SERIES B NO. 5

cycles and trends in labour force participation: 1953-1968

special labour force studies
DOMINION BUREAU OF STATISTICS

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Special Manpower Studies

SPECIAL LABOUR FORCE STUDIES

Series B, No. 5

CYCLES AND TRENDS IN LABOUR FORCE PARTICIPATION

1953 - 1968

by
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Published by Authority of
The Minister of Industry, Trade and Commerce

June 1971
8005-521

Price: 75 cents

Information Canada
Ottawa

FOREWORD

This is the fifth report in the Special Labour Force Studies (Series B). Using monthly and annual data on labour force participation, the investigation is principally designed to test for the presence of any "additional" and/or "discouraged" worker effect in response to changes in the demand for labour. Separate examinations are made at the Canada level and for the five regions.

The study was prepared under the direction of Dr. Sylvia Ostry, at that time the Director, Special Manpower Studies and Consultation.

The responsibility for the analysis and interpretation of the data is that of the author and not of the Dominion Bureau of Statistics.

Walter E. Duffett,

Dominion Statistician.

AUTHOR'S PREFACE

This study was begun under the direction of Dr. Sylvia Ostry when she was Director, Special Manpower Studies and Consultation Division, DBS. I would like to thank Dr. Ostry for the interest which she continued to show following her appointment as a Director of the Economic Council of Canada and in particular for a critical reading of an early draft. I am also particularly grateful to Mrs. Helen Buckley, Chief, Special Manpower Studies, for her helpful comments during the final stages of the study and for her careful reading and editing of the final draft.

I would also like to acknowledge my considerable debt to Mr. Gerry Gray of the Sampling and Survey Research Division of the Bureau for providing me with the data from which the sampling variances of labour force estimates were calculated and for his help in the preparation of Appendix B at the end of the study.

Thanks are also due to Mr. Paul C. Langley of the Bureau for reading drafts of the study and for many discussions and to Professor S.F. Kaliski of Queen's University who, at short notice, read and commented on the study.

Much of the credit for the improvements in the study must go to these, but for the many deficiencies that remain and any errors I am entirely responsible.

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INTRODUCTION

In 1966 Jacob Mincer began his introduction to *Labor Force Participation and Unemployment: A Review of Recent Evidence*,[1] with "After three decades of research . . . . . the short-run behaviour of the United States labour force is still not well understood." Today no less a statement could be made concerning our understanding of the Canadian experience in this respect. At the time of his writing Mincer had before him the results of a number of recent and often conflicting U.S. studies. Today, Canadian analysts are faced with a similar array of even more conflicting evidence.

The two hypotheses which have been put forward to explain the short-run response of the labour force to changing economic conditions owe their origins to the depression of the 1930's,[2] but the major preoccupation which many United States labour economists have had in this subject in the 1960's undoubtedly arose out of a desire to understand more clearly the effect, on the level of labour force participation, of the recessions of the late 1950's and early 1960's in the United States.

The more general reasoning behind the interest in the short-run behaviour of the labour force was given by Tella.[3] "If labour force changes do reflect variations in the economic environment, it should then be possible to estimate the extent to which labour force and unemployment are likely to be affected by alternative levels of economic activity or changes in government programs." And Tella's own research added force to the view.

He calculated[4] that when in 1962 the official unemployment rate in America was 5.6 per cent, the rate corrected for "hidden unemployment" would have been 8.5 per cent. Clearly, if Tella was right,[5] the policy implications of these two figures could be very different.

This study is an attempt to clarify the Canadian situation with respect to the short-run behaviour of the labour force, both regionally and nationally. It is divided into two parts. Part I begins with an examination of the two central hypotheses which have been put forward to explain cyclical variation in labour force participation, namely the "discouraged worker"

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[1] In *Prosperity and Unemployment*, Robert A. Gordon and Margaret S. Gordon (eds), New York. 1966.

[2] See page 00 for a discussion of the two hypotheses, and page 00 for a review of United States and Canadian literature.

[3] Tella, Alfred, "The Relation of Labour Force to Employment", *Industrial and Labour Relations Review*, Vol. 17, No. 3, April 1964.

