic union with Canada.

To the best of our knowledge, Bayoumi and Eichengreen (1994) provide the first empirical studies following a Mundellian perspective on the North American currency union. They conclude that “North America is less of an optimum currency area than the European Community” (1994, p. 167). They also introduce some Canadian regional dimensions into their study by dividing Canada into two separate areas: the four western provinces on one side; and Atlantic Canada, Quebec, and Ontario on the other as eastern Canada. Their analysis of regional dimensions, however, suffers from this arbitrary division and from using few annual data. Such a small number of time-series observations (15) might not be sufficient to clearly identify business cycles as well as supply and demand disturbances. By contrast, our analysis benefits from a longer time interval (1961–2000) and the use of quarterly databases.
The Bank of Canada subsequently produced a number of empirical studies on optimal currency areas following Bayoumi and Eichengreen’s methodology that was based on a structural vector autoregression (VAR) decomposition of shocks (Lalonde and St-Amant 1993; DeSerres and Lalonde 1994). The first study uses annual data and does not focus on regional issues. The authors conclude that Canada, like Mexico, is better off with an independent monetary policy with respect to the United States. DeSerres and Lalonde (1994), however, use the same quarterly estimates of provincial real GDP that we use in this paper and focus on regional considerations. To some extent, their results on the asymmetric nature of supply and demand shocks across Canadian provinces correlate with ours. They nevertheless conclude than Canadian regions overall are better off with the Canadian dollar. A recent paper by Dupasquier et al. (1998) follows the same VAR methodology but uses a different approach for modeling monetary policy. Using quarterly data on real GDP and prices at a regional level, they also identify supply and demand disturbances over the 1972–1995 period. Their conclusions differ somewhat from the previous empirical analysis produced at the Bank of Canada and from Bayoumi and Eichengreen (1994). In particular, they conclude that the cost for Canada of fixing its exchange rate to the United States does not vary much from the cost for European countries of fixing their exchange rates together. Dupasquier et al.’s (1998) regional analysis highlights the asymmetric nature of regional shocks in Canada. Furthermore, when accounting for shocks dynamics, they emphasize the similar behavior of the US and Canadian economies. Our analysis goes beyond Dupasquier et al. since we compare Canadian regions with the United States. In addition, our approach is based on measures of the business cycle rather than the VAR decomposition, enabling us to keep a larger sample (1960:1–2000:1). This turns out to be important for the identification of a changing trend in economic integration between some Canadian provinces and the United States.

The recent papers of Courchene and Laberge (2000), Courchene and Harris (1999), and Harris (2000) do not present new empirical evidence on the business cycle asymmetry. By contrast, our subsequent analysis of changing trade patterns (see section 4.2) is fully consistent with the trend identified in their paper.

The regional dimension, while crucial in the analysis of Canadian issues, turns out to be one of the most interesting developments in empirical applications of the OCA theory (see Beine (1999) for a survey). This is illustrated in the European case by recent papers by Fatás (1997) and Fuss (1997). As a whole, these studies show that the geographical definition of the European OCA does not match the existing national borders.
3. COMPARATIVE REGIONAL BUSINESS CYCLE PROPERTIES

Methodological Issues

To characterize the degree of business cycle synchronization, we use quarterly data of provincial economic activity. Real GDP and employment data are used as the basic measures of economic activity. The sources and the main features of these data are detailed in the Data Appendix.

Two different methodological approaches have been used in the OCA literature to assess the criterion of asymmetric shocks. The first approach attempts to identify different kinds of disturbances and to compare their dynamics across countries or regions. To this end, the methodology utilizes the VAR decomposition of shocks, using an appropriate identification scheme. For instance, Bayoumi and Eichengreen (1994) employ the Blanchard and Quah approach that is based on a bivariate VAR involving (the growth) of economic activity and inflation in order to isolate supply and demand shocks. The main drawback of this approach is that the set of restrictions used to identify the disturbances remains to a certain extent arbitrary (on this point, see Dupasquier et al. (1998, pp. 3–4)). Another drawback concerns the choice of the deterministic components as well as the stationary properties of the variables involved in the VAR modelling.

The other approach—the one used in this paper—focuses on the business cycle properties extracted from variables thought to capture the volume of economic activity. The issue of isolating the business cycle from the secular component of an observable time series is cumbersome and also remains necessarily an arbitrary exercise. During the last two decades, many alternative procedures have been proposed (see Canova (1998) for an extensive survey): first differencing, unobserved components models, frequency domain methods, Hodrick and Prescott’s filter (HP hereafter), and the band-pass filter (Baxter and King 1995) among other methods. In this paper, we rely on HP filter type of procedures in the spirit of the studies of, for instance, Artis and Zhang (1997, 1999) and Wynne and Koo (2000). The properties of these filters have been thoroughly investigated from a theoretical point of view. Furthermore, these procedures are less subject to the problems faced by the VAR approach. We should keep in mind, however, that our approach does not distinguish different types of disturbances. As a consequence, since the cyclical component will include domestic common shocks (including ones associated with domestic monetary policy), this will tend to overestimate to a certain extent the correlations across Canadian regions compared with correlations between Canadian regions and the United States, at least if one assumes that a monetary union between the US and Canada would imply a common monetary policy. Finally, given the arbitrary
nature of the exercise, one of our goals is to assess the robustness of our results. We will therefore examine
the choice of various filters more closely.

Our starting point relies on the popular HP filter, with the benchmark value of 1600 (for quarterly data) for
the smoothing parameter ($\lambda$). Table 1 reports the correlations between the cyclical components of real
GDP extracted using this filter. While the value of the correlation is itself important, so may also be its
significance. Indeed, it turns out that some correlations, while positive, were not significantly different
from zero. In order to estimate the standard deviation of the correlations, we use a generalized method of
moments procedure proposed by Ogaki (1993). These standard deviations are reported in italics in the
Tables 1 through 3 and in Table 6.

Although popular, the choice of 1600 for the value of the $\lambda$ smoothing parameter in the HP filter may not
be optimal. Recently, Pedersen (2001) shows that the search for another value will tend to make the HP
filter closer to an “ideal filter.” The optimal value depends on the spectral shape of the business cycle. The
value of 1600 for $\lambda$ turns out to be relevant for business cycles with a typical length of nine years. To this
end, we estimate the spectral density of the business cycle. Since the US business cycle plays a prominent
role in our analysis, we report the estimate of its cycle. Figure 1 reports the spectral density, estimated
from first differences of (log of) US real GDP.

