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A Provincial View of Economic Integration

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Abstract

This paper develops a method of testing levels of economic integration based upon consumption smoothing, and tests it using data on trade balances across Canadian provinces. The results indicate the provinces are highly integrated within Canada, but integration between Canada and the rest of the world is partial. Provincial trade balances respond only about half as much to events in the rest of the world as they do to events within Canada. In short, national borders appear to matter for intertemporal trade.

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SUMMARY

How integrated are national economies? In a world abuzz with the word globalization many might think that the answer to this question is very integrated. However, recent evidence from a number of different sources indicates that national borders are still a significant impediment to economic integration. This paper uses trade data to compare integration within and between countries, using the intertemporal approach to the balance of payments as our guide. After deriving a simple and easily implementable specification for the intertemporal trade balance, we adapt the model to allow for different levels of economic integration across groups of countries or regions.

The model is applied to data on trade balances for individual Canadian provinces, differentiating integration within Canada from that between Canada and the rest of the world. Canada has relatively open internal borders and a common currency, factors which are likely to produce close integration of markets. At the same time, the markedly different economic structures and disturbances across different provinces provide significant potential for intertemporal trade. Our results indicate that economic integration is indeed high within Canada. Integration with the rest of the world, however, is considerably lower, with trade balances responding only about half as much to events in the rest of the world as they do to events within Canada.

These results are interesting on both a methodological and empirical level. Methodologically, we are unaware of any other work with intertemporal models that enables one to identify zones of economic integration. Our empirical results indicate that a relatively simply intertemporal model can explain the behavior of trade balances between Canadian provinces quite well, as well as showing that national borders matter for intertemporal behavior.

I. INTRODUCTION

Many might think, in a world abuzz with the word "globalization," that national economies are highly integrated. For example, it is reasonable to suspect that the economy of Canada is highly integrated with the economy of the United States for reasons of geography, culture and language. Recent evidence suggests, however, that the United States-Canadian border remains a significant economic barrier. Engle and Rogers (1994) test the law of one price using data from cities in Canada and the United States. They find that the border adds between 2,500 and 25,000 miles to the "economic distance" between cities. McCallum (1995), using a gravity model of trade, finds that the level of intra-Canadian trade to be over 20 times what would be expected based on trade between Canada and the United States.[2] Helliwell (1996) shows that Quebec trades twenty time more with other provinces than with states in the United States of similar size and distance.

This paper provides a different test of economic integration between countries using a model of the trade balance based upon the framework of the intertemporal approach to the balance of payments. We use this model to consider the extent of financial integration between Canada and the rest of the world. Intertemporal models generally assume complete integration across countries. We adapt this framework to allow for different levels of economic integration. Our model suggests a method for testing whether the level of economic integration among the Canadian provinces differs from the level of integration between each province and the rest of the world.

There are many reasons to expect extensive economic integration among the provinces of Canada. Canada has a single currency, a national banking system and relatively open internal borders. There is substantial potential for gain from intertemporal trade within Canada since the provinces differ markedly in their respective economic profiles. Our empirical results indicate that economic integration is indeed high within Canada in the sense that provincial trade balances adjust in a way that smooths consumption. Economic integration between Canadian provinces and the rest of the world, however, is estimated to be considerably lower. Provincial trade balances respond only about half as much to events in the rest of the world as one would expect if financial integration were complete. In Canada, then, the national border serves as a significant boundary for intertemporal trade.

The rest of this paper is structured as follows. Section 2 develops the theoretical framework for our study. Section 2.1 presents a representative agent model and Section 2.2 presents a model in which there is heterogeneous access to capital markets among individuals in a province. In Section 2.3 we offer an empirical specification based upon the theoretical model. Section 3 opens with a discussion of the data used in this study and includes some

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[2]See also Wei (1996), who estimates trade within countries to be 3–4 times higher than would be expected from trade between countries.

simple statistics. Regression results are presented in Section 3.2. Section 4 offers some concluding remarks.

II. Trade Balances and Economic Integration

The theory of intertemporal trade is based upon the behavior of forward-looking individuals whose decisions reflect optimal responses to economic conditions.[3] In this section we develop a model of the trade balance with a focus on optimal intertemporal consumption behavior. We start with a world with fully integrated goods and asset markets. While retaining most of the features of a standard exercise of this type, our approach is relatively general, allowing for variable real interest rates and trade in equity as well as bonds. We then allow for differing zones of economic integration, with consumption smoothing occurring more easily within these zones than between one zone and another. A natural candidate for a zone of high economic integration is a single country. In recognition of this, and in anticipation of the empirical results that follow, we model the consumption decisions of representative individuals in the k provinces of a country. We begin in section 2.1 by assuming that these individuals are able to trade goods and assets costlessly with the entire world. Section 2.2 then allows for differences in access to domestic and foreign asset markets.

1. Trade Balances in an Integrated World

The representative consumer in each province maximizes the expected value of an identical time-separable utility function with a constant subjective rate of discount equal to ρ[4]

[1]

$$E_t \left(\sum_{j=0}^{\infty} \frac{U(C^i_{t+j})}{(1+\rho)^j}\right)$$

where E_t is the expectations operator, C is consumption, subscripts refer to time periods and the superscript i refers to the province. The consumption decision is subject to the budget

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[3]Overviews of the intertemporal approach include Frenkel and Razin (1987) and Obstfeld and Rogoff (1995).

[4]There is a growing literature extending this type of consumption analysis to take account of factors such as non-separabilities in the utility function. See, for example, Obstfeld and Rogoff (1995) and Lewis (1996). We use this relatively simple model as the empirical results indicate that it fits the intra-Canadian data well.

constraint that the discounted value of consumption equals wealth, defined as the discounted value of future net income available for consumption plus the value of initial assets.[5]

[2]

$$\sum_{j=0}^{\infty} \frac{C^{i}_{t+j}}{\prod_{k=0}^{j}(1+r_{t+k})} = \sum_{j=0}^{\infty} \frac{(Y-I-G)^{i}_{t+j}}{\prod_{k=0}^{j}(1+r_{t+k})} + A_t^{\,i} \equiv Q_t^{\,i}$$

where Y-I-G represents provincially-produced income available for consumption, r is the real interest rate, A^i_t is net asset holdings for the province and Q^i_t is the net present value of future consumption or, equivalently, the wealth of the province. Net assets can be of any type (conventional debt, equity) so long as certainty equivalence holds, i.e. the value of the asset is equal to the discounted value of expected future net income. The lack of a provincial superscript on the interest rate reflects the assumption that the national asset market are integrated and hence provinces face a common (and possibly time-varying) real interest rate.

