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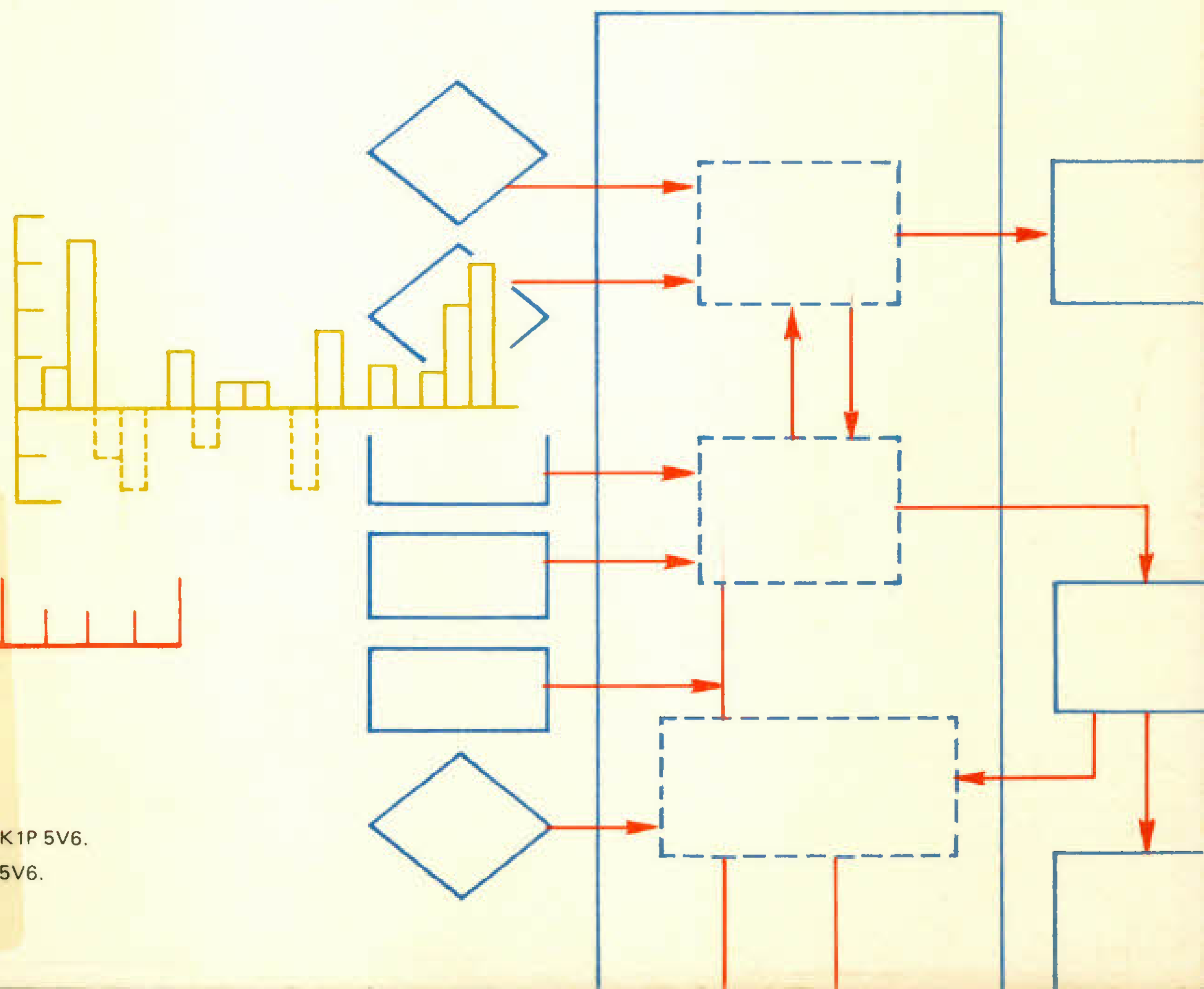

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DISCUSSION PAPER NO. 182

Unanticipated Inflation and Unemployment in Canada, Ontario and Newfoundland

by

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Abstract

This paper, completed in September 1979, was undertaken as part of the Economic Council's study of the Newfoundland economy, Newfoundland: From Dependency to Self-Reliance. The purpose of our work was to test the natural unemployment rate hypothesis and, if the hypothesis was not rejected, to estimate the natural unemployment rate for Canada, Ontario, and Newfoundland. According to this hypothesis, there exists an unemployment rate -- called the "natural" rate -- which is an equilibrium unemployment rate in the sense that, at lower unemployment rates, inflation will tend to accelerate while, at higher rates, inflation will tend to decelerate.

A detailed discussion of the natural rate hypothesis is provided in sections 2 to 4 of the paper. The author outlines two alternative views currently held by macro-economists concerning the causal sequence through which changes in aggregate demand lead to changes in prices and wages, on the one hand, and changes in output and employment, on the other. Associated with each of these views is a single-equation test of the natural rate hypothesis; these are referred to as the unemployment rate equation and the expectations-augmented Phillips curve, respectively. Both types of equations were estimated but only the former was found to produce reliable estimates. (Unfortunately the kind of wage rate data needed to produce reliable estimates of the expectations-augmented Phillips curve is not available on a regional basis.) The estimated unemployment rate equations do not contradict the natural rate hypothesis. These estimates suggest that, in 1978, inflation would have accelerated if unemployment rates had been below 7.4 per cent in Canada, 6.5 per cent in Ontario and 14.5 per cent in Newfoundland.

The natural or equilibrium unemployment rate can be expected to change over time in response to a variety of influences affecting labour markets. The empirical work in this paper allows for three influences which have often been mentioned in this context: minimum wages, unemployment insurance benefits, and the demographic structure of the labour market. The general nature of the findings are as follows. Increases in minimum wages relative to average wages do not typically have any significant positive effect on the equilibrium unemployment rate. Changes in the proportion of women or youths in the labour market do not have unambiguous or consistently significant effects. However, increases in the generosity of the unemployment insurance system are found to significantly raise the equilibrium unemployment rates in Canada,Ontario, and especially in Newfoundland.

While the study does reach some conclusions regarding the causes of changes over time in the equilibrium unemployment rates of the two provinces, it does not explain the large differences in these rates at each point in time. To do so would require a cross-sectional study involving all ten provinces.

Expectations of future inflation play an important role in the inflationary process and, in order to test the natural rate hypothesis and estimate the equilibrium rate, it is generally necessary to have a measure of the expected rate of inflation. Unfortunately no survey-based series exists for Canada, so a proxy must be constructed. Obviously the results may be sensitive to the proxy used. Because of this, some sensitivity results are included in the paper.

Résumé

Le présent Document, achevé en septembre 1979, avait été entrepris dans le cadre de l'étude du Conseil sur l'économie terre-neuvienne, laquelle a abouti au rapport intitulé Au-delà de la dépendance -- Pour une productivité accrue à Terre-Neuve (Ottawa, Approvisionnements et Services Canada, 1980). Notre travail avait pour objet de tester l'hypothèse du taux de chômage naturel et, si elle demeurait valable, d'estimer le taux de chômage naturel au Canada, en Ontario et à Terre-Neuve. Selon cette hypothèse, il existe un taux de chômage -- appelé "le taux naturel" -- qui constitue un taux d'équilibre en ce sens que, lorsque le chômage est faible, l'inflation tend à s'accélérer, tandis que s'il est élevé, elle ralentit.

Une analyse détaillée de l'hypothèse du taux naturel est présentée dans les parties 2, 3 et 4 de notre travail. Nous y décrivons les deux thèses que soutiennent les spécialistes de la macro-économique au sujet des rapports des variations de la demande globable avec celles des prix et des salaires, d'une part, et avec les fluctuations de la production et de l'emploi, d'autre part. A chacune de ces deux thèses se rattache un test de l'hypothèse du taux naturel, comportant une seule équation, soit l'équation du taux de chômage et la courbe de Phillips modifiée par les attentes, respectivement. Les deux équations ont été estimées, mais seule la première a produit des résultats fiables. (Malheureusement, les données relatives aux taux de salaire qui sont nécessaires pour produire des estimations fiables de la courbe de Phillips modifiée par les attentes ne sont pas disponibles pour les régions.) Les résultats des équations estimatives du taux de chômage ne contredisent pas l'hypothèse du taux naturel. Ils montrent qu'en 1978, l'inflation se serait accélérée si le taux de chômage avait été inférieur à 7,4 % au Canada, à 6,5 % en Ontario et à 14,5 % à Terre-Neuve.

On peut s'attendre que le taux de chomâge naturel (ou taux d'équilibre) se modifie avec le temps en raison de divers facteurs qui influent sur le marché du travail. Les travaux empiriques que nous décrivons ici vérifient l'apport de trois facteurs souvent mentionnés dans ce contexte : le salaire minimum, les prestations d'assurance-chômage et la structure démographique du marché du travail. Les résultats généraux sont les suivants : une hausse du salaire minimum par rapport au salaire moyen n'exerce ordinairement pas d'effet positif appréciable sur le taux de chômage d'équilibre; l'influence des variations de la proportion des femmes ou des jeunes adultes qui sont sur le marché du travail n'est pas décisive ni systématiquement significative. La générosité accrue du régime d'assurance-chômage a toutefois des répercussions sur le taux de chômage d'équilibre dans l'ensemble du Canada, en Ontario et surtout à Terre-Neuve.

Bien que cette étude permette de tirer certaines conclusions au sujet des causes des variations temporelles des taux de chômage d'équilibre des deux provinces, elle n'explique pas les différences considérables entre ces taux à un moment donné. Il aurait fallu, pour ce faire, une étude synchronique des données relatives aux dix provinces.

Les anticipations des agents économiques quant à la hausse future des prix jouent un rôle important dans le processus inflationniste et, pour tester l'hypothèse du taux de chômage naturel et estimer le taux d'équilibre, il faut généralement disposer d'un indicateur quelconque du taux attendu. Malheureusement, il n'existe pas, au Canada, d'enquêtes qui pourraient fournir des données utilisables ici, de sorte qu'il faut faire appel à une variable instrumentale. Les résultats peuvent évidemment varier suivant la variable choisie, et c'est pourquoi nous présentons aussi les résultats de nos tests de réactivité.

1. Introduction

This report discusses the estimation of the 'natural' (or non-inflationary) unemployment rate in both a national and a regional context, and presents estimates of the natural rate for Canada, Ontario and Newfoundland over the 1955-78 period. The effects of exogenous changes (such as changes in minimum wages, revisions to the unemployment insurance system, or changes in the age-sex composition of the labour force) on the natural unemployment rate are estimated and discussed. To the extent possible, the results of this research are compared with those obtained by other investigators. Finally, the implications of the findings for public policy and for future research on labour markets are discussed.

The next section of the paper discusses the natural rate theory in the context of a closed economy. It is not possible, of course, to provide a detailed survey of the literature but it is important to motivate the empirical work which follows, make clear the impossible limitations of the results, and provide sufficient theoretical background to facilitate discussion of the policy implications of the research. The second section is written with these objectives in mind. Section three expands on this theoretical material and discusses the derivation of the equations to be estimated. Further discussion of the natural rate theory, in particular of lagged effects, is contained in section four. The specification of the equations, the choice of variables and the construction of the data are then described in the fifth section. The empirical results for Canada follow (section six). The seventh section compares these results to those obtained by other researchers.

Section eight contains a discussion of some regional aspects of inflation and unemployment, and the empirical results for the two regions are given in the ninth section. The final section summarizes the main findings and discusses their policy implications.

2. The Natural Rate Theory

General statements of the natural rate theory were given by Friedman (1968) and Phelps (1967, 1968). These have been elaborated on by several authors; among the most important contributions are Barro (1976), Lucas (1972, 1975, 1978), Sargent (1973, 1976) and Sargent and Wallace (1975, 1976). In this section I will give an overview of these developments. The context is that of a closed economy.

The term "the natural rate theory" can be interpreted narrowly by using it to refer to a number of specific models which have been constructed to analyze this concept, or quite broadly by using it to refer to the general view that there is no permanent or "long-run" trade-off between inflation and output or employment. I will use the term in the latter sense. Thus the natural rate theory refers to the view that there is some unemployment rate below which inflation will tend to accelerate and above which inflation will tend to decelerate.

In this broad sense, the natural rate theory is, I believe, now fairly widely accepted by economists. It is not only accepted by 'monetarists' but also by leading 'Keynesian' economists such as Tobin and Baily (who prefer the term 'non-accelerating inflation rate of unemployment' or NAIRU to the term 'natural rate') and Modigliani (who prefers the term non-inflationary rate of unemployment rate or NIRU).(1)

It has been incorporated in intermediate macro texts such as Dornbush and Fischer (1978) and Gordon (1978). (This is perhaps the ultimate test of acceptance). This consensus has developed quite rapidly (it is only eleven years since Friedman's presidential address and only nine years since the publication of the Phelps et al. 'microfoundations' volume) and has had a significant impact on public policy (the question of how much inflation to 'trade off' against a reduction in unemployment is no longer discussed, at least in permanent terms). However, the fact that there is a considerable amount of agreement on the validity of the natural rate hypothesis does not mean that no disagreement remains. Important areas of controversy include the short run dynamics of inflation and unemployment, the related question of the causal sequence through which changes in aggregate demand get translated into changes in the overall price level or into changes in output and employment, and the issue of the effectiveness of stabilization policy. Not all of these areas of controversy are relevant to this essay; however, before we can discuss those that are, some elaboration of the natural rate theory is in order.

Friedman (1968) defined the natural rate as that level of unemployment

> "that would be ground out by the Walrasian system of general equilibrium equations, provided there is imbedded in them the actual structural characteristics of the labor and commodity markets, including market imperfections, stochastic variability in demands and supplies, the cost of gathering information about job vacancies and labor availabilities, the cost of mobility, and so on."

Thus the natural unemployment rate is defined in a general equilibrium context, but several of the assumptions commonly made in models of general equilibrium (important examples are (i) that economic agents have complete information and (ii) that recontracting can take place prior to exchange) are not made. Indeed, it is the relaxation of these assumptions which implies that the equilibrium unemployment rate is non-zero. The natural rate is the equilibrium unemployment rate; in Friedman's words it is that

> "level of unemployment that is consistent with equilibrium in the structure of real wage rates. At that level of unemployment, real wages are tending on the average to rise at a "normal" secular rate; i.e., at a rate that can be indefinitely maintained as long as capital formation, technological improvements, etc., remain on their long term trends."

The above quotations from Friedman's presidential address make it clear that in order to study the natural unemployment rate and its determinants it is necessary to construct a general equilibrium model with imperfect information, stochastic variability, etc. Work along these lines is just beginning; most of the theoretical research related to the natural rate theory has been partial equilibrium in nature. Lucas and Prescott (1974) have constructed and analyzed a simple general equilibrium model in which labour (which is assumed homogeneous) is exchanged in spatially distinct markets. There is imperfect information in that workers are not aware of wages being paid in other markets; there are also stochastic shocks which alter relative wages. Workers can engage in search for higher wages as an alternative to employment. An equilibrium amount of unemployment is determined by the model.

The Lucas and Prescott model is quite simple, and further work along these lines is needed in order to develop a theoretical account of the determinants of the natural rate of unemployment. However, building a theory which predicts the kind of wage and price distributions which we observe is not an easy matter. The nature of the difficulty can be illustrated in the search unemployment setting which is, of course, the most commonly analyzed type of unemployment in the natural rate literature. In order for wage rates for a single type of labour to differ at a point in time, jobs must be located in spatially (or informationally) separate markets. Not only does the amount of search undertaken by workers depend on the distribution of wages over these markets, but also the distribution of wages will depend on the amount of search. The optimal search behaviour and the wage distribution upon which search is based must be jointly determined.

The partial equilibrium nature of much of the natural rate literature can be illustrated by examining the Mortensen (1970) paper, the most carefully formulated model of the natural rate in the Phelps et al. volume. This theory was constructed as follows: taking as given a certain wage distribution, the optimal behaviour of workers was derived; then the optimal behaviour of firms was derived given the nature of worker behaviour. This model clearly suffers from the defect that worker behaviour is not allowed to influence the wage distribution, nor is the existence of a wage distribution explained within the model.

While I believe it is important, in a discussion of the theory, to point out that much of the theoretical discussion is partial equilibrium in nature when in fact the natural rate needs to be examined in a general equilibrium context, it is difficult to say how important a limitation this is. Certainly the needed further theoretical work will improve our understanding of the determinants of the natural rate. It is less clear that the specifications employed in the empirical work in this study will be affected in any significant way by these additional theoretical investigations.

It is, of course, important to have a theory which not only explains the determinants of the equilibrium level of unemployment but which also accounts for variations around this level. The consensus on the validity of the natural rate theory does not extend to the explanation of such cyclical fluctuations, and therefore of cyclical (or 'deficient demand') unemployment. Two main competing accounts can be identified; these can be termed 'classical' and 'Keynesian' although the usual problems with such labels exist here as well. Expectations play an important role in both accounts. The two theories differ in a number of ways, one of which is the predicted causal sequence through which changes in nominal aggregate demand get translated into changes in the overall price level or into changes in output and employment.

Summarizing recent work on classical and Keynesian theories of the business cycle is difficult because Keynesian economics is, understandably, in a state of disarray at present and because the classical accounts are not, as yet, fully worked out. Also both are areas of intense research activity and it is not yet clear where these investigations will lead. The following survey is thus necessarily brief and selective, concentrating on points which are relevant to later sections of this essay. For more detail the interested reader is referred to the recent surveys of the classical theories by Buiter (1979) and Lucas and Sargent (1979) and of the Keynesian theories by Drazen (1978).

The 'classical' account is that associated with the models of Barro (1976), Lucas (1972, 1975), Lucas and Prescott (1974), Sargent (1976), and others. Indeed some would call this <u>the</u> natural rate theory (the narrow interpretation). The main feature of these contributions is that they are equilibrium models of the business cycle. Modelling cyclical fluctuations 'as if' markets are in equilibrium each period has the important advantage of providing a theory of movements in aggregate variables which is fully consistent with the kind of maximizing behaviour which underlies micro-economic theory. The case for building (or, more precisely, returning to building since as Lucas (1977) indicates this was a task which had concerned inter-war business cycle theorists) such an equilibrium theory of the business cycle has been forcefully stated by Lucas (1977).

In these equilibrium models, cyclical fluctuations arise because of imperfect information. Agents may have imperfect information about what is happening elsewhere in the economy, about what is going to happen in the future, or both. In the competitive market setting which characterizes these models, the implication of imperfect information is that firms and workers will not be able to distinguish relative price or wage changes from absolute price or wage changes. This results in a causal sequence whereby unanticipated changes in aggregate demand lead to unanticipated inflation; that is, prices or wages begin rising faster than agents had expected them to or faster than agents believe they are rising elsewhere in the economy. This perceived increase in the relative price or wage faced by the particular agent leads to an increase in output and employment, the usual supply response to a ceteris paribus price increase in a competitive market. Once agents find out that the rise in prices and wages was quite general and not specific to their particular markets, output and employment will return to their previous levels (due to homogeneity of degree zero of all supply functions).