The estimate of the spectrum suggests that the typical length of the US business cycle is only five years.9
Given this, Pedersen (2001) advise choosing a $\lambda$ equal to 315 for quarterly data. We will thus use this
value for $\lambda$ in our second HP filter. The cross-correlations (and their standard deviations) of the business
cycles extracted with this procedure are reported in Table 2.

Another feature of the HP filter is that it is a high-pass filter in that it attenuates fluctuations at low
frequencies. For instance, the HP filter with $\lambda =1600$ applied to quarterly data is often considered as
eliminating frequencies of 32 quarters or higher. In the context of OCA, however, it might also be
desirable to ignore fluctuations at the other end of the frequency spectrum. Indeed, while the nominal
exchange rate could act as a buffer for relative demand shocks, its effects on economic activity take some
time to appear. For instance, as de Grauwe (1994) documents from the Belgian experience, the effects of
the devaluation of the Belgian franc in 1982 were seen only after at least 8 quarters. As a consequence, we
also extract the business cycle defined in a band of frequencies using the Baxter and King (1995) band-
pass filter (BP filter hereafter). Another motivation for using this kind of filter is suggested by Pedersen
(2001): for most autoregressive processes, distortions associated with the BP filter turn out to be less important than the ones associated with the most usual filters (including the HP filters).

Baxter and King’s (1995) band-pass filter can be constructed as the difference between two optimal approximated low-pass filters with the constraint that the filter weights sum to zero. An optimal approximation to an ideal low-pass filter can be given in the time domain by the two-sided infinite moving average filter:

\[ T_t = b(L)y_t, \]

where \( T_t \) is the trend component of the observable time series \( y_t \).

\[ b(L) = \sum_{j=-\infty}^{\infty} b_j L^j, \text{ and } \sum_{j=-\infty}^{\infty} |b_j| < \infty. \]

It can be shown that the weights are given by (2)

\[ b_j = \omega_j / \pi \text{ for } j = 0, \text{ or } \sin(j\omega_t) / \pi j \text{ for } j = \pm 1, 2, \ldots \]

where \( \omega_t \) is the lower cut-off (angular) frequency (expressed in radians). Baxter and King investigate how best to approximate the ideal filter with a finite \( K \) number of lags. They show that the optimal approximate low-pass filter \( a(L) = \sum_{j=-K}^{K} a_j L^j \) sets \( a_j = b_j \) for \( j = 0, 1, \ldots, K \) and \( a_j = 0 \) for \( j > K \). The ideal band-pass filter passes frequencies only in the range \(-T_l \) to \( T_u\), where \( T_u \) is the upper cut-off frequency.

Finally, in order to operationalize the filter, it is necessary to choose three specific parameters: first, the parameters \( U_p \) and \( L_o \) that give the upper and lower cut-off frequencies through \( T_l = 2B / L_o \) and \( T_u = 2B / U_p \). Following several authors, we choose \( U_p = 3, L_o = 8, \) and \( K = 12. \) Given that we use quarterly data, this means that the filter will identify business cycle fluctuations with periodicities ranging between 8 and 32 quarters. Consequently, we lose three years of data at the beginning and at the end of the sample. The results in terms of cross-correlations are reported in Table 3.
Empirical Results

A number of interesting findings emerge from the results reported in Tables 1 through 3. To start with, it is interesting to see that the results turn out to be robust to the alternative detrending procedures. Empirical evidence on business cycle correlations for Canadian regions and the United States as a whole is not dependent on the procedure used to extract the business cycle.

It is noteworthy that the highest estimated cross-correlations among the Canadian provinces are found among Ontario, Quebec, and British Columbia. Furthermore Ontario, followed by either Quebec or British Columbia, provides the highest correlations with the United States. However, a very strong heterogeneity in the regional business cycle dynamics in Canada is the main picture that emerges from these results. For example, most of the cross-correlations are low for provinces like Saskatchewan, Newfoundland, Prince Edward Island, and to a lesser extent Alberta, and are in many cases not significantly different from zero. To put these results into an international perspective, it is useful to refer to the cross-correlations computed for Europe by Wynne and Koo (2000) using the same approach as the one used in Table 3. Many cross-correlations at the Canadian regional level appear very low by European standards. It turns out that the correlations with the US business cycle for those Canadian provinces are lower than the correlations between non-participating EMU countries such as the United Kingdom and the core countries of the EMU. Finally, cross-correlations are higher between Canada as a whole and the United States than the typical correlations obtained between the countries considered to be the core of Europe. These results are in sharp contrast to what has been claimed in some of the previous empirical studies like Bayoumi and Eichengreen (1994).

In order to provide additional insights, it might be useful to summarize these numerous cross-correlations. Table 4 provides averages of the bivariate cross-correlations obtained from each detrending method (and also an average across the methods) for specific groupings. Although such a procedure is obviously subject to methodological criticisms, it allows the regional patterns in the business cycle co-movements to be summarized. Table 4 strikingly confirms the dichotomy in co-movements with the US business cycle between, on the one hand, Quebec, Ontario, and British Columbia and, on the other hand, the other Canadian provinces. Interestingly, among these latter provinces, the business cycles show a high degree of desynchronization. This in turn creates
some doubt about the potential room for a nation-wide stabilization process provided by a flexible exchange rate.

Finally, based on the broad picture that emerges from the analysis of business cycle correlations, it might be argued at this stage that the costs and benefits of keeping a flexible exchange rate with the United States are shared unequally across Canadian regions. Furthermore, one could argue that it is suboptimal for provinces like Quebec and Ontario to use different currencies (for instance, Quebec choosing the US dollar while Ontario remains in the Canadian monetary union). Interestingly, at least on the basis of these correlations, British Columbia could also gain from dollarizing. Nevertheless, before making any conclusions in this direction, we have to examine the empirical evidence more closely.

First, it might be useful to provide some explanation of these business cycle linkages. One possible explanation for the high correlation of the business cycles of Quebec and Ontario with the United States could lie, for instance, in the close manufacturing linkages with their neighboring states in the Great Lakes area. In this respect, one may wonder to what extent the Canada–US Auto Pact played a major role through increasing intra-industry trade. To gain some insight, we provide a complementary analysis of the business cycles with a look at the correlation between the cyclical component of employment data for some Canadian provinces and US states.