Provincially-produced net income available for consumption (hereafter simply net income) is equal to gross provincial product (the provincial analogue to GDP) less investment less provincial government consumption.[6] It refers to the level of consumption that could be achieved in autarky. Asset markets allow individuals to increase their welfare by reallocating this net income over time. We do not model the behavior of investment or government consumption explicitly since results from this analysis follow regardless of the behavior of investment and government consumption as long as all sectors in the economy face the same real interest rate.[7] The function derived here is thus relatively general.

The first-order condition for this problem is the familiar

[3]

$$\frac{E_t U'(C^{i}_{t+1})}{U'(C^{i}_{t})} = \frac{1+\rho}{1+r_t} \; .$$

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[5]We impose here the transversality condition that rules out the possibility of Ponzi game-type behavior.

[6]In our empirical tests we use both net income as well as a disaggregated measure in which income, investment and government spending enter separately. The role of net federal transfers is discussed in the Section 3.

[7]Glick and Rogoff (1993) provide a model of the current account with production and investment modeled explicitly.

In the commonly-studied case where there is a constant coefficient of relative risk aversion equal to θ, the utility function takes the form $U(c^i_t) = (c^i_t)^{1-\theta}/(1-\theta)$ and [3] takes the form

[4]
$$\frac{E_t(C^i_{t+1})^\theta}{(C^i_t)^\theta} = \frac{1+r_t}{1+\rho}.$$

The first-order condition [4] and the budget constraint [2] imply that consumption in any period t is a fraction of total wealth

[5]
$$C^i_t = \frac{Q^i_t}{E_t \sum_{j=0}^{\infty} \frac{\prod_{k=0}^{j} (1+r_{t+k})^{\frac{(1-\theta)}{\theta}}}{(1+\rho)^{j/\theta}}}.$$

For any two provinces i and j with a common discount factor and facing the same expected path of interest rates due to integrated capital markets we have

[6]
$$\frac{C^i_t}{Q^i_t} = \frac{C^j_t}{Q^j_t}.$$

Extending equation [6] across all provinces implies that the ratio of world consumption to world wealth equals the ratio of consumption to wealth in any province. As world consumption equals world income available for consumption this implies

[7]
$$\frac{C^i_t}{Q^i_t} = \frac{C^W_t}{Q^W_t} = \frac{(Y-I-G)^W_t}{Q^W_t}$$

where the superscript W refers to the world.

An equation for the trade balance of province i, TB^i_t, can be derived by noting that the trade balance equals the difference between provincial net income and provincial consumption

[8]

$$TB_t^i = (Y-I-G)_t^i - \frac{Q_t^i}{Q_t^W}(Y-I-G)_t^W .$$

Equation [8] demonstrates the scope to which the trade balance can be used to smooth provincial consumption over time. Differences between provincial net income and world net income will be manifested in the trade balance but aggregate changes in net income will be met by concomitant movements in provincial consumption.

We derive from [8] an estimating equation in first differences which includes expectational error terms. As shown in the appendix, the change in the trade balance equals

[9]

$$\Delta TB_t^i = \Delta(Y-I-G)_t^i - \Delta(Y-I-G)_t^W \frac{C_t^i}{C_t^W} + \epsilon_t$$

where the error, ϵ_t, is a linear combination of the 'news' obtained between times *t-1* and *t* about
current wealth of the province at time *t*, ϵ^i_t and the current wealth of the world at time *t*, ϵ^W_t, [8]

Equation [9] is the basic building block of our study. It states that, in a fully integrated world, the per capita trade balance for any province *i* should vary with expected changes in per capita net provincial income relative to that of the rest of the world. A striking feature of equation [9] is its simplicity and ease of estimation.[9]

2. Heterogeneous Levels of Economic Integration

Equation [9] holds across any area with fully integrated goods and asset markets. We now extend the analysis to consider situations in which access to such markets is more limited. Ideally, one would develop a fully optimizing model involving fundamentals such as costs of transactions to look at this question. We adopt a somewhat simpler approach based on the

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[8]See Deaton (1992) (chapter 3) for a similar derivation in the context of the permanent income hypothesis.

[9]Deriving an equation for the trade balance has several advantages over the more usual approach which focuses on the current account. As the current account depends upon income from capital, equations for the current account require explicit consideration about the path for the real interest rate in the estimating equation. We can also be very general about the type of assets that consumers can own (assuming that certainty equivalence holds). Despite this greater level of generality, we obtain an exact equation involving no approximations.

type of model developed by Campbell and Mankiw (among others) to look at the dependence of consumption upon income.[10]

Assume that there are two types of consumers, those who are fully integrated with world markets and those who are limited to markets within the country. If consumers with access to foreign resources represent a constant share λ of consumption while the consumers with restricted options represent the remaining $(1-\lambda)$ share of consumption, the expected change in the overall trade balance for province *i* is a weighted average of the behavior when international access is perfect (equation [9]) and the behavior of consumers with access only to Canadian markets (which is described by a version of equation [9] in which national variables replace world ones). This implies

[10]

$$\Delta TB_t^i = \Delta(Y-I-G)_t^i - \lambda \frac{C_t^i}{C_t^W}\Delta(Y-I-G)_t^W - (1-\lambda)\frac{C_t^i}{C_t^N}\Delta(Y-I-G)_t^N + \epsilon_t.$$

The term representing the change in world net income reflects the impact of the aggregate world resource constraint on behavior even in a fully integrated world. The term representing national net income captures the effect of limited international integration on the consumption of a proportion of consumers.

3. Empirical Specification

Equation [10] suggests specifications for estimating the determinants of the provincial trade balance. In the case of full financial integration of the province with the rest of the world, that is when $\lambda=1$, the trade balance equation can be estimated by

[11]

$$\Delta TB_t^i = \alpha^i + \beta^i \cdot \Delta(y-i-g)_t^{i,OECD} + \epsilon_t^i$$

where

$$\Delta(y-i-g)_t^{i,OECD} \equiv \Delta(Y-I-G)_t^i - \frac{C_t^i}{C_t^{OECD}}\Delta(Y-I-G)_t^{OECD}$$

and where α^i and β^i are estimated coefficients and ϵ_t^i is an error which is uncorrelated with information known at *t-1*. The β^i coefficients indicate the proportion of consumption which is integrated with the behavior in the rest of the OECD (which proxies for the "world" in our empirical analysis) and is not directly linked to current income.

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[10]Campbell and Mankiw (1989, 1991).