[4] *Ibid*, page 463.

[5] See Bowen, William G. and Finegan, T. Aldrich, *The Economics of Labour Force Participation*, Princeton, 1969 and references cited therein.

and "additional worker" hypotheses. Following a comment on the prevailing view in America and a review of recent Canadian evidence a labour supply model for time series data is developed. This part of the study is concluded with a discussion of the methodology employed to construct an index of labour demand for Canada and each of the regions.

In Part II the regression results obtained by applying the labour supply model to data over the period 1953-68 are examined. The first section looks at labour force participation in Canada as a whole. Both monthly and annual observations are used to test for any significant cyclical response to changing labour market conditions and results are obtained for each of five broad age groups for males and females separately. A comparison is then made with results of a recent similar study by Proulx.[6] Following this examination of the Canadian evidence the model is applied to annual data only for the same age-sex groups within each of the five economic regions.

Turning from an examination of cyclical response, the next section examines trends in labour force participation and compares the regional experience in this respect by the same broad age-sex groups in the population. The study is concluded with a summary of its main findings together with some thoughts on possible short-run developments over the next few years.

Two appendices are provided. Appendix A contains a brief description of the Monthly Labour Force Survey from which the data on labour force participation were obtained, with special reference to certain features of the survey design which affect the quality of the data for time series analysis. Appendix B is an examination of the regression results in the light of the discussion of the data given in Appendix A.

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[6] Proulx, Pierre-Paul, "La variabilité cyclique des taux de participation à la main d'oeuvre au Canada", *Canadian Journal of Economics*, May 1969.

PART I

SHORT CYCLE VARIATIONS IN THE SUPPLY OF LABOUR

The Discouraged and Additional Worker Hypotheses

In the Introduction, reference was made to two hypotheses which have been put forward to explain the short-run behaviour of the labour force in response to changes in the demand for labour. The first, due to Douglas,[7] is that when the demand for labour increases, with an associated increase in wage rates, some individuals whose primary attachment is to non-labour force activity (i.e., going to school, keeping house, etc.) will be drawn into the labour force. The second, due to Woytinsky,[8] is that when the demand for labour falls so that incomes also fall (due to increased unemployment, short-time working etc.), secondary workers will be drawn into the labour force in an attempt to stabilize the income flow of the family. The latter hypothesis, following Woytinsky's own terminology, has been termed the "additional worker" hypothesis. And because the Douglas hypothesis, also viewed in a situation of falling demand, would lead to workers leaving the labour force it has been labelled the "discouraged worker" hypothesis. The initial conflict between these two hypotheses – one suggesting that there is an outflow and the other an inflow of workers at times of depressed demand – has long been reconciled. It is now recognized that both the additional worker effect and the discouraged worker effect can and will typically operate at the same time. What is of most interest for aggregate economic policy is which, if either, of the two dominates and what is the magnitude of the net effect.

A Review of Recent Evidence

The more recent United States studies,[9] whether based on time series or cross-section data, tend to provide evidence in support of the overall dominance of the discouraged worker effect. This is in contrast with the conclusion reached earlier by Long[10] whose work indicated that the size of the labour force was relatively insensitive to the level of demand except during wartime or in conditions of severe depression. Mincer[11] in this review of the literature found that " . . . . . a growing number (of recent studies) gave unqualified support to the notion that the labour force, as measured, responds positively even to the relatively mild fluctuations characteristic of the postwar period." He further concluded after his own

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[7] Douglas, Paul H., *Real Wages in the United States, 1890-1926*, Cambridge, Massachusetts, 1930, pp. 439-441.

[8] Woytinsky, W.S., *Additional Workers and the Volume of Unemployment in the Depression*, Committee on Social Security, Social Science Research Council, Washington, 1940 (Mimeo.).

[9] See references cited by Mincer in *Prosperity and Unemployment*, *op. cit.* and Bowen and Finigen, *op. cit.*

[10] Long, C.D., *The Labour Force Under Changing Income and Employment*, Princeton, 1958.