The alternative account is associated with the 'non-market-clearing' hypothesis pioneered by Clower (1965) and thoroughly developed by Barro and Grossman (1976). In these Keynesian type models, it is assumed that (for some reason which is generally not specified in the analysis) prices and wages do not adjust each period to clear product and labour markets. The focus then is on the determination of quantities when prices and wages are given and are not necessarily equal to their market clearing levels. These disequilibrium models provide a rationale for key Keynesian constructs such as a consumption function with income as an argument. Their weakness is that no explanation is given for the wage and price 'stickiness' which is so crucial to the theory.

In the non-market-clearing models the causal sequence involves changes in aggregate demand leading to changes in output and employment which then lead to changes in prices and wages. The changes in prices and wages may occur several periods later, depending on the reason for the inflexibility of wages and prices in the first place. As before, the existence of a natural rate of unemployment follows from the homogeneity of degree zero of demand and supply functions. If prices and wages were originally set too low (i.e. if the increase in aggregate demand was unanticipated) then they will later be revised upwards; the opposite occurs if prices and wages were set too high.

As noted, this 'Keynesian' account requires some rationale for price and wage stickiness. One explanation that has received considerable attention in recent years is that provided by Azariadis (1975), Baily (1974) and Gordon (1974) who argue that differences in attitudes towards risk between workers and (owners of) firms lead both parties to enter into implicit or explicit fixed wage contracts. (The argument can also be applied to product markets to rationalize sticky prices; see Grossman (1979).) The reasoning here is that if workers are more risk averse than firms (an assumption which is based on the risk reduction role played by diversification in capital markets, the absence of similar possibilities for diversifying human capital, and the fact that most workers' wealth consists of human capital) then both can gain from a contractual arrangement that provides workers with a lower expected wage in exchange for a less variable one. The extreme case of a 'smoothed' wage is, of course, one that is fixed for a certain period.

While the implicit contracts literature appears to provide a satisfactory explanation of some important features of labour and commodity markets, it is less clear as to whether this literature provides the 'missing link' needed by Keynesian economics. Both Barro (1979) and Grossman (1979), in their appraisal of the non-market-clearing paradigm (which was characterized by Solow as being "a bit like the wolves appraising Little Red Riding Hood") suggest that this is not the case. Barro, for example, concludes that "rather than rationalizing the non-market-clearing model as a useful "as if" approach, contracting analysis suggests that - despite the existence of "sticky" wages - the continuous market-clearning model may provide a satisfactory framework for the analysis of employment and output." Similarly Grossman concludes that "as a basis for a general theory of the causal relation between aggregate demand and aggregate employment, the non-market clearing paradigm is less attractive than it once seemed, especially in comparison to the alternative paradigm of incomplete information extended to take account of implicit contractual arrangements to mitigate risk".

It is not essential to the purposes of this essay to go into this debate on the non-market-clearing hypothesis in detail; the interested reader is referred to the exchange between Barro (1977) and Fisher (1977) as well as to the Barro (1979) and Grossman (1979) papers referred to earlier. What does matter for our purposes is that (i) both alternative views of macroeconomic fluctuations predict that a natural unemployment rate exists and (ii) each view has a preferred method for estimating the natural rate. In the case of the sequence from aggregate demand to unanticipated inflation to output and employment we would treat the real variable (unemployment or output) as the dependent variable and the amount of unanticipated inflation as an explanatory or independent variable. This procedure has been applied by Sargent (1973) and Barro (1977, 1978) to U.S. data. This specification would be of the form

$$U_t = \alpha_0 + \alpha_1 \, UNEXP_t + X_t\beta + \varepsilon_t \qquad (1)$$

where U_t is the unemployment rate (or some other "real" variable), $UNEXP_t = (P_t - PE_t)/PE_t$ is the amount of unanticipated inflation in period t relative to the amount of expected inflation, P_t and PE_t being the actual and expected rates respectively, and X_t is a vector of variables which affect the natural unemployment rate which is, of course, not a constant but varies over time due to institutional and demographic changes. A more detailed discussion of the derivation of equation (1) is given in the following section. The natural rate can be solved for by setting UNEXP = 0, thus obtaining the natural rate at time t as

$$U_t^n = \alpha_0 + X_t\beta \quad .$$

The movements in the unemployment rate over time can thus be split into two components: (i) changes in the natural rate, and (ii) changes in the amount of cyclical (or deficient demand) unemployment.

The second causal sequence leads to a specification with the rate of wage or price change (or the amount of unanticipated wage or price change) as the dependent variable and the real variable, output or unemployment, as an explanatory variable. This specification is, of course, the familiar expectations-augmented Phillips curve and has been applied by many researchers. For the case of a wage equation the specification suggested by the theory is

$$W_t - WE_t = \alpha_0 + \alpha_1 f(U_t) + X_t\beta + \varepsilon_t \qquad (2)$$

where W_t and WE_t are the actual and expected rates of wage change in period t and X_t is, as before, a vector of variables which cause changes in the natural rate. The natural rate can be solved by setting $W_t - WE_t = 0$ to give

$$\alpha_1 f(U_t^n) = -\alpha_0 - X_t\beta \quad .$$

Again, one can split movements in the unemployment rate into the same two components.

Both these specifications can be tested for the "natural rate property". Equation (1) can be written as

$$U_t = \alpha_0 + \alpha_1 P_t + \alpha_2 PE_t + X_t\beta + \varepsilon_t \qquad (3)$$

in which case one tests the linear hypothesis $\alpha_1 = -\alpha_2$ or $\alpha_1 + \alpha_2 = 0$. Similarly, equation (2) can be written as

$$W_t = \alpha_0 + \alpha_1 f(U_t) + \alpha_2 WE_t + X_t\beta + \varepsilon_t \qquad (4)$$

in which case one tests the hypothesis $\alpha_2 = 1$. Frequently the expected rate of price change is used in lieu of the expected rate of wage change in (4).

This section has given a brief overview of the natural rate theory. There are a number of points which require, or at least deserve, elaboration. Before turning to these it is first necessary to provide a more detailed discussion of the derivation of equations (1) and (2).

3. Derivation of the Output - Inflation Tradeoffs

An increase in aggregate demand may lead to an increase in total output, an increase in the overall price level, or some combination of the two. The division between increases in output on the one hand and increases in the price level on the other will typically differ between the short and the long run. It will also differ according to other circumstances; for example, the extent to which the increase in aggregate demand was anticipated. Equations (1) and (2) are alternative expressions for this division - the output-inflation or inflation-unemployment "tradeoffs." This section attempts a fairly detailed derivation of these equations. Much of the material is well known and is included here only to make the report self-contained.

Equation (1) is considered first. This relation, as with equation (2) is traced out by the interaction of an aggregate demand and an aggregate supply schedule. In the classical theories, the tradeoff between output and inflation comes primarily from the supply side. To derive the aggregate supply schedule, consider a single output firm operating in a competitive industry (the extension to a multi-product firm is straightforward). Let y_i be the output of firm i, p_i the output price, $\bar{p}_i$ a vector of prices of inputs used by firm i, and pa_i a weighted average of the prices in the vector $\bar{p}_i$. The firm's output supply function $y_i = f(p_i, \bar{p}_i)$ is homogeneous of degree zero in all prices. The firm does not, however, have perfect information about the price vector $\bar{p}_i$ at the time production decisions are made. Thus supply is related to the output price and the firm's expectation about the vector of input prices $\bar{pe}_i$

$$y_i = f(p_i, \bar{pe}_i) \tag{5}$$

Since we are not interested in changes in the relative prices of the inputs, let pe_i be the index of expected prices corresponding to pa_i (i.e. using the same weights) and write (5) more simply as

$$y_i = f(p_i/pe_i) \tag{6}$$

Both (5) and (6) have the properties that a change in the absolute level of prices (i.e. one that raises p_i and pe_i by equal proportions) will not result in any change in output whereas a change in relative prices (i.e. one that alters p_i/pe_i) will have an affect on output. The natural rate of output is $y^N = f(p_i/pa_i)$. The firm's natural rate of output is altered by real changes in the economy as these will change the relative price p_i/pa_i but is not altered by nominal changes. However actual output produced may deviate from the natural rate of output because pe_i may differ from pa_i due to imperfect information. In particular, consider an increase in aggregate demand due to an increase in the supply of money. If the increase in money were anticipated <u>and</u> recognized as being a purely nominal shock, then pe_i would increase by the same proportion as p_i and the change in money would have no real effect. On the other hand, if the firm did not anticipate the increase in the money stock or did not recognize that such an increase raises all prices proportionately then the increase in p_i/pe_i will result in an increase in output and therefore employment. Once the firm realizes that input prices were also risen, output will return to its natural level.

A similar sequence of events occurs in an inflationary economy. The firm will now have some expected rate of increase of input prices, and as long as p_i increases at this rate output will remain at its natural rate. An unanticipated increase in aggregate demand will result in p_i increasing faster than the firm expects the index pe_i to increase. Such a perceived increase in relative prices will result in an increase in output and employment.

The industry in which firm i operates will be continually hit by various shocks. Those which alter relative prices can be termed 'real' shocks as they result in a change in the natural rate of output; such a change is, of course, permanent. Those which do not alter relative prices can be termed nominal shocks. These result in temporary deviations of actual from natural output because of deviations of expected from actual prices. Once expectations are revised, output will return to the natural rate.

Adding up the supply functions for each firm yields an aggregate supply function with the property that deviations of actual from natural output are caused by deviations of actual from expected prices. A simple form for this function is[(2)]

$$y^s = \alpha(P-PE) \tag{7}$$

where all variables are in logarithms, y^s is the supply of output, and P and PE are the actual and expected rates of inflation. Combining (5) with a simple aggregate demand function

$$y^d = \beta(M-PE) \tag{8}$$

where M is (the logarithm of) the rate of growth of the stock of money yields the equilibrium output and price level

$$y = \alpha(P-PE) \tag{9}$$

$$P = (1 - \frac{\beta}{\alpha}) PE + \frac{\beta}{\alpha} M \tag{10}$$

Note from (9) and (10) an increase in the rate of growth of money has no effect on output if PE increases proportionately but does affect output otherwise. To go from (9) to (1) we need to go from output to employment and unemployment. Assuming competitive labour markets, the increase in aggregate demand which caused output to increase above its natural rate will cause unemployment to fall below its natural rate and, of course, through the same mechanism - an increase in real wages as perceived by (unemployed and employed) workers.

As the above discussion makes clear, the fundamental source of cyclical fluctuations in these classical models is the inability of individual economic agents to distinguish relative price and wage changes (which according to standard micro-economic theory will produce a supply response) from price and wage changes that are quite general (which should not have any real effects). This suggests that the slope of the (short run) output inflation tradeoff (α in equation 9) should depend on the likelihood that a given shock is real rather than nominal. This point has been investigated by Lucas (1974) and Barro (1976). The general prediction is that when the variance in monetary growth is high (so that it is more likely that a given shock is nominal rather than real) the short run tradeoff should be steep, while when the variance is low the tradeoff will be flat. This prediction, which has obvious implications for the "stagflation" experienced in recent years, is tested in the empirical part of this study.

The derivation of equation (1), or (9), was made especially simple by the assumption that firms are price-takers. This ensures that firms adjust quantities in response to price changes which are determined by the "market". The assumption of perfect competition is open to criticism not only on the usual grounds that many firms are price setters but also on the now widely accepted theoretical point that in a world of imperfect information even atomistic firms will possess some market power. Thus it is important to consider the way in which cyclical fluctuations would occur in a world of price-setting firms. This is a complex issue and it will not be possible to provide more than a sketch here.

Consider a price-setting firm. The location of the firm's demand curve depends on the prices for the same product set elsewhere in the industry and on the prices of other products. The firm's profit-maximizing strategy has the property that the firm will alter its price relative to prices elsewhere in response to changes in demand which are specific to the firm or industry (or both) but will not alter its relative price in response to changes in demand which are general throughout the economy. (This is the equivalent property of the homogeneity of degree zero of supply functions in the competitive case.) However, the firm will not know the prices being charged by other firms in the industry or, especially, the prices charged for other products throughout the economy. Thus the rate at which the firm increases its prices will be based on the firm's expectations about the rate at which prices are increasing elsewhere in the industry and economy. Just as a competitive firm was unable to distinguish relative from general price changes, the firm with some market power will be unable to distinguish relative from general changes in demand. An increase in the rate of growth of money, unless anticipated and recognized as being purely nominal in effect, will lead the firm to increase its output relative to the natural rate and increase its rate of price change relative to the expected rate of price change.(3) The major additional complication introduced by having price-setting firms is that both the nominal variable (rate of price change) and the real variable (output) are jointly endogenous. This suggests that a system of equations be used to describe the short-run behaviour of output and prices, a procedure which is beyond the scope of the empirical part of this study (for reasons discussed later) but which is worthy of further investigation.

This discussion is easily extended to a growing economy. By keeping its price fixed relative to those elsewhere in the economy, the firm's demand, and therefore its natural rate of output, will grow at the trend rate of growth in the industry.

Having discussed the derivation of equation (1), let us turn to the Phillips curve relation (2). As the above discussion makes clear, it is difficult to reconcile a relation such as (2) with market clearing. In the competitive case, quantities adjust in response to changes in prices so that (1) is the correct specification while in the case of price-setting firms both prices and quantities adjust in response to changes in aggregate demand. Thus with market clearing unemployment should be endogenous whereas the Phillips curve relation treats it as an exogenous variable. It is for this reason that the Phillips curve is usually thought of as a disequilibrium price and wage adjustment relationship, and is best thought of in the context of a model in which prices and wages do not adjust to clear markets.

The original derivation of the Phillips curve due to Lipsey (1960), which assumed competitive labour markets, was based on two relationships: (i) a positive relation between wage changes and excess demand for labour and (ii) an inverse relation between excess demand for labour and the unemployment rate. The latter is often derived by expressing excess labour demand as vacancies less unemployment and assuming a stable (inverse) relation between unemployment and vacancies (e.g. Hansen (1970)). However, more recent versions of this type of model (which explicitly incorporate the various labour market flows) end up with unemployment as a dependent variable (e.g. Mortensen (1970)). Thus a preferred approach is to recognize that the labour market is dominated by long term contractual arrangements some of which are explicit (especially firm-union contracts) and others of which are implicit (typically in more atomistic markets). A characteristic of the operation of the labour market in these circumstances is that during the contract period wages are fixed at pre-determined levels and any adjustment to changes in demand will involve quantity adjustments only. When the period of the explicit or implicit contract has expired, a new wage path will be set (or negotiated). The wage settlement will be based on the current (and possibly future expected) state of the labour market which is exogenous to the individual firm and its workers. Since the settlement covers a period of non-trivial length (often one year or more) it will also make some allowance for various contingencies. The most important of these is future changes in the overall level of prices; certain anticipated real shocks may also be provided for in the terms of the contract. This leads to an equation of the form of (2) in which the rate of wage change is related to the current state of the labour market (measured by the difference between the actual and natural unemployment rate) and the expected rate of inflation. If unemployment is at the natural rate, wages will tend to rise at the expected rate of inflation plus the trend rate of growth of real wages (the constant term in (2)). Below the natural rate wage changes will tend to accelerate.

This discussion of the derivation of equations (1) and (2) suggests that the expectations-augmented Phillips curve (2) is best used to represent the labour market in which both explicit and implicit contracts are prevalent while the unemployment rate equation (1) is best used to represent the product market in which long term contractual arrangements are much less common. This is in fact the procedure followed in this study. The discussion also suggests that the unemployment rate equation (1) is based on the maintained hypothesis that the product market behaves 'as if' it were competitive; otherwise, both the real variable and the rate of price change should be treated as endogenous variables.

Throughout this section I have stressed these two alternative views about the causal sequence through which changes in aggregate demand get translated into changes in output and prices. While these two views lead to different choices for the dependent variable they are in fact quite similar with respect to their implications for economic policy and their explanation of the sources of movements in inflation and unemployment. In both cases, changes in aggregate demand which are anticipated and recognized to be nominal in nature will have no effect on output (in the Phillips curve these are already "discounted" through the PE term) while unanticipated changes in aggregate demand will affect output and employment at least temporarily. Real shocks will have permanent effects on output and employment in both cases; that is, they will alter the natural rate.

In this section I have also stressed that for changes in aggregate demand to have no effect on output and employment they must both be anticipated and recognized to be purely nominal in nature. In much of the natural rate literature this latter requirement is met by the assumption that agents expectations are rational. The discussion in this section, then, is independent of any assumptions about the way in which individuals form their expectations.

4. The Natural Rate Theory : Further Elaboration

This section amplifies the rather brief outline of the natural rate theory contained in the previous two sections. The first point to note is that some care is required in translating unemployment rates which were thought in the 1950's or 1960's to be 'full employment' targets into what we now call the natural rate. As already indicated, the natural rate theory distinguishes the cyclical component of unemployment from the permanent component (which includes what one often termed frictional, structural and seasonal unemployment). The latter has often been referred to as 'full employment'; however, previous estimates of this rate were often based on the notion of a stable long run Phillips curve (or in the 1950's on the simpler L-shaped output-inflation relationship) and in fact typically incorporated a modest rate of inflation such as 2-3 percent per year. If the natural rate hypothesis is valid, this procedure obviously produces an estimated full employment rate which is below the natural rate. (Also, these modest inflation rates cannot be maintained without allowing unemployment to rise).

The question of lagged effects and dynamics also requires further discussion. One of the main criticisms of the new classical theories of the business cycle has been their inability (according to the critics) to explain the persistence of deviations of unemployment from the natural rate. (See, for example, Hall (1975), Poole (1976) and Tobin (1977).) The reasoning here is as follows. The classical theories are based on the hypothesis that economic agents' expectations are rational in the sense of Muth (1961); that is, agents' subjective probability distributions describing their beliefs about the outcomes of the variable(s) in question coincide with the true probability distribution generating the outcomes. Muth also hypothesized that agents would use as a point predictor the mean of this distribution (the mean is generally the 'best' predictor within the class of linear unbiased predictors) so that agents' expectations are correct on average. Thus agents' forecast errors must be serially uncorrelated when expectations are rational. Since deviations of unemployment from the natural rate are caused by errors in forecasting inflation, the classical theories would appear to be unable to explain the observed serial correlation in unemployment.