This empirical specification assumes that consumers who have access to borrowing do not have differential access to national as compared to international financial markets. An alternative specification, which nests equation [11], is

[12]

$$\Delta TB_t^i = \alpha^i + \beta^i \cdot \Delta(y-i-g)_t^{i,OECD} - \lambda^i \cdot \Delta(y-i-g)_t^{CAN,OECD} + \epsilon_t^i$$

where

$$\Delta(y-i-g)_t^{CAN,OECD} \equiv \frac{C_t^i}{C_t^{CAN}} \Delta(Y-I-G)_t^{CAN} - \frac{C_t^i}{C_t^{OECD}} \Delta(Y-I-G)_t^{OECD}.$$

The coefficient β^i represents the estimate of the proportion of consumption in province *i* that is not directly linked to current income. We call this the proportion of "smoothed consumption." Thus the specification [12] allows for the possibility that some consumers lack access even to national Canadian markets. These consumers would behave in a completely autarkic manner. For example, if $\beta^i = 0.8$ then 20 percent of consumption in province *i* is estimated to be linked to current income and not smoothed with respect to national or world income. The coefficient on the second variable in [12], λ^i, represents the proportion of total consumption which is smoothed only through access to the national capital markets. The difference between the first and second coefficients, β^i-λ^i, indicates the proportion of smoothed consumption which is smoothed through access to the national capital market but not the world capital market. For example, if $\beta^i = 0.8$ and $\lambda^i = 0.32$ then the estimate is that 80 percent of consumption is smoothed but of this value only 60 percent uses access to the world capital market. The other 40 percent is smoothed only within Canada.

These trade balance equations are run for each province as well as for Canada as a whole. The implied equation for the Canadian trade balance from equation [12] is

[12']

$$\Delta TB_t^{CAN} = \alpha^{CAN} + \beta^{CAN} \Delta(y-i-g)_t^{CAN,OECD} + \epsilon_t^{CAN}.$$

If coefficients are equal across provinces, this implies a coefficient restriction. This cross equation restriction between the regressions for each province and that for Canada as a whole can be used as a further test of the validity of the model.

Lagged instrumental variables are used in the estimation because the error term includes revisions in expectations between time *t-1* and time *t*. We use past changes in income and the trade balance as our instruments. Past changes in income should be useful in helping to predict current changes in income. Since consumption is smoothed over time, it follows that the past changes in the trade balance will also include information about changes in income. Accordingly, in addition to constant terms, the first and second lags of the change in

provincial income relative to the rest of the OECD, the change in provincial income relative to the Canada, and the provincial and national trade balances were used as instruments.

III. Empirical Analysis

In this section we first discuss the sources and characteristics of the data used to test our model. We then present our results of the empirical tests specified above

1. Data Sources and Statistics

The source of provincial Canadian data is the annual *Provincial National Accounts* published by Statistics Canada. This publication provides real and nominal expenditures and nominal income (as well as population) for the ten provinces and two territories of Canada.[11] Provincial expenditures are subdivided into domestic categories such as public and private consumption and investment but do not include spending on exports and imports.[12] The income accounts divide nominal gross provincial product (the provincial equivalent of gross national product) into categories such as wages and profits as well as nominal net exports of goods and services. Net exports are calculated indirectly as the difference between total provincial expenditures (calculated from the expenditure data) and gross provincial product (calculated from the income data). Hence any statistical discrepancies are included in net exports. The nominal data start in 1961, while the real data start in 1971. Both end in 1992.

These accounts provide all the data needed to estimate the model. Per capita real domestic net income available for consumption was calculated as nominal gross provincial product minus government consumption and total investment, deflated by population and the implicit consumption deflator. Per capita real trade balances were calculated as nominal net exports, again deflated by population and the consumption deflator.[13]

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[11]These are, in descending order of size (based on 1992 income), Ontario, Quebec, British Columbia, Alberta, Manitoba, Saskatchewan, Nova Scotia, New Brunswick, Newfoundland, the combined Yukon and Northwest territories and Prince Edward Islands. Data are available for the aggregate of the Yukon and the Northwest territories only over the full sample period so the two are treated as an eleventh province in the estimation.

[12]Estimates of exports and imports do exist for certain years, see Messinger (1993) and McCallum (1995).

[13]The consumption deflator was used on both series since the model is concerned with the use of the trade balance to smooth consumption over time, hence all nominal values should be converted into their equivalent level of consumption. From 1971 onwards, individual provincial consumption deflators were used; prior to 1971 these deflators do not exist, so the national consumption deflator was spliced onto the series.

There are two issues associated with the data which deserve further discussion. One is the inclusion of a statistical discrepancy in the data for net exports. According to the national accounts identity, net exports should equal the difference between total expenditure and income. However, in most national accounts net exports are derived from direct estimates of exports and imports. The difference between the direct estimate and that implied by the national accounts identity is then labeled a statistical discrepancy. The provincial accounts do not contain a direct measure of net exports, however, and by assuming that the national accounts identity holds net exports are derived as a residual. Potentially this could affect our regression results since there would be a correlation between changes in net income and the trade balance due to the measurement of provincial expenditures and product with error. As mentioned above, we estimate equations using instrumental variables and therefore the error present in the measurement of provincial expenditures and product only affect estimates of net exports to the extent that it is predictable. We consider it unlikely that the predictable errors in provincial estimates of product and expenditure are large enough to bias the coefficient estimates significantly.

Another issue concerns the Canadian federal government. While the federal government has a budget constraint with respect to the whole of Canada, it does not have one with respect to individual provinces. Different provinces may either receive or contribute net resources to the federal government. Both net income and the trade balance should be adjusted for these flows since they are, in effect, unrequited transfers and hence income for the province. Fortunately, the data provide data on federal deficits by province. We measured these resource transfers by the deviation between per capita net lending by the federal government to a specific province, which does not have to satisfy a budget constraint, and per capita net lending by the federal government at the national level, which does.[14] This difference was added to the provincial series on per capita net income available for consumption and the per capita trade balance.[15]

Some time-series plots and summary statistics provide a first look at our data set. Chart 1 shows the evolution of the first difference of per capita values of real income available for consumption, the trade balance, and real gross provincial product for Canada as a whole and for each province separately, while Chart 2 illustrates levels of the same series.[16] The

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[14]There is one further issue, which is that in the regional accounts a significant part of federal net lending is assigned to Canadian citizens overseas (the so-called snowbirds). So as to make the transfers within Canada sum to zero, this part of net lending was eliminated from the per capital data on aggregate Canadian federal net lending in this calculation.

[15]Estimation using data without this adjustment produced very similar results.

