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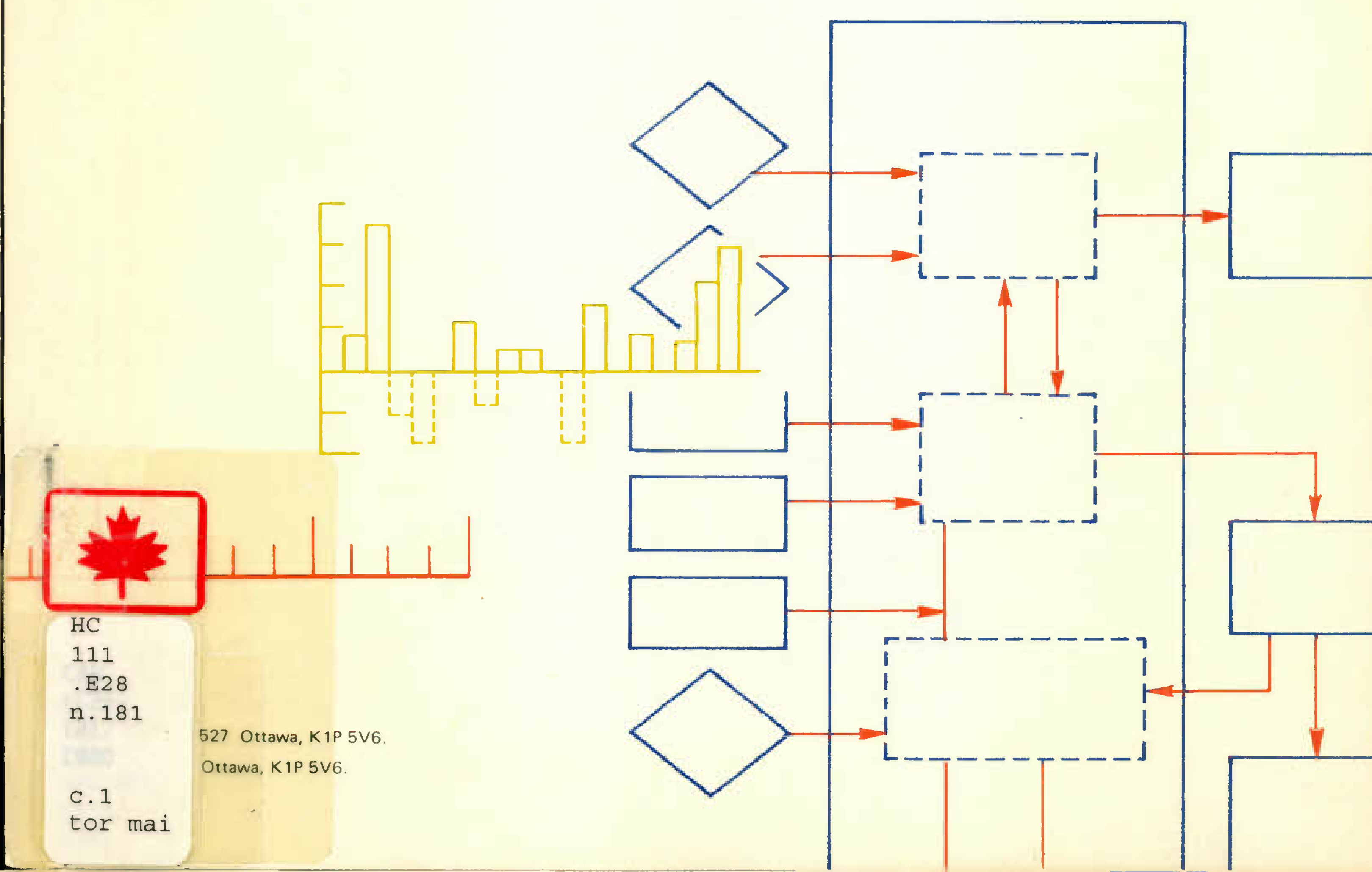

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DISCUSSION PAPER NO. 181

Employment, Investment, and Consumption in the Canadian Provinces

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RÉSUMÉ

Les auteurs utilisent des séries chronologiques nouvellement disponibles au sujet de l'activité économique dans les diverses provinces du Canada, sur lesquelles ils fondent leurs estimations économétriques de certaines équations qui rendent compte des variations annuelles de l'emploi, des investissements et de la consommation dans diverses industries au niveau provincial. Les résultats des estimations présentent en général des propriétés statistiques fort satisfaisantes.

Les estimations révèlent plusieurs similitudes, du point de vue qualitatif, dans les facteurs déterminants de l'activité économique d'une province à l'autre, mais aussi des différences importantes dans la valeur quantitative des relations mises en évidence.

Apparemment, les résultats obtenus sur le plan économétrique, ainsi que l'hétérogénéité qu'ils indiquent entre les provinces, montrent qu'un effort total de modélisation, à l'échelle régionale, serait possible et souhaitable si l'on songe aux connaissances qu'il permettrait d'acquérir sur le fonctionnement de l'économie canadienne.

ABSTRACT

This paper uses newly available time series data on economic activity in the Canadian provinces as the basis for econometric estimates of equations explaining year-to-year variations in employment, investment, and consumption for individual industrial sectors at the provincial level. The econometric results have generally quite satisfactory statistical properties.

The estimates reveal many qualitative similarities in the determinants of economic activity across provinces, but also show significant differences in the quantitative magnitude of the relationships.

The apparent success of the econometric results, together with the interprovincial heterogeneity that they reveal, suggest that a full-scale regional modelling effort would be (a) feasible, and (b) desirable, in terms of the insights into the workings of the Canadian economy that it could deliver.

I. Introduction

The paper has two purposes: to describe a new and comprehensive database of economic time series for the ten Canadian provinces, and to report a 'first cut' at using the new data to estimate econometric equations to explain, at a disaggregated sectoral level, the behaviour of employment, investment, and consumption in the provinces.

The paper is set out as follows: In section II the literature on regional modelling is surveyed, and three alternative approaches identified. They are (1) fixed coefficient models (such as Input-Output tables), (2) variable coefficient models calibrated with extraneous information (such as general equilibrium models built on assumption of perfectly competitive markets), and (3) variable coefficient models calibrated econometrically.

It is argued that fixed-coefficient models are unsuitable for analysing regional economies, with their characteristic of extreme "openness" to neighbouring economies. General equilibrium models built on optimising-assumptions are likely to be particularly appropriate for tracking long-run movements of labour and capital in response to changes in relative prices (though they will not do this well if their underlying asumptions about market behaviour are inaccurate). Econometric models may not be strong at predicting long-run movements, if the structural changes that induce them are difficult to pick up with time series data, but they should have a comparative advantage in specifying short-run economic activity, with the importance therein of lags, adjustment costs, expectations, and transmission mechanisms.

Section III focus on the econometric approach and discusses three of the issues that have been important to regional econometric modelling: (1) the question of "top-down" versus "bottom-up" -- building models that 'share out' nationally-determined aggregates against modelling behaviour directly at the regional level -- is resolved, in our opinion, in favour of the "bottom-up" approach, subject to the availability of data. (2) The scope of regional models -- the number of variables which they are built to handle -- has traditional been seriously restricted (in comparison with national models) by data constraints. The new data brought together in this paper relax significantly these constraints. (3) The specification of the behavioural equations in regional models has not followed exactly the precedents set by national model-builders. The *a priori* specifications (if not the end result after estimation) tend to be more 'neoclassical' than is thought wise by national-level econometricians. There are a number of reasons for this, some good, and some bad. We resolve to be eclectic in our choice of <u>a priori</u> specifications, and 'let the data decide'.

In Section IV the new database is described at length. Most of the data come from Statistic Canada. The framework is the set of 'Provincial Economic Accounts' now available back to 1961 for the Canadian provinces, but other new data are those at a provincial investment and capital stocks, consumer expenditures, and real domestic product by sector (the last-named from the Conference Board in Canada).

To these series we have attempted to add provincial price data, such as user-costs of capital so far not always with complete success.

Section V presents the econometrically estimated sectorally disaggregated (at least five employment and investment sectors per province; two consumption categories -- durables and non-durables) equations for employment, investment, and consumption.

The econometric work appears to have been a success -- the statistical properties of most equations are satisfactory or better.

Section VI concludes the paper with some discussion of 'uses and extensions'. In particular, the <u>scope</u> of the work could be extended to include other important economic variables, with the aim of eventually having complete models for each provincial economy. The specification of equations would also benefit from an attempt to specifically identify inter-regional factors that do not appear in the traditional national-economy-based model specifications.

Even as they stand, our results do demonstrate, we feel, that regional modelling in Canada is both feasible and desirable. Our 'first cut' at the data threw out some fairly successful econometric results, and the inter-provincial heterogeneity revealed by these may have significant implications for both national-and provincial-level economic policy-making.

II Alternative Approaches to Regional Economic Modelling

Regional economic models can be categorized according to their methods of dealing with two key issues: (a) theoretical specification and, (b) calibration. That is, we can distinguish issues of a priori specification of the model from that of replacing general algebraic expressions with actual numbers.

Sorting extant models according to their resolution of these two issues leads us to discern three categories of models (though it will be seen that neither the distinction between theoretical specification and calibration, nor those separating the three categories, is in all cases clearly maintained). These are discussed in turn in this section.

(1) Fixed-Coefficient Input-Output Models

Input-Output (I-O) models have developed in the Keynesian theoretical framework in which output is simply determined by demand. The lack of supply-side constraints on output is justified by the assumption of constant returns to scale, which has the convenient implication that a single observation (preferably a recent one) on each I-O coefficient is sufficient to calibrate the model. The I-O formulation of the links between final output and intermediate and factor inputs may be linked to a Keynesian income-determination model that determines the various final demand flows or these may simply be specified exogenously. Even when the macro-economic final demand flows are modelled endogenously, their sectoral distribution is typically fixed at the levels observed in the calibration period.

Fixed-coeffient input-output models seem best suited to the short-to-medium term analysis of closed economies. The methodology has, however, been applied to the analysis of sub-national regions (e.g. d'Amours (1979), DREE (1976), Polenske (1972)), and to international linkages between regional areas (Leontief et. al. (1977)). In these contexts the fixed-coefficients assumption is hard to justify, since the openness of regional economies strongly suggests that regional output in many sectors will have close substitutes in the domestic market from imports so that, even in the short-run, the implication of fixed-coefficients - constant market shares of domestic producers in both intermediate and final goods market - is unreasonable (cf. Hazledine, (1978)). Although the relative simplicity (at least for national statistical bureaus with access to confidential data) of calibrating I-O models pays-off in increasing the level of sectoral disaggregation that can be included, it has a cost in over-rigid specification of sectoral inter-relationships, which rules out, in our opinion, the use of fixed-coefficient models for regional analysis, in which an important focus of interest is normally the changes in the flows between regions that follow market forces and/or government policies.

(2) Variable-Coefficient Comparative-Static Models Calibrated with Extraneous Information

The demand by one sector of the economy for the output of another can change due to changes in tastes and technology which are difficult to measure and model. In the short-to-medium term, however, the main contingent factors may be changes in prices and incomes. Certainly these are the factors which economists are most comfortable analysing.

Models incorporating price elasticities are particularly suited to the analysis of comparative static issues of the effects of a change in prices due, say, to a change in tariffs or indirect taxes, after these have had time to work through the economy.

The sort of results that comparative static models give is likely to be significantly influenced by the theoretical specification imposed *a priori* on the model. The most common approach assumes that markets are neoclassical or perfectly competitive (homogeneous products, price-taking firms). For sophisticated examples of neoclassical comparative static models of national economies, cf. the papers of Taylor and Black (1974) and Boadway and Treddenick (1978). An alternative model, developed by Hazledine, (1979a), (1980) assumes a variant of imperfectly competitive behaviour in the markets for manufacturing industries and applies this to the analysis of the consequences for Canada's regions of changes in its tariff structure. Comparing this model with the neoclassical approach to the same questions taken by Auer (1979) illustrates the importance for the results obtained of the initial assumptions made about the structure of markets.