Second, correlations computed over the whole period do not show the evolution of economic integration between Canadian regions and the United States. This is, of course, an important point because we want to investigate if the empirical evidence is stable over time. For example, it has been argued by Krugman (1991) that a deeper economic integration would result in the development of a core-periphery structure. Thus it could be the case that the business cycles of Quebec and Ontario have become less similar to the US cycle over time and that this trend is likely to continue in the future. Or, following the Canadian-U.S. Free Trade Agreement (FTA) and the North American Free Trade Agreement (NAFTA), a change in the trade flow orientation at the regional level in North America might have affected the business cycle correlations. This point will be
discussed in the next section. We will find that the trend observed for cross-correlations supports the latter hypothesis.

Third, the trend in these cross-correlations should be explained. Typical explanations must refer to the usual OCA criterion of industrial specialization (Kenen 1969).

Fourth, through the analysis of correlations, we emphasize the potential stabilization cost of exchange rate fixity. In order to make a decision, this cost has to be balanced against the benefits in terms of savings in transaction costs. This in turn may be done by looking at another OCA criterion, the degree of trade openness, introduced by McKinnon (1963). These latter two points will be addressed in section four and the first two in the remaining of this section.

**Correlations Based on Employment Data**

To get some insight into the asymmetric business cycle correlations between Central Canada and Western Canada on the one side, and the United States on the other, it might prove useful to compare business cycle correlations with the Great Lakes states that are closely linked with Canada. As comparable provincial/state GDP data are unavailable, we have to rely on total employment data, which are available on an annual basis for US states for the 1969–2000 period, to extract business cycles. The counterpart Canadian employment data (computed from monthly data) range over the 1976–2000 period. With the annual frequency, we use the HP filter with \( b = 100 \). Table 5 reports the cross-correlations among the five Canadian provinces (Quebec, Ontario, Saskatchewan, Alberta, and British Columbia), four US states (Pennsylvania, Ohio, Michigan, and New York), and the overall US economy.

Two new findings emerge from the analysis of Table 5. First, the Ontario and Quebec business cycles are much more correlated with the business cycles of the United States, New York, and Pennsylvania than with Michigan. This is interesting as it indicates the high correlation between the business cycles of Central Canada and the United States is not merely the result of the high degree of integration in the North American automobile industry. Second, in the case of British Columbia, the results of Table 5 contrast with those of Tables 1 through 3: the employment pattern of British Columbia shows little co-movement with total US employment. This suggests that the case for dollarization is less obvious for British Columbia than for Ontario and Quebec. It also suggests that the channels through which business cycles are transmitted across the border are quite different between Ontario and Quebec on the one hand and
British Columbia on the other. Further differences in terms of trade patterns and industrial specialization (see the first two subsections of section four below) suggest that a pure OCA would not include the three provinces.

Finally, the analysis of employment data corroborates the main result from GDP data: Alberta and Saskatchewan’s business cycles are not correlated with Central Canada and the United States.

**Evolution Over Time**

As mentioned above, the dynamics of the business cycle asynchronicity turn out to be overwhelmingly important in assessing the net gain of a common currency. This point has been addressed recently by economists concerned about the benefits of the EMU. A typical question might be the following: Is monetary union less profitable ex post than ex ante? In other words, is there a specialization process à la Krugman that could lead to an increase in business cycle asynchronicity between the United States and the Canadian provinces? Although such a pattern has not been identified across European countries, the story is quite different when regarding European regions. In this respect, Fatás (1997) shows that the cyclical correlations between the northern and southern regions of Italy have decreased significantly over time, while the correlations between the northern regions of Italy and the German Länder have increased significantly.

To have an insight into these dynamics, we distinguish between two subperiods and follow Courchene and Harris (1999) in splitting the sample: the first, 1961:1 and 1979:4, and the second, 1980:1 and 2000:1. We distinguish three geographical areas: the United States, the aggregation of Quebec and Ontario (QUON), and the aggregation of the rest of Canada (RCA). Table 6 reports the cross-correlations computed over the full period and the two subperiods, using the different filters to extract the business cycle component.

Table 6 sheds an interesting light on the dynamics. Correlations between the US cycle and that of the central provinces of Quebec and Ontario tend to increase over time. In contrast, the correlations between the other provinces and the United States decrease over time. Even more interesting, this is also the case (i.e., the correlations decrease over time) between Quebec and Ontario on the one hand and the rest of Canada on the other. A Wald test indicates that the change of the correlations (extracted by the band-pass filter) between the two periods is significant at the 1 per cent level for QUON-RCA and RCA-US, whereas the p-value relative to the same test applied to QUON-US is 0.11. Furthermore, the Wald test allows us to test whether the correlations measured over the second period differ significantly. It turns out that the p-
values of the Wald test applied to the correlations measured from cycles extracted by the band-pass filter are all below the 1 per cent level. To sum up, it appears that Canada faces a core-periphery differentiation process at a regional level: an increasing synchronization between the central provinces and the US economy at the expense of growing idiosyncratic dynamics for peripheral Canadian provinces.

To further emphasize the contrasting evolution of business cycle correlations of Canadian regions and those of the United States, it might be interesting to look at the dynamics of the correlations since the 1980s. To this aim, Figure 2 uses a scatter diagram to contrast the evolution of the rolling correlations of Quebec-Ontario on the one hand and the rest of Canada on the other. The correlations are measured over a moving sample that begins with the 1961:1 to 1979:4 period and ends with the period from 1981:1 to 1999:4. The diagram obviously suggests that these correlations have evolved in a very different way: the one between QUON and the United States tended to increase whereas the correlation between the rest of Canada (RCA) and the United States appeared to have decreased, at least up to 1995. Furthermore, when the years covering the last recession are added to the moving sample, the correlation between Quebec-Ontario and the United States remained quite stable whereas the one between the rest of Canada and the United States dived significantly. This once more stresses the important heterogeneity of the business cycle of the central provinces with the ones of the peripheral regions.

4. UNDERSTANDING THE RESULTS: ECONOMIC STRUCTURES AND TRADE PATTERNS

This section focuses on three sets of stylized facts that will help explain and complete the previous results in terms of business cycle synchronization. The first two sets refer to the other important criteria of the OCA theory: industrial specialization and trade openness. The last one documents the persistence of shocks.