[16]All three series were adjusted for the federal transfers discussed above. The results without this adjustment (not reported) were similar. For consistency real gross provincial product was

(continued...)

striking feature of the charts is the close relationship between provincial net income and the provincial trade balance.[17] This relationship holds more closely for the smaller provinces, such as Yukon and Northwest territories and Price Edward Island, and less closely for the larger provinces, such as Ontario, and for Canada as a whole.

These visual impressions can be supplemented by some simple statistics. Tables 1 and 2 show correlations and standard deviations of the change in real provincial product, net income, and the trade balance for each province and for Canada as a whole. In addition, to give a sense of relative size of the provinces, Table 1 also reports GDP in 1992 for each province. The correlation between net income and the trade balance is generally higher for the smaller provinces than for the larger ones, while the lowest correlation of all is for the whole of Canada.[18] There is also a close connection between the variability of the trade balance and the variability of net income.

The finding that there is a closer connection between net income and the trade balance for small provinces than for large provinces or for Canada as a whole is consistent with the view that integration is higher within Canada than between Canada and the rest of the world. Small provinces, whose economic relations are largely within Canada, are able to use Canadian markets to smooth consumption. For Canada as a whole, however, it is integration with the rest of the world that matters, so any lack of integration will limit the ability of some of the larger provinces to use the capital markets to smooth consumption.[19] A formal test of this hypothesis is investigated in the next section.

2. Regression Results

Table 3 shows the results from estimating equation [11], which assumes that Canadian provinces are equally integrated with all parts of the world, using a panel which includes data on each province and aggregate data for Canada as a whole. The first column, which shows the estimated constant terms for each equation, indicates that all of the estimated constant terms are small and insignificantly different from zero. As shown in the lower part of the

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[16](...continued)
calculated using the consumption deflator, since the other series were also calculated using this deflator.

[17]By comparison, the relationship between real gross provincial product, a more traditional measure of activity, and the trade balance is much less close.

[18]By contrast, the correlation between real product and the trade balance, while positive, is relatively low.

[19]Obstfeld (1994a) and Bayoumi and MacDonald (1994) both conclude that Canada as a whole fails simple tests of consumption smoothing.

Tables, a Wald test of their joint significance also indicates that they are insignificantly different from zero, a result which holds for all other estimates in this paper.

By contrast, the estimated coefficients on net income per capita relative to the OECD are all highly significant, and many of these coefficients are close to the value of unity which would occur if all consumers had full access to world markets. Paradoxically, however, among the three provinces that fail this test are two of the largest and most important; Ontario, which makes up some 40 percent of the Canadian economy and British Columbia, the largest west coast province in economic terms. The aggregate Canadian equation also rejects the restriction that the coefficient is unity. Indeed, at 0.52, the estimated coefficient on the change in relative net income in the Canadian regression is lower than that estimated for any of the provinces individually.

A Wald test that all of the coefficients on relative income are jointly equal to unity, and hence that all consumers have full access to world markets, is rejected whether or not the aggregate Canadian data is included. The weaker restriction that coefficients are equal across provinces is also rejected by the data. The results appear to indicate that integration is lower in many of the larger (and relatively rich) provinces than in smaller ones. In addition, results from aggregate Canadian data show lower international integration than do the results from individual provinces.

The results from the extended model, which allows for differential access to national and international resources, are reported in Table 4.[20] As in Table 3, the coefficients on the change in provincial net income relative to the rest of the OECD (that is, the β^is) are large and generally significant. Unlike the simpler specification, however, the coefficients are jointly insignificantly different from unity, which implies that Canadian consumers have access to at least the national capital market.

The coefficients on the change in net income in Canada relative to the OECD generally have the expected negative sign. The joint hypothesis that all of the coefficients are zero, and hence that there is no difference in integration between national and international markets, is easily rejected. The subsidiary hypothesis that all of the coefficients are equal is accepted, as is the cross-equation restriction between the individual provincial regressions and the regression for Canada as a whole discussed earlier (not reported).[21] Hence, the results indicate high integration within Canada, but more limited integration between Canada and the rest of the OECD. The Durbin-Watson statistics in Table 4 indicate no problems with autocorrelation, while the level of fit is similar to that found in Table 3.

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[20]The constant terms, which are not reported, were uniformly small and insignificant.

[21]The Canadian results in Table 4 are identical with those in Table 3, reflecting the fact that since neither the specification nor the instrument set were changed.

The coefficient restrictions discussed above point to a highly simplified version of equations [12] and [12'] in which the constant terms are eliminated, the coefficients on the change in provincial net income relative to OECD (β_i) are constrained to be unity, the coefficients on changes in Canadian income relative to the OECD (λ_i) are constrained to be equal across provinces, and the implied cross-equation restriction is imposed on the regression for the aggregate Canadian data. The results from estimating the following system

[13]

$$\Delta TB_t^i = \Delta(y-i-g)_t^{i,OECD} - \lambda\Delta(y-i-g)_t^{CAN,OECD} + \epsilon_t^i$$
$$\Delta TB_t^{CAN} = (1-\lambda)\Delta(y-i-g)_t^{CAN,OECD} + \epsilon_t^{CAN}$$

are presented in Table 5. The estimates of λ is 0.45 and, with a standard errror of 0.07, it is highly significant. This estimate implies that 55 percent of the consumption smoothed through access to the Canadian but not the greater OECD markets.[22] Durbin-Watson and adjusted R squared statistics for each provincial equation are reported in Table 5. In spite of the simplicity of the specification—the behavior of the trade balances of the eleven provinces and Canada as a whole is explained using only one estimated coefficient, λ—the Durbin Watson statistics indicate that autocorrelation is not a problem in the equations. The adjusted R-squared statistics indicate no noticeable deterioration in the fit of the data compared to the earlier specifications. Indeed, in many cases the statistics rise, reflecting the greater parsimony of the specification.

We carried out a number of checks of the robustness of our results to alternative hypotheses. One of the assumptions in the theoretical model is that the path of the trade balance only depends upon the path of net income, defined as output less investment and government consumption. It is possible, however, that these three components have differing effects on the trade balance.[23] To investigate this, we re-estimated the constrained model presented in equation [13] allowing the coefficient that measures the level of integration between Canada and the rest of the world to vary between net income, investment and government consumption. Specifically, we estimated the regression

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[22]The high correlation between the growth of consumption and income across countries implied by this result has also been noted by Bachus, Kehoe, and Kydland (1992), Lewis (1996), Obstfeld (1995), and Tesar (1995). Obstfeld and Cole (1993) and Tesar (1995) both ascribe this lack of consumption smoothing across countries to the high costs of international transactions compared to the benefits from consumption smoothing.