Of course, the classical theories are consistent with persistence in deviations of output or unemployment from their natural levels if the supply responses to unanticipated inflation set into motion real changes which persist for more than one period. Lucas and Sargent (1979) discuss three possible propagation mechanisms which may convert serially uncorrelated forecast errors into serially correlated movements in output and employment. One is the presence of adjustment costs which cause firms to spread out over time their reactions to (perceived) changes in relative prices. A second, studied in Lucas (1975), involves investment in physical capital on the part of households and firms. Since part of unanticipated changes in income will typically result in investment rather than consumption, an accelerator-type effect will result in serially correlated real responses to unanticipated inflation. The third effect derives form the literature on search and wait unemployment. (See the survey paper by Lippman and McCall (1976) and the book by Phelps (1972).) If a worker becomes unemployed due to a supply response to unanticipated inflation, it will typically be rational not to accept the first job offer received but to search or wait for a better offer.

Thus there are a number of reasons why the classical models based on rational expectations are consistent with some serial correlation in deviations of unemployment from the natural rate. Whether these factors can account for the amount of serial correlation observed in most cyclical variables is another matter.

Another factor which can account for the observed persistence in unemployment is serial correlation in the sequence of forecast errors. Of course, this is not consistent with rational expectations in Muth's sense, but this hypothesis should really only be applied, as Friedman (1979) has emphasized, in cases where the economic agents have been operating for some time in a stable regime. In the more common case in which agents have to learn through observation the probability density function generating the outcomes, or in the also likely case in which there are switches in regimes which cannot be immediately identified as such by agents, the forecast errors may be serially correlated even though expectations are rational in the sense that they are unbiased predictors based on the information available to agents at the time the prediction is made. Survey-based evidence on inflationary expectations in the U.S. indicates quite substantial serial correlation in unanticipated inflation (see Carlson (1977) and Wachtel (1977), thus contradicting the Muthian version of rational expectations. As I discuss later, this property of serially correlated forecast errors also characterizes the inflation expectations series used in this study.

Another potential source of persistence in unemployment is the response of inventories and backorders to unanticipated changes in aggregate demand. Many firms typically hold some inventories to smooth out production in the face of demand fluctuations. Consider a firm with both production and inventories at their natural rates. The firm's response to a general increase in aggregate demand would be to raise prices,leaving output and inventories at their existing levels. The response to a relative increase in demand would be to increase production (i.e. a new, higher, natural rate). However, since the firm cannot distinguish relative from absolute increases in demand, the response to an unanticipated increase in demand will involve running down inventories (as well as increasing prices and output). This means that a general increase in demand, if unanticipated, will result in inventories being below the 'natural' levels in the following period(s). Thus the effect on output of an increase in aggregate demand will persist for more than one period. For further discussion and some empirical evidence regarding the role of inventories and backorders see Haraf (1979).

Lagged effects also play a role in the more Keynesian causal sequence. Not only are many wage and price contracts long term prior arrangements, but also a certain number are re-negotiated or simply re-set each period. The fact that contract re-openings are spread out over time has two implications for the dynamics of inflation and unemployment. One is that an increase in aggregate demand will not appear to increase the overall rate of inflation very much in the first period because only some of the prices and wages will change. Thus one has to look at the rate of increase in those prices and wages which were re-negotiated during the period rather than (say) the percentage change in an overall index in order to determine the underlying rate of inflation. The second is that unanticipated increases in inflation will have effects which persist for several periods because of the way contract re-negotiations are spread out over time. Such a 'catch-up' for previously unanticipated inflation has been found to be important in empirical studies by Auld et al. (1978) and Riddell (1979). Taylor (1979) has constructed a model in which there is a natural rate of unemployment and in which expectations are formed rationally in the sense of Muth and has shown that staggered wage contracts as short as one year are capable of explaining the type of unemployment persistence observed in post-war business cycles.

This discussion of lagged effects suggests that some additional variables should appear in the specified equations (1) and (3). In particular, lagged values of the unanticipated inflation variable ($UNEXP_{t-1}$, $UNEXP_{t-2}$, etc.) should be included on the right hand side of equation (1) and a catch-up variable or variables should be included in equation (3). These lagged effects are allowed for in the empirical work which follows.

The lagged response in the unemployment rate equation which is equivalent to 'catch-up' in the Phillips curve equation comes from the revision of expectations. As discussed in section 3, increases in the rate of change of prices relative to the expected rate of price change cause output to increase above the natural rate; once expectations are revised upwards to reflect the now higher general rate of price change, output will return to its natural rate. This suggests that the percentage revision in expectations (i.e. $(PE_t - PE_{t-1})/PE_{t-1}$) should be included as an explanatory variable in equation (1). It is remarkable that the role played by expectation revision has not been mentioned in the literature nor incorporated in empirical work prior to that reported here.

A final point for further discussion is the question of whether one should attempt to control for cyclical influences through the unanticipated inflation variable or whether one should use a more fundamental variable such as the unanticipated change in the money supply and/or unanticipated changes in fiscal policy. Barro (1977, 1978), for example, has used the unanticipated growth in the stock of money to explain cyclical fluctuations in unemployment. While this procedure may appear to have the advantage of using as an explanatory variable the originating source of cyclical fluctuations, it also has some drawbacks and I have therefore not used it in this study. Specifically, the direct cause of cyclical fluctuations in classical models of the business cycle is unanticipated inflation, and there is a case from the statistical point of view for estimating the structural equation rather than a reduced form equation. Also, it is much more difficult to construct measures of the expected growth in the money stock and of fiscal policy. After all, our (i.e., economists') views about the importance of money in economic activity have changed rather dramatically in the post-war period. (See Bailey (1977) for a good discussion of changing attitudes toward monetary and fiscal policy in the post-war period). In the 1950's it is probably fair to say that many individuals had no expectations whatsoever about the change in the quantity of money. Also, because of the openness of the Canadian economy a measure of unanticipated changes in aggregate demand would not only have to incorporate expectations about domestic monetary and fiscal policy but would also have to incorporate expectations about the U.S. and possibly other economies.

A further reason for using unanticipated inflation rather than the unanticipated change in aggregate demand is that the use of the former is not wedded to any particular hypothesis about the way in which agents form their expectations while the latter is based on the assumption of rational expectations. As pointed out in section 3, output will not deviate from its natural rate if a change in aggregate demand is anticipated and recognized as being purely nominal in effect. In my view there have been, over the post-war period, important changes in beliefs about the extent to which general changes in aggregate demand result in changes in real output versus changes in the overall level of prices. This implies that the unanticipated change in aggregate demand, even if correctly measured, would not by itself account for deviations of actual from natural output and employment.

Thus there are good reasons for using unanticipated inflation as the variable accounting for cyclical fluctuations in employment. None-theless, as discussed earlier, this usage does require the maintained hypothesis of competitive markets. With price-setting firms, both deviations of actual from natural output and of actual from expected inflation are endogenous variables. Also there is the problem of measuring the expected rate of inflation. Thus as a check on the re-sults I have also used the percentage deviation from trend of real GNP as an explanatory variable to account for cyclical fluctuations. This variable, which has also been used by other researchers (see Grubel and Maki (1979) and Benjamin and Kochin (1979) for example) clearly suffers from the defect that it is jointly endogenous with the unemployment deviations even when the competitive markets hypothesis is valid. How-ever, because it aids in the comparison of our results with those of other researchers as well as providing some sort of check on the measure of expected inflation the results of using this variable are reported here.

5. Specification of the Equations and the Choice of Variables

The two alternative specifications discussed in the previous sections can be termed the unemployment rate and augmented Phillips curve equations. Each will be obtained for Canada, Ontario and Newfoundland, leading to a pair of estimated sequences of natural unemployment rates for the nation and these two regions.

The general specification of the unemployment rate and Phillips curve equations was discussed in the previous sections. There are three specific details which remain to be discussed here: (i) the choice of the X variables, the variables which lead to movements in the natural rate, (ii) the choice of the number and type of lagged terms to enter in the equation and (iii) the choice of a wage rate for the Phillips curve equations.

The natural unemployment rate is that rate consistent with real wage equilibrium in the labour market, and a large number of factors could alter this equilibrium rate. My earlier discussion detailed many factors which could cause the natural rate to change over time or to vary across regions or countries at a point in time. For empirical work it is necessary to focus on a few key variables, and the regression results reported below thus include three main variables which were thought to be relevant on the basis of economic theory and previous empirical work. These variables are (i) the 'real' minimum wage rate, (ii) a measure of the generosity of the unemployment insurance system, and (iii) measures of the composition of the labour force. More detailed discussion of the construction of these variables and the reasons for focussing on them follows.

The minimum wage rate variable (MW) is defined as the ratio of the minimum wage rate to average weekly wages. Since the minimum wage rate differs across provinces and, in some cases (especially in the 1950's and early 1960's), differs between male and female workers, the variable was constructed as follows. A series on the minimum wage rate for both male and female adult workers was obtained for each province. Provincial minimum wage rate indexes were constructed by weighting the male and female minimum wage rate series by the fraction of the labour force in each group. The resulting series was then multiplied by the fraction of the non-agricultural labour force covered by the minimum wage legislation. The national index was then obtained as a weighted average of the provincial indexes, the weights being the fraction of the non-agricultural labour force in each region. This national series thus represents an updated version of the series produced by Swidinsky (1977).

Economic theory does not make an unambiguous prediction about the net effect of changes in the real value of the minimum wage rate on the natural unemployment rate, so the coefficient may have either sign. The effect on employment is predicted to be negative but the effect on participation may go either way (Mincer (1976), Welch (1979)). There is some reason to expect that the employment effect will dominate, thus leading to a positive sign in either the unemployment rate of the Phillips curve equation.

The minimum wage variable may also act as a proxy for another variable discussed in more detail in Riddell (1978) - the ratio of the wage for a 'job of the last resort' to the wage for the most desirable job. For most workers in most regions there is always some job which can be found - the problem an unemployed worker faces lies in finding a good or acceptable job. When the ratio of the wage for the job of last resort to that of a desirable job is low, there is an incentive to wait longer in the hope of obtaining the more desirable job. To the extent that the minimum wage rate variable acts as a proxy for this ratio, MW should have a negative sign (which would clearly counter the standard effects discussed above).

The generosity of the unemployment insurance (UI) system will clearly affect 'real' conditions in the labour market by altering the relative price of time spent at work versus time spent in other activities (searching for work, household work, leisure, etc.). Numerous effects are predicted from standard economic theory: a tendency to prolong job search, a tendency to prefer jobs which offer alternating spells of employment and unemployment, an increased tendency to remain in seasonal occupations (at least those which are covered by the unemployment insurance system), and so on. Whether these effects are good or bad is a difficult question. However, all point to the prediction that increases in the generosity of the UI system will increase the equilibrium unemployment rate. This prediction and many of its components (e.g. increased participation, increased layoffs, longer search time) has been discussed in more detail and empirically investigated by numerous researchers; see, e.g., Grubel, Maki and Sax (1975) , Green and Cousineau (1976) and Benjamin and Kochin (1979).

Since previous research indicates that the changes in the Canadian UI system may have had a significant impact on the natural unemployment rate, considerable care was taken to investigate this matter. Unfortunately, however, it is difficult to capture the generosity of the UI system in a small number of variables. Numerous changes have been made to the UI Act, and each of the following variables seemed potentially important: (a) the real value of UI benefits, (b) the coverage of the UI Act, (c) the minimum number of weeks of employment needed to qualify for benefits, (d) the maximum number of weeks for which benefits may be drawn, (e) the number of additional weeks of benefits which may be drawn for each additional week of employment, and (f) the degree to which eligibility rules are strictly or leniently interpreted. A measure or proxy was obtained for each of these variables; the measures used are discussed below, taking each variable in turn. Also, some attempts were made to combine several of these variables into an overall index of UI generosity. These attempts are also discussed below.

The real value of UI benefits is measured in two alternative ways: (i) using average benefits paid during the period (i.e. total UI benefits divided by the number of individuals receiving benefits), and (ii) using the maximum benefits paid. In both cases the series is deflated by average weekly wages; the resulting variables are termed BRAVE and BRMAX. The latter is preferred on a priori grounds in that maximum benefits are exogenous while average benefits are partly endogenous. (Indeed, average benefits could fall when the UI system is made more generous if, for example, the additional generosity results in more participation by low wage earners.) However, because it is possible that average benefits reflect more closely changes in the generosity of the UI system than maximum benefits, both measures are used.

The UI benefits variables differ across regions because both average benefits paid and, more importantly, average weekly wages differ across regions. Maximum benefits, however, are the same across the country. The real value of maximum benefits is therefore higher in low wage regions. To the extent that maximum benefits are a good measure of generosity, we would expect a larger impact of UI in lower wage or income regions. This need not, however, hold for average benefits.

An important change toward reduced generosity contained in the 1971 amendment involved making UI benefits taxable. For this reason both BRAVE and BRMAX were multiplied by a factor (1.0 to 1971, approximately 0.8 thereafter) to adjust for the taxation of benefits. The average tax rates used after 1971 were based on the calculations reported in Cloutier (1978). For 1976-78, the 1975 figure (0.835) was used.

The coverage of the UI system has steadily increased since its introduction in 1940, with the largest increase in coverage resulting from the 1971 amendments to the Act. Changes in coverage clearly result in changes in generosity in that they bring individuals who were previously at a zero level of generosity (i.e. not covered by the Act) to the current level. Indeed, given the fairly evident potential impact of coverage changes it is remarkable (to this writer at least) that other research on the impact of the UI system on Canadian unemployment rates has not incorporated a coverage variable. The variable used (denoted by COV) is the fraction of the labour force covered by the UI Act. It is available for Canada for the entire period under study (1955-1978) but not, unfortunately, by province or by age and sex after 1971. Some of the coverage series are shown in Table One. There are clearly some significant differences in coverage across the two provinces. In the 1953-1960 period the fraction of the labour force covered in Newfoundland was lower than that for the country as a whole and substantially lower than that for Ontario. From 1961-71 the fraction covered in each province has been closer to the national average, although the Newfoundland fraction has been somewhat lower on average and has fluctuated more. Thus the increase in coverage from the 1950's to the 1960's was much larger for Newfoundland than for Ontario (where it may have even declined) or Canada. In 1971 coverage was extended to all workers under 70 years of age (under 65 since 1976) except those with little employment. This change probably had a somewhat larger impact on Newfoundland (where the coverage ratio was around 60 percent during the 1968-71 period) than Ontario (which had a coverage ratio of about 67 percent in the 1968-71 period).

A case can be made for entering the coverage variable COV_t multiplicatively with all other UI variables rather than additively. To show this, let $\overline{U}_t^c$ and $\overline{U}_t^{nc}$ be the natural unemployment rates of the fraction of the labour force covered and not covered respectively. Both depend on a vector of non-UI variables, denoted by X_t, while $\overline{U}_t^c$ also depends on a vector of UI variables denoted by UI_t. Thus, letting β be a vector of common parameters (including the constant term),

$$\overline{U}_t^c = \beta X_t + \alpha UI_t \qquad (11)$$

$$\overline{U}_t^{nc} = \beta X_t \qquad (12)$$

and the aggregate natural rate $\overline{U}_t$ is given by

$$\overline{U}_t = COV_t \overline{U}_t^c + (1-COV_t) \overline{U}_t^{nc} \qquad (13)$$

Table One

PERCENTAGE OF THE LABOUR FORCE COVERED BY THE UI ACT

Year	Canada	Ontario	Newfoundland
1953	59	66	52
1954	59	64	50
1955	61	64	48
1956	65	69	63
1957	66	70	53
1958	67	73	53
1959	66	71	61
1960	65	70	67
1961	62	67	69
1962	62	65	64
1963	62	64	58
1964	64	64	66
1965	63	64	61
1966	61	66	67
1967	61	67	68
1968	65	66	63
1969	67	69	56
1970	67	68	60
1971	63	66	62
1972	88		
1973	89		
1974	89		
1975	90		
1976	91		
1977	91		
1978	90		

Substituting (11) and (12) into (13) gives

$$\bar{U}_t = \beta X_t + \alpha(COV_t \; UI_t) \qquad (14)$$

in which COV_t enters multiplicatively with all UI variables but not with other variables such as the minimum wage. The restriction of a common parameter vector β in (11) and (12) is a mild one, and is, in any event, testable. [4)]

Important changes have also occurred in the minimum amount of employment required in order to qualify for UI benefits, as well as the maximum number of weeks for which benefits can be drawn. Between 1953 and 1971, 30 weeks of employment during the previous two years were required, and at least 8 of those weeks had to be in the previous year (10 prior to 1955). From 1971-77 the minimum requirement was 8 weeks of employment during the previous year. Recently (1978 and on) this was raised to 10 to 14 weeks depending on the regional unemployment rate. It is difficult to construct a variable which captures all of even these simple changes. The variable I prefer on a priori grounds, denoted MWQ1, is the binding minimum number of weeks of employment required to qualify; i.e. 30 weeks prior to 1971 and 8 weeks from 1971-77. An alternative, used by Swan (1979) and denoted MWQ2, is the minimum weeks required in the previous year. While this does perhaps improve comparability it has the distinct disadvantage that the 8 weeks required in the previous year (prior to 1971) was not the binding constraint.

The maximum number of weeks for which benefits may be drawn (MAXWKS) is more straightforward. The main changes in this variable were from 10 to 15 weeks in 1955, from 15 to 44 weeks in 1971 and from 44 to 22 weeks in 1978.

The UI system can be said to make employment more attractive in that a period of employment carries with it a "ticket" entitling the holder to UI benefits. This feature of the system, which in part underlies the prediction of increased participation, has been discussed by Mortensen (1977). It is captured by the variable ADDWKS, the number of additional weeks of benefits that can be obtained for each additional week of work. [5)] The two changes to ADDWKS during the sample period were from 0.2 to 0.5 in 1955 and from 0.5 to 0.0 in 1971.

The final UI variable, the denial ratio, is measured as the number of initial claims ruled ineligible divided by initial claims filed. [6)] It is intended to capture changes in the strictness (or lack thereof) of enforcement of the Act. Other choices are possible; Grubel, Maki and Sax use initial and renewal claims while Green and Cousineau use a series on persons disqualified. Because of the effort required to obtain these various series by province it was not possible to experiment with alternative proxies.