*Industrial Specialization in Primary Products*

Regarding the first set of stylized facts, it is important to note that from the point of view of economic geography, Canada is far from being a homogeneous country. Canada might be viewed as a good example of Krugman's (1991) core-periphery model. Canada is a huge country physically with a relatively small population concentrated close to its southern frontier with the United States. A good proportion of the population, manufacturers, and mobile factors are concentrated in the Quebec-Windsor corridor that includes the highly urbanized areas of Montreal, Ottawa, and Toronto. Outside this industrial core, economic activities are typically related to the exploitation of natural resources. This structure is clearly portrayed by the data presented in Table 7 referring to the international trade balance of primary products.
Newfoundland, Prince Edward Island, and more importantly the four western provinces, are net exporters of primary products. In the 1990s Alberta, already an important oil exporter, took the opportunity to export natural gas to California and the US Great Lakes states following US deregulation. Alberta leads by a large margin the next contender, Saskatchewan, among the Canadian provinces that record a primary product trade surplus with the rest of the world. Virtually 100 per cent of Alberta's surplus results from oil and gas exports. The oil and gas industry in the two other prairie provinces of Saskatchewan and Manitoba are on a smaller scale. In Saskatchewan, agricultural products account for 50 per cent of the surplus; the remainder is divided equally between oil and gas on the one side and mining (mainly potash) on the other. In Manitoba, 75 per cent of the surplus is attributed to agricultural exports. British Columbia has a different economic structure with a primary product trade surplus based essentially on mining industries. But the most striking fact emerging from Table 7 is that the two most populated provinces of Quebec and Ontario are, like the United States, net importers of raw material.

This stylized fact illustrates that the Bank of Canada's main line of defense for a flexible Canadian dollar might not apply to the two largest Canadian provinces. According to the Bank of Canada (Thiessen 2000; Dodge 2001), Canadian exchange rate movements are required to stabilize the effect of commodity shocks because Canada is a net exporter of raw material and the United States is a net importer. This reasoning by the Bank of Canada applies essentially to the economy of the four western provinces. The striking stylized fact, mentioned above, can explain why Quebec and Ontario might be closer to the United States from a Mundellian perspective. Sharing the industrial structural diversity of its southern neighbor, Ontario and Quebec do not need exchange rate movements with respect to the United States in order to adjust to commodity shocks. Such exchange rate movements might even be detrimental.

**Trade Patterns**

Trade patterns are also useful in understanding the trend observed in business cycle correlations. As we have seen before, Ontario and Quebec business cycles tend to become more and more correlated with the United States when we move from the pre-1980s sample to that of the post-1980s. This result could be explained by the fact that, as was pointed out in earlier studies (Courchene and Harris 1999; Courchene and Laberge 2000), trade patterns in the last two decades have rotated from the traditional pan-Canadian east-west axis to the international north-south axis. Figure 3 illustrates this point for the aggregation of Quebec and Ontario. Our international (interprovincial) openness indicator is the ratio of the sum of international
(interprovincial) exports and imports to GDP. While the ratio of interprovincial trade to GDP for Quebec and Ontario (including the trade between these two provinces) has slowly decreased up to 1992, the volume of international trade has boomed, especially since 1991, a period that corresponds roughly to the FTA with the United States and NAFTA with the United States and Mexico.

In Figure 4, we compare the rising trend in the ratio of international trade to interprovincial trade of Quebec-Ontario with the other provinces. Even though international openness has tended to rise for the peripheral provinces especially in the last decade, this ratio has risen much more in the provinces of Ontario and Quebec since the end of the 1980s. Interestingly, the international openness of British Columbia, which was proportionally comparable with Ontario and Quebec in the 1980s, has been stagnant in the second part of the 1990s following the Asian crisis. Because of British Columbia’s geographical location, the economy of the Pacific province has partly followed the ups and downs of the Japanese economy and the emerging economies of Eastern Asia.18

**Persistence of Shocks**

Finally, it is important to observe that the so-called Canadian periphery is also far from being homogeneous from a Mundellian perspective. A good example is the case of Alberta and Saskatchewan, the two provinces responsible for the sizable commodity trade balance surplus of Canada. As shown in the empirical results of the preceding section, business cycles are poorly correlated between these two provinces. This could be explained by the differential nature of the shocks that affect these economies. A typical measure of persistence indicates that shocks affecting the Alberta economy are extremely persistent whereas shocks affecting Saskatchewan are obviously not.19 Oil shocks appear to affect the Alberta economy for years while Saskatchewan recovers rapidly from shocks that most often originate from the agriculture sector.

5. **FURTHER IMPLICATIONS**

Before concluding, let us look at some additional political implications. We investigate four different points: (1) the consequences of Quebec adopting the US dollar; (2) the prospect of a "domino effect" that would lead to the complete adoption of the US dollar by Canada; (3) the potential impact on Canadian peripheral provinces in terms of stabilization; and (4) the consequences for the US economy in a monetary unification scenario.
The Consequences of Quebec's Dollarization

First, we will briefly look at the consequences, shown by our empirical analysis, of the optimal currency for an independent Quebec. Non-reported results indicate that, over the period 1980:1–2000:1, correlations are extremely high between the business cycles of Quebec on the one side, and of the rest of Canada and the United States on the other—typically between 0.8 and 0.9. Interestingly, however, because of its deep integration with Ontario, Quebec's business cycle is slightly more correlated with the rest of Canada than with the United States. The differences, however, for the last period of the sample are much lower than the ones for the whole sample. Furthermore, it is worth remembering that, compared to a situation in which monetary policy would be different, the estimates of the correlations across Canadian provinces are biased slightly upwards because we do not adjust our methodology (in contrast to the VAR approach) for common shocks due to the Canadian monetary policy. By themselves, these results suggest that choosing between the Canadian and US dollar would not be straightforward for an independent Quebec.

Two other stylized facts, however, tend to favor the adoption of the US dollar. First, as was pointed out in the previous section, Quebec is not a net exporter of primary products and shares an industrial structure that has more in common with the United States than with the western provinces of Canada. Second, the analysis of the evolution of Quebec's international and interprovincial openness, following the methodology illustrated in Figure 3, is quite revealing. While the degree of Quebec's interprovincial openness exceeded its international openness up until 1985, the picture is completely reversed thereafter. From 1985 on, the degree of international openness has exceeded the degree of interprovincial openness and the gap between the two is increasing rapidly over time. By the end of the sample, in 2000, the degree of Quebec's international openness is 2.1 times larger than its degree of interprovincial openness. One may thus conclude that transaction costs now faced by Quebec are much higher than the ones it would face with the US dollar. This result suggests that Quebec might well be better off by adopting the US dollar.