[23]For example, markets for investment goods may be more integrated with the rest of the world than other markets.

[14]

$$\Delta TB_t^i = \beta \cdot \Delta(y-i-g)_t^{i,OECD} - \lambda \cdot \Delta(y-i-g)_t^{CAN,OECD} - \lambda_I \cdot \Delta i_t^{CAN,OECD} - \lambda_G \cdot \Delta g_t^{CAN,OECD} + \epsilon_t^i$$

where

$$\Delta i_t^{CAN,OECD} \equiv \frac{C_t^i}{C_t^{CAN}} \Delta I_t^{CAN} - \frac{C_t^{CAN}}{C_t^{OECD}} \Delta I_t^{OECD}$$

$$\Delta g_t^{CAN,OECD} \equiv \frac{C_t^i}{C_t^{CAN}} \Delta G_t^{CAN} - \frac{C_t^{CAN}}{C_t^{OECD}} \Delta G_t^{OECD} .$$

In this case the coefficient on net income for Canada as a whole, λ, provides a general estimate of the lack of integration between Canada and the rest of the OECD while the coefficients on Canadian investment and on Canadian government consumption measure the deviations from this underlying value for these components of spending.[24] The equation is parameterized so that a positive coefficient on investment or government consumption represent higher levels of integration. Hence, for example, the implicit coefficient on Canadian investment, which measures the lack of integration of investment between Canada and the rest of the OECD, is $\lambda+\lambda_I$.

The results from this specification are reported in Table 6. The coefficient on provincial net income is very close to unity, indicating that markets are fully integrated within Canada. The coefficient on Canadian net income is -0.45, very similar to that found in the earlier estimation, again implying that integration with the rest of the world, measured in terms of the response of the trade balance to disturbances in net income, is about half of that found within Canada. The coefficient on the change in Canadian investment, however, is significantly positive, indicating that investment spending is more integrated with the rest of the OECD than is the bulk of net income. Indeed, the implied coefficient on the change in Canadian investment is insignificantly different from zero, indicating that investment spending may be completely integrated with the rest of the OECD. The results for government consumption also show some offset, but it is not statistically significant, indicating that the trade balance may respond to this component in a similar manner to the rest of net income.

Another issue we investigated was whether the results were affected by replacing the OECD aggregate data by data for the United States. About three-quarters of Canada's visible

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[24]The model was also estimated with changes in provincial investment and government consumption (ΔI and ΔG) included in the specification. The coefficients on these two variables were not significant. As the coefficient of provincial net income β is insignificantly different from its optimal value of unity in the estimation, implying that all provinces have full access to local Canadian markets, we chose not to include terms in investment and government consumption which measure the level of integration with the rest of the OECD.

trade is with the United States. It is possible, then, that the United States is a better measure of the external environment than the entire OECD. Results using United States data were almost identical to those using the OECD aggregate.[25] These results confirm the lack of economic integration between the United States and Canada found in studies using levels of trade (McCallum 1995) and prices (Engle and Rogers 1994).

IV. Conclusions

This paper has developed a method of testing for zones of economic integration based upon consumption smoothing. We first derived a simple specification for the behavior of the trade balance over time. This specification was then adapted to take account of the impact of differential levels of economic integration. The model was tested using data on trade balances across Canadian provinces. The results indicate a high level of integration within Canada. Integration with the rest of the world, however, appears to be more limited. The trade balance response to foreign shocks is only midway between optimal behavior in the presence of full capital mobility and the behavior that would emerge under autarky.

These results are interesting on both a methodological and empirical level. Methodologically, we are unaware of any other work with intertemporal models which enables one to identify zones of economic integration. Our empirical results indicate that a relatively simple intertemporal model can explain the behavior of trade balances between Canadian provinces quite well. The results with respect to the rest of the world further indicate that national borders matter for intertemporal Canadian behavior which is consistent with other empirical work. This lack of international integration presumably reflects the uncertainties and costs generated by differing currencies and legal systems, including problems of enforcement of contracts across national boundaries. In short, national borders appear to matter for intertemporal trade just as they also appear to matter for levels of trade and for deviations from the law of one price.

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[25]These results are not reported for the sake of brevity but are available from the authors upon request.

Table 1. Provincial Income and Correlations Between Changes In Per Capita Income and Changes in the Trade Balance

	1992 GDP (billions of C$s)	Change in Real GDP	Change in Income Available for Consumption
Alberta	72.9	0.52	0.96
British Columbia	86.7	0.05	0.81
Manitoba	24.0	0.22	0.92
New Brunswick	13.9	0.48	0.97
Newfoundland	9.2	0.29	0.93
Nova Scotia	18.0	0.26	0.82
Ontario	277.5	0.19	0.75
Prince Edward Island	2.2	0.37	0.91
Quebec	157.1	0.10	0.73
Saskatchewan	20.2	0.10	0.98
Yukon & Northwest Territories	3.1	0.32	1.00
Canada	684.7	0.15	0.64

Notes: All series are measured in 1986 Canadian dollars and are adjusted for differences in federal net lending.

Table 2. Standard Deviation of Per Capita Variables

(Thousands of 1986 Canadian Dollars)

	Changes in Real GDP	Changes in Income Available for Consumption	Changes in Trade Balance
Alberta	1.12	0.91	0.90
British Columbia	0.65	0.43	0.40
Manitoba	0.55	0.46	0.46
New Brunswick	0.51	0.58	0.55
Newfoundland	0.36	0.48	0.43
Nova Scotia	0.41	0.34	0.33
Ontario	0.61	0.33	0.25
Prince Edward Island	0.60	0.48	0.49
Quebec	0.47	0.30	0.29
Saskatchewan	0.87	0.90	0.92
Yukon & Northern Territories	2.72	3.37	3.43
Canada	0.53	0.26	0.19

Notes: All series are adjusted for differences in federal net lending.