Variable-coefficient models are naturally more difficult to calibrate than fixed-coefficient I-O models, since they require, in addition to the base-period I-O database of inter-sectoral flows, figures for the elasticity parameters. For final demand sectors these may simply be "pulled out of the air", as in Boadway and Treddenick (1978), in which it is assumed that expenditure shares on each product are constant, implying unit price and income demand elasticities, or they may be culled from the empirical work of others (Hazledine (1979a, 1980)).

For intermediate goods and primary inputs, neo-classical modellers can make use of the factor shares theorems linking the shares in total costs of each input, (observed in the base-period) to the parameters of sectoral production functions, so long as they are prepared to assume that the latter have a convenient constant-elasticity form. With these parameters, expressions can then be derived directly for the profit-maximising input price elasticities (e.g. Boadway and Treddenick, 1978, p. 430)).

Hazledine (1979a, 1980) cites evidence on the determinants of the demand for labour in support of his assumption of constant returns to scale, which leads to a somewhat different role for price and cost changes in the determination of output levels.

These variable-coefficient models do attempt to deal with cross-price elasticities by having the market shares of domestic and imported products in each industry determined according to some formula based on relative prices (Boadway and Treddenick pp. 434-7, Hazledine 1980, Appendix).

The calibration methods adopted for these models may seem, especially to econometricians, to be disturbingly ad hoc. However, there is some evidence that results may be not very sensitive to differences in the actual parameter values used (Boadway and Treddenick, pp. 438-445). Of more quantitative significance may be differences in the a priori assumptions made about how the economy works, so that more effort should perhaps be devoted to scrutinising the plausibility of these - in particular, the empirical relevance of the neoclassical assumption of perfectly competitive markets.

With its incorporation of price elasticities, in particular for relative-price market-share effects, the variable-coefficient approach is obviously more useful than the simple I-O methodology for the analysis of open regional economies. Its relevance is probably greatest for the 'medium-term' framework in which total endowments of primary factors (capital, labour, land) are held fixed, but are given time to adjust to a new equilibrium distribution within the economy. These models are not helpful in answering short-term questions involving the speed of the adjustment process, such as those raised by concern about differential regional impacts of cyclical fluctuations, or with the long-term, in which the quantity and (most important for regions) the location of capital and labour are variable, since the model-builders have so far shied away from the difficult problem of setting reasonable investment and migration equations from *a priori* restrictions and extraneous information. (The neoclassical profit-maximising models would have particular problems avoiding predictions of catastrophic long-term shifts in primary factor location in response to differences in factor prices.)

(3) Variable-Coefficient Models Calibrated Econometrically

Econometric models make use of the information contained in the actual history of the economy or sector being studied. Much econometric work can be seen simply as an attempt to understand or "fit", these historical data with an equation or set of equations, but its implicit or explicit rationale (at least when financed by public funds) is usually that the equations may be of use in going beyond historical experience to predict the effects of unprecedented changes either in exogenous factors or in variables under the control of policymakers.

Compared with the variable-coefficient models discussed above in (2), the relative importance in econometric work of theory and calibration is reversed. Especially in regional modelling, the availability of data and of reliable statistical methods of processing them are often the factors determining the size and even the properties of the model. A priori theory, of varying degrees of sophistication, is generally used in choosing which variables are, or should be, included in the calibration exercise, and in interpreting the elasticities that are implied by it, but sophisticated theorizing may turn out to be redundant, or even embarrassing. To the extent that the data are used to 'test' theories, these become an element of the model dependent on the calibration process (though some a priori restrictions are always required to limit the number of theories to be tested). The choice from conceivable theoretical specifications may not make much difference - a number of them may be consistent with the available data - whereas small changes in the latter may lead to big changes in the calibration of the model.

All of these matters will be discussed below in Section III. For the purposes of this section in which we are concerned to discern the distinguishing traits of the main observed categories of regional models, we should note that the econometric method is particularly suited to the analysis of economic activity in the 'short-term', over which the effects of economic variables on each other is strongly influenced by adjustment costs, expectation lags, and other phenomena difficult to model precisely theoretically, so that even the most determined proponents of *a priori* reasoning may be willing to 'let the data tell' about the quantitative magnitude of the relationships.

Reliable econometric inference depends on plenty of variability in the movements of the variables in the model, in order that the effects of each can be disentangled and their precision estimated. Thus, econometric models have typically been rather more successful dealing with *quantity* variables - flows of expenditures, output, employment - than with *prices*, since the latter tend to fluctuate relatively less over the economic cycle.

Therefore, we may conclude that econometric models are likely to be particularly useful in answering questions about the adjustment mechanisms of regional economies (how quickly they respond to fluctuations in aggregate demand; how pronounced are the short-term 'spill-over' effects from one region to another; to what extent regional business cycles tend to move in phase). Depending, in particular, on the extent to which price elasticities can be identified econometrically, these models may also tell us something about the medium-term equilibria towards which adjustment is directed.

Like the other models that have been discussed in this section, econometric models are not likely to be of much help with long-term changes; in this case because the reliability of statistical inference declines the further one moves beyond the boundaries of previous experience.

The work reported in the remainder of this paper represents an attempt to apply the econometric method to the analysis of some sectors of the provincial economies of Canada. The purpose of this section has been to place this method within the larger context of the different basic approaches that have been taken to quantitative regional analysis. This context should still not be lost sight of when we narrow the focus of attention to the particular issues raised by econometric modellers.

Finally, it should be noted that the two 'variable-coefficient' approaches need not, and probably ought not, be mutually exclusive.[1] Econometric studies can be used as a source of the extraneous information in comparative-static models (for example, to provide estimates of price elasticities of demand), and a priori restrictions can be imposed (stochastically or deterministically) on econometric equations (common, simple examples are constraining a production function to show constant returns to scale, or a demand function to be homogeneous of degree zero). We will have a little more to say on the latter possibility in Section IV, but would like to note now that in our opinion, the desirability and feasibility of a consciously eclectic approach to model specification and calibration is an important matter for future research.

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1 It should also be noted that we are not here using the term 'variable-coefficient' in the sense than an econometrician would use it to denote regression coefficients that vary over time or when variables in the model change. Rather, we are distinguishing the econometric and comparative static approaches from that of Input-Output analysis in which the proportion of inputs to outputs is constant - in particular, they are invariant with respect to the scale of output and to changes in prices. In the variable-coefficient context, the I-O assumption is equivalent to the special case of unit output and zero price elasticities.

III Issues in Regional Econometrics

In this section three matters of importance to regional econometric modelling are discussed: the basic approach of the modelling exercise ("top-down" vs. "bottom-up"), the scope of the model, and the specification of its behavioural equations.

(1) "Top-Down" vs. "Bottom-Up"

An initial issue to be decided in designing a regional modelling program is whether the regional economy is to be viewed as fundamentally dependent on the performance of some super-regional aggregate, or whether its activities are autonomous or relate on equal terms to the activities of other regions. For example, should the output or a regional industry be specified as a proportion of the national output of the industry (this given by a national econometric model), or should it be estimated directly, in an equation in which any national variables that may appear are not those whose disaggregated values are determined by the regional model?

This issue should raise interesting and not well understood theoretical questions about the nature of regional economic activities - whether they are basically "competitive" or "generative" (cf. Bolton, (1979, Section I)) - but in practice positions seem to have been taken on more prosaic grounds. The 'problem' is that autonomous "bottom-up" models may yield results which, when aggregated across regions, are not consistent with those forthcoming from existing national-level econometric models. This is embarrassing when the national model is "in-house" to the regional model-builders.

Thus, Milne et. al. admit (1979, p. 4), that the 'most critical consideration', in their choice of the "top-down" methodology was that 'a highly detailed national model (the Wharton model) is available ... construction of a new model with significant bottom-up content would mean another set of national forecasts - obtained by aggregating across regions - and would pose problems of model management and operation'.

However, the official Wharton group (Fromm, et. al. (1979)) is prepared to develop a bottom-up U.S. model subject to data availability, and NRIES (Ballard and Wendling, (1979)) have apparently estimated independent models for each of the 51 states. These, and the top-down models are surveyed by Bolton (1979).

In principle, the matter should be resolved according to two considerations a) at what level does the decision-making actually take place?; and b) do the disaggregated models "add-up" to give sensible national-level predictions? Some variables - consumption, employment, much of investment - are clearly determined at the regional level or below it and so should be modelled at this level, given that the model-builder has already undertaken to assemble disaggregated data. Others, such as federal spending, some corporate investment, interest rates, and the exchange rate, are set nationally and should so be modelled.

Adding-up problems become obvious when, say, the sum of all regional demands for labour exceeds the total national labour supply, and may occur either because of biases in the specification or estimation of each regional model (the NRIES people note a tendency for individual state models to 'often produce overly optimistic forecasts of growth' (Ballard and Wendling, (1979, p. 22)), or, more fundamentally, because inter-regional or international linkages are not built into the model. Thus inter-regional net migration flows should sum to zero, and the aggregate effects of regional output and demand on national variables such as exchange rates and interest rates should be allowed to feed back to the regional economies.

Top-down models may suppress the symptoms of adding-up problems by imposing (either in the estimation stage or in the use of the models for prediction and policy-'simulations') requirements that shares sum to one. This is most drastically done by Milne et. al., who simply designate one region to be 'residual' and don't estimate any equations for it.

However, it would be more rewarding, though more difficult, to specify the various linkages and feedbacks directly, and use as a test of success the extent to which the unconstrained equations satisfy the adding-up conditions.

The econometric results reported in this paper follow the simplest bottom-up methodology - each regional equation is estimated independently and none include any allowance for inter-regional linkages, though suggestions are made how these might be incorporated in development of the work. A full scale regional modelling effort should no doubt follow the eclectic approach recommended above, with controversial questions about the relative merits of "bottom-up" and "top-down" examined empirically as part of the model-building process.

(2) Scope of the Regional Model

An econometric model may explain one variable or many. In the modelling of national economies, the active constraints on the scope of the work are usually set by the focus of interest that motivates the research (e.g. sector vs. macro models) and the resources available to specify and estimate the equations of the model. In most regional econometric work, however, the dominant restriction on scope has been data availability. This is particularly true of the U.S. efforts, which have had to make do without regional investment, consumption and profits data and with even some regional output series non-existent or requiring interpolation to get inter-census observations. Only labour market data have been reasonably adequate.

Until very recently, the Canadian situation was not much better than that of the U.S. (though annual output or value added data have always been available here), but it has been radically improved by the preparation by Statistics Canada of a set of time series (going back to 1961) of Provincial Economic Accounts, and of regionalized capital stock and investment data. The availability of these new data gave, in fact, the impetus for the present study. Indeed, the Canadian regional data base is now so rich that it has been the availability of resources - time and researchers' - that have constrained the scope of the work reported here.

We have chosen to focus on developing econometric equations to explain, at the provincial level, annual variations in consumption, investment, and employment, with each of these variables disaggregated into categories or sectors.

These choices gave us the opportunity to make extensive use of the new data, as well as to build a core of econometric work that will be of direct use as part of a more comprehensive modelling effort.

The aim of most regional modellers is to produce a system of equations comparable in their scope with the well-established macro-econometric models of national economies. The remaining barrier to achieving this in Canada, now that we have good data on intra-provincial economic activity (and given the will to devote to it the necessary research-time and resources) is the problem, which is likely to be permanent, of the absence of data on inter-provincial flows of goods and service; a problem compounded in importance, of course, by the relative openness of sub-national economies.

