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International Trade, Interprovincial Trade, and Canadian Provincial Growth

by

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Abstract

This paper provides an empirical analysis of the comparative evolution of interprovincial and international trade and their effects on regional growth for the Canadian provinces since 1981. Two sets of results emerge from the analysis. First, it appears that the rapid expansion of international trade following the Canada-United States Free Trade Agreement with a certain lag did not produce a decrease in interprovincial trade. To the contrary, we found a positive relation between the two trade channels, especially since 1991. Second, using a conditional convergence econometric framework, we found that increased international trade openness has a positive and significant long-run effect on regional standards of living, productivity, and employment. Increased interprovincial trade has a positive effect on GDP per capita and employment; however, the effect appears to be close to zero on labour productivity.

Keywords: Canada and globalization, regional economic integration, conditional convergence, FTA, Canadian provincial disparities

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Résumé : Commerce international, commerce interprovincial et croissance économique régionale au Canada - Dans cette étude empirique, l'auteur analyse l'évolution comparée du commerce international et du commerce interprovincial des provinces canadiennes depuis 1981. Une attention particulière est accordée à l'analyse de l'incidence de l'évolution des liens commerciaux sur la croissance économique des économies provinciales. Deux ensembles de résultats ressortent de l'analyse. En premier lieu, il apparaît que la forte expansion du commerce international qui a suivi avec un certain délai l'Accord de libre-échange canado-américain n'aurait pas entraîné une diminution du commerce interprovincial. Au contraire, l'analyse montre que, surtout depuis 1991, l'expansion du commerce Nord-Sud aurait exercé une incidence positive sur le commerce Est-Ouest. En second lieu, dans le cadre d'une régression de croissance fondée sur un modèle de convergence conditionnelle, l'expansion du commerce international aurait eu un effet de long terme significatif sur le niveau de vie, la productivité et l'emploi des économies provinciales. L'accroissement du commerce interprovincial, pour sa part, n'aurait un effet positif et significatif que sur l'emploi et le PIB par habitant. L'effet du commerce Est-Ouest sur la productivité de la main-d'oeuvre serait nul.

1. Introduction

The Canadian economy has gone through a process of profound structural changes in the 1990s. From the macroeconomic perspective, the decade started with inflation pressures, a deep recession, an overvalued Canadian dollar, and a rising public debt. On the eve of the new millennium, the federal government and most provincial governments were generating budget surpluses; the battle (and maybe the war) against inflation was secured; and the economy, which had gone through a long period of steady economic growth, was apparently going through the business cycle slowdown in a more favourable way than its southern neighbour.

The changes of the 1990s were related not only to macroeconomic fundamentals. As will be documented and analyzed in this paper, the orientation of regional trade links in Canada underwent a major shift around 1991. North-south trade with our U.S. neighbour started to boom and grew at a much faster pace than the traditional east-west trade channel.

The paper investigates the relationships between economic growth of the Canadian provinces and the change in the orientation of trade—north-south or international trade *vs* east-west or interprovincial trade—that occurred in the 1990s. The approach is essentially empirical and will focus on the 1981–2000 period in order to isolate the long-run trends. The goal of the empirical analysis is twofold: to analyze the relationship between the two regional trade channels (north-south *vs* east-west); and to estimate the long-run effects of increased economic integration at the regional level on regional standards of living (GDP per capita), labour productivity, and employment in a convergence-growth framework.

This paper contributes to original research by combining two types of information to analyze those empirical relationships. The first type of information is the time-series evidence that will be useful in revealing an important structural shock that occurred in 1991 in provincial trade patterns. The analysis produces a new perspective on the effect of the Canada-U.S. Free Trade Agreement (FTA) on the relationship between interprovincial and international trade in Canada. The relative decline of the contribution of Canadian interprovincial trade to GDP is a phenomenon that preceded the expansion of north-south international trade between Canada and the United States. The contribution of interprovincial trade in goods and services to GDP was decreasing steadily and significantly all through the 1981–1991 period, whereas the contribution of Canadian international trade to GDP was roughly steady. A significant structural break in the relationship between interprovincial and international trade occurred in 1991–1992. Since 1991, Canadian international trade has boomed and the value of interprovincial trade has started to grow at the same long-run rate as the GDP.

The second type of information is contained in the cross-sectional (across Canadian provinces) variance of trade data. The changes in trade patterns were not spread evenly across Canadian provinces. We will maximize the use of this cross-sectional information in a pooled time-series cross-sectional framework that will be employed to assess the effect of asymmetric provincial trade link changes on long-run regional developments. The underlying theoretical framework for the empirical analysis is the well-known conditional-convergence model of neoclassical growth (Mankiw, Romer, and Weil 1992). The conditional-convergence framework has been used recently by Vamvakidis (2002) to estimate the effect of openness on economic growth at the cross-country level. The empirical methodology to test for the growth-openness relationship in this study follows the conditional-convergence approach used by Coulombe (2000) to study long-run disparities across the Canadian provinces. We will find that international openness has a positive and significant effect on regional GDP per capita, productivity, and employment. The quantitative effect measured by combining time-series and cross-sectional information in the Canadian regional data set is comparable to the elasticity estimated recently with a completely different methodology by Frankel and Romer (1999) in a wide cross-section of countries. The long-run

regional effect of interprovincial trade is positive on GDP per capita and employment but is null on labour productivity.

The data are presented in Section 2. Section 3 focuses on the relative evolution of international and interprovincial trade. The long-run effect of openness on GDP and productivity in the convergence-econometric framework is estimated in Section 4. We conclude with a synthesis of our results and a broad policy-oriented discussion.

2. The data and general methodology

Two sets of provincial GDP and trade data are used in the paper. The first set is nominal data and comes from the Gross Domestic Product, Expenditure-Based matrices (CANSIM Matrix 9023 for Alberta and following numbers for the other provinces). The second set is real GDP data that are deflated using provincial GDP deflators from the Gross Domestic Product at 1992 Prices matrices (CANSIM Matrix 9037 for Alberta and following numbers for the other provinces).

In the econometric and descriptive analyses, the trade shares are measured as ratio to GDP (Section 3) or by logarithmic deviations from the cross-sectional mean (Section 4). Consequently, all variables are real variables, whether they come from the nominal or the real data base. The difference between the two sets of variables is intrinsically related to regional terms of trade and to the specific composition of regional GDP. With the set of GDP and trade data computed from the nominal data bank, deviations from cross-sectional means and ratio of trade to GDP include variations in terms of trade; these variations, however, are excluded from variables computed from the real data set.

A good example to illustrate the difference is the effect of an oil shock on Alberta. An increase in the relative price of oil will expand the output and export measures of Alberta in the nominal GDP data set because the relative value of oil produced in Alberta and exported abroad has increased. This regional terms-of-trade effect will be eliminated from the data set based on real GDP as only real flows (volume of oil) are computed with this data bank. Consequently, if one wants to use a real regional relative GDP measure that is intrinsically related to the real regional relative income (and welfare), one has to use relative values computed from the nominal GDP data set. An increase in the price of oil increases real relative income and relative trade values of Alberta even though the production of oil does not increase.

The two sets of data produced useful information and both sets will be employed. If one wants to measure the long-run effect of a trade shock (in Section 4) on the relative per capita GDP, the regional GDP has to be measured from the real GDP data set. This is because we want to purge the dependent variable (real income) from exogenous shifts in terms of trade determined in international markets. However, if one is interested in measuring the relative evolution of trade links between regional economies, the data set based on nominal data is the appropriate one; it captures the change in the relative value of trade across the economies. Another example will illustrate this point. If the United States exports 10 times more computers to Canada in 2000 than in 1990, at one-tenth the price, measuring the expansion of U.S. trade in Canada from a nominal GDP data set will show that U.S. exports to Canada have multiplied by 10 during the period. However, from a real data set, the real relative value of computer exports to Canada has not increased during the period. This is why relative trade data that are computed to illustrate the L curve in Section 3 and used in the econometric analysis in that section are computed from a nominal GDP data set and include the evolution of terms of trade.

Only the real data set (computed from provincial GDP deflators) was used to compute the GDP per capita and the labour productivity series used as dependent variables in the convergence regressions of Section 4. Both sets of data were used to compute alternative measures of international and interprovincial trade shares in the convergence regressions of Section 4. The analysis of Section 3 focuses on the data set generated from the nominal GDP. The evolution of the ratio of exports plus imports over GDP then includes the evolution of terms of trade.

The employment data used to compute labour productivity from the real GDP data set are total employment (CANSIM Matrix 9228 for Alberta and following numbers for the other provinces). The urbanization variable of Section 4 is borrowed from Coulombe (2000) and refers to the percentage of the population living within census metropolitan areas and census agglomerations over 10,000 inhabitants. The original data were computed from the population censuses by Ray Bollman at Statistics Canada.

3. Was north-south trade expansion a substitute for interprovincial trade?

The FTA is the obvious institutional change that was likely to affect the orientation of provincial trade patterns in Canada. The FTA gradually eliminated and reduced tariff (and nontariff) trade barriers between Canada and the United States from January 1, 1989 to January 1, 1998. The Canada-U.S. Free Trade Agreement was extended to Mexico on January 1, 1994 with the North American Free Trade Agreement (NAFTA). During this period, Canada experienced a spectacular increase in its trade with its southern neighbour. A decrease in the relative importance of interprovincial trade in the 1988–1996 period has been documented and analyzed in Helliwell, Lee, and Messinger (1999). Based on evidence from industry-level data on commodity trade and tariffs, they conclude that part of the relative decline in interprovincial trade might be attributed to FTA. We revisit this important issue below. We first establish a key stylized fact, the L curve, regarding the relative evolution of international and interprovincial trade in the 1981–2000 period.