This last conclusion is strengthened if one considers Quebec's choice in a game theoretical framework. If Quebec adopts the US dollar, the empirical analysis presented in this paper shows that it will be extremely costly for Ontario to continue to use the Canadian dollar. As was pointed out before, there is a strong incentive for Quebec and Ontario to share the same currency. With Quebec out of the Canadian monetary zone, the optimal currency for Ontario would clearly be the US dollar. This might affect Quebec's choice of currency at the time of separation since it could be expected that Ontario would also put political pressure on the Canadian government to adopt the US dollar if Quebec were doing so.
The Domino Effect

If an independent Quebec finally chose to adopt the US dollar, this could result in a domino effect. Ontario’s self-interest would push for dollarization. Of course, this is pure speculation as it has to be investigated whether Ontario could in this case remain in the Canadian confederation. After this, British Columbia, because of its close linkages in terms of business cycles with the two central provinces and the United States (as documented in Tables 1 to 5), could argue in favor of the adoption of the US dollar.

Generally speaking, the domino effect results from the fact that the adoption of a major currency (euro, dollar) by a peripheral country/region increases the potential net gains of other peripheral areas joining the monetary union. The domino effect is more powerful for peripheral areas that are highly linked. In the case of Quebec secession, the clear possibility of a domino effect suggests the future of the Canadian dollar would be in jeopardy after the first domino (Quebec) had fallen.

Practically speaking, the possibility of a domino effect is well illustrated by the recent European experience of monetary integration. Indeed, despite its special geographical location and relatively low level of economic development, Greece—the only country in the European Union not sharing a border with another member state—finally adopted the euro in 2001. One obvious reason was the prospective role of the euro as an international currency. Basically, the same applies for the United Kingdom. Although all studies (see, for instance, Beine 1999) emphasize the desynchronization of the UK business cycle with the business cycles of the continental European countries (and thus the potential stabilization costs induced by a common currency), the support for adopting the euro in UK political and economic circles has increased significantly since January 2002. The recent British attitude toward monetary unification seems to be in line with the idea that it may, in the end, be costly to maintain a separate currency on the doorstep of a major currency area (see for instance Mignolet (1998)).

Consequently, the adoption of the US dollar by an independent Quebec might be followed by a domino effect with Ontario, British Columbia, the Maritimes, and possibly the other provinces pushing for the adoption of the US dollar. In light of recent developments in Europe, it may be argued that the domino effect would in fine favor the adoption of the dollar by all Canadian provinces, although this may be suboptimal in a pure Mundellian perspective.
Possible Consequences for Western Canadian Provinces

Ex ante, Alberta and Saskatchewan might be viewed as the possible big losers in a total dollarization scenario because of their dependency on the production of commodities and the low level of cycle synchronization with the US economy. Would the stabilization costs in terms of variability of GDP or employment be so dramatic? The answer to this difficult question is not necessarily positive, for two reasons: the first one is based on the empirical record of comparable US states in the 1990s and the second one on economic theory.

First, we try to verify the possible stabilization property of exchange rate adjustments by comparing the economic performance of western and central Canadian provinces to US border states during the 1990s. The last decade was characterized by a steady depreciation of the CAD/USD exchange rate coupled with a decrease in the prices of commodities. Were Canadian peripheral economies well protected, compared with the United States, by the steady depreciation of the Canadian dollar in a way expected by the Mundellian view?

The cross-border comparative exercise is presented in Table 8. To address the issue more directly, we concentrate on the six provinces of Central and Western Canada and their 10 US border states including Alaska. Two numbers are presented for each regional economy. The first is the cumulative growth rate of real output (GSP or GPP) between 1990 and 1999; the second is the ratio of primary production to manufacturing output (the PM ratio). This ratio might be viewed as a synthetic index of the degree of dependency of an economy on natural resources. The provinces/states are grouped in three columns according to their PM ratio. The regional economies that are more dependent on primary output are shown in column 1, with PM ratios varying between 1.11 and 6.62 (for Alaska). The intermediate provinces/states, with PM ratios between 0.14 and 0.42, are listed in column 2. Finally, the industrial provinces/states of Central Canada and the Great Lakes are shown in column 3.

A preliminary remark: the analysis of the PM ratio complements the facts analyzed in Table 7 regarding the difference in the industrial structure of Ontario and Quebec compared with the western provinces. For the two central provinces, the primary/manufacturing ratio is a magnitude smaller than the numbers observed for Saskatchewan and Alberta. The PM ratios of Ontario and Quebec are even smaller than the ratio for the overall US economy (0.18) but are higher than those observed for the highly industrialized Great Lakes states.
One main point, and two exceptions to the point, emerge from the analysis of growth rates in Table 8. Generally speaking, in the 1990s, the economic performance of US states that are dependent on natural resources (columns 1 and 2) has been better than the performance of comparable Canadian provinces such as British Columbia, Manitoba, and Saskatchewan. This evidence should surprise those who argue that economies dependent on natural resources need some flexible exchange rate adjustment to smooth the effect of falling or rising commodity prices.

The two exceptions, however, are the oil and gas producers of Alberta and Alaska. Alberta had outperformed its comparable US states in terms of the PM ratio (Montana and North Dakota) whereas the economy of Alaska had shrunk during the period with a negative cumulative growth rate of 10.6 per cent. Alberta, however, is much more dependent on natural resources than any Canadian province, as shown by its PM ratio. But the Alaska experience in the 1990s might indicate that the economy of the northern areas in Canada could become more volatile in a dollarization scenario. Alaska’s story might be thought of as a proxy for the northern areas of Western Canada, Ontario, Quebec, and Labrador, which are highly dependent on the exploitation of natural resources. Without an exchange rate adjustment, the economy of these areas might become much more volatile, booming in periods of rising commodity prices, and falling into a slump when commodity prices are going down.

