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**by**
**Michel Beine and Serge Coulombe**

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Faculté des sciences sociales
Faculty of Social Sciences

**CP 450 SUCC. A**
**OTTAWA (ONTARIO)**
**CANADA K1N 6N5**

**P.O. BOX 450 STN. A**
**OTTAWA, ONTARIO**
**CANADA K1N 6N5**

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Michel Beine
University of Lille 2, France, and the
Free University of Brussels, Belgium

and

Serge Coulombe
University of Ottawa, Canada

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Corresponding author: Serge Coulombe, Department of Economics, University of Ottawa, 200 Wilbrod, Ottawa, Ont., K1N 6N5 Canada, scoulomb@uottawa.ca

## ABSTRACT

In this paper, we investigate whether it is preferable for Canadian regions to individually adopt the U.S. 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, while the peripheral regions obviously gain from the current flexible exchange rate regime, it could be economically advantageous for the central provinces of Ontario and Quebec to adopt the U.S. dollar..



*JEL classification:* F33, F41, R10, R15

*Keywords:* Optimal currency areas, Canadian regions, dollarization, exchange rate regimes, business cycles



## RÉSUMÉ

*Certaines régions canadiennes auraient-elles intérêt à adopter le dollar américain?* L'étude, essentiellement empirique, a pour but de vérifier si les provinces canadiennes, prisent individuellement, auraient intérêt à adopter le dollar américain ou à continuer d'utiliser un dollar canadien flottant. Pour ce faire, les auteurs ont évalué les trois principaux critères de la théorie des zones monétaires. Dans un premier temps, ils ont analysé les corrélations de différentes mesures du cycle économique entre les provinces canadiennes, le Canada et les États-Unis. Cette analyse est complétée par celles portant sur la spécialisation industrielle et l'interdépendance du commerce. Les résultats illustrent la forte hétérogénéité des économies des régions canadiennes. Ainsi, les bénéfices et les coûts des différentes options monétaires sont loin d'être partagés également entre les régions. Notamment, l'analyse donne à penser que les régions périphériques bénéficient du régime monétaire actuel tandis qu'il serait avantageux sur le plan économique pour l'Ontario et le Québec d'adopter le dollar américain.



*Code JEL :* F33, F41, R10, R15

*Mots-clés :* Zones monétaires optimales, régions canadiennes, dollarisation, régimes de taux de change, cycles économiques

## 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.[1] 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 U.S. 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).[2]

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 labour productivity in Canada and in the United States. In general, the opponents of the flexible exchange rate regime advocate the adoption of the U.S. 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 stabilization 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 theory (Mundell 1961). The Mundellian argument was used in 2000 as the main line of defence 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 recently re-stated 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, 4).

In this paper, we reconsider the issue of the exchange rate regime between Canada and the United States. However, unlike the main thrust of the literature, we focus on regional dynamics and show why and how

Canada as a whole is not an optimum currency area. 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 favour of currency union with the United States tend to increase over time for Quebec and Ontario. Since the 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 is the first 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 U.S. 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) would be better off adopting the U.S. dollar, while the other provinces should keep a flexible Canadian dollar. 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).

The paper is organized as follows. The following section 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 U.S. 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 optimal currency areas. According to Mundell, Canada might not be an optimal currency area 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 U.S. 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" (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, Lalonde, and St-Amant (1998) follows the same basic VAR methodology but uses a different approach for modelling 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 somehow 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. Our analysis goes beyond Dupasquier *et al.* since we compare Canadian regions with the United States. Furthermore, 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

### *3.1. 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.[3] 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, 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.[4]

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, however, keep in mind 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 a certain extent to overestimate the correlations across Canadian regions compared with correlations between Canadian regions and the United States. 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 4.

Although popular, the choice of 1600 for the value of the 8 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 U.S. 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) U.S. real GDP.