3.1. The “L Curve”

Our two measures of international and interprovincial openness (*INOP* and *IPOP* respectively) are the trade shares over GDP:

$$\begin{aligned} INOP &= (\text{international imports} + \text{international exports})/\text{GDP} \\ IPOP &= (\text{interprovincial imports} + \text{interprovincial exports})/\text{GDP} \end{aligned}$$

The data are available from Statistics Canada on an annual time-series basis for the 10 Canadian provinces for the 1981–2000 period.¹ The idiosyncratic relative evolution of the two time series for Canada as a whole is best illustrated by the following scatter diagram (Figure 1) that links interprovincial and international trade shares.

Insert Figure 1 here

The scatter observations are linked by a line to illustrate the evolution over time. The historical evolution

¹ We use trade data of goods and services in this section.

starts at the south-east of the diagram and ends at the north-west. The evolution of the two trade shares in the scatter clearly exemplifies two different periods: (1) between 1981 and 1991, the share of interprovincial trade to GDP falls continuously and (relatively) steadily while the share of international trade to GDP is roughly constant; (2) between 1992 and 2000, the share of interprovincial trade to GDP is roughly constant while the share of international trade to GDP increases continuously and steadily. Obviously it appears that the relationship between the two trade share variables has been disrupted around 1991–1992 by an important structural break.

We call this stylized fact the “L curve” to describe the L shape of the scatter. We will describe it more thoroughly in the following sections by disaggregating trade flows for province and sector.

3.2. *Disaggregation per province*

The scatter relationships between the trade share variables for the 10 provinces are displayed in Figures 2, 3, and 4.

Insert Figures 2, 3, and 4 here

The typical L shape that characterizes the aggregate relationship between interprovincial and international openness appears to be driven by the two big central provinces of Quebec and Ontario. In the two core provinces, trade patterns evolve similarly and mimic the Canadian pattern. The comparative evolution of trade links evolves differently in the periphery.

At the beginning of the period under study, the four Atlantic provinces are the most dependent on interprovincial trade. In Atlantic Canada, both international and interprovincial trade shares decrease substantially during the 1981–1991 period. Thereafter, the international trade share expands and the interprovincial trade share grows roughly at the same rate as GDP. Interestingly, most of the reduction in Atlantic Canada openness to the rest of the country and the rest of the world coincides with the big 1981–1983 recession. The drop in the international trade share to GDP during this recession is particularly substantial for Newfoundland, Nova Scotia, and New Brunswick.

There are few common patterns in trade link evolution across the four Western provinces. Saskatchewan and British Columbia are the only two Canadian provinces that did not experience a noticeable decrease in their interprovincial trade share during the 1981–1990 period. After 1992 for Manitoba, and 1993 for Saskatchewan and British Columbia, both international and interprovincial trade shares increase. During the whole period, the decrease in interprovincial trade shares is not substantial in these three provinces.

The overall picture is different for Alberta. The major oil-producing province is the only province for which the scatter suggests a negative relationship between the evolution of the international and interprovincial trade shares. In fact, Alberta is the only province for which the two trade shares *INOP* and *IPOP* are negatively correlated (-0.11) in first difference during the whole period. For the other provinces, correlations are positive and vary from 0.20 for Ontario to 0.61 and 0.72 for Quebec and Newfoundland respectively. Coupled with the graphical analysis of the scatter, this key information illustrates clearly that the trade diversion hypothesis (that the increase in international trade might have diverted interprovincial trade) might be valuable only for Alberta.

3.3. *Services vs goods*

Some insights into the L curve effect can be gained by disaggregating trade by the services and goods sectors. We computed the same trade share indexes for Canada for goods and for services by dividing exports plus imports of goods (or services) by GDP. The results are displayed in Figure 5.

Insert Figures 5 and 6 here

The comparative evolution of international and interprovincial trade share indicators differs strikingly for goods and for services. The relationship between international and interprovincial trade shares of goods follows the same L curve shape as total trade, i.e., with the interprovincial trade ratio decreasing in the 1981–1991 period while the international ratio remains relatively stable, and the interprovincial trade growing at roughly the same rate as GDP thereafter when international trade is booming.

The scatter for trade in services is completely different. Overall, both international and interprovincial trade in services tends to grow at a faster rate than GDP for the whole period. However, the expansion of interprovincial trade in services occurs in the 1994–2000 period while the expansion of international trade in services is mainly in the 1981–1994 period.

Figure 6 highlights another interesting stylized fact that raises many questions. During the whole 1981–2000 period, international trade in services remains a very small and stable fraction of international trade in goods. Thus one surely does not lose much information by focusing only on goods when analyzing the evolution of international trade in Canada. The picture is very different, however, for interprovincial trade. Trade in services is a substantial fraction of the goods trade and the share of services trade rises substantially during the period. Compared with international trade, interprovincial trade in services is much more intensive and the difference grows with time.

The explanation of this stylized fact goes well beyond the scope of this paper but the simple analysis in this section is useful. The L curve is a phenomenon that applies only to the trade in goods, not to the trade in services. Using information from the trade in services to analyze international trade would not be the basis for a major hypothesis. This is not the case, however, for interprovincial trade where trade in services plays a major and increasing role.

3.4. *Testing the diversion hypothesis*

In this section, we test the diversion hypothesis: that the expansion of international trade that started in 1991 in Canada was at the expense of interprovincial trade. The analysis is carried out in two steps. First, we combine the pooled time-series cross-sectional (across provinces) information for the 10 Canadian provinces in the 1981–2000 sample to analyze the contemporaneous relationship between international and interprovincial trade shares. Second, we will test the Granger causality between these two variables to determine if there is a simultaneous causal relationship between them.

The results of five diversion regressions are displayed in Table 1. In the first two regressions, the hypothesis is tested on the levels of the *IPOP* and *INOP* variables. In the last three regressions, the hypothesis is tested on the first difference $d(IPOP)$ and $d(INOP)$. Interprovincial trade shares are used as the dependent variable. The diversion hypothesis implies that the expansion of international trade has a negative and significant effect on interprovincial trade shares, on average, for the 10 Canadian provinces.

In all five regressions, we used fixed effects to model the fact that the Canadian provinces follow different trends in the evolution of interprovincial trade shares.

Insert Table 1 around here

In the first three regressions, we estimated the system using seemingly unrelated regression (SUR), which is the least restricted framework here as it corrects for both contemporaneous correlation and cross-sectional heteroscedasticity. For the last two regressions with subsamples, it was not possible to use SUR due to the limited number of time-series observations. For these two subsample regressions, we used iterated feasible generalized least squares (IFGLS) to account for cross-sectional heteroscedasticity. They produced estimates consistent with the ones produced with SUR for the first difference set-up in the whole sample.

In the first column, the diversion hypothesis is tested in level following a straightforward approach that ignores the important structural break that occurred around 1991 in the relationship between international and interprovincial trade shares, depicted in the L Curve. The effect of international trade shares is negative, substantial, and extremely significant (at the 1 per cent level) and the regression has a high R-squared of 0.87. This exercise illustrates the danger of testing the diversion hypothesis by comparing interprovincial and international trade for two dates (such as 1988 before FTA and 1996 after FTA as in Helliwell, Lee, and Messinger [1999]) without taking the 1991 structural brake into consideration. The negative correlation between the level of international and interprovincial trade shares in periods that include the structural brake suggests that the diversion hypothesis should not be rejected. The negative correlation between the two variables is illustrated in Figure 7 with a simple scatter between the two variables including the OLS regression.

Due to the time-series dimension of the actual analysis, an important warning is posted by the results depicted for the first regression. The very low Durbin-Watson statistic (0.32) is clear evidence of positive serial correlation in the residuals. The serial correlation is viewed in Figure 7 with systematic positive residuals at the beginning of the sample, followed by systematic negative residuals in the middle and by systematic negative residuals thereafter. As documented and explained in Granger and Newbold (1974) and Phillips (1983), the use of non-stationary data in econometrics might result in spurious regressions. A spurious regression will typically produce a very high R-squared and a very low Durbin-Watson. As a practical rule of thumb, a Durbin-Watson statistic that is lower than the R-squared is evidence of a spurious regression.

Insert Figure 7 around here

The next four regressions use two alternative approaches to tackle the econometric problems of the first diversion regression. In the second regression, we continue to estimate the diversion hypothesis with the levels of the *IPOP* and *INOP* variables. However, we explicitly model the structural brake by introducing a time dummy *BR91* that takes the value zero prior to 1991 and one thereafter for the 10 provinces. We also correct for serial correlation with a common (for all provinces) AR(1) in the regression. The result regarding the diversion hypothesis is reversed! International openness now has a positive and significant effect (at the 5 per cent level) on interprovincial trade shares. The *BR91* break variable is negative and significant at the 1 per cent level. The standard error of regression is much lower than in the first regression, the R-squared is 0.98, and the Durbin-Watson is close to 2. Obviously regression (2) provides a much better fit than regression (1).