(3) Equation Specification

Once the matter of top-down vs. bottom-up has been settled, and the scope of the model decided on, the econometrician proceeds to the specification of the equations of the model. Milliman claims (1971, p. 312) that 'no well-constructed theory of regional income generation exists' to guide the model-builder; a statement with much validity from a longer-term perspective, within which we are confronted by the important unresolved issues of "competitive" versus "generative" growth, but not so for the short-term, when we can make use of the Keynesian income determination model standard in econometric models of national economies.

It is true, though, that the relative openness of regional economies necessitates particular attention being paid to the specification of inter-regional flows both of goods and services and of factors of production, and that national models do not provide particularly reliable guidance as to how this should be done. In this sub-section we examine first the treatment of goods and services flows and employment; then we look at the determinants of capital and labour movements in regional models.

(i) Output, Employment and Consumption

Modelling the output of exporting sectors in a region is particularly difficult because these depend so much on events in other regions. The problem is compounded of course, by the lack of direct observations on trade flows across regional borders.

Regional modellers have typically (cf. the papers surveyed by Bolton) tried to deal with the missing trade data by specifying reduced-form equations which in effect, infer inter-regional flows by making output in a regionally open sector a function of levels of income, and/or of output in consuming sectors, in the regions with which the sector is assumed to be linked.

An alternative approach is proposed by the Wharton group (Fromm, *et. al*. (1979)) who have output *supply*-not demand-determined, by the intersection of marginal costs and price - that is, by the assumption that markets are perfectly competitive (though lack of data on capital stocks forces them to specify the supply curve as a reduced-form function of past changes in output). They justify this specification by an appeal to 'standard economic theory' (p. 4) which, later (p. 14) is assumed further to be a 'fact'.

This use of neoclassical assumptions is also a feature of the employment equations of Treyz *et. al.*, (1979) which rely on production function coefficients inferred from factor shares according to neoclassical distribution theory. In doing this, the regional modellers are diverging from the common practice in national econometric models, which tend to be predominantly demand-determined in the Keynesian spirit, for the good reason that empirically, prices do not in fact appear to often have a significant influence on output and employment at the national level (cf. Hazledine, 1979b).

There seem to be three reasons why neoclassical forces may play a larger role in regional models: a) the models are at an earlier stage of their development (the Wharton model, for example, had not been empirically implemented at the time the Fromm et. al. paper was written), so that the sharp edges of the neoclassical biases which most North American-trained economists naturally bring to the *a priori* specification stage of their research have not yet been dulled on the tough realities of the real world. b) In the U.S. at least, the inadequacies of regional data bases are more pronounced with respect to quantity data than with information on prices (regional wage rates and costs-of-living are usually available), and, in any case, national prices can be justified as arguments in regional supply functions. c) The relative openness of regional economies should mean that relative prices *are* indeed more important determinants of regional output than they are at the national level. Treyz *et. al.* do find the production shares of Massachusetts to be responsive to relative production costs, though this in a pooled time-series/cross-section regression, in which the cross-sectional effects (corresponding to long-run regional comparative advantages) appear to be doing the work, statistically: they did not succeed in finding significant relationships working with independent time series. (This should not be surprising, even to a neoclassicist, since the very openness of the regional economy leaves little room for persistent cyclical variations in inter-regional relative prices - these should be quickly arbitraged away, leaving nothing much in the way of deviation-from-trend for the econometric regression to get a grip on.)

Apart from the work of Treyz et. al., regional modellers of labour demand have tended to follow along the path trodden before them by the builders of national models which leads to a specification in which the main determining factors of current employment are current output (the demand side), and lagged employment (representing supply constraints or adjustment costs). Consumer expenditure, too, when modelled at all (there are data problems in the U.S.), follows the practice of national models. This seems entirely appropriate, since both national and regional consumption flows are the aggregate results of the same household decisions.

(ii) Capital and Labour Supply

The openness of regional economies is particularly important to the modelling of the availability of factor inputs. National barriers to the mobility of capital and, especially, labour are such that most of the effort in national model-building can be focused on the internal factors affecting these variables. Obviously this cannot be presumed so at the sub-national level.

Regional models are particularly well-developed (in the U.S.) in their treatment of inter-regional flows of labour, which are found to respond to differences in the availability and attractiveness of jobs. (cf. Milne et. al.). Inter-regional migration was not modelled for Canada as part of the work reported in this paper; it is an obvious and important subject for future research.

With respect to capital inputs, on the other hand, the regional modelling effort to date has been aborted, so far, by lack of time-series data on investment and capital stock. These are now available for Canada, and were used in the work reported in Section V. We have made do with fairly standard national-model-type specifications, but we recognize the importance of attempting to take explicit recognition of inter-regional capital movements, given the role these must be presumed to play in regional productivity and growth.

These concern unresolved 'long-run' questions about the nature of the growth process - the issue of 'generative' vs. 'competitive' regional growth - and its bearing on the rather persistent regional disparities of employment growth and productivity in Canada. This matter is highlighted by the apparent contrast with the U.S. economy, as reflected in the model of, for example, Milne et. al., in which factor movements seem to be rather more 'neoclassical', with capital and labour moving from the North Eastern region to the lower-cost Southern states, and thereby tending to equalize regional productivity and wage rates.

A determined research effort to answer these questions could easily be justified for its importance, not just to regional modelling per se, but also as a contribution to understanding the sources of the strains that regional disparities are imposing on the Canadian Confederation itself.

IV Data

There are two distinct approaches to building regional databases corresponding to the 'bottom-up' and 'top-down' approaches to model specification. The best way is to obtain information directly in each region; through, for example census or survey sampling techniques. When resource, or other constraints are such that the method is impractical, the second best alternative is to begin with national data and allocate it regionally on the basis of some proxy for the actual economic behaviour we are interested in.

Although it is often used, the method of generating "regional" data which are merely national numbers pro-rated on the basis of some shares formula is often subject to objections similar to those which led us to discard top-down in favour of bottom-up modelling.

Consider this illustration. In order to obtain provincial consumption figures we estimate the following relationship using national data.

$$C = a + bY$$

where C = consumption at the national level

a = constant

and Y = income at the national level

Having an estimate of a and b - the income coefficient in the national equation, we plug-in actual provincial income data and solve for C, to give us an estimate of provincial consumption.

This is a common method used for estimating regional data when better alternatives do not exist. Obviously it embodies the same bias which characterized top-down modelling effects -- that is the view that the region is merely an economic appendage, flexing and contracting in perfect sychronization with the movements of the aggregate economy.

The degree to which data so obtained characterize accurately regional behaviour depends not only upon the truth of the initial relationship implied -- $C = a + bY$, but upon the accuracy of the provincial parameters which serve as inputs into the estimation procedure.

Where it were the case for example, that the input parameter -- provincial income levels in the above illustration, was itself estimated in a similar fashion, the inbred nature of the resulting figures might severely limit their usefulness.

In the present study, we use data derived from both sources mentioned above -- direct surveys, or census activity, and indirect information from rational series, as well as data originating from a combination of these two techniques. We describe and discuss our data in the following sub-sections, beginning with a detailed discussion of the data for our dependent variables, Investment, Employment and Consumption. We then briefly describe the source of our data for all independent variables which proved useful in terms of their explanatory power, as well as for some variables we eventually chose to omit, (for reasons which may be of interest to the reader).

1. DEPENDENT VARIABLES

INVESTMENT

The investment data contained in Statistics Canada Fixed Capital Flows and Stocks (National Wealth and Capital Stock Section, Construction Division, June 1979) includes figures on annual Gross Fixed Capital Formation, Capital Consumption Allowances, and Gross as well as Net Capital Stocks, measured both at mid-year and end of year. The data covers the period 1955 and 1979 and includes current as well as constant dollar estimates for investment in Machinery and Equipment and Construction for industries at the three digit level.

Statistics Canada describes their technique for estimating capital stock figures as a "Perpetual Inventory Method". It basically involves, starting with an estimate for capital stock by industry and province for the initial year of the series, and adding to this, on a cumulative basis, investment in each subsequent year. The sum of initial capital stock plus accumulated investment is the estimate of gross capital stock (the method used to adjust for depreciation is discussed below).

Initial capital stock figures by industry are not available provincially and must be estimated. The following estimation method is used for all manufacturing industries: Shipments (as a proxy for output) are estimated as a function of capital stock and labour inputs, for each major industry gap, with national data, using a Cobb-Douglas production function specification. With labour and capital production coefficients thus derived, provincial labour and shipments data are substituted into the equation, and provincial capital stock values may be solved for accordingly.

A similar approach was used by Statistics Canada to calculate capital stock in non-manufacturing industries. Again, using national data, the relationship between Repair Expenditures and capital stock was estimated for each major industry stock. The relationship postulated was of the form

$$R = A + Bk$$

where R = repair expenditure

k = capital stock

and A = constant

Having solved for B using national data, capital stock may be arrived at on a provincial level, by replacing national repair expenditure series with their provincial counterparts and solving for k.

The data on Investment Expenditure by province and industry we compiled from annual annexed historic series on capital and repair expenditures, assembled from Private and Public Investment Survey, (Statistics Canada, Private Public Investment in Canada, Catalogue 61-205).

The Gross vs. Net measures of capital stock embodied alternative assumptions concerning the life cycle of capital assets. In "Gross Capital Stock" calculations, assets enter at their full valve over a specified period of time, -- then cease to exist. In the "Net Capital Stock" calculation, assets are depreciated in a "straight-line" fashion over an established period.

Unfortunately, information regarding the depreciation and service life of assets is largely unavailable, hence national depreciation rates and service life estimates were applied to provincial capital stock series.

Work of the Economic Council has shown that capacity utilization rates for capital assets, which are considered a principle determinant of capital depreciation, may vary by 50 per cent from one province to another. Based on these results, we may expect the absence of provincial depreciation schedules in the calculation of capital stock series, to be of more than marginal consequence.

As there were no capital goods price deflators available on a regional basis, the current dollar estimates of provincial capital stock by industry were deflated with national expenditure deflators. Hence, constant dollar series, though available, contain no additional provincial information than their current dollar counterparts.

The degree of industry disaggregation available for the larger provinces of Ontario, Quebec and British Columbia exceeded that for the remaining provinces. Agriculture, forestry, mining and construction were reported upon separately for the larger provinces, while elsewhere these four industries were lumped together to form the "primary" industries.

For our own purposes we disaggregated the investment data into six broad categories which included, manufactuing, mining, construction, primary (as previously defined), services and utilities.

Services includes Trade, Finance and Real Estate, Institutions and Commercial Services. Utilities includes "miscellaneous" Utilities, Transportation and Communications.

We omitted from our studies, Government Investment Expenditure, as there appears to be evidence that the factors wich drive private and public investment decisions are rather distinct.[2]

Finally we made no use of the available disaggregation of investment into machinery and equipment and construction (buildings) and chose only to deal with total investment.

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2 "Economic Stabilization and The Regions: The Dilemma in Canada". Y. Rabeau and R. Lacroix, to the Workshop on the Political Economy of Confederation at Queen's University, November 1979, and published by the Economic Council of Canada.

EMPLOYMENT

One of the most reliable series we had the opportunity to work with was employment figures presented in Statistics Canada's Estimates of Employees by Province and Industry (Catalogue 72-008). Statistics Canada relied primarily on the following sources of information in compiling the figuers.

Employment, Payrolls and Manhours Survey; this source is by far the largest single contributor of information, and is itself a survey of all firms employing twenty or more persons in any one month of the year. Data are collected in great geographical and industrial detail. These data are published in Statistics Canada's Employment, Earning and Hours, (Catalogue 72-002).

Employment Sample Survey; information from this source covers firms employing less than 20 persons, and is collected on a sample survey basis. These figures are not published elsewhere.

Other Employment Surveys; Census Surveys, conducted to gain information on employment in hospitals, educational institutions and related services, as well as in religious and welfare organizations. These figures are not published elsewhere.