The second reason why the lack of an exchange rate adjustment might not be dramatic lies in the endogenous nature of the concept of OCA. Endogeneity here embodies two dimensions: (1) as argued by Frankel and Rose (1998) and documented here above by the evolution over time of business cycle correlations, a monetary union may become optimal ex post because it enhances intra-industry trade and business cycle synchronization; (2) as shown by Corsetti and Pesenti (2002), apart from these structural changes, firms may adapt their pricing strategies to the new monetary environment. In this case, the cost of losing the exchange rate as a stabilization instrument is reduced and the monetary union becomes the optimal monetary arrangement in a self-validating way.20

**Impact on the US Economy**

Finally, what could be the consequences for the US economy if Canada as a whole finally adopts the US dollar? One could expect that a common currency would enhance international trade between US states and Canadian provinces. Although controversial in terms of size, the results of Frankel and Rose (2000) suggest that adopting a common currency could produce large gains in terms of trade and growth for both countries.
For the specific case of Canada and the United States, an order of magnitude for the possible effect of dollarization on trade could be estimated indirectly using Anderson and van Wincoop’s (2001) gravity model of trade flows. They estimate that the complete elimination of national borders between Canada and the United States will expand trade between the two countries by about 44 per cent. In this framework, dollarization might be thought of as a partial elimination of the Canada–US border. Consequently, the 44 per cent number might be viewed as the maximum potential effect of dollarization on trade between the two countries.

Two more points could be made regarding the impact of dollarization on the US regional economies, using Anderson and van Wincoop’s (2001) model. First, the magnitude of the effect of dollarization on trade flows would be on average about 10 times larger for a Canadian province than for a US state. This is due to the fact that the Canada–US border increases the resistance to trade much more for a Canadian province than for a typical US state because of the relative smaller size of the Canadian economy. Dollarization will decrease the trade barriers, on the one hand, between a Canadian province and most of its potential trading partners, which are the US states. However, on the other hand, dollarization will not push trade barriers down too much between a US state and most of its potential trading partners, because most of them are other US states. The second point is that the effect of dollarization will be more important for US states that are close to the Canadian border. This occurs because, as shown in the empirical literature on gravity models, distance matters for trade flows. But even for a typical US border state, the effect on trade flows would be substantially smaller than for a Canadian provinces because of the relative smaller size of the Canadian economy and of the relative remoteness of Canadian provinces in the upper part of North America.

6. CONCLUSION
This paper contributes to the literature on the optimality of a flexible exchange rate for Canada by providing a thorough analysis of the relationship between Canadian regional business cycles and those of the United States. This issue has strong policy implications as the official argument put forward and defended by the Bank of Canada is that the Canadian economy needs a floating exchange rate because the shocks to the Canadian and US economies are asymmetric. To this end, our analysis provides some striking stylized facts regarding the asymmetric structure of Canadian regions and the changing trends in regional trade orientation. The strong heterogeneity among Canadian provinces suggests that a floating Canadian dollar is the best monetary arrangement for only a subset of Canadian regions. Canada as a whole is not an optimum currency area. Therefore, it can be concluded that the official argument does not apply to all
Canadian regions and in particular not to the central provinces of Quebec and Ontario that represent roughly two-thirds of the Canadian GDP.

Our analysis also shows that the business cycles of the central provinces tend to become more similar to the US business cycle over time. This contrasts with the business cycle dynamics of the peripheral Canadian regions. This core-periphery distinction is also reflected in the industrial specialization of the provinces and in the evolution of international trade patterns. It turns out that the dollarization of the Canadian economy might be harmful for the Canadian periphery. However, given the structural changes induced by the setting-up of a monetary union and the overrating of the stabilization costs made by the traditional OCA approach, the exact magnitude of the cost faced by the peripheral provinces in a dollarization scenario remains to be further investigated.

Finally, the analysis of the regional dimension could become the critical element in the economic policy debate and the political process regarding the future of the Canadian monetary union, whether or not Quebec separates from the Canadian federation. In the first case, an independent Quebec might have a clear incentive to adopt the US dollar. If it does so, a domino effect might induce most of Canadian regions to follow suit. As the net benefits of dollarizing increase in the periphery when other peripheral regions dollarize, the domino effect will eventually turn those previously reluctant provinces (such as Alberta or Saskatchewan) to the dollarization side. The regional dimension is crucial even in the second case where Quebec does not separate. Although a floating Canadian dollar might be beneficial for some peripheral regions – an argument that could be debated – it could be detrimental for the economies of the two big central provinces and to a lesser extent for British Columbia. Canada cannot be governed without the support of both Quebec and Ontario, and the net benefit of these two provinces adopting the US dollar is trending up.
Data Appendix

All quarterly data are seasonally adjusted. Canadian quarterly output data are real gross domestic product at factor cost produced by the Conference Board of Canada, using provincial GDP deflators.

Provincial trade data (Table 7) are Statistics Canada data computed by the authors from Trade Data Online (Industry) of Industry Canada’s web site at <strategis.ic.gc.ca/se_mrkti/tdst/tdo/tdo.php#tag>. Following Industry Canada's official classification, the primary sector is the aggregation of the following industries: agricultural and related services, fishing and trapping, logging and forestry, quarrying and oil wells, and mining.

The following data were downloaded from the Bureau of Economic Analysis’s web site at <http://www.bea.doc.gov> : current-dollar GSP for primary (agricultural, forest, fish, and mining) and manufacturing output, and real GSP (for Table 8), state total employment (Table 5).

All other data were retrieved from Statistics Canada’s CANSIM (I and II) database. US quarterly output data are gross domestic product in 1996 constant dollars (CANSIM number d369455). Canadian quarterly and annual provincial employment data were computed from Statistics Canada monthly series (numbers d981111, d981484, d981857, d982230, d982603, d982976, d983349, d983722, d984095, d984468, and d980595 for Canada). U.S. national employment data refer to civil employment (CANSIM number b53104).

Canadian sectorial data (Table 8) were retrieved from the Inputs and Outputs Table 3810013 of CANSIM II. Here, the primary sector is defined as the aggregation of crop and animal production, forestry and lodging, fishing, hunting and trapping, mining, oil and gas. Real output growth data (Table 8) were computed from gross domestic output in 1992 constant dollars (CANSIM II table 3840002).