Two supplementary points are worth mentioning regarding the econometric results of regression (2). First, the negative value of the 1991 break does not imply that FTA had a negative effect on interprovincial trade. The reason for the negative value is that the *INOP* variable grows faster after 1991 and the effect of *INOP* on interprovincial trade is positive. The total effect of the changing trade patterns after 1991 on interprovincial trade shares will be best viewed with the following three regressions in first differences. Second, the parameter estimates for the fixed effects are indicators of the relative interprovincial trade shares across the Canadian provinces. It is interesting that the three provinces with a lower dependence on interprovincial openness are Ontario, British Columbia, and Quebec. In Beine and Coulombe's study (2002), those three provinces show a business cycle that is more correlated with the U.S. business cycle.

In regressions (3), (4), and (5), we use a straightforward approach to tackle the issue of non-stationarity by taking the first difference of both trade variables. In regression (3), the system is estimated for the entire 1981–2000 period. We repeated the same regression setting for the two subsamples 1981–1991 and 1991–2000, which are divided by the date of the structural break for the relationship between the levels of the two trade variables.

For the three diversion regressions using first differences, the diversion hypothesis is strongly rejected with a positive, substantial, and significant (at the 1 per cent level) effect of the change in the international trade shares on the change of interprovincial trade shares. Interestingly, the effect is stronger after 1991 than before. A 100 per cent point increase in international trade induces a 17.5 and 26.4 per cent point increase in interprovincial trade before and after 1991 respectively.

In the first difference set-up, fixed-effect parameters estimate annual growth long-run trends in interprovincial trade shares, using the assumption that there is no change in international trade shares. The point estimates are not all statistically different from zero. They are, however, all negative and some of them are very significant. For Ontario and Quebec, the long-lasting decrease in interprovincial trade is significant at the 1 per cent level. For Newfoundland, the decrease is significant at the 5 per cent level. For Alberta, the decrease is significant at the 1 per cent level in the 1991–2000 period only.

Having now established that there is a positive relationship between international and interprovincial trade in the light of the 1981–2000 cross-sectional and time-series information, we attempt in the last empirical step of this section to verify if there are causality links between the two trade channels. The following Granger causality exercise has to be viewed with great caution of course, since the number of time-series observations at our disposal is very limited. We have to split the sample into two periods (1981–1991 and 1991–2000) because Granger causality tests would suffer from a serious bias if performed over a period during which a structural break in the relation between the two variables under study was observed. Given the limited number of time-series observations, we have to restrict our study to a one-year lag.

Insert Table 2 around here

Results for the 1991–2000 period are presented in Table 2. Interestingly, the null hypothesis of non-Granger causality could not be rejected for both relationships (*INOP* causing *IPOP* and the reverse) for the aggregate trade data of both Canada and Quebec. Evidence is mixed for Ontario since the null hypothesis cannot be rejected for one relationship. Overall, the results suggest that there is some evidence of a simultaneous (and positive, given the results of regression [5] in Table 1) causality between

international trade and interprovincial trade in Canada over the 1991–2000 sample.²

3.5. Discussion: The FTA

One insight revealed by the comparative analysis of the evolution of interprovincial and international trade links in this section is the fact that the structural shock that disrupted the relationship between the two trade channels did not coincide with the establishment of FTA. The structural shock affected the data between 1991 and 1992; the FTA came into effect on January 1, 1989. Between the end of 1988 and years 1991–1992, the relationship between interprovincial trade and international trade appears to continue to evolve along the general trend observed during the 1980s: a decrease in interprovincial trade coupled with international trade growing at the same rate as the GDP.

It is interesting to note that the structural shock to the evolution of our trade links occurred at the same time as the start of a period that was characterized by a steady decline in the value of the Canadian dollar as measured by the bilateral exchange rate with the United States. The value of the Canadian dollar reached its peak in October 1991 but had lost 35 per cent of its value with respect to the U.S. dollar by January 2002.³ It is usually understood that the Canadian dollar was overvalued in the 1988–1991 period due to the restrictive monetary policy at the time. We cannot test directly in the framework used in this paper whether or not the exchange rate misalignment delayed the FTA effect on the expansion of Canada international trade. This, however, is a possible explanation that could account for the stylized facts reported in this section.

4. Estimating the long-run effect of international and interprovincial trade on provincial growth

As pointed out in Aghion and Howitt (1998, section 11.6), it is very difficult in modern growth theory to isolate the effect of expanding trade links on an economy's long-run income and welfare. Many different dynamic channels intervene, such as human and physical accumulation, factor price equalization, agglomeration effect and scale economies, and dynamic comparative advantage. For example, Ben-David and Loewy (1998) found that knowledge spillovers resulting from increased trade have a positive effect on economic growth during the transition process and in the long run. On empirical grounds, however, most modern research emphasizes the positive effect of increased international trade on economic growth. As Vamvakidis (2002) shows, this positive effect might be limited to recent decades since 1970. Prior to this, he finds no support for a positive relationship between economic growth and trade measures in a

² The results of table 1 on the diversion hypothesis are robust to many alternative econometric set-ups. For example, following the Granger causality analysis, one could think at modelling the effect of international openness on interprovincial openness as: $ipop_{i,t} = f(ipop_{i,t}(-1), inop_{i,t}(-1), 1991break, \dots)$. In this dynamic set-up, using correction for serial correlation and IFGLS estimation, the point estimate for the lagged international openness variable is positive and significant at the 1 per cent level.

³ The percentage change is measured as a logarithmic difference.

cross-section of countries.⁴

In this section, we use cross-sectional information contained in the asymmetric evolution of provincial trade patterns to estimate the long-run effect of trade on provincial GDP per capita and labour productivity in a conditional-convergence framework. This framework works well for testing the relationship between openness and growth, as was done in Vamvakidis (2002).

4.1. Theoretical Foundations and Empirical Methodology

The underlying theoretical framework for the empirical analysis in this section is the conditional-convergence growth model of Mankiw, Romer, and Weil (1992) and of Barro and Sala-i-Martin (1995). In this framework, during the transition process toward the steady state, the evolution of the logarithm of per capita output or labour productivity $y_{i,t}$ in the regional economy i at time t (for $i = 1, \dots, N$ and $t = 1, \dots, T$) is a function of its initial level $y_{i,0}$ and its steady-state value y^*_i . This dynamic process can be written as

$$y_{i,t} = e^{-\beta} y_{i,t-1} + (1 - e^{-\beta}) y^*_i + \varepsilon_{i,t}. \quad (1)$$

In this equation, β is the annual speed of convergence toward the steady state and the additive error term $\varepsilon_{i,t}$ captures the effect of regional shocks that temporarily affect the economy i at time t . If β equals 0, $y_{i,t}$ is determined only by $y_{i,t-1}$; the economy does not converge to y^*_i ; and $y_{i,t}$ is integrated of order one. The economy, however, converges to a steady state y^*_i when β is positive and smaller than one. The conditional-convergence hypothesis refers to the case when the N economic units converge to different steady-state values for y^*_i . In equation (1) (following Coulombe and Lee 1995)—and as will be the case for all variables used in the empirical analysis in this paper—the regional economic variable $x_{i,t}$ (like $y_{i,t}$ and y^*_i) is measured as logarithmic deviation from the cross-sectional mean at time t :

$$x_{i,t} = \log \left(X_{i,t} / \sum_{i=1}^N \frac{1}{N} X_{i,t} \right),$$

where $X_{i,t}$ is the level of the logarithm $x_{i,t}$. In this setting, y^*_i is the relative long-run gap between province i and the unweighted provinces' mean value of economic indicator y . The use of variables measured by deviation from their sample mean proved extremely useful in pooled time-series cross-sectional convergence regressions as it eliminates common factors such as the productivity slowdown that might bias the results.

In this paper, we follow the empirical methodology employed by Coulombe (2000) to test equation (1) using annual pooled time-series cross-sectional observations. Coulombe's analysis focuses on the relative evolution of the pre- and post-transfers measures of per capita income across the 10 Canadian provinces

⁴ Vamvakidis (2002) provides a short updated synthesis on the vast and growing empirical literature on the growth-openness connection.

in the 1950–1996 sample where relative rates of urbanization across the provinces are used as instruments for the y_i^* . The results indicate that the provinces have converged at a rate around 5 per cent per year to their relative long-run steady states. Furthermore, most provinces appeared to be in the neighbourhood of their respective steady states since the mid-1980s. Coulombe (2000) also found significant structural shocks to the steady-state relative position of Alberta and Quebec in the early 1970s that were associated with the oil shock and the relative decline of Montreal. The convergence regression used by Coulombe (2000) is

$$y_{i,t} = \gamma_1 y_{i,t-1} + \gamma_2 RU_i + \gamma_3 DA_{i,t} + \gamma_4 DQ_{i,t} + \varepsilon_{i,t}.$$

The convergence parameter (γ_1) is equal to $e^{-\delta}$ of equation (1) and the variables RU_i , $DA_{i,t}$, and $DQ_{i,t}$ —the relative urbanization variable and the Alberta and Quebec dummies respectively—determine the relative steady-state values y_i^* .

In this paper, we want to test the hypothesis that the developments observed in interprovincial and international trade links in the 1981–1999⁵ period might have affected long-run relative provincial key macroeconomic indicators such as GDP per capita and labour productivity. To this end, the methodology of Coulombe (2000) has to be adapted to the problem under study in this paper, in three different ways. First, the sample used in Coulombe (2000) has to be restricted to the 1981–1999 period, given the availability of comparable trade data at the regional level. Second, the whole series regarding international and interprovincial trade has to be used in the empirical analysis since provincial trade patterns have evolved asymmetrically during the period under study. Third, we ignore specific shocks to Quebec and Alberta since they occurred prior to the period under study.⁶ The first two of these modifications to the previous methodology used by Coulombe (2000) are important methodological changes and are discussed here.