Public Administration and Defence Data; data gathered by Statistics Canada's Public Finance Division pertaining to employment in Public Administration and defence published in Statistics Canada, Catalogue 72-004, Federal Government Employment, Catalogue 72-007, Provincial Government Employment, and Catalogue 72-009, Local Government Employment.

Monthly Labour Force Household Survey; captures data concerning employment in fishing, trapping and private household services, (Statistics Canada, Catalogue 71-001 The Labour Force).

Weaknesses in the data may arise from "sampling errors" which occur in the employment survey of firms with fewer than 20 employees and the Household Sample Survey. And while these errors are themselves unknown, an effective indicator of their presence and size is derived from the "Standard Error" of survey estimate, -- a statistical measure of sampling error. Statistics Canada uses the sample estimate along with its relative standard error to construct a range within which the unknown census value may (at a certain level of confidence) be expected to lie. Such ranges are constructed for each major industry and each province and published in the methodology section of Statistics Canada, Estimates of Employees, by Province and Industry (Ibid).

With the exception of construction, forestry and to a lesser extent finance, Insurance and Real Estate, the standard error of sampling estimate is generally within the range of .5 per cent to 5.0 per cent.

The weakest employment figures are for forestry in the Eastern province of Prince Edward Island and Nova Scotia, followed by those for construction in most of the smaller provinces.

The level of sectoral disaggregation of our analysis of the employment data was the same as that discussed above, for investment.

CONSUMPTION

We were fortunate to obtain from Statistics Canada some recently compiled estimates of Consumption by type of commodity and province, which allowed us to estimate consumption functions provincially for durables as well as total consumption less durables.

The data was provided in current and constant dollars covering the period 1961-77.

Consumer Spending on Goods

The Old Retail Trade Survey (ORTS) and the New Retail Trade Survey (NRTS), adjusted to remove business expenditures in retail outlets, form the basis for estimating the provincial consumption series.[1] The ORTS was used for the period 1961-1971, while the NRTS was employed for the years 1972 and after.

Commodity by "kind of business" weights are applied to the adjusted series to give personal expenditure on consumer goods. Kind of business weights were obtained from the commodity distribution of retail trade establishment sales from the 1961 Census and the 1968 and 1974 Retail Commodity Survey (Retail Commodity Survey, 1968, cat. 63-518 and Retail Commodity Survey, 1974, cat. 63-526). Any discrepancy between consumption so determined and the national totals prorated over the provinces.

The consumptions figure are adjusted to account for sales of goods from vending machines and non-retail outlets, and consumption of alcoholic beverages, electricity and other items not based upon the retail data.

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1. See, Retail Trade, 1961-1966, cat. 63-517; Retail Trade, Revisions to 1966-1970 Post-Censal Estimates, cat. 63-519; Retail Trade, Montly, cat. 63-005 and the 1961 and 1966 Census of Merchandising and Services.

Series, similar to those used to derive the national aggregate values are used to derive provincial figure for consumer expenditure on services, for example, expenditures on laundry and dry cleaning, various transportation services, telephone, hotel accommodation and meals, and postal services are distributed across the provinces on the basis of annual surveys or published statements of Statistics Canada or other agencies. For other service components, such as funeral and burial expenditures, taxis, car and truck rentals, motion pictures, barbers and beauty parlors, and other personal care services, the 1961, 1966 and 1971 censuses of services provides benchwork estimates for a provincial allocation. Extrapolation and interpolation serves to fill the gap between benchmark years. Finally some series are provincially allocated on the basis of data from the income side. For example, the provincial distribution of personal expenditure on domestic servants, babysitting, boarding and lodging, legal fees, doctors and dentists based upon labour income data.

Transformation of current dollar expenditure figures by commodity, to constant dollar figures was achieved by applying provincial, commodity specific, price deflators.

Consumer expenditure deflators were derived for over a 100 expenditure items, largely from two major sources

- the city consumer price index (CPI), and regional wage rate data.

In provinces where only one city price index exists, this single index constitutes the provincial deflator.

In the provices of Ontario, Quebec, Saskatchewan and Alberta, where more than one city price index has been established, a weighted average of the city price indexes in question is used to generate the provincial deflator. Weights are based on population shares.

In Ontario, for example, the consumer price index since 1969 is the weighted average of Toronto, Ottawa and Thunder Bay city price indexes.

The calculation of a consumer price index for Prince Edward Island prior to 1973 was based upon the CPI's of Saint Johns, N.B., and Halifax, N.S. The combination of N.S.'s and N.B.'s provincial sales taxes were accounted for and removed from the initial composite index, to which was then added the effect of the P.E.I. provincial sales tax.

In certain circumstances, deflators for specific commodities were represented by an average of several commodity CPI's weighted by the appropriate expenditure shares.

Regional wage indexes served as a good approximation to CPI's where none were available for certain commodity (notably services) items. Wage rate indexes are available by region from 1961 on.

In many cases, no regional data whatever exists to describe the price movements in consumer expenditure items. In such cases, the national price index is used, after allowing for the combined effects of provincial sales taxes and then including the provincial sales tax for the specific sales tax for the specific province in question.

INDEPENDENT VARIABLES

Real Domestic Product

Data on Real Domestic Product (RDP) by province and industry were supplied by the Conference Board in Canada, and are available in their publication The Provincial Economies 1961-1978 Data, (Conference Baord in Canada, Ottawa 1979).

The Conference Board arrived at their provincial distribution of RDP for the goods producing industries by allocating national RDP industry totals which were based on data from Statistics Canada's, Real Domestic Product by Industry (Catalogue 61-213) by census value added as reported in Survey of Production (Statistics Canada; Catalogue 61-202).

RDP for the service industries is calculated by subtracting from total provincial gross domestic product the sum of RDP in the goods producing industries.

Total RDP by province is available in Statistics Canada publication, the Provincial Economic Accounts (Catalogue 13-213).

A detailed discussion of the derivation of the Conference Board figure is contained in Part I of The Provincial Economies (Ibid.).

Gross Domestic Product

We derived our provincial distribution of GDP by allocating total industry GDP as reported in the National Income and Expenditure Accounts, Volume I, (Statistics Canada: Catalogue 15-531) on the basis of RDP.

Salaries and Wages

Statistics Canada has constructed monthly as well as annual series on labour income, by province and by industry. Salaries and Wage data are contained in Estimates of Labour Income (Catalogue 72-005).

Annual Wage and Salary data are constructed by Statistics Canada from censuses, sample surveys, administrative records. Where complete historical records do not exist projections are generated from benchmark years with current employment and payroll data. A common projector is employment data from Statistics Canada Employees by Province and Industry (Ibid.).

Annual data collected from taxation T4 slips serves as an accounting measure against which the sum of industry or provincial estimates can be compared and/or adjusted.

"Real Wages" were obtained by deflating current Salaries and Wages data by the appropriate industry output deflator contained in the Economic Council's CANDIDE forecasting model data base. Alternatively, we could have arrived at industry output deflators dividing current dollar GDP by constant dollar RDP by industry. Recalling however that both provincial GDP and RDP figures were obtained by pro-rating the respective national series on the basis of census value added, it is apparent that deflators arrived at in this fasion would only reflect the national industry deflator embodied in the national RDP series.

Relative Factor Price

We calculated Relative Factor Price as Unit Labour Costs over the User Cost of Capital. Unit Labour Costs were equivalent to Salaries and Wages divided by employees. The User Cost variable, described below, unfortunately was derived solely from national parameters so that relative factor price itself contained only partial information on a provincial basis.

User Cost of Capital

While the User Cost of Capital did not prove effective as an explanatory variable in our investment equations we must regard this result with suspicion because, as previously mentioned, this variable was essentially calculated as a rational parameter.

User cost is an amorphous concept which attempts to accomodate the behavioural incentives/disincentives of Effective Tax Rates, Economic Depreciation and Service Life of Capital, Tax Depreciation, Tax Credits and Tax Defferal, Accelerated Depreciation, Investment Price Deflators as well as the Interest Rate.

The Effective Tax Rate is calculated in our model as the sum of federal and provincial corporate income taxes paid divided by total taxable income.

By law, corporations must each year, file income tax returns in duplicate to Revenue Canada. One copy is forwarded to Statistics Canada for compilation and statistical analysis. The information thus made available to Statistics Canada includes detailed figures on corporate income, and federal taxes paid, along with an estimate of the provincial origin of corporate income. However, there is no requirement that corporations provide to Statistics Canada any information on provincial taxes paid.

While there is some provincial differentiation of the federal corporate tax rate the bulk of the variation in the overall effective tax rate by province stems from different provincial corporate tax rate structures.

Modest problems would arise in the calculation of an effective provincial tax rate for a given industry for any one particular year. Several provinces for example levy more than are corporate tax rate to create different incentives for corporations of different size.

The task however, of compiling an historical record of provincial corporate tax treatment by industry over the last twenty years, would certainly be formidable, as was beyond our resources.

The other key ingredients of user cost services, lives of capital, capital depreciation and investment inflators, as embodied within our provincial capital stock data are unfortunately national, as we have noted.

The Rate of Return

The rate of return was calculated as GDP - Salaries and Wages divided by mid-year capital stock, with the numerator serving as a proxy for net profits.

We initially tried using actual Net Profits figures for Primary, Mining and Manufacturing, and Other sectors, provided to us by Statistics Canada's Capital Expenditures Section, on a provincial basis. However, no suitable means was found, at the time, to disaggregate mining and manufacturing profits, as the profit performance within these different sectors appeared to have no common denominator. A similar problem was run up against in attempting to break out profits of Utilities and Services from the category "Other" in Statistics Canada's presentation. It is well known that utility profits are to a large extent provincially regulated, and hence would bear no resemblence to profits in the relatively laissez-faire domain of the service sector.

Cash Flow

Cash flow was approximated by GDP - Salaries and Wages.

Real Per Capital Disposable Income

Personal Income as defined by the National Income and Expenditure Accounts, Vol. 3, (Ibid.) is the sum of all incomes received by residents of Canada including earnings from current production as well as transfers from governments and other institutions. Personal Disposable Income is Personal Income less Direct Taxes and other current transfers from governments to persons.

Personal Income itself is the sum of various component estimates, some important ones of which are discussed briefly in terms of their origin on a provincial level.

Wages and Salaries are distributed provincially largely on the basis of a comprehensive set of annual and monthly surveys conducted at the provincial level. A small part of this item is allocated according to partial-coverage monthly employment and payroll data.

Supplementary Incomes are distributed provincially on the basis of wages and salaries in the case of employer's contributions to private pension funds and employee welfare-funds. Employer's contribution to Workmens Compensation are taken directly from provincial government financial accounts, while employer's contributions to the Canada Pension Plan are obtained by province from the Department of National Revenue.

Corporation profits before taxes in Manufacturing, Mining and Construction were distributed provincially according to operating surplus, with Value Added being obtained from Survey of Production (Statistics Canada, Catalogue 61-202). Profits for utilities, transportation, communication services and storage industries were provincially allocated using the "taxation formula" established by Revenue Canada and described in the Technical Notes section of Statistics Canada Corporation Taxation Statistics (Catalogue 61-208).

The Department of National Defence keeps a record of the provincial distribution of Defence employees, and these records are used by Statistics Canada to derive the provincial distribution of Military Pay and Allowances.

Net Income Received by Farm Operator from Farm Production Provincially is estimated by the Agricultural Division of Statistics Canada annually.

Personal Disposable Income was converted to constant dollars by the application of implicit deflators obtained by dividing current by constant dollar estimates of total consumer expenditures by province.

Real Personal Disposable Incomes thus obtained was converted to a per capita measure by dividing by population as reported in National Income and Expenditure Accounts, Vol. I (Ibid.).