International and interprovincial openness data (Figures 3 and 4) were computed from Provincial Economics Accounts:
- numbers d24213, d24247, d24281... for international exports;
- numbers d24216, d24250, d24284... for interprovincial exports;
- numbers d24220, d24254, d24288... for international imports;
- numbers d24223, d24257, d24291... for interprovincial imports;
- numbers d24227, d24266, d24299... for gross domestic product at market prices.
References


### TABLE 1: Cross-correlations of Business cycles

Business cycles from HP filter, $\lambda=1600$; 1961Q1-2000Q1

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Notes: Standard deviation in italics; these standard deviations are computed by GMM, following Ogaki (1993).
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Notes: Standard deviation in italics; these standard deviations are computed by GMM, following Ogaki (1993).
### TABLE 3: Cross-correlations of Business cycles

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Notes: Standard deviation in italics; these standard deviations are computed by GMM, following Ogaki (1993).
TABLE 4: Average cross-correlations for specific groupings

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<thead>
<tr>
<th></th>
<th>HP, $\lambda=1600$</th>
<th>HP, $\lambda=315$</th>
<th>BP</th>
<th>Average</th>
</tr>
</thead>
<tbody>
<tr>
<td>ROC1-US</td>
<td>.354</td>
<td>.342</td>
<td>.427</td>
<td>.374</td>
</tr>
<tr>
<td>(BC-ON-QU)-US</td>
<td>.689</td>
<td>.657</td>
<td>.756</td>
<td>.701</td>
</tr>
<tr>
<td>among ROC1</td>
<td>.271</td>
<td>.248</td>
<td>.294</td>
<td>.271</td>
</tr>
<tr>
<td>among BC-ON-QU</td>
<td>.703</td>
<td>.672</td>
<td>.803</td>
<td>.726</td>
</tr>
<tr>
<td>(BC-ON-QU)-ROC1</td>
<td>.405</td>
<td>.375</td>
<td>.466</td>
<td>.415</td>
</tr>
</tbody>
</table>

Notes: ROC1=Canada minus Quebec, Ontario and British Columbia
These correlations are computed as averages of cross-correlations of Tables 1, 2 and 3
### Table 5: Cross-correlations between US states and Canadian provinces

Business cycles from HP filter, $\lambda=100$; 1976-2000

<table>
<thead>
<tr>
<th></th>
<th>US</th>
<th>AL</th>
<th>BC</th>
<th>ON</th>
<th>QU</th>
<th>SA</th>
<th>NY</th>
<th>PN</th>
<th>OH</th>
<th>MI</th>
</tr>
</thead>
<tbody>
<tr>
<td>US</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>AL</td>
<td>.279</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>BC</td>
<td>.277</td>
<td>.652</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>ON</td>
<td>.800</td>
<td>.268</td>
<td>.638</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>QU</td>
<td>.803</td>
<td>.285</td>
<td>.725</td>
<td>.903</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>SA</td>
<td>.522</td>
<td>.363</td>
<td>.266</td>
<td>.479</td>
<td>.571</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>NY</td>
<td>.711</td>
<td>.275</td>
<td>.388</td>
<td>.828</td>
<td>.710</td>
<td>.490</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>PN</td>
<td>.908</td>
<td>.192</td>
<td>.520</td>
<td>.863</td>
<td>.783</td>
<td>.458</td>
<td>.862</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>OH</td>
<td>.900</td>
<td>.040</td>
<td>.353</td>
<td>.705</td>
<td>.692</td>
<td>.534</td>
<td>.785</td>
<td>.914</td>
<td></td>
<td></td>
</tr>
<tr>
<td>MI</td>
<td>.826</td>
<td>-.177</td>
<td>.140</td>
<td>.574</td>
<td>.536</td>
<td>.475</td>
<td>.681</td>
<td>.802</td>
<td>.943</td>
<td></td>
</tr>
</tbody>
</table>

Notes: Business cycles extracted from annual data on total employment.

For symbols, see Table 1; OH = Ohio, PN = Pennsylvania, NY = New-York, MI = Michigan.
TABLE 6: Cross-correlations: Evolution over time

<table>
<thead>
<tr>
<th></th>
<th>QUON-RCA</th>
<th>QUON-US</th>
<th>RCA-US</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>HP, ( \lambda = 1600 )</strong></td>
<td>.698</td>
<td>.766</td>
<td>.612</td>
</tr>
<tr>
<td></td>
<td>.070</td>
<td>.116</td>
<td>.111</td>
</tr>
<tr>
<td><strong>Full period</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>HP, ( \lambda = 315 )</strong></td>
<td>.687</td>
<td>.747</td>
<td>.596</td>
</tr>
<tr>
<td></td>
<td>.067</td>
<td>.082</td>
<td>.106</td>
</tr>
<tr>
<td>BP</td>
<td>.763</td>
<td>.816</td>
<td>.677</td>
</tr>
<tr>
<td></td>
<td>.058</td>
<td>.057</td>
<td>.104</td>
</tr>
<tr>
<td><strong>HP, ( \lambda = 1600 )</strong></td>
<td>.752</td>
<td>.774</td>
<td>.684</td>
</tr>
<tr>
<td></td>
<td>.087</td>
<td>.068</td>
<td>.127</td>
</tr>
<tr>
<td><strong>1961:1-1979:4</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>HP, ( \lambda = 315 )</strong></td>
<td>.730</td>
<td>.750</td>
<td>.664</td>
</tr>
<tr>
<td></td>
<td>.080</td>
<td>.073</td>
<td>.114</td>
</tr>
<tr>
<td>BP</td>
<td>.901</td>
<td>.819</td>
<td>.797</td>
</tr>
<tr>
<td></td>
<td>.040</td>
<td>.105</td>
<td>.043</td>
</tr>
<tr>
<td><strong>HP, ( \lambda = 1600 )</strong></td>
<td>.688</td>
<td>.859</td>
<td>.568</td>
</tr>
<tr>
<td></td>
<td>.107</td>
<td>.144</td>
<td>.132</td>
</tr>
<tr>
<td><strong>1980:1-2000:1</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>HP, ( \lambda = 315 )</strong></td>
<td>.666</td>
<td>.817</td>
<td>.533</td>
</tr>
<tr>
<td></td>
<td>.120</td>
<td>.134</td>
<td>.192</td>
</tr>
<tr>
<td>BP</td>
<td>.721</td>
<td>.913</td>
<td>.583</td>
</tr>
<tr>
<td></td>
<td>.056</td>
<td>.054</td>
<td>.034</td>
</tr>
</tbody>
</table>

Notes: QUON=agregate of Quebec and Ontario
RCA= Canada minus Quebec and Ontario
Standard deviation in italics; these standard deviations are computed by GMM , following Ogaki (1993).
TABLE 7: International trade balance of primary products, per province
1996-2000 annual means, millions of dollars