Table Two shows the denial ratio for Canada, Ontario and Newfoundland over the 1953-78 period. The most salient feature of the three series is the substantial reduction in the denial ratio since 1972. Looking at regional differences, during the period 1953-59 the denial ratio for Newfoundland was higher than that for Ontario and Canada as a whole while from 1960-71 the ratios are similar for the two regions and approximately equal to the national average (albeit with some year to year fluctuations such as 1970). Since 1972 the denial ratio for Newfoundland has generally been substantially below

Table Two

DENIAL RATIO FOR CANADA, ONTARIO AND NEWFOUNDLAND

Year	Canada	Ontario	Newfoundland
1953	0.185	0.176	0.215
1954	0.168	0.148	0.219
1955	0.162	0.142	0.189
1956	0.171	0.153	0.253
1957	0.171	0.158	0.262
1958	0.172	0.166	0.204
1959	0.180	0.176	0.185
1960	0.174	0.166	0.165
1961	0.177	0.169	0.164
1962	0.165	0.157	0.163
1963	0.163	0.157	0.141
1964	0.165	0.161	0.147
1965	0.162	0.153	0.161
1966	0.158	0.150	0.139
1967	0.154	0.153	0.110
1968	0.155	0.161	0.141
1969	0.127	0.129	0.151
1970	0.140	0.076	0.161
1971	0.189	0.143	0.178
1972	0.091	0.096	0.070
1973	0.099	0.111	0.061
1974	0.109	0.113	0.092
1975	0.084	0.080	0.115
1976	0.086	0.095	0.037
1977	0.086	0.100	0.041
1978	0.098	0.121	0.065

that for Ontario and Canada. To the extent that the denial ratio is a good proxy for administrative tightness, these trends suggest that the changes in strictness of enforcement (which have generally been towards more leniency) have been relatively greater in Newfoundland than Ontario. It would be useful to construct other proxies for administrative tightness in order to determine whether or not they yield the same conclusion.

Table Three lists some of the other UI variables used in this study. MAXBEN and AVEBEN are maximum and average weekly benefits respectively, the latter being for Canada. Dividing these by average weekly wages for Canada and multiplying by one minus the average tax rate gives BRAVE and BRMAX. Multiplying these two series by COV for Canada gives UICAVE and UICMAX. The other four series were discussed above. The 1978 figure for MWQ1 and MWQ2 is that for regions with unemployment rates in the 7-8 percent range (e.g. Ontario). For Newfoundland (over 9 percent) this will be 10 weeks.

Examination of Tables One to Three indicates that many of the UI variables are highly correlated so that it is unlikely that we will be able to determine their separate influences using regression analysis. This suggests the desirability of combining several of the variables into a "generosity index" or possibly even using dummy variables to control for major changes. Unfortunately it is not clear how to construct such an index. The main indexes relied on in this study are UICAVE and UICMAX. These capture changes in the real value of benefit, the fact that benefits were made taxable in 1971, and the coverage of the UI Act (which enters multiplicatively for reasons discussed above). They do not, however, capture the changes measured by MWQ, MAXWKS and ADDWKS. Thus these

Table Three

MEASURES OF CHANGES IN THE UNEMPLOYMENT INSURANCE SYSTEM, CANADA

Year	MAXBEN	AVEBEN	MWQ1	MWQ2	MAXWKS	ADDWKS	BRMAX	BRAVE	UICMAX	UICAVE
1953	24	18	30	10	10	0.2	0.42	0.32	0.246	0.186
1954	24	18	30	10	10	0.2	0.41	0.31	0.241	0.186
1955	25.5	18	30	9.5	12	0.275	0.42	0.30	0.255	0.182
1956	30	19	30	8	15	0.5	0.47	0.29	0.301	0.189
1957	30	21	30	8	15	0.5	0.44	0.31	0.292	0.203
1958	30	21	30	8	15	0.5	0.43	0.30	0.287	0.202
1959	32	21	30	8	15	0.5	0.44	0.29	0.288	0.189
1960	36	22	30	8	15	0.5	0.48	0.30	0.308	0.191
1961	36	24	30	8	15	0.5	0.46	0.30	0.287	0.189
1962	36	24	30	8	15	0.5	0.45	0.30	0.277	0.184
1963	36	24	30	8	15	0.5	0.43	0.29	0.269	0.180
1964	36	24	30	8	15	0.5	0.42	0.28	0.264	0.o79
1965	36	24	30	8	15	0.5	0.40	0.27	0.247	0.167
1966	36	24	30	8	15	0.5	0.37	0.25	0.226	0.153
1967	36	25	30	8	15	0.5	0.35	0.25	0.215	0.151
1968	44.5	27	30	8	15	0.5	0.40	0.24	0.262	0.157
1969	53	32	30	8	15	0.5	0.45	0.27	0.303	0.182
1970	53	35	30	8	15	0.5	0.42	0.28	0.278	0.184
1971	76.5	40	21	8	27	0.25	0.56	0.29	0.350	0.184
1972	100	62	8	8	44	0.0	0.55	0.34	0.489	0.302
1973	107	69	8	8	44	0.0	0.55	0.35	0.491	0.314
1974	113	75	8	8	44	0.0	0.52	0.35	0.465	0.308
1975	123	85	8	8	44	0.0	0.51	0.35	0.453	0.312
1976	133	93	8	8	44	0.0	0.49	0.34	0.441	0.308
1977	147	101	8	8	44	0.0	0.49	0.34	0.444	0.305
1978	160	110	12	12	22	0.0	0.50	0.35	0.454	0.311

variables are included with either UICMAX or UICAVE in order to estimate their separate influences even though it is recognized that this may result in large standard errors associated with each of the UI variables. A further attempt at a generosity index was to use UICMAX/MWQ, a variable suggested by Swan (1979) to be used in addition to ADDWKS. This index is denoted by SWAN1 or SWAN2, depending on which measure of MWQ is used. [7)]

The use of dummy variables to capture the main changes in the UI Act was rejected, despite being the simplest alternative by a considerable margin, for two reasons. First, "no change" is still a policy; for example, MAXBEN was maintained at $36 from 1960-67 yet the real value of the maximum weekly benefits fell throughout this period, a fact that would not be captured by dummy variables. Second, there have been many changes to the Act and it is not clear which ones to capture by dummies, nor that these would be the same across regions (e.g. coverage was extended to fishermen in 1957).

The third set of variables involve some measure of the demographic composition of the labour force. As is well known (see, e.g., Economic Council of Canada (1976)), important changes in the composition of the labour force have occurred in the last 20 years, the increasing proportion of the labour force accounted for by younger workers and women being two of the most important. Perry (1970) was one of the first to use an unemployment rate which is adjusted for unemployment rate changes in an aggregate wage equation. Such adjusted rates have since been used by many researchers; see, e.g., Wachter (1976) and Modigliani and Papademos (1975). A useful discussion of some alternative measures is provided in Economic Council of Canada (1976) and Smith (1977).

The measures used here are (i) the unemployment rate for prime age males (UPAM), (ii) an adjusted unemployment rate which is a weighted average of the unemployment rates of various age-sex groups using as weights the proportion of each group in the labour force in 1965 (UA), (iii) the overall unemployment rate supplemented by the additional variables the fraction of the labour force under 25 years of age (FY) and the fraction of women workers in the labour force (FW). The first variable is used under the hypothesis that the unemployment rate of prime age males has remained a consistent measure of the state of the labour market, while the second holds constant the demographic composition of the labour force. Both these measures have some drawbacks as there is clearly some substitutability among workers in different age-sex groups. The last measure is less restrictive in that it doesn't impose any particular form on the adjusted unemployment rate measure.

An alternative procedure, which is in my view preferable, is to run separate unemployment rate regressions for different age-sex groups. The aggregate natural rate can then be obtained as a weighted average of the natural rate for each sub-group. This procedure is potentially very informative in that it provides a more detailed picture of movements in the natural rate. It also has the advantage (over the inclusion of FW and FY in the aggregate unemployment rate equation) of using more disaggregated data. For example, the minimum wage index differs between males and females both because the minimum wage itself differs, at least in the 1950's, and because average weekly wages differ. Also, the minimum wage for younger workers typically differs from that of adult workers, although it was not possible to construct a youth minimum wage index for this study. Similarly, the real value of UI benefits differs across age-sex groups because of differences in average weekly wages and average UI payments. Coverage of the UI Act also differ across age-sex groups. The problem with using more disaggregated data is, of course, that the series become harder to obtain. This is particularly true for the regions and especially for Newfoundland where, for example, unemployment rates by age-sex groups are not available prior to 1966. Thus while some results broken down by age and sex are presented for Canada, it was generally not possible to obtain these for the provinces.

These three sets of variables - the minimum wage index, the UI "generosity" measures, and the demographic composition of the labour force series - are the main exogenous variables used in this study to capture movements in the natural unemployment rate. [8)] While these three influences were felt on a priori grounds to be the most important (quantitatively speaking), they do not exhaust the list of exogenous changes affecting the labour market (and therefore potentially the equilibrium unemployment rate) over this period. Some of the influences which are omitted in this study include: changes in welfare and other social assistance programs (ii) unionization (iii) inter-regional wage rate spillovers (discussed in section eight) (iv) changes in labour standards such as the period of notice and the compensation required on dismissal of employees. The main reason for not testing the influence of these exogenous changes is the lack of reliable data.

Having discussed the variables causing changes in the natural unemployment rate, let us now turn to the variables used to capture cyclical variations around the equilibrium rate. As indicated earlier, two variables were used: (i) the percentage deviation of actual from expected inflation, UNEXP =(P-PE)/PE, and (ii) the percentage deviation of real GNP from trend, GNPDEV. These two series are shown in Table Four. The first requires a measure of expected inflation; a discussion of the measure used follows.

Since no directly observed (i.e. survey-based) measures of inflationary expectations are available for Canada It is necessary to construct a proxy for this important variable. The series used is taken from Riddell and Smith (1978) who provide a detailed discussion of its properties. The main points to note here are two: (i) the measure is based on the previous inflationary experience (which is a limitation in that individuals undoubtedly base their expectations about future inflation on other factors as well) and (ii) the measure is based only on the information available at the time the forecasts were made, the forecasts (and, indeed, the parameters of the model making the forecasts) being updated as new observations become available (this is, of course, an advantage and one that is not possessed by many such proxies). Thus the series incorporates the adjustments made to expectations due to learning from the inflationary experience. The need to allow for learning about the process generating inflation has been stressed by Friedman (1979), Riddell and Smith (1978) and several others.

Examination of Table Four indicates that the actual inflation rate (the January to January percentage change in the CPI during the year in question) was generally greater than anticipated, sometimes markedly so (e.g., 1971-74). This observation is in general agreement with U.S. findings based on survey-based measures of expected inflation. (See, e.g., Carlson (1977) and Wachtel (1977).) Individuals raised their expectations about future inflation in response to increases in the actual rate,

Table Four

UNANTICIPATED INFLATION AND REAL GNP FLUCTUATIONS IN CANADA, 1953-78

Year	Expected Inflation (PE)	Actual Inflation (P)	Unanticipated Inflation (P-PE)	Percentage Error in Forecasting Inflation (UNEXP)	Percentage Deviation of Real GNP from Trend (GNPDEV)
1953	-0.3	0.0	0.3	-1.0	3.7
1954	0.4	0.4	0.0	0.0	-2.4
1955	0.1	0.4	0.3	4.0	1.8
1956	1.3	2.9	1.6	1.3	5.0
1957	2.0	2.6	0.6	0.3	2.5
1958	1.7	2.2	0.5	0.3	-0.1
1959	0.8	1.1	0.3	0.4	-1.2
1960	0.9	1.4	0.5	0.6	-3.2
1961	0.4	0.4	0.0	-0.1	-5.3
1962	0.8	1.7	0.9	1.0	-3.5
1963	1.0	1.7	0.7	0.7	-3.4
1964	1.1	2.1	1.0	1.0	-1.7
1965	1.6	3.0	1.4	0.9	-0.1
1966	2.4	3.4	1.0	0.4	1.7
1967	2.4	4.5	2.1	0.8	0.2
1968	2.7	3.8	1.1	0.4	1.0
1970	2.4	1.7	-0.7	-0.3	-1.1
1971	2.3	4.9	2.6	1.1	0.7
1972	3.4	5.7	2.3	0.7	1.8
1973	5.8	9.0	3.2	0.5	4.2
1974	9.2	12.1	2.9	0.3	2.9
1975	9.2	9.6	0.4	0.0	-0.7
1976	5.8	6.1	0.3	0.0	-0.1
1977	6.9	9.0	2.1	0.3	-2.4
1978	7.6	8.9	1.3	0.2	-1.6

but not, generally, sufficiently to compensate for the extent to which the actual rate was itself rising.

While the expected inflation series used in this study is carefully constructed and has several desirable features, it is only a proxy for the 'true' series. How imperfect a proxy is not known. This suggests that the sensitivity of the results to alternative proxies should be checked. Further, as explained earlier, the use of unanticipated inflation as a cyclical variable involves the maintained hypothesis of a competitive economy. For these reasons the alternative cyclical variable GNPDEV is employed. In both cases the percentage deviation was employed since an error in predicting inflation of, say, 2 percent will clearly have a larger impact when the expected rate is 2 percent than when the expected rate is 10 percent, and similarly for real output deviations. The percentage deviation of real GNP from trend was calculated as the natural logarithm of real GNP minus the logarithmic trend in real GNP. The latter was obtained by regressing log GNP on a constant and a time trend over the 1947-78 period.

Comparison of the two cyclical variables (the last two columns in Table Four) reveals some similarities and differences. Of course, there is no reason to expect close correspondence between the two series as GNPDEV is only a contemporaneous measure of cyclical fluctuations whereas lagged effects may play an important role in the case of unanticipated inflation. If there were no lagged effects (and if the natural rate theory is correct) then the fact that inflation was generally greater than expected would mean that the actual unemployment rate was generally below the natural rate. With lagged effects from unanticipated inflation and, especially, with the effects of revisions to expectations this no longer follows. In particular, expectations have generally been revised upwards during the period which tends to offset the generally positive values of UNEXP.

Turning to the question of the number of lagged terms to be used, it was felt that lagged effects of more than two years were unlikely (this was also tested and found to be valid) so that the current and two lagged values of UNEXP were included in the annual unemployment rate regressions. Since the expected inflation variable was available from 1953, the time period used is 1955 to 1978. Lagged effects were also included in the Phillips curve equations through the variables (i) the change in unemployment ($\Delta u_t = u_t - u_{t-1}$) ane (ii) catch-up for previously unanticipated inflation (CATCH). As discussed earlier, the variable in the unemployment rate equation corresponding to catch-up in the Phillips curve equation is the expectations revision variable (REV), measured as the percentage revision of expectations, $REV_t = (PE_t - PE_{t-1})/PE_t$. Lagged effects of one or two years were also allowed for in this case.

Two other explanatory variables were used in this study: (i) a dummy variable for the AIB period (1975-1977) and (ii) a measure of the variability of inflation. The rationale for the first is clear; the purpose of a controls programme is to (temporarily at least) "break" the relationship between inflation and unemployment with the result being either less inflation or less unemployment or both than would otherwise have been the case. While there are alternative (and perhaps preferred) methods to test for the effects of the controls programme (see, e.g., Reid (1979)) the use of a dummy variable for the "controls on" period was felt to be satisfactory. The rationale for the inflation variability measure was explained earlier. An implication of some natural rate models is that the higher the variability of inflation the steeper the short run output-inflation or inflation-unemployment tradeoff. A similar argument could be made for the slope coefficient associated with the unemployment rate variable in the Phillips curve equation, although this has not been noted in the literature.[9)] Since the variability of inflation (VAR) is hypothesized to alter the slope of the tradeoff, it enters multiplicatively in the equation. That is, write the unemployment rate equation as

$$U_t = \alpha_0 + \alpha_1(VAR_t)\ UNEXP_t + \beta X_t \tag{15}$$

and

$$\alpha_1(VAR) = \gamma_0 + \gamma_1\ VAR_t \tag{16}$$

to obtain

$$U_t = \alpha_0 + \gamma_0\ UNEXP_t + \gamma_1\ VAR_t \cdot UNEXP_t + \beta X_t \tag{17}$$

Thus VAR enters multiplicatively with UNEXP. Since $\alpha_1<0$ and the slope increases with VAR, we expect $\gamma_0<0$ and $\gamma_1>0$.

In measuring the variability of inflation, it is important to use a measure based only on the variability up to that point in the sample, that is, a "moving sample" approach similar to that used to measure expected inflation is needed to measure variability. The measure used is the standard deviation of the inflation rate over the previous six years; that is, for 1967, VAR_t would be the standard deviation of the inflation rate over the 1961-1966 period.

This completes the discussion of the explanatory variables used in the unemployment rate and augmented Phillips curve equations. It remains to discuss the dependent variables. In both cases there are some problems associated with the dependent variable.

In the case of the unemployment rate equations, the difficulty is created by the revisions made to the Labour Force Survey (LFS) in 1975. Data from the old LFS are available for the 1953-75 period, while Statistics Canada has provided data based on the revised LFS for the 1966-78 period. These data were obtained using the "overlap year" 1975 during which both surveys were run. Revisions to data prior to 1966 were not made because it was felt these would be less reliable. However, it is clear that neither the revised LFS (1966-78) period nor old LFS (1953-75) period would be satisfactory for the purposes of this study. Thus the old LFS data for the 1953-65 period were revised by multiplying monthly data by the monthly old LFS/revised LFS ratios calculated from the overlap year (1975). Annual data were then obtained in the usual way, by averaging the monthly observations. This procedure was applied to all relevant series; unemployment, employment and labour force. It is the same procedure as that used by researchers at the Bank of Canada to revise national unemployment rates back to 1953. In fact, the national series used here were kindly supplied by the Bank of Canada.

The dependent variable for the augmented Phillips curve equations is the percentage change in average hourly earnings (AHE) from one period to the next (i.e. $(w_t - w_{t-1})/w_{t-1}$). Results were also obtained using the Phillips-Lipsey measure of the rate of change $(w_{t+1} - w_{t-1})/2w_t$; see the discussion in Lipsey (1960) for a justification of this measure of the rate of change.

The use of a dependent variable constructed from AHE has important drawbacks; these are discussed in detail in Rowley and Wilton (1977) and Riddell (1979). A preferred method, for reasons discussed in Riddell (1979), is to use individual contract data or averages of such individual observations. Unfortunately, neither of these measures are available for Newfoundland. Since this is the region of primary interest in this study, AHE was used to form the dependent variable.

6. National Results

The estimated equations for Canada are presented and discussed in this section. The unemployment rate regressions are presented first. The augmented Phillips curve results, which are somewhat less reliable because of the limitations of average hourly earnings, follow. The unemployment rate results are further divided into these using the (percentage) deviation of GNP from its trend as the cyclical variable and those using unanticipated inflation as the source of cyclical fluctuations. All the results use annual data and cover the period 1955-78.

The first set of unemployment rate regressions are shown in Table Five. The dependent variable is the annual average unemployment rate (U). Regressions were also run using the logarithm of the unemployment rate and the logarithm of U/100-U, the dependent variable used by Barro (1977). Because there were no important differences in the results with these different choices of dependent variable and because the regressions with U are easiest to interpret, these are reported in the remainder of the paper.