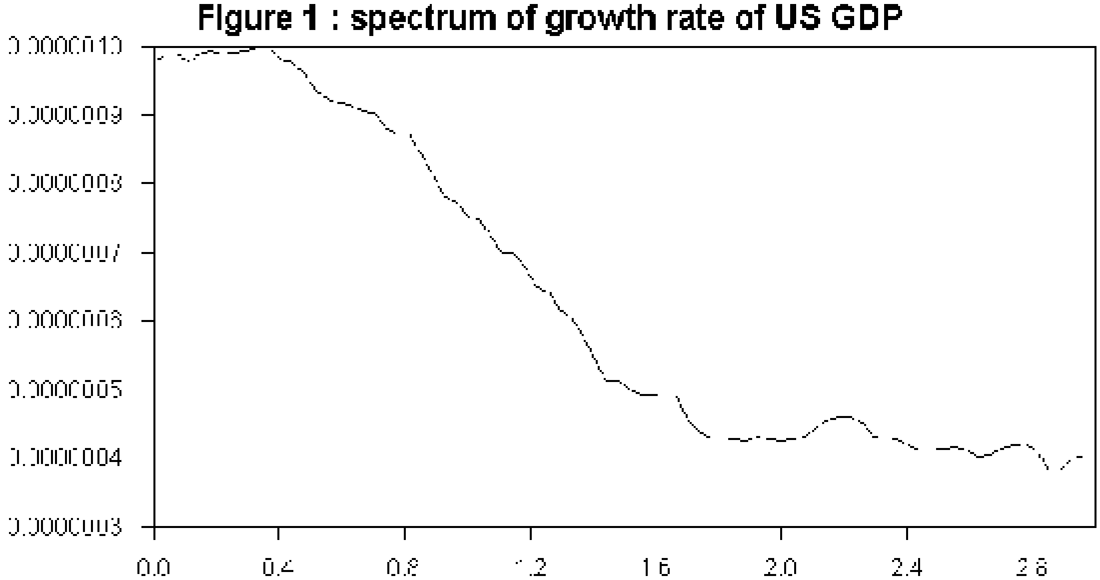
**Table 1. Cross-correlations of business cycles**

business cycles from HP Filter, λ=1600; 1961Q1-2000Q1

| | CA | US | AL | BC | ON | PE | QU | SA | MA | NB | NS | NF |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| US | 0.771 | 1 | | | | | | | | | | |
| | *0.094* | | | | | | | | | | | |
| AL | | 0.367 | 1 | | | | | | | | | |
| | | *0.094* | | | | | | | | | | |
| BC | | 0.624 | 0.527 | 1 | | | | | | | | |
| | | *0.123* | *0.078* | | | | | | | | | |
| ON | | 0.797 | 0.391 | 0.658 | 1 | | | | | | | |
| | | *0.084* | *0.074* | *0.086* | | | | | | | | |
| PE | | 0.426 | 0.111 | 0.286 | 0.473 | 1 | | | | | | |
| | | *0.129* | *0.115* | *0.140* | *0.088* | | | | | | | |
| QU | | 0.646 | 0.439 | 0.651 | 0.801 | 0.439 | 1 | | | | | |
| | | *0.194* | *0.091* | *0.103* | *0.132* | *0.067* | | | | | | |
| SA | | 0.081 | 0.047 | 0.110 | 0.027 | -0.015 | -0.018 | 1 | | | | |
| | | *0.131* | *0.144* | *0.171* | *0.136* | *0.141* | *0.165* | | | | | |
| MA | | 0.474 | 0.369 | 0.394 | 0.551 | 0.153 | 0.447 | 0.418 | 1 | | | |
| | | *0.128* | *0.129* | *0.100* | *0.106* | *0.108* | *0.199* | *0.088* | | | | |
| NB | | 0.470 | 0.216 | 0.487 | 0.587 | 0.512 | 0.553 | -0.113 | 0.162 | 1 | | |
| | | *0.111* | *0.097* | *0.128* | *0.087* | *0.089* | *0.088* | *0.209* | *0.134* | | | |
| NS | | 0.475 | 0.353 | 0.360 | 0.569 | 0.301 | 0.486 | 0.116 | 0.430 | 0.456 | 1 | |
| | | *0.135* | *0.099* | *0.137* | *0.109* | *0.126* | *0.187* | *0.131* | *0.128* | *0.096* | | |
| NF | | 0.183 | 0.179 | 0.186 | 0.356 | 0.374 | 0.424 | -0.123 | 0.055 | 0.346 | 0.288 | 1 |
| | | *0.144* | *0.115* | *0.170* | *0.119* | *0.110* | *0.112* | *0.234* | *0.118* | *0.149* | *0.144* | |

Notes : Standard deviation in italics; these standard deviations are computed by GMM , following Ogaki (1993).