First, restricting the study period to the 1981–1999 sample translates into a massive loss of information compared to Coulombe’s (2000) analysis. As shown in a number of studies published recently on convergence across Canadian provinces (e.g., Coulombe and Day 1999; Coulombe 2000; Coulombe and Tremblay 2001), most of the evolution of the cross-sectional variance among Canadian provinces’ per capita income and related indicators occurred in the 1950–1980 period. During this period, the relative dispersion across provinces of per capita income and other related indicators showed a tendency to decrease over time, a phenomenon known as F-convergence in economic growth. Since the early 1980s, the relative dispersion appears to be in the neighbourhood of its steady-state level. Consequently, the cross-sectional variance is much smaller in the 1981–1999 sample than in the 1950–1996 sample used in Coulombe (2000). A convergence regression tested for the 1981–1999 sample would rely more on the information related to the time-series variance that came out with the evolution of the variables $y_{i,t}$ over time. It is important to bear this in mind when analyzing the results of the empirical analysis in this paper. Results might differ from the ones found in Coulombe (2000), and the parameter estimations be less precise, since a great deal of information has been removed from the analysis due to the restrictions

⁵ We have to switch to the 1981–1999 sample since real GDP data are not available for year 2000.

⁶ The results are robust to specific modelling of Alberta and Quebec dummy variables. An Alberta fixed-effect is generally positive and significant and the Quebec fixed-effect is negative and significant.

imposed on the period under study.

Second, we test if the evolution of relative interprovincial and international openness in the 1981–1999 sample has affected the steady-state relative values of labour productivity and GDP per capita of the Canadian provinces. The convergence regression equation used to test this hypothesis for both relative GDP per capita and relative labour productivity is the following variation of equation (1):

$$y_{i,t} = \gamma_1 y_{i,t-1} + \gamma_2 RU_i + \gamma_3 INOP_{i,t-1} + \gamma_4 IPOP_{i,t-1} + \varepsilon_{i,t}. \quad (2)$$

As in Coulombe (2000), RU_i stands for the relative urbanization variable. It is a cross-sectional variable with just one observation per province. $INOP_{i,t-1}$ and $IPOP_{i,t-1}$ are the measures of international and interprovincial trade shares respectively. The $INOP_{i,t-1}$ and $IPOP_{i,t-1}$ are lagged one period in convergence regression equation (2) to avoid the simultaneity problem that might occur if there were a mutual contemporaneous causality between these variables and the dependent variable. In this dynamic set-up, if γ_3 and γ_4 are statistically significant and γ_1 smaller than one, shocks to $INOP_{i,t}$ and $IPOP_{i,t}$, which are measured as deviations from the cross-sectional mean, disturb the steady-state relative values of variable y .⁷

4.3. The results

Convergence regression results for four specifications of equation (2) are displayed in Table 3. The conditional-convergence speeds were estimated using the first difference of $y_{i,t}$ as the dependent variable in equation (2). This does not change the estimation of the other parameters reported in Table 3. Convergence speeds are significant at the 1 per cent critical level for GDP per capita, and at the 5 per cent level for labour productivity. Interestingly, the conditional-convergence speeds vary between 4.9 and 5.9 per cent—very close to the estimates of 5.0 and 5.1 per cent obtained in Coulombe (2000) for per capita income and per capita income minus government transfers in the 1951–1996 sample. However, the urbanization variable is significant (with the expected positive sign) only for specification (1). Long-run differences in per capita GDP and labour productivity are not captured by the relative urbanization variable for the other three specifications. It appears that the long-run effect of the urbanization variable is harder to estimate when the cross-sectional and time-series information associated with the F-convergence of the 1950–1980 period is not taken into account in the conditional-convergence regression.

Insert Tables 3 and 4 around here

More importantly for the purpose of this paper, the analysis of the estimated coefficients for the international and interprovincial openness variables is revealing. The various estimated coefficients for the international openness variable are all positive and extremely significant with p value below 0.013 in the four cases. For the interprovincial openness variable, however, the effect is significant (at the 1 and the 10 per cent level) only for GDP per capita. The long-run estimated effect of interprovincial trade on labour productivity is virtually zero.

⁷ If γ_1 equals one, there is no steady-state growth path.

To complement this qualitative analysis, we present in Table 4 the long-run elasticities of per capita GDP and labour productivity to the different environmental variables. The estimated elasticity of the urbanization variable on the long-run relative per capita GDP is 0.61 when the openness variables are captured by the nominal data set. This number is consistent with the estimated elasticities of the urbanization variable in Coulombe (2000) of 0.78 and 0.51 for per capita income minus transfers and per capita income, respectively.

Regarding the impact of trade openness on per capita GDP, the effect is larger for international openness than for interprovincial openness for both the nominal and the real measures of trade. Not surprisingly, the long-run effect is greater for the nominal than for the real measure as the effect of terms-of-trade changes is included in the former and excluded in the latter. A 10 per cent increase in trade shares, including the terms-of-trade effects, translates into an increase in per capita relative GDP of 6.3 and 5.4 per cent for international trade and interprovincial trade respectively. For the real measures of trade, the effect on per capita GDP is 5.1 and 3.5 per cent for international trade and interprovincial trade respectively. In this regional growth framework, increased relative (with respect with the other provinces) trade openness in a province produced a higher standard of living in the long run as measured by per capita GDP.

The effect, however, of trade openness on labour productivity is more muted. The elasticities are smaller for international openness (roughly two-thirds of the effect produced on per capita GDP) and the effect is null for interprovincial openness.

On quantitative grounds, the estimated elasticities for the international trade shares are consistent with the empirical estimates of Frankel and Romer (1999) using a cross-country data set and a geographic adjustment in the spirit of gravity models to correct for size and distance. They estimated that an increase of 10 per cent in the trade share to GDP generates an increase of at least 5 per cent in income per capita. They also found a much smaller effect for within-country trade with a real GDP per worker elasticity to interior trade around 0.1.

Furthermore, the comparative analysis between the per capita GDP and labour productivity in this convergence growth framework might reveal some interesting insights regarding the relative evolution of regional employment, such as those revealed in Coulombe and Day (1999). The difference between the effect of trade openness (and the urbanization variable) on GDP per capita and labour productivity is explained by the evolution of provincial relative employment. Since the effect of interprovincial trade on labour productivity is null, the results suggest that interprovincial trade increases long-run standard of living at the provincial level only by increasing employment. International trade, however, spurs both relative labour productivity and employment at the provincial level. The long-run effect of trade on regional employment in Canada might come from two different channels. First, increased trade openness might have an effect on regional natural rates of unemployment and participation rates. Second, trade openness might affect regional employment through the interprovincial migration channel. We are not able to separate the effect on the regional employment market through the two channels in this paper's analytical framework. However, given the relative substantial size of the long-run elasticities estimated here, the analysis suggests that both channels could play an important role. The asymmetric development of trade links across Canadian provinces in the last 20 years might have been one of the driving forces of interprovincial migration flows. Canadians tend to migrate to provinces that are developing trade links faster than the others and labour market conditions appear to improve with trade openness. The effect works for both interprovincial and international trade openness. Both trade channels create jobs at the regional level.

The effect of increased international openness on regional standards of living is higher than for interprovincial openness since it enhances the level of regional labour productivity. This is one of the key results of this paper. Not only does international trade create jobs at the regional level, but it creates good jobs with a higher-than-average productivity level.

Finally, as shown in Tables A1 and A2 in Appendix 1, the results are robust to alternative econometric techniques of combining cross-sectional and time-series information. The results discussed above are based on the same methodology as the one used in Coulombe (2000). The approach is based on iterated feasible generalized least-squares (IFGLS) estimations using cross-sectional weight regressions. This is to account for cross-sectional heteroscedasticity and the non-parametric White heteroscedasticity-consistent standard error approach for asymptotically valid inferences in the presence of the remaining time-series heteroscedasticity. Estimation results using seemingly unrelated regression (SUR) are presented in Appendix 1. This approach is designed to produce a feasible GLS estimator in the presence of both cross-sectional heteroscedasticity and contemporaneous correlation in the residuals. Even though the *RU* variable is not significant with SUR, the conditional-convergence model works well and the effect of the trade shares is roughly the same. The estimated long-run elasticities are close to the one estimated with IFGLS and the relative effect of interprovincial trade and international trade on per capita GDP and labour productivity is similar.

4.4. Theoretical interpretation of the results

The long-run relative differential effects of interprovincial and international trade on regional productivity can be interpreted in the framework of the neoclassical growth model of Solow-Cass-Koopman, coupled with an international trade model of Grossman and Helpman (1991) and Ben-David and Loewy (1998).

In the framework of the neoclassical convergence-growth equation (1), a shock to the relative y^*_i will affect the long-run relative level of labour productivity. This is what is captured by the estimated effect of international openness on labour productivity in this section. Many different theoretical channels have been developed in international trade theory to assess the effect of international trade openness on productivity. In the approach of Grossman and Helpman (1991), for example, the level of regional knowledge stock is positively related with the number of transactions in international markets. Trade with foreign agents creates a knowledge spillover at the regional level because it brings new ideas into the production process.