Table 3
The Basic Model

$$\Delta TB^i = \alpha^i + \beta^i \Delta(y\text{-}i\text{-}i)^{i,OECD}$$ 1/

	Constant (α^i)	Net Income Coeff. (β^i)	Durbin-Watson Statistic	R-squared
Alberta	.00 (.05)	1.05 (.08)**	1.37	0.97
British Columbia	-.01 (.04)	0.61 (.18)**	1.92	0.61
Manitoba	.03 (.03)	0.93 (.09)**	1.70	0.83
New Brunswick	-.03 (.03)	1.00 (.07)**	1.63	0.94
Newfoundland	-.02 (.02)	0.90 (.14)**	1.31	0.86
Nova Scotia	.00 (.03)	0.75 (.10)**	1.80	0.69
Ontario	.02 (.03)	0.59 (.17)**	1.98	0.56
Prince Edward Island	-.01 (.03)	0.88 (.09)**	1.55	0.87
Quebec	-.02 (.04)	0.79 (.18)**	1.35	0.61
Saskatchewan	.01 (.05)	1.12 (.07)**	1.64	0.92
Yukon & Northern Territories	.02 (.06)	0.99 (.06)**	1.87	0.99
Canada	.01 (.03)	0.52 (.18)**	2.07	0.46
Wald Tests (on provincial equations only):				
Constant Terms are equal to 0 $\chi^2(12)$	3.7			
Income Coefficients are equal to 1 $\chi^2(12)$		24.2**		
Income Coefficients are equal $\chi^2(11)$		21.7**		

Notes: All standard errors are adjusted for heteroscedascity. The instruments for the provincial regressions were to first and second lags of the change in provincial income relative to adjusted OECD income, the change in the provincial trade balance, the adjusted change in Canadian income relative to adjusted OECD income, and the Canadian trade balance. For the Canadian regression Canadian values were used in place of provincial ones, and OECD values in place of Canadian ones.

1/ $\Delta(y\text{-}i\text{-}g)^{i,OECD} = \Delta(Y\text{-}I\text{-}G)^i - (C^i/C^{OECD})\,\Delta(Y\text{-}I\text{-}G)^{OECD}$.

Table 4
The Extended Model

$$\Delta TB^i = \alpha^i + \beta^i \Delta(y\text{-}i\text{-}g)^{i,OECD} - \lambda^i \Delta(y\text{-}i\text{-}g)^{CA,OECD}$$ 1/

$$\Delta TB^{CA} = \beta^{CA} \Delta(y\text{-}i\text{-}g)^{CA,OECD}$$

	Coefficient on Provincial Income (β^i)	Coefficient on Canadian Income (λ^i)	Durbin Watson Statistic	R^2
Alberta	1.07 (.06)**	-0.57 (.35)	1.87	0.94
British Columbia	0.46 (.40)	0.36 (.58)	2.01	046
Manitoba	1.22 (.12)**	-1.24 (.40)**	2.32	0.88
New Brunswick	1.00 (.07)**	-0.04 (.18)	1.64	0.94
Newfoundland	0.90 (.11)**	-0.53 (.26)*	1.75	0.92
Nova Scotia	1.13 (.21)**	-0.92 (.49)	2.31	0.69
Ontario	0.95 (.29)**	-0.61 (.40)	2.42	0.53
Prince Edward Island	0.94 (.14)**	-0.30 (.55)	1.74	0.89
Quebec	1.08 (.24)**	-0.44 (.28)	1.74	0.72
Saskatchewan	1.16 (.07)**	-0.61 (.31)	1.48	0.95
Yukon & Northern Territories	1.02 (.06)**	-1.50(1.47)	2.48	0.99
Canada	0.52(.18)**		2.07	0.46
Wald Tests (on provincial equations only):				
Income Coefficients are equal to 1 $\chi^2(11)$	12.9			
Income Coefficients are equal to 0 $\chi^2(11)$		31.2**		
Income Coefficients are equal $\chi^2(10)$		13.3		
Income Coefficients are equal plus restriction on Canadian equation $\chi^2(11)$		13.3		

Notes: See Table 3.

1/ $\Delta(y\text{-}i\text{-}g)^{i,OECD} = \Delta(Y\text{-}I\text{-}G)^i - (C^i/C^{OECD})\,\Delta(Y\text{-}I\text{-}G)^{OECD}$.

$\Delta(y\text{-}i\text{-}g)^{CA,OECD} = \Delta(C^{CA}/C^{OECD})\,(Y\text{-}I\text{-}G)^{CA} - (C^i/C^{OECD})\,\Delta(Y\text{-}I\text{-}G)^{OECD}$.

Table 5

Constrained Model Results

$$\Delta TB^{i} = \Delta(y\text{-}i\text{-}g)^{i,OECD} - \lambda\, \Delta(y\text{-}i\text{-}g)^{CA,OECD}$$ 1/

$$\Delta TB^{CA} = (1\text{-}\lambda)\, \Delta(y\text{-}i\text{-}g)^{CA,OECD}$$

Proportion of Consumption constrained outside Canada (γ)	0.45 (.07)**	
Regional Results	Durbin-Watson Statistic	R^2
Alberta	1.57	0.95
British Columbia	2.05	0.72
Manitoba	1.88	0.92
New Brunswick	1.87	0.94
Newfoundland	1.35	0.91
Nova Scotia	2.04	0.79
Ontario	1.82	0.59
Prince Edward Island	1.87	0.89
Quebec	1.87	0.74
Saskatchewan	1.54	0.96
Yukon and Northwest Territories	2.13	0.99
Canada	2.00	0.48

Notes: See Table 3.

1/ $\Delta(y\text{-}i\text{-}g)^{i,OECD} = \Delta(Y\text{-}I\text{-}G)^{i} - (C^{i}/C^{OECD})\, \Delta(Y\text{-}I\text{-}G)^{OECD}$.

$\Delta(y\text{-}i\text{-}g)^{CA,OECD} = (C^{CA}/C^{OECD})\, \Delta(Y\text{-}I\text{-}G)^{CA} - (C^{i}/C^{OECD})\, \Delta(Y\text{-}I\text{-}G)^{OECD}$.

Table 6

Results with Separate Coefficients on Investment and Government Saving

$$\Delta TB^{i} = \beta\, \Delta(y\text{-}i\text{-}g)^{i,OECD} - \lambda\, \Delta(y\text{-}i\text{-}g)^{CA,OECD} - \lambda^{I}\, \Delta i^{CA,OECD} - \lambda^{G}\, \Delta g^{CA,OECD}$$ 1/

Provincial Net Income (β)	1.02 (.03)**
Canadian Net Income (λ)	-0.45 (.07)**
Canadian Investment (λ^{I})	0.39 (.07)**
Canadian Govt Consump (λ^{G})	0.39 (.26)

Regional Results	Durbin-Watson Statistic	R^2
Alberta	1.55	0.98
British Columbia	1.70	0.81
Manitoba	2.16	0.93
New Brunswick	1.88	0.95
Newfoundland	1.90	0.93
Nova Scotia	2.06	0.86
Ontario	1.35	0.84
Prince Edward Island	2.00	0.88
Quebec	1.95	0.85
Saskatchewan	1.72	0.97
Yukon and Northwest Territories	2.37	0.99
Canada	1.89	0.82

Notes: See Table 3.