**Figure 1 : spectrum of growth rate of US GDP**



The estimate of the spectrum suggests that the typical length of the U.S. business cycle is only five years.[5] Given this, Pedersen (2001) advises to choose a λ equal to 315 for quarterly data. We will thus use this value for λ 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.

**Table 2. Cross-correlations of business cycles**
business cycles from HP Filter, λ=315; 1961Q1-2000Q1

| | CA | US | AL | BC | ON | PE | QU | SA | MA | NB | NS | NF |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| US | 0.753 | 1 | | | | | | | | | | |
| | *0.079* | | | | | | | | | | | |
| AL | | 0.364 | 1 | | | | | | | | | |
| | | *0.096* | | | | | | | | | | |
| BC | | 0.593 | 0.455 | 1 | | | | | | | | |
| | | *0.105* | *0.068* | | | | | | | | | |
| ON | | 0.775 | 0.425 | 0.663 | 1 | | | | | | | |
| | | *0.061* | *0.079* | *0.077* | | | | | | | | |
| PE | | 0.331 | 0.080 | 0.179 | 0.351 | 1 | | | | | | |
| | | *0.112* | *0.094* | *0.127* | *0.084* | | | | | | | |
| QU | | 0.603 | 0.459 | 0.610 | 0.744 | 0.291 | 1 | | | | | |
| | | *0.150* | *0.071* | *0.100* | *0.101* | *0.070* | | | | | | |
| SA | | 0.123 | 0.129 | 0.197 | 0.044 | -0.045 | 0.007 | 1 | | | | |
| | | *0.110* | *0.129* | *0.131* | *0.108* | *0.142* | *0.189* | | | | | |
| MA | | 0.511 | 0.436 | 0.470 | 0.543 | 0.072 | 0.443 | 0.383 | 1 | | | |
| | | *0.093* | *0.110* | *0.066* | *0.079* | *0.102* | *0.132* | *0.083* | | | | |
| NB | | 0.462 | 0.274 | 0.459 | 0.522 | 0.152 | 0.487 | -0.097 | 0.152 | 1 | | |
| | | *0.087* | *0.085* | *0.100* | *0.088* | *0.114* | *0.100* | *0.152* | *0.114* | | | |
| NS | | 0.422 | 0.388 | 0.348 | 0.512 | 0.420 | 0.411 | 0.160 | 0.420 | 0.437 | 1 | |
| | | *0.078* | *0.082* | *0.126* | *0.076* | *0.086* | *0.098* | *0.142* | *0.086* | *0.076* | | |
| NF | | 0.180 | 0.172 | 0.155 | 0.347 | 0.095 | 0.406 | -0.088 | 0.095 | 0.347 | 0.244 | 1 |
| | | *0.123* | *0.106* | *0.157* | *0.100* | *0.106* | *0.084* | *0.226* | *0.106* | *0.116* | *0.142* | |

Notes : Standard deviation in italics; these standard deviations are computed by GMM , following Ogaki (1993).

Another feature of the HP filter is that it is a high-pass filter in the sense that it attenuates fluctuations at low frequencies. For instance, the HP filter with λ=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 turn out to be less important than the ones associated with the most usual filters (including the HP filters). The BP filter is defined as the combination of two low-pass filters (for further details, see Baxter and King [1995]):

$$bp = lp_u - lp_l , \tag{1}$$

where $lp_u$ is a low-pass filter with an upper frequency *u*, and $lp_l$ is a low-pass filter with a lower frequency *l*. We choose *u*=32 and *l*=8, meaning that we isolate business cycles lasting between 8 and 32 quarters.[6] The results in terms of cross-correlations are reported in Table 3 .