V Econometric Equations for Provincial Employment, Investment, and Consumption

In this section we report on our efforts to explain, at the Canadian provincial level, fluctuations in employment, investment and consumption expenditure. Depending on data availability, employment and investment is modelled for five or six industrial sectors of each province's economy, and consumer expenditure for durables and non-durables.

Initial attempts were made to specify 'output' equations, making provincial sectoral output a function of industrial output and disposable income within and without of the province, so that the structural and cyclical interdependence of the provinces could be examined. However, resources have not, up until now, been available to develop these equations and our preliminary results are not reported here. Undoubtedly, the specification of inter-provincial linkages is an important area for further research, and one that could be examined fairly easily with the database that we have put together.

In the section we discuss in turn the three variables to be modelled; noting first earlier work done by others, then presenting our own results. Our research strategy is to test a number of alternative specifications, and then present, for each province and sector, that one which gave the most 'interesting' results. We were interested, of course, in getting specifications that gave a 'good' fit to the data, but our selection criterion was not simply R^2 - maximization. We distinguished between alternatives in specification without particular theoretical implications - for example, the choice of lag length on a variable and the inclusion or exclusion of the time trend - and those with potential for seriously jolting a priori beliefs, as when the importance of relative price effects was at stake. In the former case we generally added or dropped variables according to their effect on the R^2 'corrected' for degrees of freedom (except when two rather collinear variables, such as the time trend and capital stock, together had a 'significant' effect on the dependent variable but were individually insignificant when both included), but in the latter, variables that showed significance in a majority of the provincial regressions were allowed to remain in the specification for comparative purposes, even when they did not contribute much to the goodness of fit.

Although no formal criterion for 'data mining' exists, we were very much aware of the dangers of fine-tuning each equation to get the best possible sample-period fit, given the rather short time series data available, and hope that we were sufficiently restrained in our choice of alternative specifications to test for our results to have some out-of-sample-period validity. This will only be testable when new data for 1978 and later years are available.

Each model was estimated for Canada and for nine or ten provinces (the employment and investment equations were not run for Prince Edward Island because of the data problems mentioned in Section IV), by ordinary least squares regression. The computer package used (SAS) includes programs for the Zellner 'Seemingly Unrelated Regression' technique of pooling time series equations, as well as options that allow across-equation constraints to be imposed, and some preliminary experiments using these techniques were quite promising. This is something which should probably be picked up in future work. In all cases the data, as described in Section IV, are annual and estimation covers the period 1961 to 1977.

(1) Employment

(a) Survey of Previous Work

In national econometric modelling, the standard approach since Ball and St. Cyr (1966) has been to specify actual employment levels to be determined by the demand for labour, with this in turn dependent on the level of output, subject to adjustment costs and lags, and to the availability of other factors of production, in particular capital. Thus, a typical employment equation has output, lagged employment (justified by a simple partial adjustment process), and either the capital stock or relative prices, depending on how much factor substitution goes on within the time periods of the data. A time trend may also be included to capture the effects of technical change.

The U.S. regional models surveyed in Section III mostly adopt this approach as a basis, though with many variations. Milne et. al. include the real wage (wage rate relative to output price) which implies that the price of output has an influence independent of actual output on the demand for labour. This could be justified by assuming that the data are generated by a mixture of perfectly and imperfectly competitive market structures, so that some firms are price-constrained and others 'demand'-constrained in the output levels that they achieve.

The Wharton model, as proposed in the Fromm et. al. paper, does not include a term in lagged employment, implying that employment adjusts fully to its desired level within each time period. This is also a feature of the NRIES and Chase models, both of which include national productivity variables as proxies for unavailable capital stock data. The Maryland model of Ballard et. al. puts the lags on output rather than employment, and used lagged investment as a substitute variable for capital stock. The IDIOM model simply assumes fixed output/labour proportions, thus following the Input-Output rather than the econometric methodology (cf. Section II above).

This profusion of specifications is not particularly satisfying, no doubt it reflects both the many gaps in the U.S. regional database and the fact that regional econometric modelling is still at an early stage of development compared to work at the national-economy level. Perhaps some consensus will emerge as the various models evolve and are compared.

Canadian work on regional employment fluctuations has, to date, been both less intensive and less varied than the U.S. research. Swan (1972) estimated a straight-forward Ball and St. Cyr model for five regions using annual data for the years 1949 to 1968. He did not try to disaggregate the regional economies sectorally, and was therefore forced to fall in some gaps in the regional output data that was then available.

Foster (1978), for Nova Scotia, estimated employment equations at the II-digit level, and Taylor has done this for the Saskatchewan economy disaggregated into four sectors. Both Foster and Taylor (1979) did their work before the Conference Board's estimates of sectoral provincial real domestic product were available (see Section IV), and were forced to use aggregate regional product or expenditure data as proxies for sectoral output.

(b) Results

Employment equations for the nine provinces and Canada were estimated for a four-sector disaggregation of their economies. As well, data were available for the three largest provinces (Quebec, Ontario, British Columbia) for 'Mining' and 'Construction' industries which were imbedded in the category Primary and Construction for other provinces. A disaggregation of the Services sector would be possible, but we did not judge this worth the bother, at this stage of our research.

A number of employment function versions of the orthodox specification discussed above were tried out. As well, the model developed by Hazledine and applied by him, apparently successfully, to aggregate quarterly data on Canadian manufacturing industry (1979c) was tested with these annual regional data. It did not perform well (possibly because Hazledine's actual/peak output variable does not vary enough year-by-year), and the results are not shown here.

The most interesting specifications are shown, sector by sector on Tables 1 through 6. We look at each in turn. The dependent variable in all cases is the logarithm of current employment minus the logarithm of the previous year's employment, and all the independent variables except the time trend are in logarithms, so that coefficients can be interpreted as elasticities. When a variable is omitted from a specification it can be assumed that it was either not significant (t 2), or was less significant than an alternative variable.

Table 1 gives the results for the Primary and Construction sector. The most striking feature of these is that the real wage is mostly a strongly significant determinant of employment fluctuations, while output more often than not isn't significant. This probably reflects the structure of Primary industries, of which most, if not perfectly competitive, at least sell products traded at world prices over which Canadian producers have little control.

The lagged employment variable coefficient is mostly not significantly different from 1, the value it would take if there was no partial adjustment process.

The goodness-of-fit is in all cases at least satisfactory (remember that the dependent variable is the change, not the level of employment), and the generally high values of the Durbin-Watson statistic may be an indication that serial correlation is not generally a problem, though this statistic is not strictly valid in specifications in which the lagged employment coefficient is significantly different from one (the fewness of observations prevent the use of Durbin's "h" statistic).

The Manufacturing sector employment equations (Table 2) also show strong real wage effects in most provinces, but output too has a mostly significant impact. We should expect output (implying demand-constrained employment) to be of more importance in the generally imperfectly, competitive manufacturing sector than it is in Primary industries.

The coefficients on lagged employment again do not allow us to reject, in most cases, the hypothesis that employment adjusts fully to its equilibrium value within one year. Capital stock does not show through as an independently significant modifier of employment, though in some cases this may be due to the variable's collinearity with the time trend (in which cases capital is retained in the specification tabulated). The R^2s are rather good but the Durbin-Watson statistic is not always satisfactory.

Table 3 shows the results for Utilities. Although the overall statistical properties of these regressions are quite satisfactory, no clear pattern of significance for individual variables is discernable across the provinces. This may well reflect the diversity in the ways that the different provinces run or regulate their Utilities.

The regressions explaining fluctuations in service sector employment are set out in Table 4. They appear to have been rather successful and reveal strong output and real wage effects and generally complete adjustment of employment in response to output and real wage changes within the year.

Table 5 gives employment function equations for two industries within the 'Primary and Construction' sector - Mining and Construction - for the three provinces for which data are available. The two industries make for an interesting contrast. Price effects are particularly important to employment in the Mining sector, whereas output is the dominant factor in Construction. This is as we would expect, given the natures of the two industries - Mining sells homogeneous products traded in world markets under 'perfectly competitive' conditions whereas the output of Construction industries is sold in local markets in which imperfect-competitive, output-constrained market conditions are likely to be the rule.

Overall, there are a number of things that can be said about these results. First, the econometric modelling effort can be judged apparently a success. Without much mining of the data (by, for example, trying-out large numbers of lag distributions), well-fitting sensible looking regression equations were produced for nearly every sector in every province. That is, it does seem to be quite possible, with the data now available, to model regional employment fluctuations.

Secondly, (though we haven't yet tried formal hypothesis tests), the provinces do appear to differ quite a lot in their employment behaviour amongst themselves and with the aggregate behaviour picked up in the 'Canada' regressions. If these differences are significant (and they may just reflect random variations due to the limited number of degrees of freedom of our annual time series data) they do imply that provincial-level employment model is worthwhile, perhaps even necessary - there is genuine regional heterogeneity which is smoothed out by national models.

Thirdly, real wage variables show rather more significance than they typically have demonstrated in national-level empirical research, most of which used quarterly data (cf. Hazledine, 1979b, Section III for a variety of these results). They dominated relative factor price variables (so that no regressions with relative factor prices are shown here), implying either that labour and capital are not regarded as substitutes over time periods of up to one year, or that the user cost of capital variable used in factor prices is not well-measured. Since this variable also generally fails to show significance in the investment equation, it is difficult to rule out the latter possibility.

(2) Investment

(a) Survey of Previous Work

The modern econometric literature on the determinants of investment spending at the national-economy level is substantial and contentious. Rather than attempt a full survey here, we will refer the reader to the recent paper by Clark (1979) in which the main approaches are assembled and tested against each other on a quarterly U.S. data base.

There seem to be two main issues: (1) the relative importance of capital market "push" factors (availability of retained earnings, interest rates) and product market "pull" (the state of demand for output); and, (2) whether product markets are "neoclassical" (perfectly competitive), so that exogenous prices are the proper demand variable, or "Keynesian", such that firms typically face quantitity constraints on sales and thus investment, so that expected sales or orders are the prime mover of investment decisions.

Clark's principal finding, which is consistent with other work that has attempted to discriminate empirically between models rather than impose the expected behaviour a priori, is that the Keynesian quantity-constraints predominate. He found that neither cash flow nor (relative) prices were of much use, and that the most significant explanatory variable was capacity utilization - the pressure of output (proxying sales) on supply.

Work on investment equations at the regional level has been hampered, especially in the U.S. by lack of regional investment data. In his survey, Bolton suggests that investment modelling is a "frontier", and calls for a "concerted effort" to get the necessary data.

For Canada, Foster, too, complained of a lack of investment data, though Taylor found series for six sectors of the Saskatchewan economy, and estimated investment equations for four of them, using a simple specification of distributed lags on GNE or Personal Disposable income as explanatory variables.

For Canada, Guccione and Gillen (1972) made a pioneering attempt to estimate investment equations for the five regions using lagged investment and national output (no regional output data were then available) as their explanatory variables. They found that the adjustment speeds implied by their lagged dependent variables were not significantly different across the regions.

We are able to present results more complete in their coverage than has previously been possible due to the recent availability of regional capital stock and investment data from Statistics Canada.

(b) Results

The investment equations reported here cover the same provincial/sectoral disaggregation as our employment equations. We had hoped to comprehensively test the various specifications that have surfaced in national-level research, but the problems with some of the regional price data described in Section IV may have prevented us from properly investigating the 'neoclassical' hypothesis of price-determined output and investment. Price variables were not significant.

Thus, our explanatory variables are restricted to real output (expected to proxy demand factors), and cash flow or rate of return, which should pick up availability-of-finance constraints, and/or be proxies for expected future demand conditions. Since new capital takes rather longer to install than it takes to take on more labour, and since, once installed, it is relatively "fixed", we felt justified in searching for lagged effects of up to two years (for our employment equations, the maximum lag specified was one year).