But this knowledge spillover will result from new trade links. If a set of regional economies—such as the Canadian provinces—has traded with each other for a long time period, there is no reason to assume that there is a knowledge spillover positively related with the number of interprovincial transactions in a specific province. One can assume in a neoclassical growth framework that the relative evolution of trade flows across Canadian provinces is in the neighbourhood of a steady-state distribution and that the knowledge associated with this trade has already been diffused to the regions. The actual relative interprovincial trade shares do not capture the rate of learning of new ideas but rather reflect geographical locations, industrial structures, and natural resource endowments.

But this is not the case with international trade. Following FTA with a certain lag, the positive shock to international trade might be viewed as a shock to the relative steady-state position of the provinces since the expansion of international trade since 1991 has not been distributed evenly across the Canadian provinces (see Beine and Coulombe 2002). In this framework, the central provinces of Quebec and

Ontario appear to be the most favourably positioned, given their geographical location and the spectacular expansion of their international trade since 1991.

5. Discussion, policy issues, and extension

The analysis presented in this paper suggests that, overall or from an aggregate perspective, the vigorous increase in Canadian-U.S. trade that followed FTA (really starting in 1991) might have a positive effect on Canadians' welfare, for two reasons. First, the expansion of north-south trade links was not at the expense of a contraction in the traditional east-west pan-Canadian trade channels. Consequently, the expansion of international trade since 1991 represents new trade opportunities. Second, it appears that the expansion of international trade at the regional level in Canada increases both productivity and GDP per capita in the long run. The estimated elasticities are relatively high (0.5 to 0.6 for GDP per capita and 0.3 to 0.4 for labour productivity) for international openness and consistent with estimates found by Frankel and Romer (1999) in a cross-section of countries.

These two results, taken together, are good news for the Canadian public and policy-makers since modern growth theory is somewhat sceptical about the effect of increased trade openness and industrial specialization on long-run economic perspectives of economies that are concentrated in primary product exports. For example, Aghion and Howitt (1998, p. 391) point out that increased international trade might not be beneficial for all types of economies. Based on the argument of dynamic comparative advantages, they fear that a natural-resource-based economy might not capture the dynamic gains of increased specialization as would economies specializing in manufacturing. Furthermore, Baldwin, Martin, and Ottavio (2001) propose a growth model where increased international trade widens the gap between industrialized and less industrialized economies. In this context, despite the core-periphery nature of the Canadian economy (an industrial core located in the Quebec-Windsor corridor in Ontario and Quebec and a vast periphery more dependent on exploitation of natural resources), our results indicate that the vigorous expansion of international trade links since 1991 has had on average a positive effect on the key macroeconomic indicators of GDP per capita, labour productivity, and employment at the regional level in Canada.

We conclude with two points of prospective analysis regarding policy issues that emerge from the analysis presented in this paper.

First, the empirical analysis of this paper suggests that, for the overall Canadian economy, the fast expansion of international trade links observed since 1991 is good news since international openness has a significant effect on the long-run relative provincial positions. Recent studies on convergence across Canadian provinces (Coulombe and Day 1999; Coulombe 2000) indicate that since the 1980s, relative income and GDP indicators across the Canadian provinces appear to be in the neighbourhood of their steady-state distribution. What remains in provincial disparities is structural and not likely to decrease following the steady convergence process observed in the 1950–1980 period. The analysis presented in this paper indicates that the change in trade link orientation observed in 1991 is of such a magnitude that it is likely to have already affected the long-run relative steady states at the regional level. Consequently, from a prospective analysis, we could observe a significant change in the relative evolution of some key economic indicators at the provincial level in Canada in the medium run. The exact effect of the trade shocks on the evolution of a dispersion index of GDP per capita at the provincial level is hard to predict right now since the relative international trade shares are still changing across the Canadian provinces. From their evolution since 1991, one could argue that the three relative “losers” of the trade shocks are

respectively New Brunswick, Nova Scotia, and British Columbia and that the two relative “winners” are clearly Ontario, followed by Quebec. It is important to note that the “winner and loser” terminology here is relative since the estimated effect of the trade shock on the fortunes of provincial economies is positive. But some provinces benefit more than others. The effect on the degree of regional disparity is thus hard to predict since both rich provinces (Ontario and British Columbia) and poor provinces, i.e., those receiving equalization payments (New Brunswick, Nova Scotia, and Quebec), appear in both the winner and loser circles.

British Columbia is just starting to qualify for receiving equalization payments but it is still the third richest Canadian province. The analysis presented in this paper suggests an interpretation for the relative decline of British Columbia observed in recent years. The Pacific province has not benefited as for the others of the fast expansion of international trade since 1991. Geography might have played an important role here since British Columbia trade links were relatively tied to Asia and the trade channels were disrupted by the Asian crisis and the poor performance of the Japanese economy.

Second, there is the question why the interprovincial trade share shows a decreasing trend in the 1981–1991 period. This is certainly a promising subject for future research. Even though the decrease in the interprovincial trade share came to a sudden halt in 1991 with the expansion of international trade, it certainly raises the question of the future of interprovincial trade. If the international trade shares reach their steady-state levels in the future, will interprovincial trade shares again start their decline? The analysis presented in this paper indicates that it might well be the case for Ontario, Quebec, and Newfoundland. This point raises a key policy issue regarding the future of some important institutional arrangements in the country, such as the political willingness to continue contributing to equalization payments and keeping the actual monetary arrangements at the regional level in Canada.

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Figure 1. Trend in trade of goods and services -- Canada