**Table 3. Cross-correlations of business cycles**

business cycles from BP Filter , 1961Q1-2000Q1

| | CA | US | AL | BC | MA | NB | NF | NS | ON | PE | QU | SA |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| US | 0.811 | | | | | | | | | | | |
| | *0.057* | | | | | | | | | | | |
| AL | | 0.393 | 1 | | | | | | | | | |
| | | *0.133* | | | | | | | | | | |
| BC | | 0.740 | 0.606 | 1 | | | | | | | | |
| | | *0.117* | *0.041* | | | | | | | | | |
| MA | | 0.570 | 0.532 | 0.605 | 1 | | | | | | | |
| | | *0.111* | *0.112* | *0.082* | | | | | | | | |
| NB | | 0.624 | 0.186 | 0.576 | 0.384 | 1 | | | | | | |
| | | *0.066* | *0.150* | *0.099* | *0.128* | | | | | | | |
| NF | | 0.174 | 0.260 | 0.236 | 0.101 | 0.375 | 1 | | | | | |
| | | *0.202* | *0.219* | *0.198* | *0.185* | *0.190* | | | | | | |
| NS | | 0.620 | 0.441 | 0.578 | 0.553 | 0.582 | 0.203 | 1 | | | | |
| | | *0.105* | *0.069* | *0.140* | *0.109* | *0.096* | *0.228* | | | | | |
| ON | | 0.843 | 0.450 | 0.785 | 0.663 | 0.720 | 0.372 | 0.704 | 1 | | | |
| | | *0.053* | *0.084* | *0.056* | *0.080* | *0.046* | *0.209* | *0.081* | | | | |
| PE | | 0.479 | 0.006 | 0.296 | 0.058 | 0.657 | 0.498 | 0.245 | 0.478 | 1 | | |
| | | *0.130* | *0.145* | *0.183* | *0.176* | *0.105* | *0.094* | *0.127* | *0.141* | | | |
| QU | | 0.686 | 0.513 | 0.770 | 0.561 | 0.654 | 0.504 | 0.596 | 0.854 | 0.412 | 1 | |
| | | *0.098* | *0.088* | *0.056* | *0.084* | *0.065* | *0.173* | *0.132* | *0.060* | *0.111* | | |
| SA | | 0.129 | 0.130 | 0.211 | 0.382 | 0.125 | 0.010 | 0.133 | 0.038 | -0.134 | 0.007 | 1 |
| | | *0.182* | *0.207* | *0.192* | *0.087* | *0.173* | *0.234* | *0.156* | *0.207* | *0.164* | *0.189* | |

Notes : Standard deviation in italics; these standard deviations are computed by GMM , following Ogaki (1993).

### *3.2. 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.

Interestingly, the highest estimated cross-correlations between the Canadian provinces are found between Ontario, Quebec, and British Columbia. Furthermore, Ontario, followed either by 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.[7] Many cross-correlations at the Canadian regional level appear very low by European standards. It turns out that the correlations with the U.S. 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.

Moreover, 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.[8] These results are in sharp contrast to what has been claimed in some of the previous empirical studies like Bayoumi and Eichengreen (1994).

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 U.S. dollar while Ontario remains in the Canadian monetary union). Nevertheless, before making any conclusions in this direction, we have to examine the empirical evidence more closely.

First, 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 U.S. cycle over time and that this trend is likely to continue in the future. Or, following the FTA and 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.

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

Third, 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 4.