The results in columns (1) to (4) of Table Five include only the minimum wage and unemployment insurance variables as factors accounting for movements in the natural unemployment rate. Equations (5) to (7) include, in addition, some variable(s) to control for the composition of the labour force. The FY and FW variables are based on data revised back to 1953 using the old LFS/revised LFS overlap year (1975); they thus correspond to the dependent variable.

Examination of all the equations in Table Five reveals that the unanticipated inflation variables have the predicted negative signs and that both the current and two lagged values are significantly different from zero. (Figures in parentheses are t statistics). Regressions were also run (with an appropriately reduced sample period) with three and four lagged terms, and these were found to be insignificant. These findings accord with our a priori expectation that not more than two lagged terms would be needed. The lag pattern (declining lag coefficients) is also in accord with a priori expectations.

The findings with respect to lagged effects are similar to those of Barro (1977) who found that a two year lag was significant in U.S. annual data. There are two important differences between these results and Barro's (apart from the obvious difference that they are for different countries): (i) Barro used the unanticipated growth in the money supply rather than unanticipated inflation, and (ii) Barro used the difference between actual and expected money whereas the percentage amount of unanticipated inflation is used here. The first factor would tend to make our lagged effects shorter than Barro's as there is a lag between changes in the money supply and changes in the price level; this may not be as long as one year, however, so that two lagged terms could be significant in either case. The second factor tends to offset the first, and was found to be of considerable quantitative importance. In earlier versions

Table Five

REGRESSIONS OF THE ANNUAL AVERAGE RATE OF UNEMPLOYMENT, CANADA, 1955-78

Equation	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Constant	3.37	4.72	5.87	5.78	5.36	3.86	5.95	6.36
	(2.9)	(5.1)	(6.8)	(6.8)	(2.4)	(2.6)	(2.0)	(2.2)
UNEXP	-0.54	-0.60	-0.87	-0.86	-0.87	-0.73	-0.60	-0.58
	(-1.9)	(-2.9)	(-4.4)	(-4.3)	(-4.1)	(-3.2)	(-2.2)	(-2.2)
$UNEXP_{-1}$		-0.83	-0.82	-0.78	-0.78	-0.61	-0.61	-0.64
		(-4.2)	(-5.0)	(-4.6)	(-4.5)	(-3.5)	(-3.0)	(-3.2)
$UNEXP_{-2}$			-0.51	-0.54	-0.54	-0.47	-0.42	-0.38
			(-3.0)	(-3.1)	(-3.1)	(-2.6)	(-2.2)	(-2.1)
MW	-3.28	-5.12	-6.12	-5.37	-5.80	-9.69	-9.13	-9.66
	(-1.2)	(-2.4)	(-3.4)	(-3.0)	(-1.6)	(-2.4)	(-2.2)	(-2.5)
UICMAX	10.94	10.71	9.79					8.46
	(4.1)	(5.4)	(5.8)					(3.2)
UICAVE				13.95	13.52	10.54	11.68	
				(5.6)	(3.4)	(2.8)	(2.9)	
FY					2.79		-22.44	-25.97
					(0.1)		(-0.9)	(-1.0)
FW						13.8	21.86	23.07
						(1.2)	(1.5)	(1.6)
R^2	0.56	0.77	0.85	0.84	0.84	0.85	0.86	0.87
DW	1.20	1.54	1.42	1.51	1.52	1.66	1.69	1.82
SEE	1.02	0.76	0.63	0.65	0.67	0.64	0.65	0.62

of this work, the amount of unanticipated inflation was used as the cyclical variable and only one lagged term was significant. The use of the percentage error in expected inflation resulted in a considerable improvement in the goodness of fit and in the second lag term being significant.

Both the MW and UIC variables are significant, with the former having a negative sign and the latter the expected positive sign. The negative influence of the minimum wage on unemployment is unexpected; as pointed out earlier we generally expect the (predicted) positive effect on unemployment through reduced employment to dominate the predicted negative effect through reduced participation, resulting in a positive effect overall. However, as also discussed earlier, the minimum wage may act as a proxy for the spread between high and low wage jobs which would account for the negative sign.

The results are not sensitive to the unemployment insurance variable used. Comparison of equations (3) and (4) shows that UICMAX gives a slightly better fit and lower standard error of estimate but the differences are not large. The coefficient on UICAVE is of course larger because this variable has a lower mean. The estimated quantitative effects of changes in average or maximum benefits are very similar.

Turning to the equations which control for changes in the composition of the labour force, the addition of FY and FW is seen to make little difference to the results. FY is insignificant in all three equations ((5), (7), (8)). FW is also insignificant, although it borders on significance. The two percentages FW and FY are highly correlated so that their separate effects are difficult to estimate. This is the reason for the large (and opposite in sign) coefficients in equations (7) and (8).

In all of the equations in Table Five, the Durbin Watson static (DW) is in the inconclusive range at both the one and five percent significance levels. Since the bounds are quite wide with only 24 observations, each of the equations (3) to (8) was estimated using the Cochrane-Orcutt procedure which is based on the hypothesis of an AR(1) process in the errors. Without exception, the estimated auto-correlation coefficient was small and not significantly different from zero. Also, the individual estimated parameters were not affected by the use of generalized rather than ordinary least squares. Thus it appears reasonable to conclude that the errors in these equations are sufficiently free of autocorrelation to permit hypothesis testing with ordinary least squares. This absence of autocorrelation is important not only for the usual estimation and hypothesis testing reasons but also because it indicates that the natural rate theory, as implemented empirically by equations (3) to (8), does not have any difficulty in explaining the persistence of unemployment over the 1955-78 period. Of course, it must be remembered that the expectations series used here is not rational in the Muth sense.

The unemployment insurance variables UICAVE and UICMAX include coverage (COV) entered multiplicatively with the real benefits variable (BRAVE or BRMAX). This multiplicative restriction was tested and found to be valid. Equations (9) and (10) in Table Six have COV entered separately from BRMAX and BRAVE. Comparing these equations to their counterparts in Table Five ((3) and (4)) reveals no significant improvement in the goodness of fit.

As reported earlier in this paper, an attempt was made to incorporate as many of the changes in the unemployment insurance system as possible into the estimated equations. There are too many such results to report them in detail; some examples of the results obtained are shown in the last five columns of Table Six. The basic UI variable in each of these equations is either UICAVE or UICMAX. Each of the additional UI variables shown (MWQ1, MWQ2, ADDWKS, SWAN2) were adjusted multiplicatively for coverage. (Recall the earlier derivation which showed that all UI variables should be multiplied by COV). Variables which were also used, both separately and together with other UI variables, included MAXWKS, SWAN1, and DR. Also, each of the UI variables and combinations of these were entered without being multiplied by COV. Thus a large number of features of the UI system were measured and entered both separately and in combinations into the unemployment rate equations. The results are almost uniformly disappointing. None of the variables MWQ1, MWQ2, or ADDWKS are significant although the latter two have the predicted negative sign. Similarly, DR and MAXWKS were found to be insignificant. The combination variables SWAN1 and SWAN2 were not found to yield a significant improvement in goodness of fit over UICAVE entered alone (compare equation (13) to equation (4) for example); on the other hand, there was no appreciable improvement in goodness of fit when MWQ2 and UICAVE were entered separately (compare equations (12) and (13)).

In summary, the results reported in Table Six (plus the additional results not reported) suggest that the various changes to the Unemployment Insurace Act captured in the MWQ, ADDWKS, MAXWKS and DR

Table Six

REGRESSIONS OF THE CANADIAN UNEMPLOYMENT RATE ON ALTERNATIVE MEASURES OF THE CHANGES IN UNEMPLOYMENT INSURANCE, 1955-78

Equation	(9)	(10)	(11)	(12)	(13)	(14)	(15)
Constant	0.90 (1.7)	2.30 (3.0)	7.96 (5.0)	9.90 (2.8)	7.67 (3.2)	7.13 (2.2)	5.15 (2.1)
UNEXP	-0.94 (-4.6)	-0.86 (-4.3)	-0.73 (-3.2)	-0.84 (-2.6)	-0.91 (-3.3)	-1.22 (-3.1)	-1.17 (-3.8)
$UNEXP_{-1}$	-0.76 (-4.6)	-0.81 (-4.9)	-0.81 (-4.8)	-0.78 (-4.3)	-0.79 (-4.3)	-0.68 (-3.4)	-0.72 (-3.9)
$UNEXP_{-2}$	-0.57 (-3.4)	-0.51 (-3.0)	-0.58 (-3.4)	-0.56 (-3.1)	-0.51 (-2.1)	-0.50 (-2.7)	-0.48 (-2.8)
MW	-3.34 (-1.5)	-5.88 (-3.2)	-4.38 (-2.3)	-5.25 (-2.0)	-6.77 (-3.3)	-6.10 (-2.4)	-5.90 (-2.8)
BRMAX/ UICMAX		7.57 (2.3)					7.17 (1.3)
BRAVE/ UICAVE	23.55 (2.4)		29.79 (2.4)	24.37 (1.5)		5.80 (0.5)	
COV	0.17 (0.1)	4.53 (2.6)					
MWQ1						2.21 (0.9)	0.26 (1.2)
MWQ2			-1.05 (-1.3)	-1.03 (-1.2)			
ADDWKS				-2.36 (-0.5)	-2.22 (-0.7)	-11.17 (-1.1)	-10.99 (-1.3)
SWAN2					52.78 (1.3)		
R^2	0.86	0.86	0.85	0.86	0.85	0.85	0.86
DW	1.37	1.44	1.33	1.32	1.46	1.66	1.66
SEE	0.62	0.63	0.64	0.65	0.64	0.66	0.64

variables have not had a significant impact on the equilibrium unemployment rate and that the majority of the impact of changes in the Act can be captured in terms of the coverage and benefit rate changes incorporated in the UICMAX or UICAVE variables. While this result is somewhat disappointing, it is perhaps not too surprising given the relatively small number of observations and the fact that the various UI variables are all correlated with each other, making estimation of their individual effects difficult. It is possible that a "super index" of the various UI variables would result in some improvement over the use of UICMAX or UICAVE alone; until such an index is available, one of these two variables (usually UICMAX) will suffice to control for the effects of changes in the genorisity of the UI system.

While the results using unanticipated inflation accord well with the predictions of the natural rate theory, the fact that our measure of expected inflation, even though carefully constructed, is only a proxy for the "true" unobserved series implies a need to check the results obtained using alternative measures. As explained earlier, this is done using the percentage deviation of real GNP from its trend (GNPDEV). Some of the results obtained with GNPDEV are shown in Table Seven. The overall pattern of these results is similar to those obtained with UNEXP. The cyclical variable has the expected negative sign and is significant. Only the contemporaneous value of GNPDEV accounts for cyclical fluctuations in unemployment; indeed, the lagged value $GNPDEV_{-1}$ was always positive, sometimes significantly so, when included. The UI variables are positive and significant. Their coefficients are also

Table Seven

REGRESSIONS OF THE CANADIAN UNEMPLOYMENT RATE ON DEVIATIONS IN GNP INSTEAD OF UNEXPECTED INFLATION, 1955-78

Equation	(16)	(17)	(18)	(19)	(20)	(21)
Constant	1.45 (2.1)	1.43 (2.3)	-5.81 (-1.5)	-5.84 (-1.7)	1.00 (0.9)	-1.81 (-0.5)
GNPDEV	-32.59 (-5.7)	-35.12 (-6.8)	-35.91 (-3.9)	-39.24 (-4.7)	-35.31 (-6.7)	-36.43 (-6.8)
MW	-0.27 (-0.2)	-1.25 (-0.8)	-9.29 (-2.5)	-8.64 (-2.7)	-1.29 (-0.8)	-0.04 (-0.0)
UICAVE	18.49 (7.2)		10.20 (2.9)			
UICMAX		13.37 (8.3)		8.43 (3.9)	11.68 (2.8)	15.92 (3.5)
FY			41.71 (1.3)	44.45 (1.6)		
FW			7.56 (0.5)	2.91 (0.2)		
ADDWKS						-5.63 (-1.1)
MWQ1					0.17 (0.4)	0.20 (1.2)
R^2	0.81	0.84	0.87	0.90	0.84	0.85
DW	1.15	1.17	1.32	1.51	1.21	1.29
SEE	0.68	0.61	0.59	0.52	0.62	0.62

larger than in the corresponding equations using UNEXP; compare equations (16) and (4) and (17) and (3) for example. Thus these equations will attribute more of the increase in the unemployment rate to the changes in the UI system than will the results with UNEXP. The coefficient on the MW variable is again generally negative in sign, although it is typically insignificant. The demographic composition variables and the additional UI variables are also insignificant.

In summary, there are no major differences in results when GNPDEV is used rather than UNEXP to control for cyclical fluctuations. The fit is somewhat better with UNEXP, and there are some differences in conclusions about the magnitude of the influence of the minimum wage and unemployment insurance variables. Thus it is not clear that one set of results is better in some sense than the other. The main reason one would have for preferring the results with UNEXP is that under the condition of competitive markets UNEXP is a truly exogenous variable whereas GNPDEV is endogenous no matter what conditions hold. Another reason for preferring the unanticipated inflation results is that these permit one to test the natural rate theory, a matter to which we now turn.

Each of the equations in Tables Five and Six was tested for the natural rate property by adding, ACT, the actual rate of inflation (plus lagged values of the actual rate as appropriate) as explanatory variables, and testing the hypothesis of a zero coefficient vector on these actual inflation variables. This test is equivalent (i.e. it gives identical results) to including the actual and expected rates as separate variables and testing the restriction that the coefficient on one is equal but opposite in sign to the other. Some of the results are shown in the first three columns of Table Eight. These should be compared to equation (3) in Table Five. All of the calculated F values were well below the appropriate critical value at the five percent significance level; indeed, they were all below the ten percent critical values. Thus the estimated equations have the natural rate property.

Table Eight also shows the results of some additional tests. Equation (25) reports on the incorporation of REV, the variable measuring the percentage revision in expected inflation. The prediction of a positive coefficient on REV is seen to hold but the variable is not significant. It was unfortunately not possible to include lagged values of REV because REV and REV_{-1} were so highly correlated that the $X'X$ matrix could not be inverted. Some other tests which also gave insignificant results were those incorporating the inflation variability measure and those incorporating the AIB dummy variable. The AIB dummy was typically positive but insignificant. The inflation variability coefficient, on the other hand, had the predicted sign (i.e. an increase in the variability of inflation lead to an increase in the slope of the unemployment-unanticipated inflation tradeoff) but was also insignificant.

The final two columns of Table Eight examine the sensitivity of the two basic equations to small changes in the sample. Such sensitivity tests are worth conducting in most circumstances; in this case, the fact that there were some quite large values of UNEXP in the first three years of the sample made such a test even more appealing. The estimated equations (26) and (27) are thus for the sample period 1958-78;

Table Eight

REGRESSIONS TO TEST THE EXISTENCE OF A NATURAL RATE OF UNEMPLOYMENT, THE REVISION OF EXPECTATIONS, AND A SHORTER SAMPLE PERIOD, CANADA, 1975-78

Equation	(22)	(23)	(24)	(25)	(26)*	(27)*
Constant	5.29 (4.1)	5.29 (4.0)	5.12 (3.8)	5.87 (6.6)	6.26 (7.5)	1.71 (1.7)
UNEXP	-0.85 (-4.2)	-0.84 (-3.7)	-0.79 (-3.4)	-0.82 (-2.3)	-0.89 (-2.4)	
$UNEXP_{-1}$	-0.81 (-4.8)	-0.81 (-4.5)	-0.74 (-3.7)	-0.83 (-4.4)	-1.37 (-3.7)	
$UNEXP_{-2}$	-0.48 (-2.7)	-0.48 (-2.6)	-0.44 (-2.3)	-0.52 (-2.9)	-1.08 (-3.1)	
MW	-5.30 (-2.3)	-5.32 (-2.3)	-5.20 (-2.2)	-6.26 (-3.0)	-4.41 (-2.3)	-1.89 (-0.8)
UICMAX	11.20 (3.9)	11.15 (3.7)	11.08 (3.7)	9.79 (5.7)	8.20 (4.7)	13.35 (7.7)
ACT	-0.06 (-0.6)	-0.06 (-0.6)	-0.08 (-0.1)			
ACT_{-1}		0.01 (0.1)	-0.03 (-0.3)			
ACT_{-2}			0.08 (0.8)			
REV				0.27 (0.7)		
GNPDEV						-32.70 (-4.2)
R^2	0.85	0.85	0.86	0.85	0.86	0.80
DW	1.43	1.45	1.55	1.43	2.02	0.96
SEE	0.64	0.66	0.67	0.65	0.59	0.66

* Sample period 1958-78

they should be compared with equations (3) and (17) respectively. The first equation is affected slightly in that the lagged coefficients $UNEXP_{-1}$ and $UNEXP_{-2}$ increase in size. The only other change is the improvement in the DW statistic which is now out of the inconclusive range. The parameter estimates in the GNPDEV equation are hardly affected at all by dropping the three observations. However, the DW statistic falls quite dramatically, indicating positive autocorrelation at the 5 percent significance level. Overall, then, the results are not too sensitive to this change in sample size. In particular, the UNEXP equations are not very sensitive to the omission of the extreme values of UNEXP in the early part of the sample. Some problems are indicated with respect to the GNPDEV equation, however.

As explained in earlier sections, an alternative to controlling for changes in the composition of the labour force by including the FY and FW variables in the aggregate unemployment rate equation is to run separate regressions for each age-sex group. Table Nine presents some of the results obtained with this method. The dependent variables in equations (28) to (36) are the unemployment rates for the following groups: (28 both sexes 15 to 19 years of age, (2a) both sexes 20 to 24 years of age, (30) both sexes 25 years of age and over, (31) females 15 to 19, (32) females 20-24, (33) females 25 years and over, (34) males 15 to 19, (35) males 20 to 24 , and (36) males 25 years and over. The minimum wage variable differs between males and females. Thus equations (28) to (3) use the minimum wage index for both sexes , (31) to (33) use the female index, and so on. Unfortunately it was not possible to obtain coverage data by age and sex after 1971, nor is an age-sex breakdown of average weekly wages available for the entire sample period. Thus the UICMAX variable is the same in each equation. It may not therefore reflect the differential impact of UI changes across age-sex groups.

The results in Table Nine are generally in accord with the aggregate results discussed earlier. The UNEXP coefficients are negative and significant; as before two lagged terms are significant but further lagged terms (results not shown) are not. There are important differences in the size of the UNEXP, $UNEXP_{-1}$ and $UNEXP_{-2}$ coefficients across age-sex groups. The cyclical sensitivity of the unemployment rate is greatest for males aged 15 to 19 years and least for females 25 years of age and over. The other parameter estimates also differ considerably across age-sex groups. For females the constant term is approximately zero and the minimum wage coefficient is positive but insignificant while for males the constant term is significantly greater than zero and the minimum wage coefficient is negative and significant. The UI coefficient is positive and significant in all cases, but it differs considerably in size across groups being smallest for males 25 years and over and largest for younger females. In each sex it is largest in the 20 to 24 age group.