We also included the value of the stock of capital on hand at the end of the previous year. Lagged capital stock is frequently included in investment equations. It can be expected to pick up two factors - the amount of adjustment needed to get capital stock in the current period to its desired level, and the amount of wearing-out of plant and machinery that will lead to replacement investment. Since these two factors go in opposite directions - ceteris paribus the larger the stock on hand the less additional capital will be required, but the more replacement there will be of worn-out and obsolete equipment - we have no priors on the sign of the coefficient on lagged capital stock.

The 'best' regression equations are shown on Tables 6 to 10. For the Primary and Construction Sector (Table 6) the results are mixed. For all Canada we get a quite impressive collection of significant coefficients, but the provincial results are mostly weak with the encouraging exception of the two most important Western Primary-producing provinces - Saskatchewan and Alberta - in which both lagged rate-of-return and lagged output appear to play a significant part.

The absence of reliable price data may matter particularly in this sector (though they may turn out to be quite closely related to rates of return) as too may the unavoidable lumping-together of the very dissimilar Primary and Construction sectors. This may be more of a problem for those provinces in which Primary activities do not generate a very large part of provincial domestic product than for the Prairie provinces, in which the Construction sector may be a quite small part of the Primary and Construction aggregate.

Table 7 gives the results for Manufacturing industries. In line with Clark's findings, and consistent with our own results for employment behaviour, real output (lagged one year) is the most consistently significant variable. Since most manufacturing investment is done in Quebec and Ontario (about 75 per cent of the Canadian total), the equations for these two provinces are of particular interest. We found that both output and cash flow are significant factors in Ontario and in Quebec, but that their relative importance is reversed in the two equations - Quebec has a larger lagged output coefficient, whereas the elasticity of lagged cash flow is bigger in Ontario. This finding demonstrates the potential importance of modelling at the regional level, since the coefficients in the 'Canada' equation appear to be approximate averages of those estimated for Quebec and Ontario - that is, the national equation covers up significant differences in provincial investment behaviour.

The equations for Utilities (Table 8) are not very successful. Lagged rate of return is significant for Canada as a whole, but only for one province - British Columbia - and output variables sometimes turn out to have negative but 'significant' coefficients. The variety of institutional arrangements under which utilities operate in Canada may explain the difficulty we had in coming up with sensible results.

In Service industries (Table 9) output seems often to be a determinant of investment, though the generally low t-values along with 'respectable' R^2's suggest that multicollinearity between the explanatory variables has made it difficult to isolate the effects of particular factors.

Finally, in Table 10, are shown the results for Mining and for Construction, for Canada and the three largest provinces. Those for Mining are not very good - no doubt price data would be particular useful in modeling this sector. The Construction equations are somewhat better. As was the case with the employment equations, we found output to be the most important explanatory factor. 'Cash flow' did show marginal significance in the Canada equation, but this could not be replicated in any of the provincial specifications, and so should not be taken very seriously.

In discussing these results, we have not focused attention on the lagged capital stock variable, as it is not of great interest in itself. We may note, though, that it does show significance in nearly half of the investment equations, and on all these occasions its coefficient is negative, consistent with the 'stock adjustment' effect dominating the 'replacement motive'.

Overall, the R^2's and Durbin-Watson statistics of the investment functions do suggest that we have uncovered some of the factors affecting provincial investment behaviour. However, individual equations are often unsatisfactory, containing insignificant or wrong-signed coefficients, and the research effort no doubt suffered from the lack of reliable price data. More work is needed.

3. Consumer Expenditure

We estimated equations to explain provincial fluctuations in real consumer expenditure, disaggregated into expenditure on durables and on non-durables.

Models of consumption behaviour are built up, implicitly or explicitly, from hypotheses about the behaviour of individual households, and so we do not expect the theoretical specification of our regional consumption equations to raise any issues distinct from those discussed in the extensive literature on national-economy-level expenditure models.

However, there may well be interesting inter-provincial differences in the <u>empirical</u> results, to the extent that households face different economic environments in different provinces.

In this section, we report econometric specifications of two consumer expenditure models. For a comprehensive exposition of these models, and an entrée to the literature on consumption functions, cf. Kuh and Schmalensee, (1973, (Chap. 3)). One specification, known as the "Brown" model, has real per capita consumption as a function of real per capita disposable income and of real per capita consumption in the previous year. Thus, changes in income are the determining factor of changes in consumption, but with effects that differ according to the length of the time period considered.

The other specification, due to Houthakker and Taylor, allows past behaviour to influence present consumption. Rather analogous to the role of lagged capital stock in investment behaviour, previous consumption can have a positive (through 'habit formation') or negative (through stock adjustment) effect on curent consumption expenditure. We don't have data on the stock of consumer goods left over from earlier periods, but Houthakker and Taylor showed how an equation could be specified in terms of variables of which the coefficients have an interpretation in terms of the assumed underlying model.

The results are on Tables 11 to 14. All variables are in log form. First we look at the equations for non-durable expenditure (Table 11). Though the Canada equation suffers seriously from serial correlation, most of the provincial equations do not, and their coefficients are mostly comfortably significant. There is quite a lot of inter-provincial variation in the estimated short-run marginal elasticities of consumption (the coefficient of personal disposable income, YPDR), but less in the long-run elasticities computed by setting lagged expenditure equal to its current value.

The short-run elasticities are particularly low for the Prairie provinces which may reflect the greater instability experienced by the primary industry-based economies of the Prairies, leading to a more cautious reaction by households to short-run variations in their disposable incomes.

The more sophisticated Houthakker-Taylor model (Table 12) does not add significantly to the explanatory power of the non-durables equation for any of the provinces, though individual coefficients are mostly significant enough for the model to be acceptable if there were strong prior grounds for preferring it to the simple Brown specification. We note that the implied long-run marginal elasticities of consumption do not differ much between the two models.

Table 13 shows the results of applying the Brown specifications to data on expenditures on durable goods. Again, serial correlations was more of a problem in the all Canada regression than in those for the provinces.

Most of the short-run, and all of the long-run income elasticities are greater than one, implying, not surprisingly, that durables are luxury goods - the proportion of income spent on them increases with income.

The Houthakker-Taylor model (Table 14) does not give significant increases in R^2 over the Brown specification, though there may be good theoretical reasons for preferring it as a specification of expenditure on durables, given the likely importance for current decisions of the stock of durables on hand from past expenditures. The logarithmic version of Houthakker-Taylor's " " coefficient (calculated as the coefficient on lagged expenditure, plus the ratio of the coefficients of lagged income and the logarithmic change in income, minus one) turns out to be negative for some provinces, and in most cases, is less than its value in the non-durable equations. This is consistent with 'stock adjustment' being relatively more important than 'habit formation' for durables (cf. Kuh and Schmalensee, pp. 37-40).

Overall, these results seem at least to be promising. It would be good to experiment with more complicated specifications; for example, including price effects on consumption, and looking for differences in the responses to changes in earned income compared with changes in transfers (given the inter-provincial differences in per capita transfer receipts). We have done some regressions breaking down income in this way; the initial results appear interesting.

VI Uses and Extensions

As it stands, the work reported in this paper represents a substantial but incomplete 'first bite' at modelling provincial economic activity using the provincial data that have recently become available.

To the extent that our econometric results are judged acceptable, then they should be of some use in the future development of regional economic modelling in Canada. In particular, researchers interested in building models of individual provinces will, even if their own preferred employment, investment and consumption equations end up differing from those presented here, at least have a benchmark for companying their province with the others.

As for the research program reported here, it could usefully be extended in two dimensions - better equations and more of them.

On the latter, the important regional economic policy questions concerning inter-provincial linkages and the provincial dissemination of national-level cyclical fluctuations can only be answered with complete models of the provincial economies, which can be used in simulation exercises. The level of sophistication of complete models is variable, of course, but there must be enough equations to close the circular flow of income, so that the effects of exogenous shocks can be traced right through the provincial economy.

A first step in building closed provincial models on the foundations provided here might be to add an equation linking provincial expenditure on consumption and capital formation to provincial outputs, with particular attention paid to the 'leakages' of spending across provincial and national borders. Predicted provincial outputs could then be plugged-in to our equations explaining employment and capital formation, in which output effects are, in most cases, important.

We did make an atempt to estimate these output equations, but have not been able to develop these to a usable level in the time available.

Another important extension would be into modelling <u>public</u> sector expenditures at federal, provincial and local levels. One of us has already done a considerable amount of preparatory work on the theoretical specification and data requirements of public expenditure equations, building on his earlier research for the Economic Council's <u>Confederation Study</u> (Macdonald, 1979), and it is to be hoped that this work can continue.

On the second dimension for extension of our research - better equations - we have noted, in the previous section, a number of potential improvements, subject to data availability, which would result from a more complete application of the models and methods proposed in previous work at the national-economy level.

It may be more fruitful, however, to focus future research on extending the frontiers of provincial models past those reached in national-economy research in order to take proper account of any peculiarly regional aspects to economic behaviour. We think, in particular, of the generally greater mobility of factors of production - both capital and labour - between provinces than across national borders.

Even in the context of relatively "open" economies such as Canada, national-level modelling of employment and investment has been able to proceed without paying any attention to extra-territorial movements of labour and capital. Whether or not this is really justifiable at this level, it can hardly be so when the focus of attention is the provincial economy.

Therefore, future work might very usefully attempt to model inter-provincial migration of labour and inter-provincial flows of investment funds. The latter would involve specifying rate of return in provincial investment equations relative to returns obtainable in other provinces.

A successful attempt to model inter-provincial factor mobility should throw valuable light on the very important and unresolved issues raised by the persistent unequal levels of economic development observed in the regions of Canada. Why is the Canadian economy apparently not 'neoclassical', in the sense of containing mechanisms which work to equalize returns to factors across regions, when the U.S. apparently is, (cf. the model of Milne et. al, in which regional disparities inexorably diminish over time)? What policies might be adopted by federal and provincial governments to increase regional balance, and what has been the effect of past policies such as DREE grants and equalization payments? These are crucial questions.

Table 1: Primary and Construction Employment Equations

	Constant	Trend	X	XW	WP	KR	EL1	R^2	DW
Canada	6.47 (1.35)	-0.0009 (-0.04)	0.10 (0.65)		-0.17 (-3.49)	0.03 (0.07)	-0.89 (-3.76)	0.663	2.334
Newfoundland	2.41 (2.40)	-0.02 (-2.39)		0.38 (2.28)	-0.39 (-2.89)		-0.35 (-2.30)	0.697	2.199
Nova Scotia	7.32 (3.17)	-0.0004 (-0.30)	0.08 (0.35)				-0.98 (-3.99)	0.689	1.685
New Brunswick	4.29 (4.12)	-0.03 (-4.10)		0.51 (3.87)	-0.33 (-3.39)		-1.17 (-5.63)	0.735	2.152
Quebec	6.89 (4.69)	-0.0005 (-0.07)	0.47 (3.64)		-0.31 (-3.54)	-0.37 (-3.02)	-0.89 (-4.55)	0.767	2.092
Ontario	9.31 (4.53)	0.01 (2.07)	-0.08 (-0.44)		-0.14 (-2.79)		-1.31 (-5.91)	0.805	1.660
Manitoba	4.57 (2.86)	-0.01 (-1.66)	0.06 (0.34)		-0.14 (-1.76)		-0.89 -3.07	0.462	1.878
Saskatchewan	5.01 (3.27)	0.01 (1.63)	0.02 (0.19)		-0.34 (-2.83)		-0.58 (-2.51)	0.508	1.818
Alberta	3.48 (1.36)	0.003 (0.14)	0.55 (1.65)				-0.14 (-1.17)	0.698	2.254
British Columbia	-0.92 (-0.82)	-0.07 (-3.67)	0.80 (6.29)		-0.35 (-4.53)	0.65 (3.22)	-1.34 (-10.43)	0.928	2.372

Dependent Variable: logarithmic difference between current and lagged employment (E-EL1). All independent variables except the time trend are in logarithms.