*3.3. 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 this 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, and the aggregation of the rest of Canada. Table 4 reports the cross-correlations computed over the full period and the two subperiods, using the different filters to extract the business cycle component (HP with $\lambda$=1600, HP with $\lambda$=315, BP).[9]

**Table 4. Cross-correlations: Evolution over time**

| | | QUON-RCA | QUON-US | RCA-US |
|---|---|---|---|---|
| | HP, $\lambda$=1600 | 0.698 | 0.766 | 0.612 |
| | | *0.070* | *0.116* | *0.111* |
| *Full period* | HP, $\lambda$=315 | 0.687 | 0.747 | 0.596 |
| | | *0.067* | *0.082* | *0.106* |
| | BP | 0.763 | 0.816 | 0.677 |
| | | *0.058* | *0.057* | *0.104* |
| | HP, $\lambda$=1600 | 0.752 | 0.774 | 0.684 |
| | | *0.087* | *0.068* | *0.127* |
| *1961:1-1979:4* | HP, $\lambda$=315 | 0.730 | 0.750 | 0.664 |
| | | *0.080* | *0.073* | *0.114* |
| | BP | 0.901 | 0.819 | 0.797 |
| | | *0.040* | *0.105* | *0.043* |
| | HP, $\lambda$=1600 | 0.688 | 0.859 | 0.568 |
| | | *0.107* | *0.144* | *0.132* |
| *1980:1-2000:1* | HP, $\lambda$=315 | 0.666 | 0.817 | 0.533 |
| | | *0.120* | *0.134* | *0.192* |
| | BP | 0.721 | 0.913 | 0.583 |
| | | *0.056* | *0.034* | *0.034* |

*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 4 sheds an interesting light on the dynamics. Correlations between the U.S. cycle and that of the central provinces of Quebec and Ontario tend to increase substantially 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. 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 U.S. economy at the expense of a growing idiosyncratic dynamics for peripheral Canadian provinces.

## 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.

### *4.1. 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.[10] 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 5 referring to the international trade balance of primary products.[11]

**Table 5. International trade balance of primary products, per province**
1996-2000 Annual Means, millions of dollars

| | Exports | Imports | Trade balance |
|---|---|---|---|
| NF | 919 | 722 | 197 |
| PE | 99 | 4 | 96 |
| NS | 975 | 1367 | -392 |
| NB | 627 | 2177 | -1550 |
| QU | 1552 | 6031 | -4479 |
| ON | 3882 | 5081 | -1199 |
| MA | 2275 | 248 | 2027 |
| SA | 8027 | 83 | 7944 |
| AL | 22717 | 609 | 22108 |
| BC | 4595 | 1292 | 3323 |

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 U.S. Great Lakes states following U.S. 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 that emerges from Table 5 is that the two most populated provinces of Quebec and Ontario are, like the United States, net importers of raw material.[12]

This stylized fact illustrates that the Bank of Canada's main line of defence 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 neighbour, 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.

*4.2. Trade patterns*

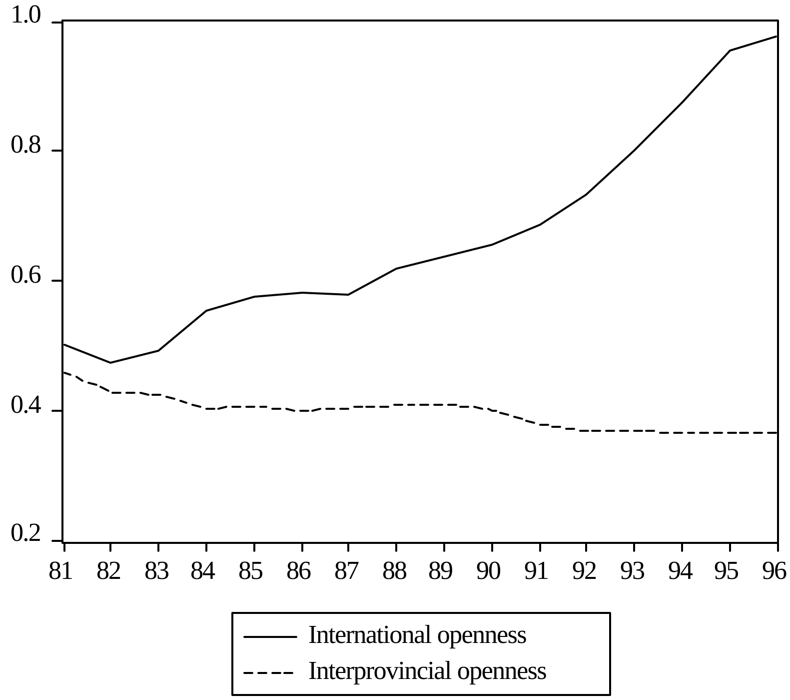
Trade patterns are also useful in understanding the trend observed in business cycle correlations. As we have seen before, Ontario and Quebec business cycles tend to become more and more correlated with the United States when we move from the pre-1980s sample to that of the post-1980s. This result could 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 2 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 during the period for which data are available, the volume of international trade has boomed, especially since the end of the 1980s, which corresponds to the FTA with the United States and NAFTA with the United States and Mexico.