The equation for males 25 years and over shows no evidence of autocorrelation while the DW statistics for the other two males equations are in the inconclusive range. The females equations, on the other hand, all show evidence of positive autocorrelation at the 5 percent

Table Nine

REGRESSIONS OF CANADIAN UNEMPLOYMENT RATES FOR SPECIFIC AGE AND SEX GROUPS, 1955-78

Equation	(28)	(29)	(30)	(31)	(32)	(33)	(34)	(35)	(36)
Dependent Variable	UB1519	UB2025	UB25P	UF1519	UF2024	UF25P	UM1519	UM2024	UM25P
Constant	11.68	6.00	5.58	-0.06	-0.65	0.46	17.71	9.06	6.96
	(6.7)	(4.6)	(9.1)	(0.9)	(0.5)	(1.0)	(9.0)	(6.5)	(11.5)
UNEXP	-1.77	-1.22	-0.67	-1.42	-0.83	-0.41	-2.15	-1.52	-0.77
	(-4.2)	(-3.6)	(-4.9)	(-3.3)	(-2.3)	(-2.1)	(-4.6)	(-4.2)	(-5.5)
$UNEXP_{-1}$	-1.75	-1.23	-0.64	-1.38	-0.98	-0.56	-1.94	-1.38	-0.62
	(-4.9)	(-4.3)	(-5.5)	(-3.6)	(-3.0)	(-3.31)	(-4.9)	(-4.6)	(-5.2)
$UNEXP_{-2}$	-1.12	-0.69	-0.39	-1.15	-0.57	-0.38	-1.14	-0.80	-0.41
	(-3.1)	(-2.3)	(-3.3)	(-3.1)	(-1.8)	(-2.2)	(-2.8)	(-2.6)	(-3.3)
MW(·)	-5.58	-8.45	-6.45	15.97	1.90	0.72	-12.63	-11.95	-7.32
	(-1.4)	(-2.7)	(-5.1)	(1.6)	(0.2)	(0.2)	(-3.6)	(-4.4)	(-6.8)
UICMAX	16.37	19.09	6.34	17.93	20.89	12.93	12.32	17.65	2.71
	(4.5)	(6.5)	(5.3)	(4.3)	(5.9)	(6.9)	(3.1)	(5.8)	(2.3)
R^2	0.84	0.84	0.85	0.88	0.85	0.88	0.78	0.83	0.82
DW	1.28	1.19	1.74	1.02	0.75	0.84	1.49	1.47	1.99
SEE	1.36	1.10	0.47	1.39	1.18	0.62	1.51	1.16	0.46

significance level. This is especially so for the 20 to 24 and 25 years and over age groups. Examination of the residuals of these equations indicates an upward trend in the dependent variable which is not fully explained by the changes in the independent variables. This suggests a need to include some of the variables accounting for the increased labour force participation of female workers, especially those over 20 years of age. There is some disagreement among labour economists about the cause of this increased participation; in particular, the extent to which it is due to increased real family income as opposed to exogenous factors such as improved methods of birth control and changing attitudes towards working mothers. These, then, are the main candidates as omitted variables in the female unemployment rate equations.

This discussion indicates that some further work needs to be done on the female unemployment rate equations before tests of parameter equality across age-sex groups can be conducted (such F tests assume that the errors are homoskedastic and free of autocorrelation) and before aggregate natural unemployment rates can be calculated as weighted averages of individual natural rates for each age-sex group. I have not yet done this additional work, mainly for the reason that it could only be done on a national level. Since the regional results are of primary interest, these additional tests are best left to a study which focusses on the national unemployment rate. A second reason is that there is a need to allow for interaction among age-sex groups (which, of course, the equations in Table Nine do not) but I have not yet worked out the way such interaction effects should enter the equations. For example, the increased participation of females may not only have raised the equilibrium unemployment rate of females but also have lowered that of males. One possible reason is that the increased participation makes male workers relatively more scarce (and female relatively less scarce) so that employers became less willing to let male workers go (through layoffs of dismissals) and more willing to let female workers go.

The estimated Phillips curve equations are shown in Table Ten. As reported earlier, two alternative measures of the rate of change of wages were used: (i) the year to year increase $(w_t - w_{t-1})/w_{t-1}$, and (ii) the Lipsey measure of rate of change $(w_{t+1} - w_{t-1})/2w_t$. Equations (37) and (39) to (42) use the former and equation (38) the latter. Comparison of equations (37) and (38) reveals that the parameter estimates are not very sensitive to the choice of dependent variable. The Lipsey measure does, by its construction, tend to lead to autocorrelated errors which explains the much lower DW statistic in (38) and the higher 't' values in (38) over (37). For this reason the results using the year to year increase as the dependent variable are preferred, and are presented in the rest of the table.

The Phillips curve results are uniformly poor. The unemployment rate coefficient has the correct sign (UNIV is the inverse of the unemployment rate) and is similar in magnitude to estimates in the published literature; however, it is never significant. The change in unemployment variable ΔU has a positive coefficient in all of the regressions using the year to year percentage change in wages as the dependent variable. This implies clockwise loops around the Phillips curve, an implication which is consistent with other research using better wage data. This

Table Ten

AUGMENTED PHILLIP'S CURVE RELATIONS, CANADA, 1955-78*

Equation	(37)	(38)	(39)	(40)	(41)	(42)
Constant	-0.85	-0.83	-12.62	-10.62	-8.73	-14.62
	(-0.2)	(-0.3)	(-1.1)	(-1.0)	(-0.8)	(-1.4)
UINV	13.18	14.02	18.31	16.26	14.15	28.29
	(0.7)	(1.1)	(0.8)	(0.7)	(0.6)	(1.2)
ΔU	0.78	-0.16	1.19	1.13	1.04	1.34
	(0.7)	(-0.2)	(1.0)	(0.9)	(0.9)	(1.1)
PE	1.65	1.57	0.83	0.99	0.23	0.62
	(4.7)	(6.5)	(1.1)	(1.6)	(0.9)	(0.9)
MW			24.47	22.67	18.93	25.18
			(1.9)	(1.9)	(1.3)	(2.1)
UICMAX				7.58	4.27	11.08
				(0.4)	(0.2)	(0.6)
UICAVE			17.86			
			(0.5)			
CATCH					1.23	
					(0.05)	
AIB						4.51
						(1.4)
R^2	0.58	0.70	0.65	0.65	0.65	0.69
DW	2.14	1.30	2.14	2.11	2.05	2.27
SEE	4.06	2.75	3.89	3.90	3.99	3.89

* The dependent variable is the per cent change in annual hourly earnings in regressions 37, 39-42. The dependent variable is $W_{t+1} - W_{t-1})/2W_t$ in regression 38, where W_t is average hourly earnings in year t.

variable is never significant either. The expected inflation variable is close to the predicted value of unity in equations (39) and (40) and it borders on significance in these equations. A formal test for the natural rate property ($\alpha_4 = 1$) can be conducted using a t statistic since only one coefficient is involved. This test yields t = 0.3 for equation (39) and t = 0.0 for equation (40). Thus the natural rate property holds in these equations. It also holds in (42) but not in (41). However, the confidence interval around the PE coefficient is extremely wide (especially in equations (41) and (42)) so that it includes zero as well as unity at the usual significance levels in equations (39), (40) and (42).

The other variables are also generally insignificant with only the MW variable bordering on significance. Equations were also estimated with the labour force composition variables and these were found to be insignificant.

In summary, the Phillips curve results are extremely weak with the standard error of estimate being close to 4 percent in each equation and very few, if any, of the variables being significant. With the exception of the equation including the catch-up variable (41), the results are consistent with the natural rate theory. However, the confidence intervals on each parameter estimate are so wide that the results are also consistent with other theories of the relationship between inflation and unemployment. It should be noted that the weak results come mainly from the use of average hourly earnings to form the dependent variable. Other Phillips curve studies, such as those of Auld et. al., Riddell (1979) and Ridell and Smith, which are based on individual contract data give much stronger results even when carried out at the same level of aggregation as done here [10)].

Since the majority of the results reported in this section are consistent with the predictions of the natural rate theory, it is possible to solve for the estimated natural unemployment rate at various points in time. Three such estimated U^N vectors are shown in Table Eleven, along with the actual rate. Two of the three equations ((3) and (8)) are based on unanticipated inflation as the cyclical variable while the third (17) uses GNPDEV. Both (3) and (8) were tested for the natural rate property and this was found to hold. As explained earlier, Equation (17) could not be so tested; the estimated natural rates are thus based on setting GNPDEV = 0. All of the estimated natural rates in Table Eleven are based on UICMAX as the unemployment insurance variable. The estimates are not sensitive to the use of UICAVE as an alternative. The difference between equations (3) and (8) is the addition of the FW and FY variables.

Examination of Table Eleven shows that the alternative cyclical variables UNEXP and GNPDEV lead to important differences in estimated natural rates[11)]. In particular, the estimated U^N based on equation (17) is considerably lower than that based on equation (3), especially in the 1955-70 period. After 1972 the difference between the two estimates narrows as equation (17) attributes a larger increase in the natural unemployment rate to the 1971 changes in the UI Act. The estimates based on equation (8) are generally between the other two except for the recent

Table 11

ESTIMATED NATURAL UNEMPLOYMENT RATES : CANADA 1955-78

Year	Actual U	Estimated U^N Based on Equation: (3)	(17)	(8)
1955	3.9	6.8	4.5	5.7
1956	3.1	7.3	5.1	6.2
1957	4.2	7.1	5.0	6.3
1958	6.3	7.1	4.9	6.4
1959	5.3	7.2	5.0	6.7
1960	6.3	7.2	5.2	6.9
1961	6.4	7.0	4.9	6.9
1962	5.4	6.9	4.8	6.9
1963	5.1	6.0	4.5	5.5
1964	4.3	6.0	4.5	5.6
1965	3.6	5.7	4.2	5.3
1966	3.4	5.6	3.9	5.3
1967	3.8	5.3	3.8	5.0
1968	4.5	5.9	4.4	5.5
1969	4.4	6.0	4.9	5.7
1970	5.7	5.7	4.6	5.3
1971	6.2	6.5	5.5	6.1
1972	6.2	7.8	7.4	7.3
1973	5.6	7.9	7.4	7.4
1974	5.3	7.6	7.1	7.0
1975	6.9	7.4	6.9	7.1
1976	7.1	7.4	6.8	7.5
1977	8.1	7.6	6.8	7.7
1978	8.4	7.7	7.0	8.1

period 1976-78 when they are the largest of the three estimates.

The estimated natural rates were based on equations (3), (8) and (17) because these are in some sense the preferred equations. But which of these three sets of estimates is the preferred choice? This is a difficult question. There are a number of reasons for preferring the estimates based on UNEXP (i.e. either (3) or (8)), the main ones being (i) that UNEXP is an exogenous variable under certain conditions whereas GNPDEV is not, and (ii) that the UNEXP results were found to be less sensitive to changes in the sample size. On the other hand, the reasons for preferring the estimates based on GNPDEV are (i) that the expected rate of inflation series is a proxy and (ii) that these estimates are closer to our a priori views about the numerical value of the natural unemployment rate. Adding these arguments together leads me to conclude that the natural rate is somewhere between the estimates based on equations (3) and (17), and probably closer to the latter.

Estimates of the natural rate were also calculated based on the Phillips curve estimates in Table Ten. These were quite erratic, emphasizing further the unreliability of these results. For example, the estimated natural rate based on equation (40), which is the preferred equation in that group, varied from 2.8 to 29.7 percent. Of course the confidence interval around these point estimates would be quite large so the estimates may not differ significantly from those in Table Eleven.

To the reader who was used to thinking of "full employment" as involving an unemployment rate of about 3 percent in the 1950's and early 1960's and 5 to 6 percent in the 1970's, even the estimated natural rates based on equation (17) will seem on the high side. However, these earlier views were generally based on the notion of a stable Phillips curve. That such views were substantially,if not completely, wrong is now clear. Further, the period 1955-78 was one of steadily (but mainly slowly) rising inflation which implies that, unless there were forces pushing in the other direction, the natural unemployment rate was generally above the actual rate. Indeed, this is the reason why the results based on UNEXP are generally above the actual rate. (The main opposing force is the upward revision of expectations which was not found to be a significant factor here).

7. Comparison of National Results with those of other Researchers

Thise section compares the national results obtained in this study with those obtained in the related studies of Kierkowski (1977), Grubel and Maki (1979) and Fortin and Phaneuf (1979). The purpose is not to provide a detailed comparison, but rather to point out the main differences between these various studies and this one so that the source of differences in conclusions can be identified.

The Kierkowski and Grubel and Maki studies parallel the unemployment rate regressions reported here in that they employ a 'real' dependent variable. Kierkowski employs the unemployment rate as the dependent variable and uses the amount of unanticipated inflation to control for cyclical fluctuations; thus the specification is quite similar to that used here. However, Kierkowski only enters the current amount of unanticipated inflation as an explanatory variable. Since his data are quarterly this is an extremely strong restriction. Indeed, our results indicate that quite a large number of lagged terms would need to be included in a quarterly model. Comparison of equations (1) and (3) in Table Five illustrates the effect of restricting the unanticipated inflation variable to have only contemporaneous effects. Such a restriction is of course even more severe in a quarterly model. For this reason I do not feel it is worthwhile discussing Kierkowski's results any further.

The main differences between the Grubel and Maki study and this one are (i) they employ old Labour Force Survey data rather the revised LFS data, (ii) they use as dependent variables the labour force to population ratio and the employment to population ratio, calculating unemployment effects from the difference between these two equations, and (iii) they include time trend variables (time and time squared) in each of these two equations. The first difference implies that their study ends in 1975. The second implies that the estimated unemployment effects are for the unemployment to population ratio rather than the unemployment rate. Thus some care is required in comparing the results. The third difference makes it almost impossible to compare results in any meaningful way. The use of a trend variable (and worse, its square) makes it even more difficult than usual to estimate the separate effects of the various proper explanatory variables, most of which exhibit fairly strong time trends. Further, trend variables are most unsatisfactory in that they do not provide any explanation of the phenomenon being analysed. One might call them "non-explanatory" explanatory variables.

The Grubel and Maki study employs a cyclical variable very similar to our GNPDEV. Thus were it not for the trend and trend squared variables, their results would be comparable to our GNPDEV results.

The Fortin and Phaneuf study obtains estimates of the natural unemployment rate from a Phillips curve in which the dependent variable is the percentage change in prices (measured as the percentage change in the CPI excluding food). This variable is regressed on the expected rate of change of prices (actually the expected rates of change of both consumer prices and imports are used), a measure of excess demand, and some additional explanatory variables which would tend to shift the Phillips curve. The expected rate of change of prices is proxied simply by the one period lagged value of the actual rate of price change. There is a considerable amount of evidence which indicates that this is a poor measure of the expected rate of price change. Since the price expectations variable is rather critical in studies of this type it is unfortunate that a proxy with more a priori justification was not constructed. The excess demand series was constructed through an elaborate procedure similar to that of Wachtel (1976). The most important aspect of this procedure is that it assumes that the natural unemployment rate for prime age males has been constant throughout the sample period. Our evidence contradicts this assumption. In particular, equation (36) in Table Nine indicates that the prime age male natural rate has been affected by changes in the minimum wage and the unemployment insurance system. It is, however, probably true (again, based on the evidence in Table Nine) that the natural unemployment rate for prime age males has been closer to being a constant than the natural rate for any other age-sex group.

A peculiar aspect of the Fortin and Phaneuf study is that the remaining variables (examples include the real minimum wage and an unemployment insurance generosity index) are entered as percentage changes rather than levels. This is clearly a mis-specification for it implies that permanent changes in, for example, unemployment insurance benefits will only have temporary effects on unemployment. That is, the implication is that the changes to the UI Act in 1971-72 would affect unemployment in 1972 (due to a positive percentage change in the UI variable) but not in later years (percentage change in UI variable equals zero) in spite of benefits remaining at their higher levels. This is, of course, an absurd implication.

In summary, a number of other recent studies have provided estimates of the natural unemployment rate for Canada. Two of the studies (Kierkowski, Fortin and Phaneuf) have serious limitations so that there is little reason to devote effort and space to a comparison of their results with ours. The results of the Grubel and Maki study, however, could fruitfully be compared to ours.

8. The Natural Rate Theory in a Regional Setting

A characteristic feature of the Canadian economy is that average unemployment rates differ markedly across regions. The facts (i) that these unemployment rate differences have persisted for a long time and (ii) that the timing of cyclical fluctuations around the average rates appears to be quite similar across regions together suggest that these differences are equilibrium ones; that is, that observed differences in average unemployment rates reflect differences in regional natural rates. But are these observations consistent with alternative views and, if so, what empirical tests could be used to determine the 'correct' explanation? The natural rate theory has unfortunately not yet been developed to the point where these sorts of questions can be answered.

I have discussed at some length elsewhere (Riddell (1978)) the relationship between the natural unemployment rate theory and observed regional unemployment rate differentials. The different types of non-cyclical unemployment are described and the many reasons why these may differ across regions are discussed. The literature drawn on is almost entirely not only partial equilibrium in nature but also directed towards the analysis of a single market. However, it does suggest reasons why permanent unemployment rate differentials may exist across countries or regions.

While it would not be fruitful to summarize my earlier discussion, some key points should be stated here. Differences in unemployment rates arise because of differences in the number of individuals flowing into and out of the unemployed state and because of differences in their duration in that state. These can usefully be broken down into four factors: (i) the probability of being dismissed or laid off, (ii) the probability of quitting, (iii) the probability of receiving a job offer and (iv) the probability of accepting a job offer. Equilibrium differences in any of these probabilities will lead to differences in equilibrium (or natural) unemployment rates across regions. Of course, the effect arising from one of these factors may be offset by that arising from another. For example, it is known that the equilibrium probability of quitting or being laid off is lower for an older worker than a younger worker but also the probability of receiving a job offer during any given time period is lower so that the equilibrium unemployment rate of older workers may be higher or lower than that of younger workers.