[11] Mincer, *op. cit.*

examination of the evidence that "positive cyclical sensitivity (net "discouragement" effect) is readily discernible in the annual behaviour of the secondary labor force" but added that "so is the added worker response in some low income groups." This, then, is perhaps a reasonable synthesis of the prevailing view. There is cyclical sensitivity in labour force participation in the United States and the procyclical, discouraged worker effect dominates. While considerable uncertainty and controversy still surround the best specification of the relationship and, hence, of the strength of this net discouragement effect, there does seem to be general agreement among U.S. researchers that they have both a real and recognizable phenomenon to explain.

This view has to be contrasted with that which currently prevails in Canada. A reading of the most recent literature on the Canadian experience would appear to indicate that it is the additional worker and not the discouraged worker effect which dominates in this country. Proulx,[12] examining annual data for the periods 1948-67 and 1953-67 concludes: "Nos résultats indiquent au contraire que c'est l'hypothèse des **travailleurs d'appoint** qui domine au Canada." Officer and Anderson[13] using quarterly data for the years 1950-67 find an equation to explain variation in the total labour force participation rate which "exhibits an additional worker effect". Both studies support the view that in Canada it is the stronger additional worker response among females (with some age group exceptions) which in the aggregate dominates over the discouraged worker response among males – again with some age group exceptions.

Some earlier authors have been more agnostic in the interpretation of their findings. Whittingham,[14] after his examination of cross-section data, concluded: "To the extent that married women in Canada change their labour force status when labour market conditions deteriorate, this change occurs in one direction only, that is, a movement out of the labour force. The statistical evidence, however, suggests this labour force withdrawal is not a very common phenomenon." This study would therefore appear to give guarded support to a discouraged worker response among married women. Hutton and Polianski,[15] following their analysis of gross movement data, suggest: "A conclusion offers itself that for the years under analysis no predominant cyclical influences exerted any significant impact, and

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[12] Proulx, Pierre-Paul, *op. cit.*

[13] Officer, Lawrence H. and Anderson, Peter R., "Labour Force Participation in Canada", *Canadian Journal of Economics*, May 1969.

[14] Whittingham, Frank J., "Short-run Labour Force Participation of Married Women" Seminar Paper, Queen's University, Kingston, August 1968 (Mimeo.).

[15] Department of Manpower and Immigration, Manpower Supply Studies, Report No. 1, "Gross Movements in the Labour Force" by Hutton, M. and Polianski, A.N., Ottawa, 1966.

trends therefore predominated both in entries and withdrawals. Otherwise, results show the prevalence of **discouraged worker effect.**" Kaliski[16] analysed data for the period 1946 - 59 and concluded: "Those groups for which participation responds to unemployment display a variety of directions and intensities of response." But added in his suggestions for further work: "The computations presented here are extremely inconclusive, if not completely useless, partly because of the difficulties of multicolinearity and the presence of trend." More recently Swidinsky[17] analysed both time series and cross-section data and concluded, by way of comparison: "Generally, the findings from the cross-section are comparable neither qualitatively nor quantitatively with those from the time series. In the aggregate, the time series implies no net response for the male labour force (a discouragement response among the 14 - 19 and 65 + age groups equalising an additional worker effect among the 20 - 24 age group), whereas the cross-section implies a sizeable net withdrawal of males from the labour force as unemployment rises. For the aggregate female labour force, the cross-section implies a much stronger negative relationship with unemployment than does the time series."

The only other study examining Canadian data is that of Montague and Vanderkamp.[18] They limited their attention to the cyclical variation in the British Columbian labour force and concluded that the discouraged worker response dominated in that province over the period 1949 to 1964.

The conclusion that must be drawn from this admittedly brief review of the Canadian literature is that considerable uncertainty exists. Moreover, this uncertainty is not only about which of the two competing hypotheses appears to dominate in Canada but whether cyclical variation in response to changing labour market conditions exists to any significant extent. The Canadian studies include both cross-section as well as time series analysis. The periods of analysis vary and the choice of explanatory variables also vary considerably. Some researchers attempted to isolate both the additional worker and the discouraged worker effect while others concerned themselves with detecting only the "net" response, i.e., to find the dominant effect. And two of the studies focussed their attention only on sub-groups of the population.