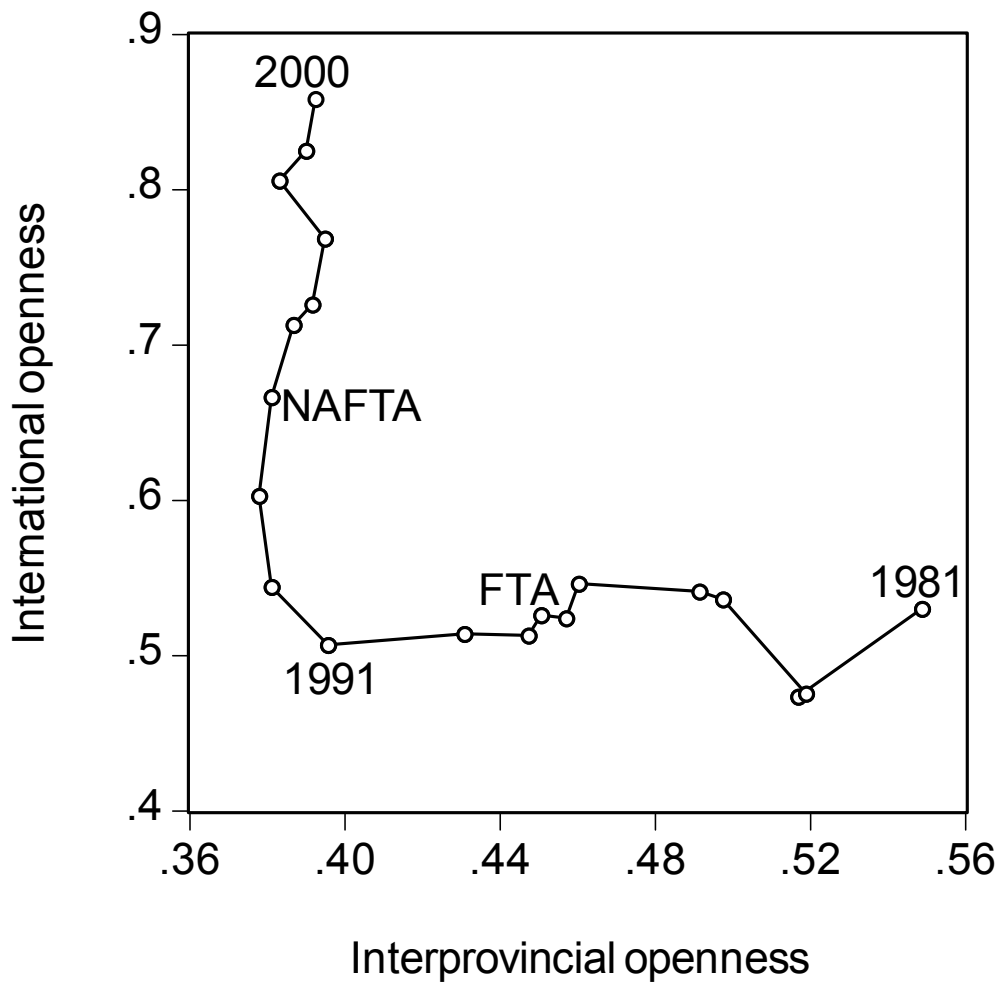


Figure 2. Trade of goods and services -- Atlantic

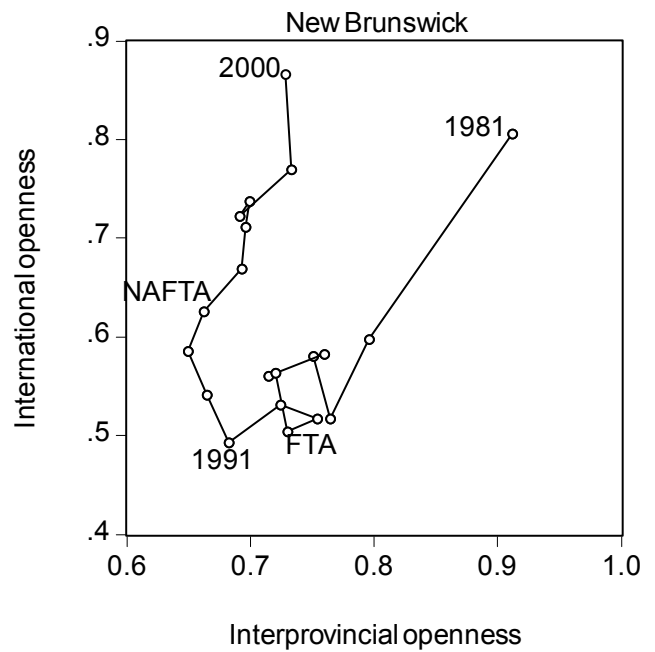
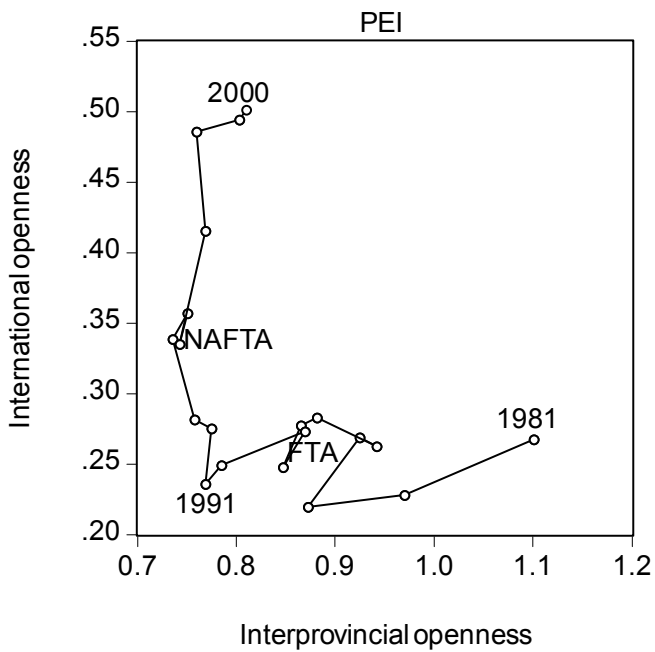
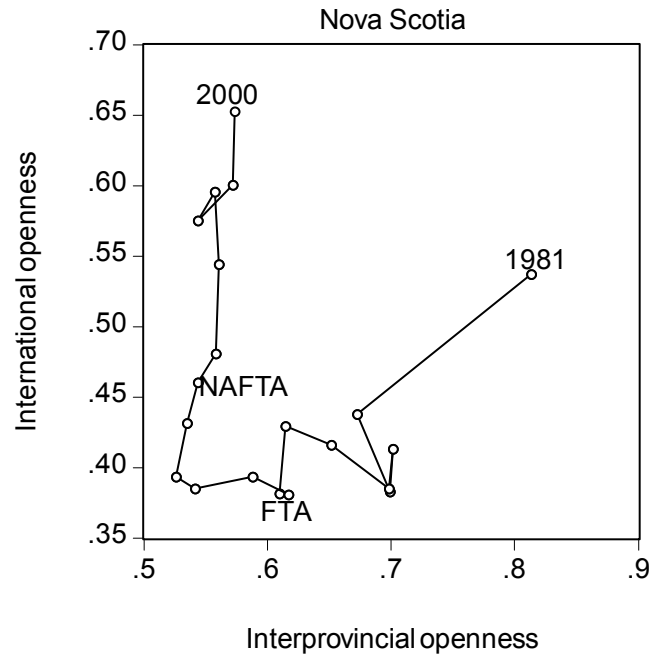
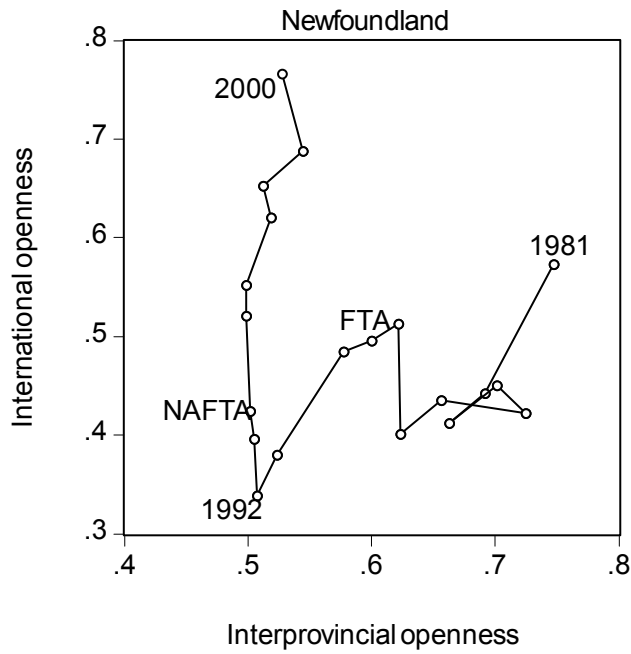


Figure 3. Trade of goods and services -- Central Canada

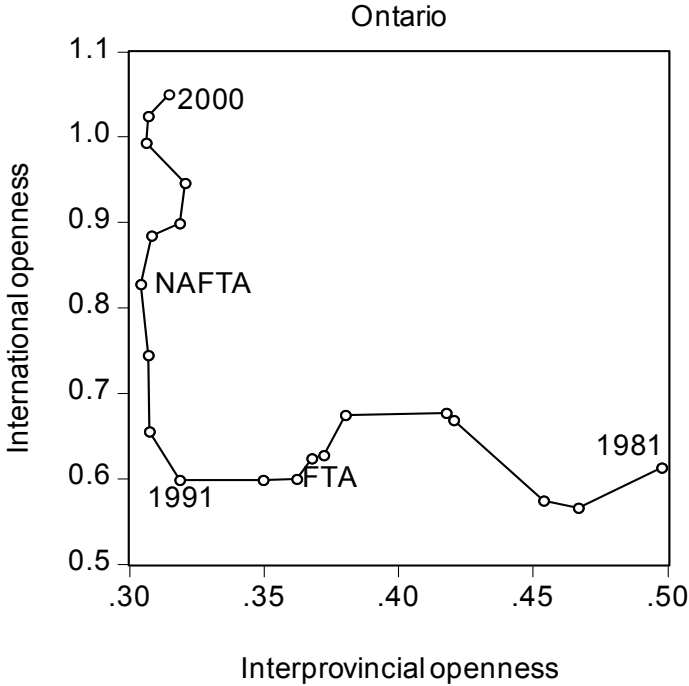
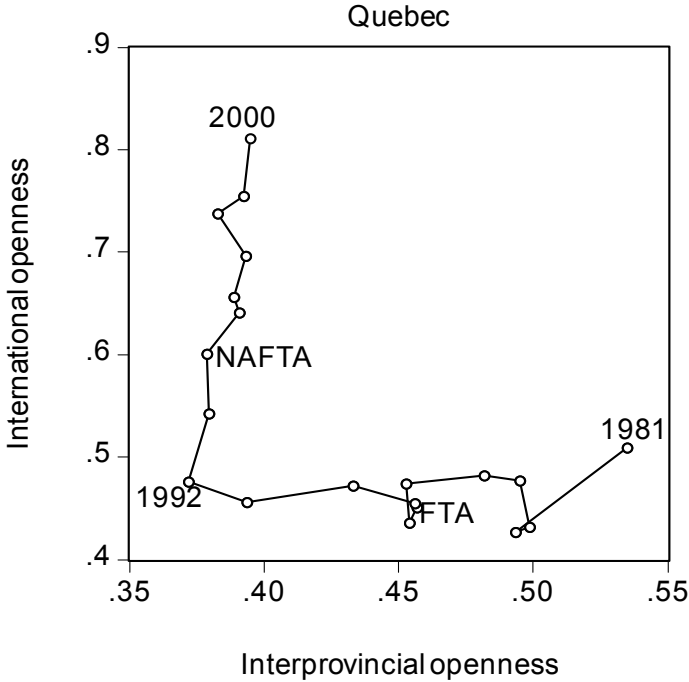