Much of the natural rate literature has focussed on job search by unemployed workers and has examined the fourth probability mentioned above, that of accepting a job offer. It seems unlikely, to this writer at least, that this "supply side" explanation can account for a substantial portion of the observed differences in regional unemployment rates in Canada. Rather, these differences may be primarily due to "demand side" factors such as the probability of a worker being laid off or receiving a job offer. It is only quite recently that the natural rate literature has begun to analyse these "demand side" determinants of equilibrium unemployment rates. For example, Hall (1979) examines the determinants of the length of employment which clearly affects the probability of being laid off. Papers which examine layoffs more directly include those of Baily (1977) and Feldstein (1975, 1976). Similarly, Nickell (1979) examines the effect of changes in labour standards legislation (examples include the period of notice required prior to dismissal and severance payments which must be made to workers laid off or dismissed) on the unemployment rate.

One observation which suggests that demand side factors are important determinants of observed regional unemployment rate differences is the simple one that regions with higher average unemployment rates have lower average vacancy rates. This is certainly true in comparing Ontario and Newfoundland, and would undoubtedly remain true after correction of measured vacancy rates to make them more comparable to measured unemployment rates. A low equilibrium vacancy rate would imply a low equilibrium probability of receiving a job offer in any given period, and thus a high equilibrium unemployment rate. Such an equilibrium could be accounted for by differences among regions in the extent to which employers have a "captive audience" of potential workers. In a region in which employers recognize that they are unlikely to lose workers laid off (i.e. they face a "captive audience") the probability of being laid off will be higher and the probability of finding a vacancy lower than in a region in which employers recognize that they are likely to lose any workers let go. The extreme case of a "captive audience" is that of a single employer in the region - with no other potential employers the probability of not being able to rehire workers laid off is quite low.

In order that the high vacancy rate - low unemployment rate and low vacancy rate - high unemployment rate situations represent equilibrium states, real wages would have to be at equilibrium levels in each region. Thus the simple measure V-U (where V is the vacancy rate and U the unemployment rate) could not be used to characterize excess demand in each region; otherwise, there could be excess demand indicated in one region and excess supply in the other. Of course, there is nothing which requires that V-U be a consistent indicator of excess demand across regions or countries. Thus it is quite possible to have $V-U>0$ in equilibrium in a region in which employers do not face much competition from other employers for workers and $V-U<0$ in a region in which the opposite holds.

An explicit theoretical model of the sort described above has not, to my knowledge, been presented in the literature, This is perhaps not too surprising given the fact that the literature has concentrated, until recently, on "supply side" determinants of the natural rate. However, a model along these lines would appear to be of considerable relevance to regional unemployment disparities.

In addition, there is a need for an extension of natural rate theory to a multi-market setting. Brechling (1974) has made some initial investigations in this direction, examining the roles of intersectoral dependencies in wage setting and expectations and of inter-regional migration. However, considerably more theoretical work remains to be done, especially with respect to incorporating the explanation of regional unemployment rate differences in a model of regional wage determination.

In the absence of this further theoretical work, two types of empirical studies seem relevant. One is a cross-sectional study explaining regional natural unemployment rates by the various factors discussed in Riddell (1978) as well as those suggested above. The second is a time series study explaining movements in regional unemployment rates over time and breaking these down into changes in the natural rate and cyclical variations around the natural rate. Both types of studies have their advantages. In the case of the former, some of the factors accounting for permanent regional unemployment rate differentials will be fairly constant over time in each region (but will differ across regions); for example, the geographical dispersion of the labour force within each region or the average birth and death rates of firms. On the other hand, some factors (e.g. the fraction of women in the labour force or some unemployment insurance variables) may not vary much across regions at a point in time but may display considerable variation over time.

As already indicated, this study is strictly time series and in fact only covers the two regions Ontario and Newfoundland (plus Canada of course). A cross-sectional study would be quite limited in terms of the number of variables that could be used to explain differences in natural rates as there would only be ten observations (one for each province) on the dependent variable. Even with only annual data, there are 24 observations on the dependent variables used in the regressions reported in the next section. An important extension of this study would be to combine the time series and cross-section observations. A pooled study of this sort would be a major undertaking but would be useful in allowing one to incorporate a larger number of variables that influence the natural rate, both variables which tend to be fairly constant over time but not across regions at a point in time and vice versa, than it is possible to incorporate with either the time series or cross-section approaches alone.

The fact that the results reported on here are time series ones means that many of the factors that cause the Newfoundland natural rate to be higher than the Ontario natural rate (this assumes that the natural rate property holds in each region which has not yet been demonstrated) are subsumed in the constant term. Of course, several of these omitted variables are probably not strictly constant over time but rather display some temporal variation. For example, there have been changes in labour standards legislation in both provinces over this period. It is hoped, however, that there are no omitted variables of any quantitative significance.

A brief comment should be made about the cyclical variables used in the regional part of the study. As the discussion in sections three and four made clear, the source of the shock to aggregate demand does not matter when using unanticipated inflation as the cyclical variable. This is an advantage in that we did not need to take account of the openness of the Canadian economy. Its advantage for the regional aspect of the study is even clearer. If, on the other hand, the original source of cyclical fluctuations were to be used as the explanatory variable then it would be necessary to take into account the openness of the economy or region. For example, it would be necessary not only to include the unanticipated changes in money and in fiscal policy but also the unanticipated change in export demand.

There is also the question of whether a given shock in national aggregate demand gives rise to an equal amount of unanticipated inflation in each region. Because regional price indexes are not available for more than a small fraction of the sample period, it is not possible to construct measures of unanticipated inflation which differ across regions. Thus in using UNEXP in the regional unemployment rate equation it is assumed that unanticipated changes in aggregate demand give rise to equal amounts of unanticipated inflation in each region. This assumption is probably not too inaccurate, but it would be preferable to be able to test it. The use of GNPDEV as an alternative does not change the implicit assumption very much. Thus in order to allow for regional differences in cyclical fluctuations, the percentage deviation of provincial employment from its trend (EDEV) was used in addition to the two national cyclical variables.

It should perhaps be mentioned that the use of UNEXP in the regional unemployment rate regressions does not assume that either the timing or the magnitude of the responses to unanticipated inflation are the same across regions for the estimated parameters are allowed to differ between the two regions. Rather, it assumes that the amount of unexpected inflation is similar in each region.

Finally, it should be mentioned that the regional Phillips curve equations have both the rate of change of wages and the unemployment rate differing between regions. The expected inflation variable is common to both regions.

9. Regional Results

The provincial cyclical measures are shown in Table Twelve. These were obtained by regressing the logarithm of provincial employment (based on revised LFS data; observations prior to 1966 were revised in the same manner as reported earlier for unemployment rate data) on a constant and a time trend. The estimated equations were

$$\ell n\ EONT = \underset{(607.0)}{7.33} + \underset{(50.0)}{0.029}\ T \qquad R^2 = 0.99$$

$$\ell n\ ENFL = \underset{(110.8)}{4.21} + \underset{(15.3)}{0.028}\ T \qquad R^2 = 0.91$$

where ℓn EONT is the natural logarithm of employment in Ontario, T is the time trend and the figures in parentheses are 't' statistics. The trend rate of growth in employment is almost equal in each region. (These

Table Twelve

PERCENTAGE DEVIATIONS FROM TREND OF PROVINCIAL EMPLOYMENT

Year	Ontario	Newfoundland
1953	2.5	12.9
1954	1.6	7.9
1955	1.1	8.8
1956	3.3	8.3
1957	3.5	1.5
1958	-0.3	-9.9
1959	-0.6	-9.1
1960	-1.2	-11.8
1961	-3.2	-14.8
1962	-4.0	-11.3
1963	-4.2	-3.5
1964	-3.3	-1.9
1965	-3.2	0.8
1966	0.1	4.9
1967	0.3	4.2
1968	0.0	1.5
1969	0.7	-0.4
1970	-0.2	-2.0
1971	-0.7	-0.0
1972	0.4	1.5
1973	1.8	6.6
1974	3.1	1.8
1975	1.7	0.8
1976	0.7	1.8
1977	-0.3	0.9
1978	0.3	0.6

regressions cover the period 1953-1978). However, there was considerably more variability in employment growth in Newfoundland during the 1953-63 period; this accounts for the lower R^2 in the Newfoundland equation.

Comparison of the two employment deviations series in Table Twelve indicates that they are similar in direction but different in magnitude. In particular the percentage deviations from trend have been much larger in Newfoundland, especially during the 1953-63 period, than in Ontario. The pattern of the two series is also similar to that of GNPDEV (see Table Four) although they are by no means identical. All three label the 1958-65 period as below trend but the employment deviations measures differ from GNPDEV on the 1975-78 period, the former labelling this period as above trend.

Table Thirteen contains the first set of regional results. The dependent variable is the provincial unemployment rate, adjusted as explained earlier to the revised LFS. As indicated at the top of each column, the first four equations relate to Ontario and the last four to Newfoundland. All of the regressions in Table Thirteen use national measures to account for cyclical fluctuations. The other explanatory variables do differ across regions, however, and when this is the case they are indicated by a dot in parentheses. Thus MW(·) indicates the Ontario minimum wage index in the first four equations and the Newfoundland index in the last four.

The first equation for each province (43 or 47) does not incorporate the UI coverage variable, while the second for each province (i.e. (44) and (48)) includes COV additively as a separate variable. Recall (see Table One) that coverage data by province are not available after 1971; thus COV is the national series. It is clear from comparison of

Table Thirteen

PROVINCIAL REGRESSIONS OF AVERAGE UNEMPLOYMENT RATES, ONTARIO AND NEWFOUNDLAND, 1953-78

Equation	(43)	(44)	(45)	(46)	(47)	(48)	(49)	(50)
Province	ONT	ONT	ONT	ONT	NFL	NFL	NFL	NFL
Constant	-0.09 (-0.1)	-0.42 (-0.3)	3.14 (4.4)	0.27 (0.5)	5.99 (1.2)	3.49 (1.0)	13.18 (6.2)	0.90 (0.6)
UNEXP	-0.83 (-3.5	-0.72 (-3.3)	-0.73 (-3.4)		-3.27 (-4.6)	-2.63 (-5.2)	-2.82 (-5.4)	
$UNEXP_{-1}$	-0.79 (-4.0)	-0.79 (-4.3)	-0.79 (-4.3)		-2.05 (-3.3)	-1.93 (-4.6)	-2.02 (-4.5)	
$UNEXP_{-2}$	-0.47 (-2.3)	-0.45 (-2.4)	-0.46 (-2.4)		-1.53 (-2.4)	-1.41 (-3.2)	-1.45 (-3.1)	
GNPDEV				-31.95 (-5.5)				-105.03 (-7.6)
MW(·)	-1.87 (-1.6)	-2.73 (-2.4)	-2.86 (-2.5)	0.35 (0.3)	-18.67 (-2.4)	-34.59 (-5.5)	-32.16 (-5.4)	-10.94 (-1.9)
BRMAX (·)	14.19 (4.6)	8.17 (2.0)			28.72 (3.0)	14.07 (1.9)		
UICMAX(·)			10.20 (5.4)	12.35 (6.8)			29.81 (5.7)	35.18 (7.2)
COV		4.44 (2.1)				20.19 (4.6)		
R^2	0.78	0.82	0.82	0.80	0.68	0.86	0.83	0.84
DW	0.89	1.30	1.34	1.09	0.51	1.60	1.21	1.43
SEE	0.76	0.70	0.69	0.68	2.36	1.62	1.73	1.60

equations (43) and (44) for Ontario and (47) and (48) for Newfoundland that coverage is an important variable in each province, especially in Newfoundland. It is unfortunate that provincial series are not available as these would no doubt perform even better. Equations (45) and (49) impose the multiplicative restriction, national coverage being multiplied by the provincial real maximum benefit rate variable. This restriction improves the Ontario results slightly (in terms of lower SEE) and worsens the Newfoundland results somewhat. Thus, as with the national results, the multiplicative form is not rejected by the data, although it is closer to rejection for Newfoundland than for Ontario.

The first three equations for each province use unexpected inflation (and its lagged values) as the cyclical variable while the fourth uses GNPDEV. All have the predicted negative signs and are significantly different from zero. The lag pattern (declining lag coefficients) in each province is similar to the national pattern, the only difference of any note being that in Ontario the one period lagged term has almost the same impact as the contemporaneous term. Comparison of equations (45) and (46) for Ontario and (49) and (50) for Newfoundland reveals that the two alternative cyclical measures perform similarly in terms of overall goodness of fit. There is some reason to prefer the GNPDEV results in that these have a lower standard error of estimate for each province, but the differences are not large.

The minimum wage variable gives similar results to those obtained nationally. It is negative and significant when UNEXP is used to control for cyclical fluctuations, and insignificant when GNPDEV is the cyclical variable. The UI variable is positive and significant in each province, with the Newfoundland coefficient being approximately three times the

Ontario coefficient. (Also the mean of UICMAX is higher for Newfoundland).

Tables Fourteen and Fifteen show the results obtained when additional unemployment insurance variables are included. The maximum weeks of benefits (MAXWKS) and additional weeks of benefits for each week of work (ADDWKS) variables are the same in all regions. The minimum weeks required to qualify for benefits variables (MWQ1, MWQ2) differ between Ontario and Newfoundland in 1978 but not in other years. The denial ratio (DR) differs across regions (see Table Two). Table Fourteen contains the results obtained when unanticipated inflation is the cyclical variable and Table Fifteen when GNPDEV is the cyclical variable.

The regional results with the additional unemployment insurance variables are similar to those obtained for Canada - disappointing. MWQ generally has the wrong sign for Ontario and the predicted negative sign for Newfoundland, and is typically insignificant in both provinces. The ADDWKS variable generally has the predicted negative sign but is also insignificant. The denial ratio has the predicted negative sign for Ontario but a positive sign for Newfoundland.[12)] This variable is also insignificant in both regions.

In summary, the movements in the real value of maximum benefits, and in coverage seem to be able to account for all of the observed changes in the provincial unemployment rates caused by changes in the unemployment insurance system. The additional features of the UI system captured in the MWQ, ADDWKS, MAXWKS and DR variables are not significant factors in affecting unemployment rates.

Table Sixteen contains results obtained using the percentage deviation of provincial employment from its trend, EDEV, as the cyclical

Table Fourteen

REGRESSIONS OF PROVINCIAL UNEMPLOYMENT RATES ON ALTERNATIVE MEASURES OF UNEMPLOYMENT INSURANCE, ONTARIO AND NEWFOUNDLAND, 1953-78

Equation	(51)	(52)	(53)	(54)	(55)	(56)	(57)	(58)
Province	ONT	ONT	ONT	ONT	NFL	NFL	NFL	NFL
Constant	2.80 (0.6)	3.65 (0.9)	2.29 (2.5)	4.06 (3.4)	23.27 (2.8)	22.60 (2.6)	13.80 (4.6)	11.83 (3.8)
UNEXP	-0.73 (-3.1)	-1.42 (-4.1)	-0.69 (-3.3)	-0.66 (-2.9)	-2.81 (-5.5)	-3.03 (-2.9)	-2.82 (-5.3)	-2.88 (-5.4)
$UNEXP_{-1}$	-0.80 (-4.2)	-0.59 (-3.1)	-0.80 (-4.5)	-0.71 (-3.6)	-1.85 (-4.0)	-1.79 (-3.3)	-2.01 (-4.3)	-2.12 (-4.5)
$UNEXP_{-2}$	-4.45 (-2.4)	-0.40 (-2.4)	-0.42 (-2.3)	-0.44 (-2.4)	-1.42 (-3.1)	-1.40 (-2.9)	-1.45 (-3.0)	-1.50 (-3.2)
MW(·)	-2.80 (-2.0)	-3.17 (-2.6)	-2.21 (-1.9)	-4.44 (-2.2)	-36.07 (-5.1)	-36.16 (-4.9)	-32.48 (-4.5)	-26.51 (-2.8)
UICMAX(·)	10.77 (1.4)	4.81 (0.7)	15.18 (3.8)	9.50 (4.7)	16.11 (1.3)	15.87 (1.3)	28.99 (3.1)	28.87 (5.3)
MWQ1(·)	0.01 (0.1)	0.26 (2.1)			-0.15 (-1.2)	-0.05 (-0.1)		
ADDWKS		-13.26 (-2.5)				-4.46 (-0.2)		
MAXWKS			-4.04 (-1.4)				0.01 (0.1)	
DR(·)				-5.99 (-1.0)				8.58 (0.8)
R^2	0.88	0.87	0.83	0.82	0.84	0.84	0.83	0.83
DW	1.35	2.04	1.58	1.37	1.45	1.48	1.22	1.19
SEE	0.71	0.63	0.67	0.69	1.70	1.75	1.78	1.75

Table Fifteen

REGRESSIONS OF PROVINCIAL UNEMPLOYMENT RATES USING DEVIATIONS IN GNP IN PLACE OF UNEXPECTED INFLATION, ONTARIO AND NEWFOUNDLAND, 1953-78

Equation	(59)	(60)	(61)	(62)	(63)	(64)	(65)	(66)
Province	ONT	ONT	ONT	ONT	NFL	NFL	NFL	NFL
Constant	-0.90 (-0.2)	-2.65 (-0.6)	-0.41 (-0.6)	1.75 (1.5)	8.93 (1.2)	12.89 (1.6)	1.65 (0.7)	-1.50 (-0.5)
GNPDEV	-32.01 (-5.4)	-33.30 (-5.7)	-31.31 (-5.5)	-28.65 (4.6)	-101.67 (-7.2)	-97.30 (-7.0)	-104.79 (-7.5)	-109.14 (-7.6)
MW(·)	0.54 (0.4)	0.96 (0.8)	0.86 (0.8)	-2.04 (-1.0)	-14.70 (-2.2)	-16.19 (-2.5)	-12.08 (-1.9)	-3.90 (-0.4)
UICMAX(·)	14.33 (2.1)	15.73 (2.3)	16.74 (4.4)	11.25 (5.8)	24.20 (2.1)	21.92 (2.0)	32.45 (3.9)	34.30 (6.9)
MWQ1(·)	0.02 (0.3)	0.13 (1.2)			-0.12 (-1.1)	-0.39 (-1.9)		
ADDWKS		-4.15 (-1.4)				11.03 (1.5)		
MAXWKS			-0.04 (-1.3)				0.03 (0.04)	
DR(·)				-7.67 (-1.4)				9.41 (1.0)
R^2	0.80	0.82	0.82	0.82	0.84	0.86	0.84	0.84
DW	1.21	1.11	1.24	1.24	1.55	1.71	1.46	1.33
SEE	0.69	0.68	0.67	0.66	1.59	1.53	1.63	1.60

Table Sixteen

REGRESSIONS OF PROVINCIAL UNEMPLOYMENT RATES USING DEVIATIONS
IN PROVINCIAL EMPLOYMENT,
ONTARIO AND NEWFOUNDLAND, 1953-78

Equation	(67)	(68)	(69)	(70)	(71)	(72)	(73)	(74)
Province	ONT	ONT	ONT	ONT	NFL	NFL	NFL	NFL
Constant	0.10 (0.1)	-8.26 (-2.5)	-1.86 (-0.6)	-1.99 (-0.6)	0.77 (0.0)	-4.18 (-1.5)	14.99 (3.7)	-0.28 (-0.1)
UNEXP			-0.5 (-2.5)				-2.95 (-4.8)	
$UNEXP_{-1}$			-0.66 (-3.5)				-2.10 (-4.2)	
$UNEXP_{-2}$			-0.38 (-2.1)				-1.49 (-3.0)	
GNPDEV				-27.95 (-3.4)				-100.37 (-6.4)
EDEV(·)	-21.89 (-2.1)	-8.24 (-0.8)			-39.32 (-5.1)	-35.59 (-4.9)		
MW(·)	-0.48 (-0.3)	-10.15 (-2.5)	-7.37 (-2.25)	-2.31 (-0.6)	-0.24 (-0.0)	-19.72 (-1.7)	-28.92 (-2.8)	-16.35 (-1.6)
UICMAX(·)	13.54 (5.0)	4.15 (0.9)	6.25 (2.1)	10.08 (2.7)	27.33 (4.3)	27.60 (4.7)	29.76 (5.5)	34.97 (7.1)
FW(·)		43.78 (2.5)	22.61 (1.7)	11.60 (0.7)		37.22 (2.1)	-8.09 (-0.4)	10.69 (0.7)
R^2	0.60	0.70	0.84	0.81	0.72	0.77	0.83	0.84
DW	0.99	1.44	1.62	1.17	0.75	0.98	1.19	1.48
SEE	0.97	0.86	0.66	0.69	2.07	1.92	1.77	1.62

variable. It also contains estimated equations which control for demographic changes by including the fraction of women in the provincial labour force, FW.