In Figure 3, we compare the rising trend of international openness of Quebec-Ontario with the other provinces. Even though international openness has tended to rise during the 1981–1996 sample for seven of the eight peripheral provinces (excluding Prince Edward Island), the international openness ratio has risen much more in the provinces of Ontario and Quebec since the end of the 1980s.[13]

*4.3. Persistence of shocks*

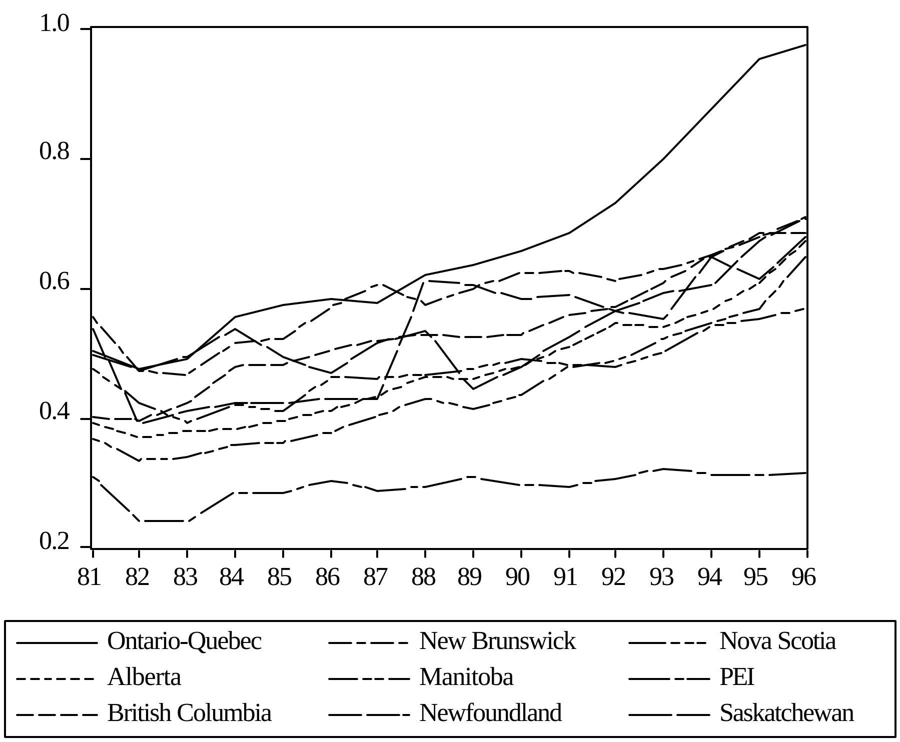
Finally, it is important to observe that the so-called Canadian periphery is also far from being homogeneous from a Mundellian perspective. A good example is the case of Alberta and Saskatchewan, the two provinces responsible for the sizable commodity trade balance surplus of Canada. As shown in the 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.[14] Oil shocks appear to affect the Alberta economy for years while Saskatchewan recovers rapidly from shocks that most often originate from the agriculture sector.

**Figure 2. Interprovincial and international openness trend - Quebec and Ontario**




Note: the openness indicator is the ratio of exports plus imports to GDP

**Figure 3. Trends in international openness - Quebec-Ontario and the Canadian provinces**



## 5. Should an independent Quebec adopt the U.S. dollar?

Before concluding, we will briefly look at the consequences, shown by our empirical analysis, of the optimal currency for an independent Quebec.[15] 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. By themselves, these results suggest that choosing between the Canadian and U.S. dollar would not be straightforward for an independent Quebec.