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[16] Kaliski, S.F., *The Relationship between Labour Force Participation and Unemployment in Canada: Interim Report on a Pilot Study*, A paper read to the Political Science Association Conference on Statistics, McMaster University, June 1962.

[17] Swidinsky, Robert, "Unemployment and Labour Force Participation: The Canadian Experience," Discussion Paper No. 15, Department of Economics, University of British Columbia, March 1969.

[18] Montague, J.T. and Vanderkamp, J., *A Study in Labour Market Adjustment*, Institute of Industrial Relations, University of British Columbia, 1966.

However, notwithstanding these differences in the investigations, it might be thought that some consensus of opinion should be emerging by now. Perhaps the two recent studies by Proulx[19] and Officer and Anderson[20] in their support for a net "additional worker" response come nearest to this and because their findings, in the aggregate, suggest that the Canadian experience is the reverse of that in the United States, particular attention may well be paid to their results.[21]

A Labour Supply Model

Despite conventional terminology the additional worker and the discouraged worker hypotheses were originally conceived only in terms of an inflow of workers into the labour force following a change in the demand for labour. Neither hypothesis included any explicit reference to an outflow of workers when the level of demand, or change in demand for workers, is the reverse of that considered, i.e. when demand is rising (additional worker) or falling (discouraged worker). From the point of view of developing a labour supply model there would appear to be three competing but not mutually exclusive hypotheses which can be put forward concerning these outflows. The first is that no outflows occur due to a price or income effect; all outflows are then assumed to occur for demographic or social reasons independent of changes in wage rates and incomes. This is equivalent to assuming that both the price and income inflow effects operate like a ratchet with no slip back. The second hypothesis is that inflows and outflows are equal for equal but opposite changes in demand. No ratchet effect is assumed and no permanent increase or decrease in the size of the labour force results from a temporary change in wage rates or income levels. The third possibility is that the true situation lies between these two extreme positions. A shift in demand for labour causes an inflow or outflow to occur but that in the process some members of the inflow or outflow populations develop a "permanent" shift in attachment, either to the labour force from non-labour force activity or to non-labour force activity from the labour force.

Ideally, it is the third hypothesis that should be tested. However, although initially some attempt was made to construct models which would allow for the detection of a significant, even if partial, ratchet effect, it was found impossible to isolate this effect from the long run trend. As in

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[19] *Op. cit.*

[20] *Op. cit.*

[21] See Officer, Lawrence H. and Anderson, Peter R., "The Cyclical Variability of Labour Force Participation Rates in Canada: Comment" and Swidinsky, Robert, "A Note on Labour Force Participation and Unemployment," *The Canadian Journal of Economics*, February 1970.

other studies, therefore, an assumption is made that inflows and outflows are equal for equal but opposite changes in demand. But this and the subsequent results should not be interpreted as meaning that the family of indifference curves for an individual are not subsequently adjusted following a change in their labour force status (the required condition for a ratchet effect). It is to be understood in the model developed below that coefficients, excepting that of the time trend, will be estimated net of this effect and that the trend coefficient (see page 22) will include any "ratchet" effect that might be present.

The time series models which have usually been tested, and which provide the starting point for the model developed in this study have been either of the form:

$$P = \alpha_0 + \alpha_1 W + \alpha_2 Y + \text{other variables} + \epsilon \qquad (1)$$

or

$$P = \alpha_0 + \alpha_1 D + \text{other variables} + \epsilon \qquad (2)$$

where P is the labour force participation rate[22] and W, Y and D are variables designed to represent the wage rate, or more generally the substitution and job opportunity effect, the income effect and a total demand effect. In a model in the form of equation (1) the coefficient of W would be expected to have a positive sign in support of the discouraged worker effect and that of Y a negative sign in support of the additional worker hypothesis. The sign of D in equation (2) could be either positive or negative and could give support to the dominance of either effect.