The EDEV equations are uniformly poor compared to their GNPDEV and UNEXP counterparts. Equation (67) should be compared to equations (45) and (46) and equation (71) to equations (49) and (50). The goodness of fit is considerably poorer, and the DW statistic lower. The situation improves somewhat when FW is added (compare (68) to (69) and (70) and (72) to (73) and (74)); however, the fit is still noticeably poorer. Further, the EDEV variable is insignificant in equation (68), the equation which appears to be the best of the Ontario equations containing EDEV. Thus the provincial employment deviations measure does not perform as well as either of the national measures, and further results with EDEV will not be reported. It is unfortunate that real provincial product measures are not available; these would be preferable to GNPDEV as cyclical variables.

Turning to the demographic variable, the FW coefficient is not significant in any of the preferred equations (69 and 70 for Ontario and 73 and 74 for Newfoundland). Thus there is no indication that changes in the fraction of women in the labour force have had a significant effect on the equilibrium unemployment rate. Judging from the national results, which were similar in this respect, this conclusion would not be altered by the inclusion of FY, the fraction of younger workers in the provincial labour force.

Table Seventeen presents the appropriate tests of the natural rate hypothesis. As we found with the national results, the estimated UNEXP

Table Seventeen

TESTS OF THE EXISTENCE OF NATURAL RATES OF UNEMPLOYMENT, ONTARIO AND NEWFOUNDLAND, 1953-78

Equation	(75)	(76)	(77)	(78)	(79)	(80)
Province	ONT	ONT	ONT	NFL	NFL	NFL
Constant	3.02 (2.9)	3.03 (2.8)	2.92 (2.7)	16.44 (5.7)	16.53 (5.7)	16.30 (5.5)
UNEXP	-0.72 (-3.2)	-0.66 (-2.7)	-0.61 (-2.4)	-2.82 (-5.6)	-2.64 (-4.7)	-2.52 (-4.4)
$UNEXP_{-1}$	-0.79 (-4.2)	-0.76 (-3.8)	-0.67 (-3.1)	-2.02 (-4.6)	-1.94 (-4.3)	-1.77 (-3.5)
$UNEXP_{-2}$	-0.44 (-2.2)	-0.44 (-2.1)	-0.39 (-1.9)	-1.62 (-3.5	-1.60) (-3.4)	-1.51 (-3.1)
MW(·)	-2.70 (-1.8)	-2.84 (-1.8)	-2.94 (-1.9)	-38.07 (-5.1)	-39.46 (-5.1)	-40.20 (-5.1)
UICMAX(·)	10.64 (3.2)	10.19 (2.9)	9.81 (2.8)	23.75 (3.6)	23.43 (3.5)	23.54 (3.5)
ACT	-0.02 (-0.2)	-0.05 (-0.4)	-0.06 (-0.5)	0.31 (1.4)	0.21 (0.8)	0.18 (0.7)
ACT_{-1}		0.06 (0.6)	0.01 (0.0)		0.19 (0.8)	0.08 (0.3)
ACT_{-2}			0.11 (1.1)			0.20 (0.9)
R^2	0.82	0.82	0.83	0.85	0.85	0.86
DW	1.35	1.43	1.55	1.26	1.41	1.48
SEE	0.71	0.73	0.72	1.67	1.69	1.71

equations have the natural rate property at the usual significance levels. Indeed, the F statistics testing for the natural rate property are all close to zero.

We now turn to an examination of the size of the individual coefficients. There is, of course, considerable interest in these as they indicate the sensitivity of the regional unemployment rate to changes in the explanatory variables. It is clear from the results in Tables Thirteen to Seventeen that the various parameter estimates are all much larger for Newfoundland than for Ontario. This is not too surprising - we know simply from examination of the unemployment rate data that unemployment fluctuations are much larger in Newfoundland than in Ontario so we expect the coefficients on the cyclical variables to be larger for Newfoundland. Similarly, since Newfoundland's unemployment rate is much higher than Ontario's at any point in time, we would expect changes in the unemployment insurance system to have a larger effect in Newfoundland. Less clear is whether the percentage effect should differ between the regions. In order to examine this question, regressions using the natural logarithm of unemployment as the dependent variable are presented in Table Eighteen. With log U as the dependent variable, each coefficient shows the percentage change in unemployment associated with a unit change in the explanatory variable. Examination of Table Eighteen reveals that the percentage response of unemployment is greater in Newfoundland, the difference being mainly in the contemporaneous response. (The coefficient on UNEXP is much larger in Newfoundland than in Ontario but the lagged term coefficients are very similar in size). The unemployment insurance coefficient is also larger for Newfoundland than for Ontario, indicating

Table Eighteen

REGRESSIONS OF THE NATURAL LOGARITHMIC VALUES
OF PROVINCIAL UNEMPLOYMENT RATES,
ONTARIO AND NEWFOUNDLAND, 1953-78

Equation	(81)	(82)	(83)	(84)	(85)	(86)	(87)	(88)
Province	ONT	ONT	ONT	ONT	NFL	NFL	NFL	NFL
Constant	1.20 (8.3)	0.89 (1.3)	0.50 (4.1)	0.84 (1.1)	2.56 (12.1)	2.84 (7.3)	1.26 (7.5)	1.17 (4.6)
UNEXP	-0.17 (-4.0)	-0.16 (-3.3)			-0.31 (-6.1)	-0.33 (-5.6)		
$UNEXP_{-1}$	-0.21 (-5.7)	-0.20 (-4.9)			-0.21 (-4.9)	-0.23 (-4.8)		
$UNEXP_{-2}$	-0.10 (-2.6)	-0.09 (-2.4)			-0.12 (02.7)	-0.13 (-2.8)		
GNPDEV			-7.64 (-5.7)	-8.24 (-4.3)			-10.94 (-7.7)	-10.60 (-6.5)
MW(·)	-0.70 (-3.1)	-0.98 (-1.5)	0.09 (0.4)	0.49 (0.5)	-3.04 (-4.9)	-2.40 (-2.4)	-0.85 (-1.5)	-1.25 (-1.2)
UICMAX(·)	2.27 (5.9)	2.03 (3.1)	2.78 (6.6)	3.12 (3.6)	2.94 (5.8)	2.93 (5.7)	3.50 (6.9)	3.49 (6.7)
FW(·)		1.38 (0.5)		-1.73 (-0.5)		-1.60 (-0.8)		0.79 (0.5)
R^2	0.86	0.86	0.80	0.80	0.80	0.85	0.83	0.83
DW	1.59	1.63	1.19	1.18	1.33	1.30	1.40	1.43
SEE	0.14	0.14	0.16	0.16	0.17	0.17	0.17	0.17

that changes made to the UI system have not only raised the unemployment rate more in Newfoundland than in Ontario but they have even had a greater percentage effect on the unemployment rate. Further, it should be remembered that the value of UICMAX is larger in Newfoundland than Ontario, which adds to the conclusion that the impact of the unemployment insurance system is much larger in Newfoundland. The minimum wage variable also tends to have a larger coefficient in Newfoundland; it is not, however, significant in several of the equations. The demographic variable FW is also insignificant.

Since the natural rate property was found to hold, the estimated parameter vectors can be used to solve for the natural unemployment rate at various points in time. The calculated natural rates based on the preferred equations (45 and 46 for Ontario and 49 and 50 for Newfoundland) are shown in Tables Nineteen and Twenty. The pattern is very similar to that obtained nationally. The equations which use UNEXP as the cyclical variable (45 for Ontario and 49 for Newfoundland) give larger estimated natural rates than those which use GNPDEV as the cyclical variable, particularly in the 1955-1970 period. They thus attribute less of an increase in the natural rate to the 1971-2 changes in the UI system. The other two columns in each Table are for the corresponding equations with the demographic variable FW included. Thus (69) is the UNEXP equation (45) with FW added, (70) is the GNPDEV equation (46) with FW added, and similarly for Newfoundland. The changes made to the estimated natural rates are fairly minor.

In order to examine the impact of the 1971 changes to the UI Act, it is best to compare the 1970 and 1972 unemployment rates as the full

Table Nineteen

ESTIMATED NATURAL UNEMPLOYMENT RATES : ONTARIO, 1955-78

Year	Actual U	Estimated U^N Based on Equation: (45)	(46)	(69)	(70)
1955	3.1	5.4	3.3	4.7	3.2
1956	2.3	5.9	3.9	5.3	3.8
1957	3.2	5.8	3.8	5.3	3.7
1958	5.1	5.7	3.7	5.2	3.6
1959	4.3	5.8	3.7	5.4	3.7
1960	5.1	5.9	4.0	5.6	4.0
1961	5.3	5.7	3.7	5.6	3.9
1962	4.2	5.6	3.6	5.6	3.8
1963	3.7	5.2	3.5	4.8	3.5
1964	3.1	5.1	3.5	5.0	3.6
1965	2.5	5.0	3.3	5.0	3.5
1966	2.6	4.2	3.1	3.9	3.1
1967	3.2	4.2	3.0	4.2	3.1
1968	3.6	4.4	3.6	4.0	3.4
1969	3.2	4.9	4.1	4.6	4.0
1970	4.4	4.7	3.7	4.6	3.8
1971	5.4	5.3	4.6	5.0	4.5
1972	5.0	6.7	6.2	6.1	6.0
1973	4.3	6.8	6.3	6.3	6.1
1974	4.4	6.5	6.1	6.2	5.9
1975	6.3	6.5	6.0	6.3	6.0
1976	6.2	6.4	5.9	6.5	5.9
1977	7.0	6.5	5.9	6.8	6.1
1978	7.5	6.7	6.0	7.1	6.3

Table Twenty

ESTIMATED NATURAL UNEMPLOYMENT RATES : NEWFOUNDLAND, 1955-78

		Estimated U^N Based on Equation:			
Year	Actual U	(49)	(50)	(73)	(74)
1955	4.6	14.5	8.6	15.0	8.2
1956	5.1	16.2	10.5	16.7	10.1
1957	7.9	16.2	10.1	16.6	9.9
1958	10.9	16.2	10.2	16.6	10.0
1959	14.6	16.5	10.5	16.8	10.5
1960	13.4	16.7	10.6	16.8	10.8
1961	14.9	16.3	9.7	16.3	10.0
1962	13.1	15.8	9.4	15.9	9.6
1963	10.6	12.4	8.0	12.8	7.8
1964	8.0	12.6	8.0	12.7	8.0
1965	8.0	12.1	7.4	12.2	7.5
1966	5.9	12.1	6.8	12.1	7.2
1967	6.1	12.4	6.6	12.2	7.1
1968	7.2	10.6	7.2	10.7	7.2
1969	7.4	10.9	8.5	11.1	8.3
1970	7.4	10.2	7.3	10.4	7.2
1971	8.5	12.2	10.2	12.4	10.0
1972	9.4	16.8	15.5	16.9	15.4
1973	10.2	17.0	15.3	17.0	15.4
1974	13.3	14.9	13.7	15.1	13.4
1975	14.3	14.1	12.8	14.3	12.6
1976	13.7	13.8	12.3	13.9	12.3
1977	16.0	15.1	12.9	15.0	13.2
1978	16.6	16.1	13.9	15.9	14.2

impact of the changes was not felt in 1971. According to equations (45) and (46) the Ontario natural rate rose from 4.7 to 6.7 percent or 3.7 to 6.2 percent respectively between 1970 and 1972. These are increases of 2.0 and 2.5 in absolute terms and 42 and 67 percent in percentage terms. As mentioned earlier, the GNPDEV equation attributes a larger effect to the unemployment insurance variable. The corresponding changes in Newfoundland were from 10.2 to 16.8 based on equation (49) or 7.3 to 15.5 based on equation (50), increases of 6.6 or 8.2 points in absolute terms and 64 and 112 percent in percentage terms. Of course, not all of this increase need be due to the UI changes as the other explanatory variables may have changed between 1970 and 1972. Checking this, an examination of the data reveals that UICMAX increased from 0.27 to 0.47 in Ontario from 1970 to 1972 and from 0.30 to 0.54 in Newfoundland. These changes, given the estimated parameters, produce changes in the natural rate of 2.0 and 2.5 points for equations (45) and (46) and 7.2 and 8.4 points for equations (49) and (50). Thus the estimated impacts are identical for Ontario and a bit larger for Newfoundland.

Augmented Phillips curve equations were also estimated using the regional rate of change of wages (as measured by the percentage change in average hourly earnings) as the dependent variable and using regional explanatory variables, except for the expected rate of inflation which is common to both provinces. The results were uniformly weak, and are not in fact worth reporting. They parallel the national results in that they are consistent with the natural rate theory (the estimated price expectations coefficient does not differ significantly from unity) but most of the variables, including the regional unemployment rate, are insignificant.

10. Conclusions

The purpose of this paper was to test the natural rate theory using data for Canada and two provinces - Ontario and Newfoundland. The discussion of the theory led to two alternative specifications, the unemployment rate equation and the augmented Phillips curve. Both types of equations were estimated, but only the former type was found to produce reliable results.

The main specific conclusions can be briefly summarized:

1. The results for Canada, Ontario and Newfoundland are all consistent with the predictions of the natural rate theory.
2. The estimated natural unemployment rate in 1978 was approximately 7.4 percent for Canada, 6.5 percent for Ontario and 14.5 percent for Newfoundland.
3. Increases in the minimum wage did not have any noticeable upward effect on the equilibrium unemployment rate, their estimated effect being insignificant in some equations and significantly negative in others.
4. Increases in the "generosity" of the unemployment insurance system have significantly increased the equilibrium unemployment rate. The largest changes, which occurred in 1971, raised the Ontario unemployment rate by approximately 2.0 to 2.5 points and the Newfoundland unemployment rate by approximately 7.2 to 8.4 points. Their percentage impact was greatest in Newfoundland.

There are a number of ways in which the research reported here could be extended. The extension to all ten provinces and a pooled time series/cross-section study has already been discussed. The extension to a system of equations in which both the unemployment rate and the amount of unanticipated inflation are jointly endogenous was also discussed. A third worthwhile extension would be to quarterly data.

If the natural rate hypothesis is valid (and this study indicates that it is) then regional policy should concentrate on measures designed to lower the equilibrium unemployment rate rather than on measures to stimulate national, or even regional, aggregate demand. Some job creation programs may succeed in lowering the equilibrium unemployment rate (Tobin and Baily (1978), Johnson (1979)) but these need to be designed with their inflationary effects in mind. If the average unemployment rate is to be lowered in high unemployment regions, this will come about mainly through policies which operate directly on the structure of labour and product markets rather than on national or regional aggregate demand. A study with more micro detail than this one is needed to determine what those policies might be.

FOOTNOTES

1. I will continue to use the term 'natural' throughout the remainder of this essay, primarily because it is the most frequently used term. Some readers may prefer alternative, and possibly more neutral and/or more operational, terms such as the NAIRU or the 'equilibrium rate'. Whatever term is used, no normative significance should be attached to it; the natural rate may be either too high or too low. Indeed, one of the important advances resulting from the natural rate theory is the beginning of the application of the traditional tools of welfare economics, which have been applied successfully to many areas such as public finance, to the problems of inflation and unemployment. See, for example, Phelps (1972) and Prescott (1976).

   It is also worth noting that the unemployment rate is concentrated on because of the tremendous policy interest in this statistic and because of the central role the unemployment rate has played in the Phillips curve literature. The theory could, however, be phrased in terms of any other real variable; thus we could talk of the 'natural employment rate', the 'natural vacancy rate', etc.

2. The development in equations (7) through (10) follows closely that in Barro and Fischer (1976).

3. This is simply the dynamic counterpart of the prediction of static theory that a monopolist will increase both its price and output in response to a ceteris paribus increase in demand.

4. If the parameter vectors are allowed to differ, (11) and (12) can be written as

$$\bar{U}_t^c = \beta X_t + \alpha UI_t$$

$$\bar{U}_t^{nc} = \gamma X_t$$

which gives

$$\bar{U}_t = \gamma X_t + \alpha(COV_t UI_t) + (\beta-\gamma)(COV_t X_t)$$

Thus testing the hypothesis $\beta-\gamma = 0$ is straightforward.

5. This is the same as the variable THETA used in Swan (1979).

6. This series (for Canada and the provinces) was kindly supplied by my colleague Peter Chinloy.

7. It should be noted, however, that our SWAN2 is not identical to that used in SWAN (1979) because we correct for the taxation of benefits and for coverage

8. In a more complete model FW and FY would be endogenous variables explained, for example, by real family incomes, family size, improved methods for birth control, changes in the economic returns to higher education, and possibly a time trend to capture other influences such as changes in attitudes towards working mothers.

9. Indeed, as is by now clear, for each variable entering the unemployment rate equation there is a corresponding variable in the augmented Phillips curve.

10. The weak results may also be accounted for to some extent by the use of annual rather than quarterly or monthly observations.

11. Confidence intervals attached to these estimates have not yet been constructed. However, the differences between (3) and (17) appear large enough to be statistically significant.

12. Note that there may be reverse causation in the case of the denial ratio; that is, changes in unemployment causing changes in the denial ratio. The positive sign is an indication of this.

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