Figure 4. Trade of goods and services -- Western Canada

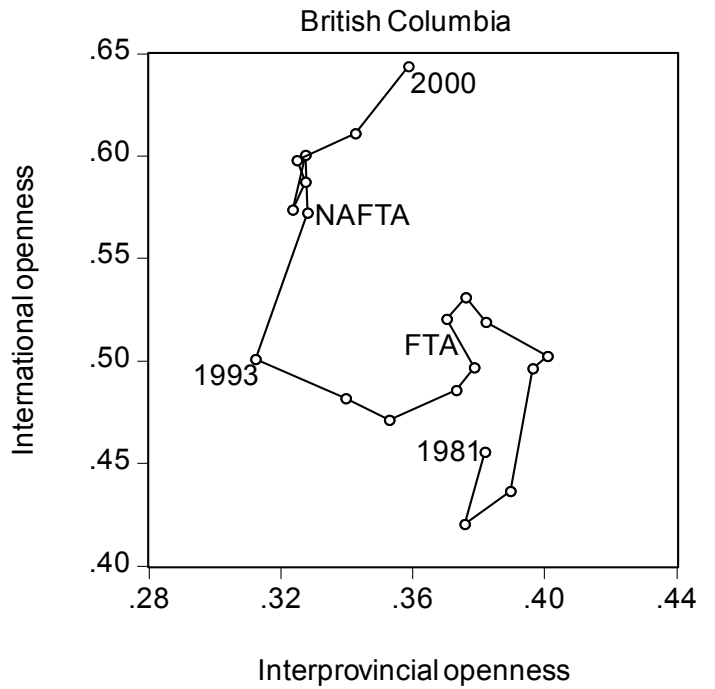
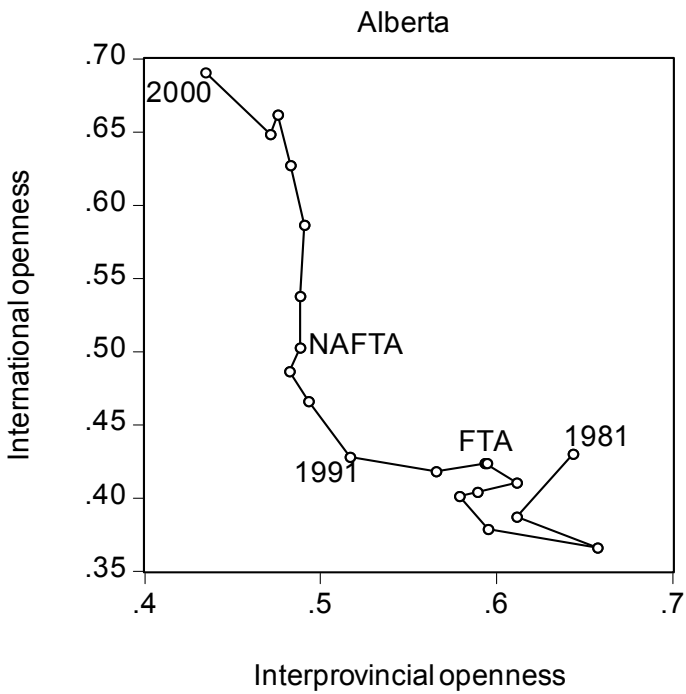
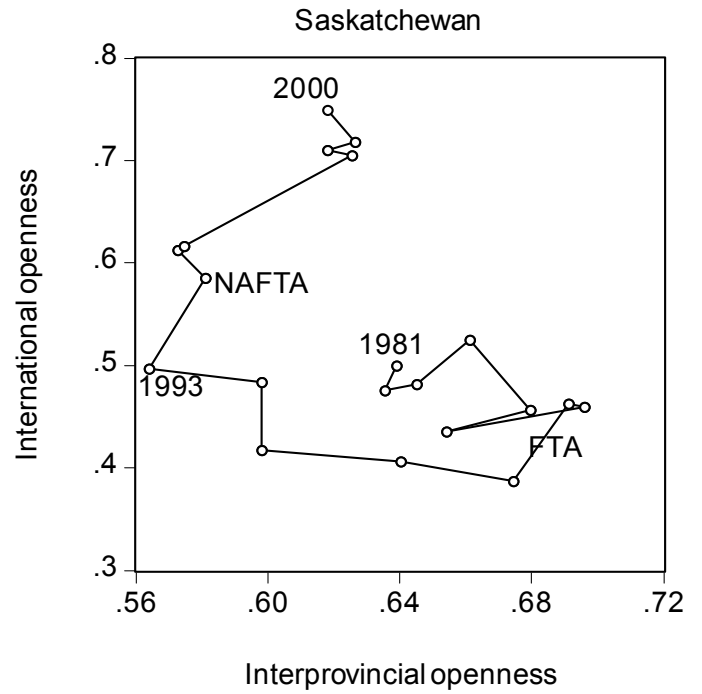
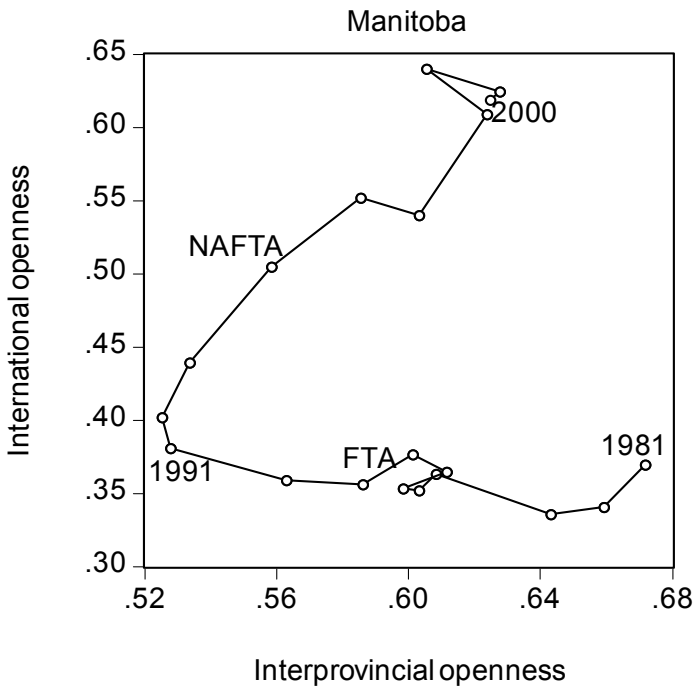


Figure 5. Goods vs services -- Canada

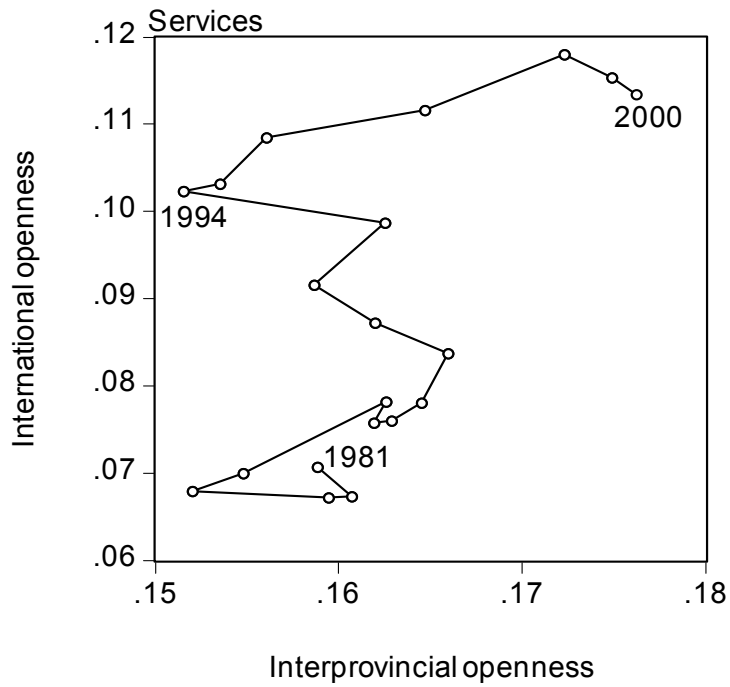
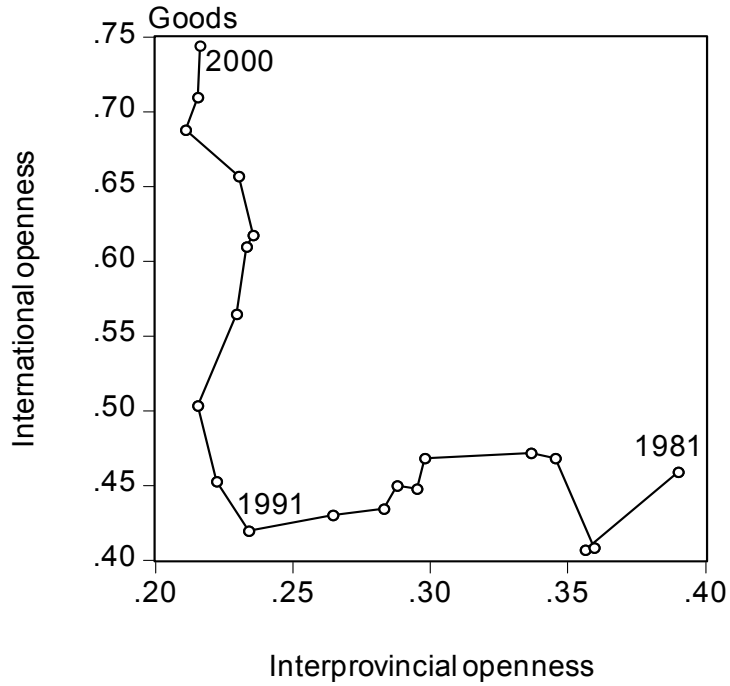


Figure 6. Ratio of trade in services over trade in goods -- Canada



Figure 7. The negative correlation between interprovincial and international trade -- Canada