Some of the earlier United States studies were faulted not in their choice of model but in the series which they used to represent the independent variables. Given adequate data, the ideal variables for equation (1) above would be those which directly reflect relevant wage rates and income levels. However, this would mean that information was available on the demand-induced effect on changes in wage rates for those members of the population who are near the threshold between participating and not participating, and that the income variable similarly reflected the change in incomes of those most affected by changing labour market conditions. Since such data are not available for time series studies, indicators which are particularly sensitive to changing labour market conditions have been employed instead. The employment rate and the unemployment rate are two such indicators. But the use of such data presents certain problems. Participation rates in both the United States and Canada are obtained from monthly household surveys. These surveys are also the source of estimates

[22] The labour force participation rate is defined as the ratio of the labour force to the corresponding non-institutional population of the same age and sex, expressed as a percentage.

of employment (E) and unemployment (U). If, therefore, the level of employment or unemployment or some variant of these is used as an indicator of general labour market conditions such that they can act as proxies for the level of, or changes in, wage rates and income, then two major statistical problems are encountered. First, the dependent variable in equation (1), P, is a definitional function of U and E[23] and secondly, as U and E and therefore P are obtained from the same sample survey, they will have correlated sampling errors.

The first of these problems has been reduced in those studies in which the participation rate of one population group has been regressed on the employment or unemployment rate of another.[24] And in studies in which lagged relationships have been employed the effect of correlated sampling errors will also have been reduced. However, neither of these two approaches, for which there may be good economic arguments, entirely overcome the statistical problems. First, the sampling errors of estimates of, say, labour force participation for one age-sex group and the unemployment rate of another group are still correlated and, secondly, the survey design introduces autoregressiveness into the series so that even lagged observations will also have correlated sampling errors (see Appendix A at the end of this study). These problems necessarily introduce doubts about the inferences which can be drawn from observed statistical relationships and for this reason analysts have recently sought to dispense with both the employment rate and the unemployment rate as explanatory variables. This is the course which will be followed in this study.

Returning to the form of the model to be used, consider equation (1) which postulates that the level of labour force participation, after allowing for the effect of population growth, is a function of wage rates and income levels in the form:

$$P_t = a_0 + a_1 W_t + a_2 Y_t + \epsilon_t \qquad (3)$$

In the discussion above, mention was made of relevant wage rates and income levels which should be included in the model, emphasizing that it is the demand-induced components which are of primary concern. It is therefore assumed that while long-run increases in wage rates and incomes will influence long-run participation behaviour, such effects will be included in the trend component which will be incorporated in the model (see page 23). Similarly, the effect on participation rates of changes in wage

[23] This follows because the labour force is the sum of the employed plus the unemployed.

[24] This is done primarily because certain age-specific employment or unemployment rates are judged to be better indicators of demand than the overall rates.

rates which only compensate for price changes is assumed to be negligible. If the W_t and Y_t in equation (3) are therefore assumed to be measured free of price and long-run effects then:

$$W = w(D) \tag{4}$$

$$Y = y(D) \tag{5}$$

It is now necessary to consider what form w(D) and y(D) should take. These will depend on the form of D, the demand variable. Let D be an index of demand such that D>1 represents a state of excess demand and D<1 a state of deficient demand. While the relationship between the level of demand for labour and the level of incomes is complex, for relatively small changes in demand, the demand-induced income effect can be assumed to be proportional to the level of demand. That is:

$$Y_t = \beta_2 D_t \tag{6}$$

However, the relationship between the wage rate and the demand for labour is likely to be of the form:

$$\frac{W_t}{W_{t-1}} = D_t^{\beta_1} \tag{7}$$

or

$$\frac{W_t}{W_{t-1}} = \beta_1 D_t. \tag{8}$$

Dow and Dicks-Mireaux[25] developed a general model for changes in wage rates in the form of equation (7) but concluded that one in the form of equation (8) would have produced almost identical results. Because of its greater simplicity the relationship given by equation (8) is therefore the one which is developed in this study.[26] Given equation (8) it follows that:

$$W_t = \beta_1^t \prod_t D_t \tag{9}$$

In other words, the current level of trend-free real wage rates is proportional to the product of all past levels of demand.

And substituting from equations (6) and (9) into equation (3) gives:

$$P_t = \alpha_0 + \alpha_1 \beta_1^t \prod_t D_t + \alpha_2 \beta_2 D_t + \epsilon_t \tag{10}$$

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[25] Dicks-Mireaux, L.A. and Dow, J.C.R., "The Determinants of Wage Inflation: United Kingdom, 1946-56" *Journal of the Royal Statistical Society*, Series A, Vol. 122, Part 2, 1959.