1/ The equation for Canada as a whole is:

$$\Delta TB^{CA} = (\beta\text{-}\lambda)\, \Delta(y\text{-}i\text{-}g)^{CA,OECD} + \lambda^{I}\, \Delta i^{CA,OECD} + \lambda^{G} \Delta g^{CA,OECD}.$$

The variables are:

$$\Delta(y\text{-}i\text{-}g)^{i,OECD} = \Delta(Y\text{-}I\text{-}G)^{i} - (C^{i}/C^{OECD})\, \Delta(Y\text{-}I\text{-}G)^{OECD}.$$

$$\Delta(y\text{-}i\text{-}g)^{CA,OECD} = (C^{CA}/C^{OECD})\, \Delta(Y\text{-}I\text{-}G)^{CA} - (C^{i}/C^{OECD})\, \Delta(Y\text{-}I\text{-}G)^{OECD}.$$

$$\Delta i^{CA,OECD} = (C^{CA}/C^{OECD})\, \Delta I^{CA} - (C^{i}/C^{OECD})\, \Delta I^{OECD}.$$

$$\Delta g^{CA,OECD} = (C^{CA}/C^{OECD})\, \Delta G^{CA} - (C^{i}/C^{OECD})\, \Delta G^{OECD}.$$

Chart 1. Canada: Change in GDP, Income, and Trade Balance.

(In thousands of 1986 dollars per capita)

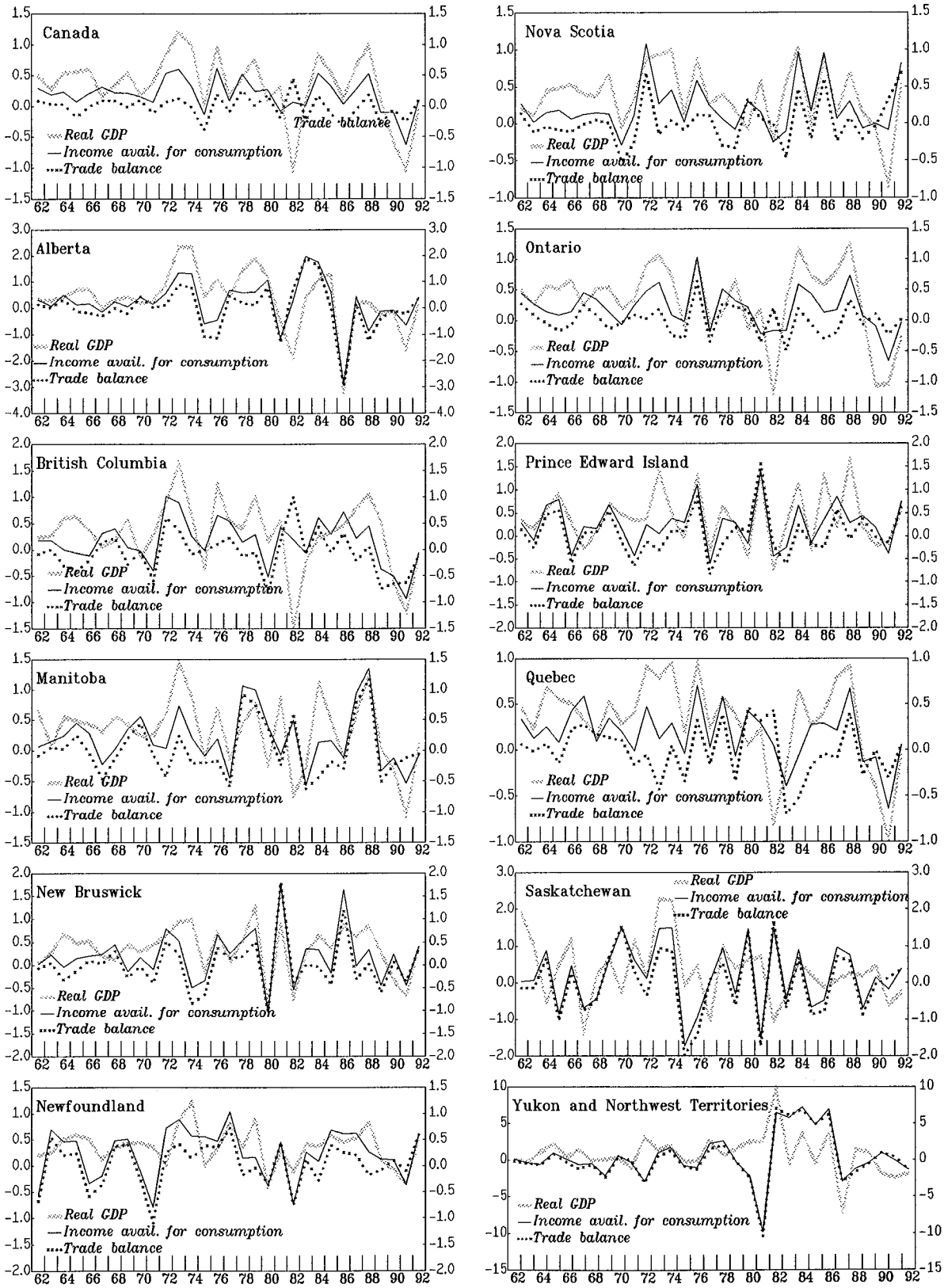
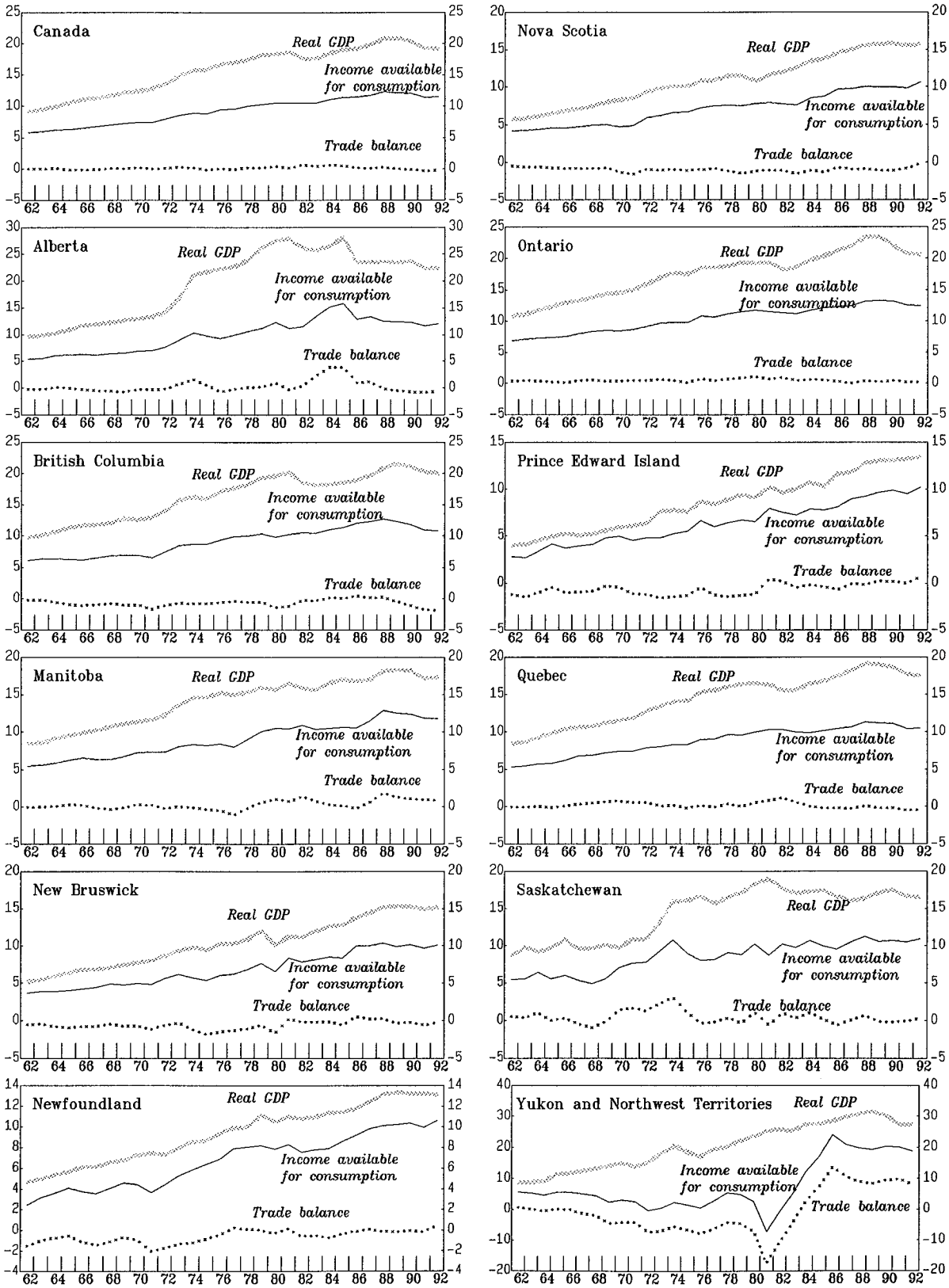