Table 2: Manufacturing Employment Equations

	Constant	Trend	X	XW	WP	KR	EL1	R^2	DW
Canada	-4.43 (-2.46)	-0.01 (-3.32)	0.62 (9.88)		-0.42 -3.56	0.12 (1.02)	-0.64 (-8.11)	0.923	1.198
Newfoundland	-0.39 (-0.61)	0.02 (2.49)	0.29 (4.08)		-0.23 (-3.51)	-0.05 (-0.75)	-0.82 (-4.51)	0.816	2.020
Nova Scotia	-3.86 (-3.16)	-0.0009 (-0.06)	0.64 (3.90)		-0.65 (-3.03)	0.06 (1.01)	-0.99 (-5.12)	0.755	1.238
New Brunswick	0.27 (0.47)	0.01 (1.30)	0.30 (2.34)				-0.95 (-3.83)	0.675	2.085
Quebec	-3.10 (-2.69)	-0.01 (-0.59)	0.58 (7.19)		-0.38 (-2.49)	-0.03 (-0.51)	-0.55 (-3.35)	0.863	1.575
Ontario	-3.47 (-2.80)	-0.01 (-1.14)	0.65 (7.82)		-0.36 (-2.33)	0.06 (0.61)	-0.67 (-6.29)	0.897	1.198
Manitoba	-1.25 (-1.36)	-0.02 (-2.40)	0.51 (4.88)				-0.61 (-2.91)	0.740	1.022
Saskatchewan	-2.59 (-1.37)	0.04 (1.87)	0.08 (0.33)		-0.71 (-3.93)	0.06 (0.28)	-0.77 (-5.29)	0.816	1.284
Alberta	-3.12 (-3.66)	0.01 (0.61)		0.71 (3.56)	-0.47 (-4.24)		-0.96 (-5.54)	0.824	1.578
British Columbia									

Dependent Variable: logarithmic difference between current and lagged employment (E-EL1). All independent variables except the time trend are in logarithms.

Table 3: Utilities Employment Equations

	Constant	Trend	X	XW	WP	KR	EL1	R^2	DW
Canada	1.39 (0.60)	-0.01 (-0.60)		0.51 (2.17)	-0.32 (-2.83)		-0.47 (-2.75)	0.657	2.596
Newfoundland	7.61 (5.32)	0.05 (4.39)	0.03 (0.85)		-0.72 (-3.90)		-0.70 (-4.15)	0.816	1.541
Nova Scotia	1.42 (1.19)	-0.02 (-1.63)	0.82 (6.64)		-0.40 (-3.97)		-0.72 (-9.81)	0.945	2.427
New Brunswick	4.81 (2.22)	0.02 (1.25)	0.11 (0.41)		-0.44 (-2.05)		-0.56 (-2.62)	0.534	1.767
Quebec	-0.03 (-0.02)	-0.01 (-0.81)	0.05 (0.41)		-0.02 (-0.12)	0.58 (2.89)	-1.07 (-3.63)	0.566	1.593
Ontario	2.83 (1.13)	0.01 (0.33)	0.28 (1.38)		-0.27 (-3.62)		-0.51 (-2.24)	0.665	2.469
Manitoba	-2.67 (-0.60)	-0.04 (-1.33)	0.71 (1.78)		-0.47 (-2.02)	0.57 (1.61)	-0.43 (-1.58)	0.539	1.795
Saskatchewan	7.79 (3.53)	-0.01 (-0.69)	0.97 (5.27)			-1.37 (-4.95)	-0.86 -6.56	0.863	1.515
Alberta	-9.33 (-3.45)	-0.11 (-4.18)	1.22 (5.62)			0.47 (1.74)	-0.35 (-2.96)	0.757	2.529
British Columbia	0.91 (0.55)	-0.02 (-1.40)		0.68 (5.13)	-0.24 (-1.13)		-0.77 (-6.22)	0.842	1.533

Dependent Variable: logarithmic difference between current and lagged employment (E-EL1). All independent variables except the time trend are in logarithms.

Table 4: Services Employment Equations

	Constant	Trend	X	XW	WP	KR	EL1	R^2	DW
Canada	0.26 (0.13)	-0.003 (-0.27)	0.75 (3.94)		-0.33 (-2.74)	-0.04 (-1.46)	-0.58 (-3.69)	0.741	2.507
Newfoundland	0.87 (0.67)	-0.01 (-0.50)		0.88 (4.82)	-0.41 (-3.31)		-0.68 (-4.42)	0.774	1.538
Nova Scotia	-1.37 (-0.69)	-0.01 (-0.78)	0.90 (2.53)				-0.75 (-4.22)	0.713	2.646
New Brunswick	0.12 (0.08)	0.01 (0.63)	0.60 (2.01)		0.02 (0.52)		-0.98 (-5.78)	0.788	2.627
Quebec	1.00 (0.73)	-0.01 (-0.89)	0.85 (4.76)		-0.52 (-3.05)		-0.61 (-4.18)	0.745	2.147
Ontario	-4.30 (-1.82)	-0.03 (-1.86)		1.26 (4.01)	-0.34 (-2.92)		-0.62 (-3.36)	0.685	1.735
Manitoba	2.80 (2.05)	0.01 (1.57)	0.59 (4.78)				-1.03 (-6.53)	0.880	1.933
Saskatchewan	6.20 (3.63)	0.01 (1.82)	0.66 (4.75)		-0.97 (-3.87)		-0.55 (-2.77)	0.846	1.770
Alberta	-2.10 (-0.90)	-0.03 (-2.07)	1.11 (3.95)		-0.42 (-2.78)	0.30 1.93	-0.92 -5.41	0.788	2.666
British Columbia	-0.81 (-0.63)	-0.002 (-0.21)		1.06 (6.72)	-0.18 (-2.21)		-1.10 (-8.29)	0.888	2.327

Dependent Variable: logarithmic difference between current and lagged employment (E-EL1). All independent variables except the time trend are in logarithms.

Table 5: Employment Equations for Mining, Construction

	Constant	Trend	X	XW	WP	KR	EL1	WC	R^2	DW
(a) Mining										
Canada	1.374 (0.70)	0.048 (5.40)	-0.096 (-0.69)		-0.876 (-4.67)		-1.083 (-6.13)		0.871	1.396
Quebec	-6.327 (-3.91)	0.017 (2.74)		0.759 (3.46)	-1.025 (-8.77)		-0.973 (-9.45)		0.945	1.654
Ontario	-6.690 (-4.72)	0.022 (4.33)	0.703 (4.26)		-1.111 (-10.30)		-0.902 (-9.55)		0.956	1.297
British Columbia	-3.830 (-5.00)	-0.051 (-2.66)	0.393 (2.66)		-0.160 (-1.14)	0.602 (3.12)	-1.202 (-7.28)	0.063 (1.	0.868	1.943
(b) Construction										
Canada	-3.489 (-2.15)	-0.005 (-0.99)	1.026 (5.77)		-0.250 (-2.39)	-0.114 (-1.10)	-0.943 (-7.39)		0.883	1.700
Quebec	0.363 (0.39)	-0.009 (-1.61)	0.746 (4.08)			-0.303 (-2.56)	-0.838 (-4.33)		0.685	1.902
Ontario	-3.949 (-3.48)	0.010 (2.14)	0.755 (5.10)		-0.467 (-4.81)		-0.796 (-5.31)		0.744	2.12
British Columbia	-0.386 (-0.71)	0.030 (4.53)	0.890 (7.89)			-0.514 (-2.64)	-0.828 (-5.15)		0.887	2.598

Dependent Variable: Logarithmic difference between current and lagged employment (E-EL1). All independent variables except the time trend are in logarithms.

Table 6: Primary and Construction Investment Equations

	Constant	Trend	XL1	KRL1	RL2	R^2	DW
Canada	41.20 (5.15)	0.23 (5.41)		-3.53 (-4.16)	0.32 (3.51)	0.979	2.350
Newfoundland	8.49 (2.63)	0.02 (0.35)		-0.47 (-0.76)	1.01 (2.13)	0.564	1.615
Nova Scotia	4.28 (5.50)	0.06 (3.80)		0.04 (0.40)	0.88 (1.76)	0.722	2.014
New Brunswick	28.71 (3.91)	0.25 (4.15)	1.02 (2.15)	-5.70 (-3.62)		0.841	1.178
Quebec	2.67 (0.39)	0.04 (1.37)	-0.79 (-0.96)	1.11 (1.34)		0.857	1.035
Ontario	19.77 (3.75)	0.11 (5.40)	0.57 (1.19)	-2.28 (-4.88)		0.954	1.475
Manitoba	23.53 (3.07)	0.15 (3.37)		-2.74) (-2.40)	0.29 (1.88)	0.860	1.234
Saskatchewan	10.79 (2.00)	0.06 (2.01)	0.77 (2.20)	-1.30 (-1.88)	0.55 (3.01)	0.690	1.440
Alberta	0.13 (0.01)	-0.04 (-0.51)	2.18 (2.87)	-0.94 (-1.26)	1.15 (10.07)	0.985	2.085
British Columbia	2.27 (0.30)	0.08 (0.77)	0.96 (1.39)	-0.52 (-0.47)		0.867	1.366

Dependent variable: Log total Real Gross Fixed Capital Formation. All independent variables except the time trend are in logarithms.

Table 7: Manufacturing Investment Equations

	Constant	Trend	XL1	KRL1	CFL2	R^2	DW
Canada	-8.37 (-0.92)	-0.06 (-1.27)	2.30 (5.16)	-0.40 (-0.35)	1.34 (1.58)	0.935	1.706
Newfoundland	-0.80 (-0.09)	0.09 (0.59)	3.71 (2.25)	-2.38 (-1.57)		0.406	1.514
Nova Scotia	-13.51 (-0.67)	-0.26 (-0.81)	1.54 (0.49)	1.90 (1.11)		0.295	0.620
New Brunswick	12.20 (1.13)	0.23 (1.77)	3.53 (2.69)	-4.62 (-3.48)		0.799	1.659
Quebec	4.86 (3.70)		3.52 (6.65)	-3.10 (-5.21)	0.95 (2.07)	0.882	2.064
Ontario	4.75 (3.82)		1.03 (3.17)	-0.44 (-1.13)	2.78 (5.18)	0.924	2.269
Manitoba	39.39 (2.23)	0.30 (2.14)	-3.04 (-1.52)	-3.10 (-1.59)		0.352	1.203
Saskatchewan	30.90 (2.04)	0.17 (1.28)	0.16 (0.08)	-5.19 (-2.95)		0.656	1.271
Alberta	9.26 (1.07)	0.20 (1.95)	-1.13 (-0.75)	0.10 (0.20)		0.936	2.539
British Columbia	-11.11 (-0.75)	-0.11 (-1.02)	2.74 (1.53)	-0.23 (-0.14)		0.337	0.906

Dependent variable: Log total Real Gross Fixed Capital Formation. All independent variables except the time trend are in logarithms.