[26] No alternative formulations were examined, i.e., based on the work of Phillips and Lipsey, but it is felt that for the purpose of this study the simple model employed captures the main relationship between wage rates and demand for labour suggested by recent empirical evidence.

By combining coefficients this yields:

$$P_t = \gamma_0 + \gamma_1 \prod_t D_t + \gamma_2 D_t + \epsilon_t \qquad (11)$$

where $\gamma_0 = \alpha_0$, $\gamma_1 = \alpha_1 \beta_1^t$ and $\gamma_2 = \alpha_2 \beta_2$

Equation (11) now states that the level of labour force participation, P, is a linear function not only of the level of demand for labour but also of the product of the current and all past levels of demand. In this sense, therefore, it is a distributed lag model and arguments which might have otherwise existed for specifically including distributed lags into the model have been answered in this special way. The relationship between the two variables is that while the slope of the curve traced by D_t at time $t-n$ would depend on whether D_{t-n} were greater or less than D_{t-n-1}, the slope of the curve traced by $\prod_t D_t$ at time $t-n$ would be either positive or negative depending on whether D_{t-n} was greater or less than one.

Before discussing the interpretation which should be placed on the coefficients, γ_1, and γ_2, a point of practical significance needs to be discussed. A model in the form of equation (11) calls for a knowledge of all possible past levels of demand and, by definition, a knowledge of the level of the demand variable when a state of zero excess demand obtains. This is only the case, however, before a trend variable is added.

Consider equation (11) with a linear trend variable[27] and where t extends over the range $-\infty \ldots\ldots 0,1,2, \ldots\ldots T$ and where $t>0$ refers to a period for which data is available. Then:

$$P_t = \gamma_0 + \gamma_1 \prod_t D_t + \gamma_2 D_t + \gamma_3 T + \epsilon_t \qquad (12)$$

Now if D_t is set equal to $(1 + D'_t)$ then:

$$\prod_t D_t = (1 + D'_{-\infty}) \ldots\ldots\ldots (1 + D'_0)(1 + D'_1) \ldots\ldots (1 + D'_T) \qquad (13)$$

such that if the range of values $D'_{-\infty} \ldots\ldots D'_0, D'_1, D'_2$, etc. are small and take both positive and negative values

$$\prod_t D_t \approx 1 + \sum_t D'_t$$

$$\approx 1 + \sum_{t=-\infty}^{0} D'_t + \sum_{t=1}^{T} D'_t \qquad (14)$$

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[27] Because a participation rate is theoretically bounded in the range of zero to 100 percent it would be unrealistic to assume that, over a long period, the trend in these rates would be linear. This problem could be overcome by transforming the participation rates (See DBS Special Labour Force Studies, Series B, No. 3, (*Some Methods of Analysing Cross-Classified Census Data – The Case of Labour Force Participation Rates* by N.H.W. Davis, Ottawa, 1969). However, since over the relatively short period covered in this study, trends are not likely to depart to a great extent from a straight line, this is the assumption which has been made in this study.

Equation (12) can now be written:

$$P_t = \gamma_0 + \gamma_1 + \gamma_2 + \gamma_1 \sum_{t=-\infty}^{0} D'_t + \gamma_1 \sum_{t=1}^{T} D'_t + \gamma_2 D'_t + \gamma_3 T + \epsilon_t \qquad (15)$$

Now if D'_t is unobservable but X_t is, where X_t is some measure of the demand for labour for which there is an associated but unknown value $\tilde{X}_t$ then:

$$D'_t = X_t - \tilde{X}_t \qquad (16)$$

In other words $\tilde{X}_t$ is that value of X_t which would obtain if the labour market was in a state of zero excess demand at time t. Let

$$D'_t = (X_t - \tilde{X})_t = (X_t - \bar{X}) + (\bar{X} - \tilde{X}_t) \qquad (17)$$

where $\bar{X}$ is the average level of demand X_t over the observable period. The term $\gamma_1 \sum_{t=1}^{T} D'_t$ in equation (15) can now be written as:

$$\gamma_1 \sum_{t=1}^{T} D'_t = \gamma_1 \left\{ \sum_{t=1}^{T} (X_t - \bar{X}) + \sum_{t=1}^{T} (\bar{X} - \tilde{X}_t) \right\} \qquad (18)$$