Chart 2. Canada: GDP, Income, and Trade Balance.

(In thousands of 1986 dollars per capita)



APPENDIX I. Derivation of the Estimating Equation

In this appendix we derive equation [9] in the text. First, we multiply each side of [8] by Q^W_t and then quasi-difference. After some manipulation this yields

[A1]

$$\begin{aligned}&\Delta TB^i_t\, Q^W_t + TB^i_{t-1}(Q^i_t - (1+r_{t-1})Q^W_{t-1}) \\ &= \Delta(Y-I-G)^i_t\, Q^W_t + (Y-I-G)^i_{t-1}(Q^W_t - (1+r_{t-1})Q^W_{t-1}) \\ &+ \Delta(Y-I-G)^W_t\, Q^i_t + (Y-I-G)^W_{t-1}(Q^i_t - (1+r_{t-1})Q^i_{t-1})\ .\end{aligned}$$

Note from equation [2] and the definition of the provincial trade balance that provincial wealth can be rewritten as

[A2]

$$Q^i_t = E_t \sum_{j=0}^{\infty} \frac{(Y-I-G)^i_{t+j} - TB^i_{t+j}}{\prod_{k=0}^{j}(1+r_{t+k})}$$

and hence that the quasi-difference of wealth is

[A3]

$$Q^i_t - (1+r_{t-1})Q^i_{t-1} = (1+r_{t-1})((Y-I-G)^i_t - TB^i_t) + \epsilon^i_t$$

where ϵ^i_t is the 'news' about wealth at time t obtained between times t-1 and t[26]

[A4]

$$\epsilon^i_t = (E_t - E_{t-1}) \sum_{j=0}^{\infty} \frac{(Y-I-G)^i_{t+j} - TB^i_{t+j}}{\prod_{k=0}^{j}(1+r_{t+k})}\ .$$

A similar equation (excluding the term in the trade balance) holds for the quasi-difference of national future expected income available for consumption, including ϵ^N_t, the expectational error for the region as a whole.

Substituting these results into equation [A1] gives

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[26]See Deaton (1992) (chapter 3) for a similar derivation in the context of the permanent income hypothesis.

[A5]

$$\Delta TB_t^i\ Q_t^W + TB_{t-1}^i((1+r_{t-1})(Y-I-G)_{t-1}^W+\epsilon_t^i)$$
$$= \Delta(Y-I-G)_t^i\ Q_t^W + (Y-I-G)_{t-1}^i((1+r_{t-1})(Y-I-G)_{t-1}^W+\epsilon_t^i)$$
$$+ \Delta(Y-I-G)_t^W\ Q_t^i + (Y-I-G)_{t-1}^W((1+r_{t-1})((Y-I-G)_{t-1}^i-TB_t^i)+\epsilon_t^W)\ .$$

Since the terms in the levels of lagged incomes and trade balances all cancel, equation [A5] simplifies to

[A6]

$$\Delta TB_t^i\ Q_t^W = \Delta(Y-I-G)_t^i\ Q_t^W - \Delta(Y-I-G)_t^W\ Q_t^i$$
$$+ ((Y-I-G)_{t-1}^W\epsilon_t^i+(Y-I-G)_{t-1}^i\epsilon_t^W-TB_{t-1}^i\epsilon_t^W)\ .$$

While provincial wealth and national wealth are not observable, equation [4] shows that their ratio equals the ratio of provincial consumption to national consumption. Using this, a simple transformation of equation [A6] implies the following equation for the change in the trade balance

[A7]

$$\Delta TB_t^i = \Delta(Y-I-G)_t^i - \Delta(Y-I-G)_t^W\ \frac{C_t^i}{C_t^W} + \epsilon_t$$

where the error, ϵ_t, is a linear combination of the 'news' about current wealth of the province, ϵ^i_t and of the world, ϵ^W_t. Equation [A7] corresponds to equation [9] in the text.

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