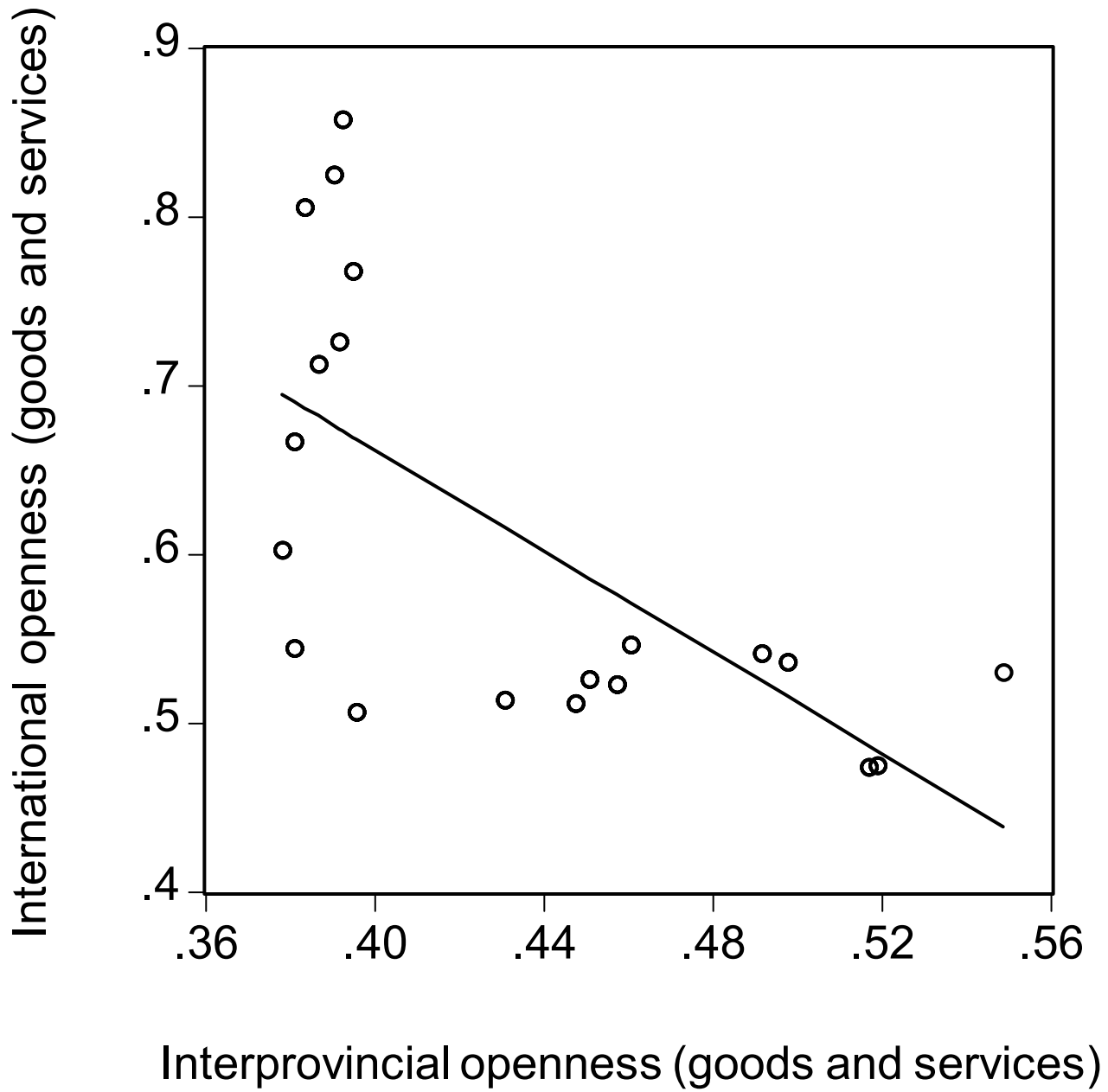


Table 1. Estimation results for the diversion hypothesis					
Dependent variable	(1)	(2)	(3)	(4)	(5)
SAMPLE \square	<i>IPOP</i> 1981–2000	<i>IPOP</i> 1981–2000	<i>d(IPOP)</i> 1981–2000	<i>d(IPOP)</i> 1981–1991	<i>d(IPOP)</i> 1991–2000
Estimation	SUR	SUR	SUR	IFGLS	IFGLS
<i>INOP</i>	-0.187*** (0.011)	0.052** (0.024)			
<i>d(INOP)</i>			0.223*** (0.027)	0.175*** (0.060)	0.264*** (0.050)
<i>BR91</i>		-0.036*** (0.008)			
<i>AL-FE</i>	0.63***	0.51***	-0.015**	-0.012	-0.020***
<i>BC-FE</i>	0.46***	0.35***	-0.003	-0.003**	-0.005*
<i>MA-FE</i>	0.68***	0.59***	-0.005	-0.015***	-0.001
<i>NB-FE</i>	0.84***	0.69***	-0.010*	-0.017*	-0.008
<i>NF-FE</i>	0.68***	0.55***	-0.014**	-0.019**	-0.012**
<i>NS-FE</i>	0.70***	0.57***	-0.014*	-0.024	-0.008
<i>ON-FE</i>	0.50***	0.31***	-0.015***	-0.018***	-0.016***
<i>PE-FE</i>	0.90***	0.80***	-0.018*	-0.033	-0.004
<i>QU-FE</i>	0.53***	0.40***	-0.011***	-0.013***	-0.013***
<i>SA-FE</i>	0.72***	0.62***	-0.004	-0.002	-0.011
AR-correction	NO	YES	NO	NO	NO
S.E. of regression	0.059	0.022	0.026	0.031	0.018
R-squared	0.87	0.98	0.21	0.16	0.26
Durbin-Watson	0.32	1.75	1.84	1.97	1.77
Panel observations	200	190	190	100	100

Notes: See notes at end of Table 3 for details on estimation techniques.

Table 2. Pairwise Granger causality tests: interprovincial and international openness		
Null hypothesis	F-Statistic	P-Value
INOP (Canada) does not Granger Cause IPOP (Canada)	6.8	0.035
IPOP (Canada) does not Granger Cause INOP (Canada)	14.02	0.007
INOP (Quebec) does not Granger Cause IPOP (Quebec)	7.08	0.032
IPOP (Quebec) does not Granger Cause INOP (Quebec)	11.57	0.011
INOP (Ontario) does not Granger Cause IPOP (Ontario)	1.3	0.292
IPOP (Ontario) does not Granger Cause INOP (Ontario)	8.82	0.021

Notes: Sample 1991–2000; 10 time-series observations, one lag; estimations are done using EViews 4.0.

Table 3. Estimation results for per capita GDP and labour productivity convergence regression (equation 2 with IFGLS)				
Dependent variable y ▢	GDP per capita (1)	GDP per capita (2)	Labour productivity (3)	Labour productivity (4)
$y(-1)$	0.941*** (0.016)	0.951*** (0.017)	0.942*** (0.027)	0.948*** (0.026)
Convergence speed (p value)	0.059 (0.0003)	0.049 (0.004)	0.058 (0.032)	0.052 (0.0500)
RU	0.036** (0.020)	0.023 (0.020)	0.000 (0.007)	-0.001 (0.008)
$INOP$ (-1) (nom)	0.037*** (0.001)		0.023*** (0.008)	
$IPOP$ (-1) (nom)	0.032*** (0.011)		(0.001) (0.007)	
$INOP$ (-1) (real)		0.025** (0.001)		0.020** (0.008)
$IPOP$ (-1) (real)		0.017* (0.001)		0.001 (0.006)
S.E. of regression	0.024	0.024	0.021	0.021
R-squared	0.987	0.984	0.959	0.959

Notes (Tables 1 and 3): IFGLS are iterated feasible generalized (linear) least-squares estimations using cross-section weighted regressions to account for cross-sectional heteroscedasticity.

- The ***, **, and * indicate that the null hypothesis could be rejected at 1 per cent, 5 per cent, and 10 per cent critical levels, respectively.

- White heteroscedasticity-consistent standard error (between brackets) (HCCME) allows for asymptotically valid inferences in the presence of heteroscedasticity.

- SUR is seemingly unrelated regression; standard error (between brackets) are not HCCME with SUR.

- Adjusted sample 1982–1999; 180 panel observations for Table 3.

- AR-correction is correction for autocorrelation. With the exception of the first regression in Table 1, AR-correction was systematically performed and the AR coefficients were dropped when not significant. No significant autocorrelation in Table 3.

- Estimations are done using EViews 4.0.

Table 4. Long-run elasticity of environmental variables		
Dependent variable y ▣	GDP per capita	Labour productivity
<i>RU</i>	0.61	–
<i>INOP</i> (nominal)	0.63	0.4
<i>IPOP</i> (nominal)	0.54	–
<i>INOP</i> (real)	0.51	0.38
<i>IPOP</i> (real)	0.35	–

Note: Computed from Table 3, using long-run solution of equation (2).

Table A1. Estimation results for per capita real GDP and real labour productivity convergence regression with SUR (equation 2)

Dependent variable y Y	Real GDP per capita (1)	Real GDP per capita (2)	Real labour productivity (3)	Real labour productivity (4)
y (-1)	0.973*** (0.014)	0.984*** (0.015)	0.953*** (0.024)	0.959*** (0.024)
RU	0.007 (0.012)	-0.005 (0.012)	-6.39E-05 (0.006)	-0.001 (0.006)
$INOP$ (-1) (nominal)	0.019*** (0.006)		0.014*** (0.005)	
$IPOP$ (-1) (nominal)	0.013** (0.005)		0.001 (0.003)	
$INOP$ (-1) (real)		0.010** (0.006)		0.012** (0.005)
$IPOP$ (-1) (real)		0.005 (0.004)		0.001 (0.003)
S.E. of regression	0.023	0.024	0.021	0.021
R-squared	0.984	0.984	0.959	0.959

Notes: SUR is seemingly unrelated regression.

- The ***, **, and * indicate that the null hypothesis could be rejected at 1 per cent, 5 per cent, and 10 per cent critical levels, respectively.

- Estimations are done using Eviews 4.0.

- Adjusted sample 1982–1999; 180 panel observations.

Table A2. Long-run elasticity of environmental variables

Dependent variable y Y	Real GDP per capita	Real labour productivity
$INOP$ (nominal)	0.47	0.31
$IPOP$ (nominal)	0.69	-
$INOP$ (real)	0.65	0.29

Note: Computed from Table A1, using long-run solution of equation (2). No significant effect for $IPOP$ nominal.