Table 8: Utilities Investment Equations

	Constant	Trend	X	XL1	KRL1	RL2	R^2	DW
Canada	60.91 (6.33)	0.31 (6.60)			-5.13 (-5.32)	0.50 (3.07)	0.991	1.887
Newfoundland	10.54 (2.62)	0.46 (4.35)		-1.52 (-5.19)	-0.67 (-0.93)		0.791	1.306
Nova Scotia	21.84 (5.10)	0.20 (5.15)		0.30 (0.48)	-3.10 (-5.37)		0.975	1.447
New Brunswick	38.16 (1.86)	0.40 (1.97)	-1.81 (-0.70)	-0.91 (-0.35)	-3.40 (-1.62)		0.781	0.841
Quebec	45.64 (4.03)	0.36 (5.22)	-0.69 (-0.42)	-4.33 (-2.45)	-0.47 (-0.32)		0.855	1.354
Ontario	-9.11 (-0.87)	-0.14 (-1.80)		4.58 (4.34)	-2.00 (-2.84)		0.959	0.975
Manitoba	105.40 (3.88)	0.85 (3.91)	-2.02 (-0.96)	-5.95 (-2.11)	-7.55 (-3.57)		0.887	1.354
Saskatchewan	18.51 (1.59)	0.06 (0.64)	0.08 (0.05)	0.02 (0.01)	-1.87 (-1.10)		0.217	1.074
Alberta	46.58 (2.14)	0.45 (2.22)	-3.30 (-1.65)	1.28 (0.60)	-3.93 (-1.67)		0.906	1.435
British Columbia	54.12 (5.32)	0.36 (4.84)			-5.18 (-4.18)	2.53 (5.35)	0.918	1.732

Dependent variable: Log total Real Gross Fixed Capital Formation. All independent variables except the time trend are in logarithms.

Table 9: Services Investment Equations

	Constant	Trend	X	XL1	XL2	KRL1	R^2	DW
Canada	-25.85 (-2.31)	-0.145 (-2.26)		5.739 (5.05)	-2.738 (-2.36)	0.419 (3.17)	0.975	1.413
Newfoundland	-3.79 (-0.28)	0.09 (0.56)	3.96 (1.50)	0.93 (0.29)		-3.74 (-2.91)	0.801	1.643
Nova Scotia	18.20 (0.68)	0.13 (0.64)	1.48 (0.34)	-3.96 (-0.97)		0.24 (0.45)	0.661	0.999
New Brunswick	6.48 (0.23)	0.06 (0.23)	0.24 (0.09)	-1.25 (-0.44)		0.57 (0.23)	0.867	1.590
Quebec	-29.36 (-2.75)	-0.12 (-1.82)	4.20 (2.61)	4.98 (2.26)		-5.05 (-5.41)	0.911	1.441
Ontario	-44.18 (-2.37)	-0.299 (-2.78)		6.023 (2.56)	-1.715 (-0.95)	1.456 (1.50)	0.947	1.659
Manitoba	11.95 (0.67)	0.09 (0.67)	-1.16 (-0.58)	1.22 (0.47)		-1.16 (-0.97)	0.760	1.730
Saskatchewan	-12.16 (-1.34)	-0.06 (-1.06)		3.60 (3.70)		-1.05 (-1.26)	0.744	2.099
Alberta	-3.81 (-0.31)	-0.01 (-0.10)	6.06 (3.30)	-3.80 (-2.20)		-1.05 (-1.19)	0.936	1.796
British Columbia	15.43 (3.39)	0.22 (4.87)		2.11 (4.20)		-3.65 (-6.89)	0.991	1.981

Dependent variable: Log total Real Gross Fixed Capital Formation. All independent variables except the time trend are in logarithms.

Table 10: Investment Equations for Mining, Construction

	Constant	Trend	X	XL1	KRL1	CF	CFL2	CFL2	R^2	DW
(a) Mining										
Canada	-3.929 (-0.49)	-0.046 (-0.61)		-0.519 (-1.00)	1.767 (1.41)			1.338 (3.03)	0.960	2.723
Quebec	30.15 (4.03)	0.227 (5.13)		-3.554 (-3.69)	-0.931 (-1.23)		0.362 (1.11)		0.891	1.403
Ontario	21.64 (2.84)	0.269 (5.54)	2.335 (2.72)	1.949 (1.91)	-6.367 (-4.49)				0.833	2.000
British Columbia	2.421 (0.42)	0.30 (0.10)		0.980 (0.76)	-0.306 (-0.17)			2.023 (3.25)	0.727	1.728
(b) Construction										
Canada	13.484 (0.92)	0.087 (1.29)	1.602 (1.50)	-1.315 (-1.48)	-1.302 (-1.89)	1.481 (2.04)			0.947	2.243
Quebec	-13.258 (-3.43)	-0.019 (-0.86)	2.577 (4.10)	-0.187 (-0.27)	0.094 (0.20)				0.887	2.005
Ontario	-2.992 (-0.84)	0.037 (1.59)		1.360 (3.41)	-0.489 (-2.44)				0.972	1.984
British Columbia	1.876 (1.04)	0.083 (4.32)	1.737 (5.59)	0.440 (1.10)	-2.499 (-6.43)				0.955	1.381

Dependent variable: Log total Real Gross Fixed Capital Formation. All independent variables except the time trend are in logarithms.

Table 11: Consumption Equations; Non-Durables (ZCNDR) "Brown" Specification

	Constant	YPDR	ZCNDR-1	R^2	DW	LR Elasticity
Canada	0.889 (2.93)	0.446 (4.16)	0.425 (2.87)	0.996	0.91	0.776
Newfoundland	0.429 (1.15)	0.445 (2.54)	0.486 (2.26)	0.977	1.87	0.866
Prince Edward Island	0.511 (1.45)	0.272 (1.91)	0.656 (3.50)	0.990	2.04	0.791
Nova Scotia	0.748 (1.42)	0.331 (1.68)	0.562 (2.09)	0.987	1.67	0.756
New Brunswick	0.794 (1.94)	0.274 (2.08)	0.614 (3.34)	0.985	1.39	0.710
Quebec	1.106 (2.42)	0.616 (3.22)	0.219 (0.86)	0.989	1.62	0.789
Ontario	1.313 (3.57)	0.540 (4.64)	0.274 (1.66)	0.995	1.29	0.743
Manitoba	0.633 (1.85)	0.265 (2.98)	0.644 (4.87)	0.991	1.21	0.744
Saskatchewan	0.557 (1.82)	0.165 (3.79)	0.755 (9.43)	0.988	1.86	0.673
Alberta	0.284 (1.31)	0.355 (4.95)	0.599 (6.14)	0.996	1.25	0.885
British Columbia	0.688 (1.67)	0.367 (2.49)	0.537 (2.70)	0.988	1.65	0.792
Mean	0.706	0.535	0.363			0.775

Dependent Variable: Log real per capita expenditure on non-durables.
Independent variables in logarithms.

Table 12: Consumption Equations; Non-Durables, "Houthakker Taylor"

	Constant	ΔYPDR	YPDR-1	ZCNDR-1	R^2	DW	LR Elasticity	
Canada	0.418 (1.15)	0.539 (4.99)	0.232 (1.59)	0.707 (3.61)	0.997	1.29	0.792	0.137
Newfoundland	0.358 (0.92)	0.684 (1.83)	0.401 (2.13)	0.540 (2.34)	0.978	1.97	0.872	0.126
Prince Edward Island	0.317 (1.94)	2.05 (1.37)	0.408 (2.32)	0.476 (2.05)	0.991	1.61	0.779	0.325
Nova Scotia	0.719 (1.32)	0.431 (1.48)	0.306 (1.46)	0.592 (2.09)	0.988	1.78	0.750	0.302
New Brunswick	0.663 (1.66)	0.599 (2.43)	0.200 (1.49)	0.705 (3.80)	0.987	1.76	0.676	0.039
Quebec	1.023 (2.09)	0.697 (2.87)	0.564 (2.61)	0.283 (1.00)	0.990	1.90	0.789	0.092
Ontario	1.042 (2.20)	0.612 (4.35)	0.429 (2.55)	0.423 (1.82)	0.995	1.69	0.743	0.124
Manitoba	0.335 (0.79)	0.296 (3.23)	0.159 (1.26)	0.793 (4.34)	0.992	1.72	0.768	0.124
Saskatchewan	0.796 (1.92)	0.166 (3.77)	0.215 (2.96)	0.671 (5.29)	0.989	1.66	0.653	0.967
Alberta	0.332 (1.23)	0.334 (3.37)	0.382 (3.39)	0.565 (3.85)	0.996	1.25	0.876	0.709
British Columbia	0.408 (1.00)	0.547 (3.30)	0.188 (1.14)	0.755 (3.49)	0.991	2.20	0.764	0.099
Mean	0.579	0.642	0.325	0.580			0.767	0.246

Dependent Variable: Log real per capita expenditure on non-durables. ΔYPDR is the log of the ratio of current and lagged real personal per capita disposable income. Other variables in logarithms.

Table 13: Consumption Equations; Durables "Brown Specification"

	Constant	YPDR	ZCDR-1	R^2	DW	LR Elasticity
Canada	-4.74 (-4.22)	1.210 (4.44)	.182 (1.00)	0.988	1.08	1.479
Newfoundland	-1.125 (2.16)	0.886 (2.24)	.365 (1.34)	0.960	1.23	1.395
Prince Edward Island	-1.125 (-2.16)	.278 (1.95)	.835 (6.60)	0.969	1.29	1.685
Nova Scotia	-3.863 (-3.43)	1.045 (3.66)	.275 (1.41)	0.982	1.98	1.441
New Brunswick	-3.719 (-2.96)	1.089 (3.22)	.207 (0.87)	0.978	1.33	1.373
Quebec	-5.659 (-3.54)	1.329 (3.70)	.187 (0.87)	0.985	1.14	1.635
Ontario	-3.702 (-3.15)	1.015 (3.45)	.261 (1.26)	0.979	1.47	1.374
Manitoba	-4.857 (-4.16)	1.247 (4.34)	.156 (0.80)	0.984	1.94	1.478
Saskatchewan	-1.948 (-3.56)	.644 (4.50)	.482 (4.14)	0.974	1.62	1.243
Alberta	-4.443 (-5.32)	1.113 (5.37)	.272 (1.93)	0.992	1.734	1.529
British Columbia	-4.816 (-3.86)	1.130 (4.16)	.303 (1.89)	0.986	1.40	1.621
Mean	-3.728	.978	.334			1.477

Dependent Variable: Log real per capita expenditure on durables. Independent variables in logarithms.

Table 14: Consumption Equations; Durables, "Houthakker-Taylor"

	Constant	ΔYPDR	YPDR-1	ZCDR-1	R^2	DW	LR Elasticity	
Canada	-2.611 (-2.47)	1.935 (6.54)	0.708 (2.79)	0.491 (2.99)	0.994	1.86	1.391	0.143
Newfoundland	-2.93 (-2.09)	2.087 (2.93)	0.817 (2.25)	0.410 (1.64)	0.976	1.77	1.385	0.199
Prince Edward Island	-1.075 (-1.96)	0.417 (1.12)	0.253 (1.59)	0.857 (6.03)	0.969	1.39	1.769	0.464
Nova Scotia	-2.029 (-1.68)	2.066 (4.34)	0.591 (1.94)	0.557 (2.78)	0.988	2.21	1.334	0.157
New Brunswick	-2.768 (-2.53)	2.269 (4.42)	0.841 (2.86)	0.361 (1.76)	0.986	2.16	1.316	0.265
Quebec	-3.273 (-2.00)	2.132 (4.90)	0.798 (2.17)	0.485 (2.25)	0.990	2.12	1.549	0.141
Ontario	-2.391 (-2.05)	1.972 (4.10)	0.707 (2.46)	0.448 (2.28)	0.985	2.03	1.281	0.194
Manitoba	-5.031 (-3.00)	1.238 (4.09)	1.289 (3.14)	0.129 (0.48)	0.984	1.86	1.480	0.170
Saskatchewan	-2.975 (-3.49)	0.663 (4.83)	0.948 (3.92)	0.252 (1.34)	0.977	1.34	1.267	0.682
Alberta	-4.214 (-3.04)	1.146 (4.30)	1.057 (3.11)	0.308 (1.38)	0.992	1.826	1.527	0.230
British Columbia	-2.325 (-2.73)	2.085 (9.08)	0.609 (3.40)	0.574 (5.59)	0.996	2.24	1.429	0.134
Mean	-2.900	1.607	0.791	0.438			1.434	.045

Dependent Variable: Log real per capita expenditure on durables. Independent varibles in logarithms. ΔYPDR defined as for Table 12.

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