Two other stylized facts, however, tend to favour the adoption of the U.S. 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 1996, the degree of Quebec's international openness is 1.8 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 U.S. dollar. This result suggests that Quebec might well be better off by adopting the U.S. dollar.

This last conclusion is strengthened if one considers Quebec's choice in a game theoretic framework. If Quebec adopts the U.S. 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 U.S. dollar. This might affect Quebec's choice of currency at the time of separation since it could be expected that Ontario would also opt for the U.S. dollar if Quebec were doing so. In this scenario, the future of the Canadian dollar appears to be in jeopardy.

## 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 that of the United States. The paper also provides some striking stylized facts regarding the asymmetric structure of Canadian regions and the changing trends in regional trade orientation. The strong heterogeneity between Canadian provinces suggests that a floating Canadian dollar is the best monetary arrangement for only a subset of Canadian regions.

The main results are the following. First and not surprisingly, Canada as a whole is not an optimum currency area. More importantly, the business cycles of the central provinces , Quebec and Ontario, that represent roughly two-thirds of the Canadian GDP tend to become more similar to the U.S. business cycle over time. This contrasts with the business cycle dynamics of the peripheral Canadian regions. This core-periphery distinction is also reflected by the industrial specialization of the provinces and by the evolution of international trade patterns. It may be concluded that, on the whole, keeping a flexible Canadian dollar could be detrimental for Quebec and Ontario. In contrast, the prevailing flexible exchange rate can work well in stabilizing the effects of idiosyncratic economic disturbances occurring in the other provinces.

Finally, this paper illustrates why and how the regional dimension could become the critical element in the political process regarding the future of the Canadian monetary union. Canada cannot be governed without the support of both Quebec and Ontario and the net benefit of adopting the U.S. dollar by those two provinces 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 5) are Statistics Canada data computed by the authors from Trade Data Online (Industry) of Industry Canada's web site at < strategis.ic.gc.ca/sc_mrkti/tdst/tdo/tdo.php#tag >. The primary sector is the aggregation of the following industries: agricultural and related services, fishing and trapping, logging and forestry, mining, quarrying and oil wells industries.

All other data were retrieved from Statistics Canada's CANSIM database. U.S. output data are gross domestic product in 1996 constant dollars (CANSIM number d369455). Canadian quarterly 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. employment data refer to civil employment (CANSIM number b53104).

International and interprovincial openness data were computed from Provincial Economics Accounts:
– numbers d21528, d21548, d21568... for international exports;
– numbers d21531, d21551, d21571... for interprovincial exports;
– numbers d21535, d21555, d21575... for international imports;
– numbers d21538, d21558, d21578... for interprovincial imports;
– numbers d21546, d21566, d21586... for gross domestic product at market prices.

## Endnotes

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

2. 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 >.

3. Corresponding results obtained from 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 U.S. and Canadian labour markets. The correlations across Canadian provinces are higher for employment data, reflecting the fact that interregional migrations might play some limited stabilization role. The cross-correlations involving some provinces like Saskatchewan and Prince Edward Island nevertheless remain quite low.

4. 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.

5. Here the higher frequency (one quarter) corresponds to a value on the X axis of Figure 1 equal to *2B/T*, i.e., a value of 0.04. Thus, a value between 0.4 and 0.8 means that the typical length of the U.S. 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).

6. The BP procedure implies the choice of a third parameter, K, capturing the order of moving averages. Following Baxter and King's (1995) recommendations, we use K=12.

7. 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.

8. 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).

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

10. Coulombe (1999, 2000) refers to the core-periphery structure and the heterogeneity of Canadian provinces for explaining relative provincial growth patterns since the 1950s.

11. Refer to the Data Appendix for details.

12. As Courchene and Laberge (2000) pointed out, Quebec and Ontario are part of the Great Lakes economy.

13. 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.

14. 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).

15. On the topic of Quebec's secession, refer to Courchene and Laberge (2000).

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