<table>
<thead>
<tr>
<th>Province</th>
<th>Exports</th>
<th>Imports</th>
<th>Trade balance</th>
</tr>
</thead>
<tbody>
<tr>
<td>NF</td>
<td>919</td>
<td>722</td>
<td>197</td>
</tr>
<tr>
<td>PE</td>
<td>99</td>
<td>4</td>
<td>96</td>
</tr>
<tr>
<td>NS</td>
<td>975</td>
<td>1367</td>
<td>-392</td>
</tr>
<tr>
<td>NB</td>
<td>627</td>
<td>2177</td>
<td>-1550</td>
</tr>
<tr>
<td>QU</td>
<td>1552</td>
<td>6031</td>
<td>-4479</td>
</tr>
<tr>
<td>ON</td>
<td>3882</td>
<td>5081</td>
<td>-1199</td>
</tr>
<tr>
<td>MA</td>
<td>2275</td>
<td>248</td>
<td>2027</td>
</tr>
<tr>
<td>SA</td>
<td>8027</td>
<td>83</td>
<td>7944</td>
</tr>
<tr>
<td>AL</td>
<td>22717</td>
<td>609</td>
<td>22108</td>
</tr>
<tr>
<td>BC</td>
<td>4595</td>
<td>1292</td>
<td>3323</td>
</tr>
</tbody>
</table>
Figure 1: spectrum of growth rate of U.S. GDP.
Correlation from HP 315 between rest of Canada and the U.S.

Correlation from HP 315 between Ontario-Quebec and the U.S.

FIGURE 2: Dynamics of Canadian regional business cycle correlations with the US.
Notes

1. For a detailed historical analysis of the Canadian dollar, see Powell (1999).

2. As shown by Hawkins (2002), the number of currencies in the world has probably peaked. Following the adoption of the euro, there has been an important increase in the number of proposed future regional currency areas, either made by the governments themselves or hypothesized in academic circles.

3. At the Bank of Canada, the debate over the exchange rate regime has been thoroughly reconsidered, as illustrated by the 1996 and 2000 conferences organized by the Bank. See the proceedings of the 1996 conference and the web page devoted to the 2000 conference on the Bank's web site at <www.bank-banque-canada.ca/conference2000/papers.htm>.

4. The other traditional criteria concern the degree of labor mobility and the extent of risk-sharing (for instance, through fiscal transfers). These two criteria are nevertheless much more controversial in the literature. Recently, the features of OCA regarding the real economy have been extended to financial aspects. See Hawkins (2002) on this point.

5. Of course, although the OCA approach has been one of the key areas of analysis of monetary integration processes (see De Grauwe 1994), numerous other points have to be discussed before some clear-cut policy recommendations can be drawn in terms of currency unification. Among these points, there is the question of the change in the design of monetary policy. Obviously one may argue that the Canadian strategy of inflation targeting has been successful in terms of internal price stability and that US monetary policy would have to take into account some Canadian macroeconomic developments. Another important point concerns the gains drawn from using an international currency and its implications in terms of the functioning of financial markets (see Hawkins 2002 on this point). The issue of transition is also highly important, as shown by the European experience. A thorough discussion of these and other related points is nevertheless beyond the scope of this paper.

6. Corresponding results obtained from quarterly employment data are not reported here due to space constraints. The basic conclusions drawn from the analysis of real GDP are similar, although some slight differences appear and may be summarized as follows. In general, the highest correlations with the United States are also observed for Quebec and Ontario. The correlations are nevertheless lower than those obtained from the GDP, reflecting some structural differences between the US and Canadian labour markets. The correlations across Canadian provinces are higher for employment data, reflecting the fact that interregional migrations might play some limited stabilizing role. The cross-correlations involving some provinces like Saskatchewan and Prince Edward Island nevertheless remain quite low.

7. Basically, this strand of literature also includes approaches like the serial-correlation common-features technique aimed at measuring the degree of co-movement across countries (see Beine, Candelon, and Hecq 2000).

8. For instance, since the VAR requires stationary variables, inflation is assumed to follow an I(0) process, something that may not be valid during the 1970s.

9. Here the higher frequency (one quarter) corresponds to a value on the X axis of Figure 1 equal to $2BT$, i.e., a value of 0.04. Thus, a value between 0.4 and 0.8 means that the typical length of the US
business cycle falls between 2.5 and 5 years. Nevertheless, we used first differences to filter the data, which tends to overestimate this typical frequency. Our estimate is consistent with those of Forni and Reichlin (2001).

10. It could be argued that smaller provinces will tend to be less correlated with the US business cycle since they are likely less diversified than the larger provinces (namely Quebec, Ontario, and British Columbia). Two things are worth mentioning regarding this particular point. First, Alberta is not a small province but nevertheless displays quite a low correlation with the US business cycle. Second, in Table 6 below, we report correlation results across the United States, the aggregation of Quebec and Ontario, and the aggregation of the other eight provinces. It turns out that the relatively low correlations are not due to a size effect.

11. Wynne and Koo (2000) also use a band-pass filter with the same values for the upper and lower cut-off parameters. Nevertheless, in contrast to our data, they use GDP data on annual frequency basis.

12. These are typically considered as Belgium, France, Germany, The Netherlands, Austria, and Denmark, although the precise composition of the core and the periphery differs across studies (on this particular point, see Beine 1999; Beine and Hecq 1997).

13. Due to the low number of data points, we do not compute the standard errors of the cross-correlations. These are nevertheless available upon request.

14. In contrast with Table 4, we aggregate Quebec and Ontario since these two provinces share the same evolution in the trade volumes both at the intraprovincial and international levels. By contrast, over the investigation period, the increase in the ratio of international to interprovincial trade for British Columbia was far less important and more in line with the one faced by the other Canadian provinces (see Figure 4). Of course, as explained before, the degree of international integration is thought to play a major role in the evolution of the business asymmetries.

15. Furthermore, the trend identified from these results is consistent with the one extracted with first differences. The results are not reported here due to space constraints but are available on request.


17. Refer to the Data Appendix for details.

18. The data on international openness overrate the transaction costs of using the Canadian dollar for Ontario since a significant portion of Ontario’s exports and imports are intra-industry trade in the automobile industry (parts and vehicles). In 1996, exports in the automobile industry accounted for 38.6 per cent of total Ontario exports.

19. For example, the non-parametrical Cochrane’s measure of persistence for a lag of 60 quarters is 23 times higher for Alberta than for Saskatchewan. The effect of shocks to the Saskatchewan economy dies out rapidly, unlike the situation in Alberta. For details on Cochrane’s measure of persistence, refer to Campbell and Mankiw (1987, section V).
Conversely, such a behavior might partly explain why, in spite of the pessimistic assessment of the traditional OCA approach, the Canadian monetary union has survived for such a long time.