If now, over the limited observable range, $\tilde{X}_t$ is assumed to be constant for all t, say $\tilde{X}$ then:

$$\gamma_1 \sum_{t=1}^{T} D'_t = \gamma_1 \sum_{t=1}^{T} (X_t - \bar{X}) + \gamma_1 (\bar{X} - \tilde{X})\, T \qquad (19)$$

Similarly:

$$\gamma_2 D'_t = \gamma_2 X_t - \gamma_2 \tilde{X} \qquad (20)$$

By substitution from equations (16), (18) and (20) into equation (15) and rearranging:

$$P_t = \left\{ \gamma_0 + \gamma_1 \left[1 + \sum_{t=-\infty}^{0} (X_t - \tilde{X}_t) \right] + \gamma_2 (1 - \tilde{X}) \right\} + \left\{ \gamma_1 \sum_{t=1}^{T} (X_t - \bar{X}) \right\} + \left\{ \gamma_2 X_t \right\} + \left\{ \left[\gamma_3 + \gamma_1 (\bar{X} - \tilde{X}) \right] T \right\} + \epsilon_t \qquad (21)$$

which can be simplified to:

$$P_t = \xi_0 + \xi_1 \sum_{t=1}^{T} (X_t - \bar{X}) + \xi_2 X_t + \xi_3 T + \epsilon_t \qquad (22)$$

This is the form of the model which has been tested in this study. It can be seen that the constant term will include the cumulative demand effect up to the beginning of the period covered in the empirical analysis. Similarly the coefficient of the trend variable will include the effect of any long-term net discouraged or added worker response over the period examined.

In the discussion earlier it was seen that the original interpretations of the coefficients (equation 3) were those of the substitution and income effects. However, following the transformation of the model to equation (22), this interpretation should be relaxed. Rather, in examining the empirical results, the coefficients of $\sum_t (X_t - \bar{X})$, if significant, should now be more correctly interpreted as the net response of the population to the cumulative demand situation (of which the **level** of average wage rates and earnings are one aspect), while the coefficient of X_t will be interpreted as the response to the **level** of labour demand (of which the **rate of change** in wage rates are also only one aspect). When interpreting the regression results, $\sum_t (X_t - \bar{X})$ will be referred to as the **cumulative demand** variable and X_t as the **level of demand** variable. The next section will discuss the method used to construct X_t, the measure of labour demand employed in this study.

Measurement of the Demand for Labour

Mention has been made in the previous section of some of the statistical problems encountered when using the unemployment rates or employment rates as a measure of labour demand. For these reasons an alternative measure was sought. The purpose of this section is to describe the method which has been used to construct the indices of demand for labour employed in this study.

In a recent article Marion[28] discusses the method which he employed to calculate an index of excess demand for labour in Canada. Briefly the Marion formula is:

$$\frac{D - S}{S}$$

where D = Demand for Labour
S = Supply of Labour

The demand for labour is equated with the level of employment desired by employers and is estimated using a Koyck distributed time lag function from data on employment, hours worked and production. The supply of labour is the employed plus the unemployed.

The advantage of this type of index of labour demand is that it includes the effect of adjustments to demand within the firm, i.e. in hours of work and productivity. Its disadvantage is that it does not specifically

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[28] Marion, Gérald, "La Demande excédentaire de travail et la variation des salaires dans l'industrie manufacturière au Canada," *Canadian Journal of Economics*, August 1968.

allow for adjustments to changing demand as reflected outside the firm; that is, it does not include job vacancies. Moreover, the index is only available for Canada and could not have been constructed for the regions separately. This would have precluded its use in this study since an examination of regional data was also planned.

What has been calculated, therefore, is an index for which regional as well as national data are available. This necessarily means that the measure is restricted to one which ignores adjustments to demand within the firm. It should also be added at this stage that since the purpose of this variable in the model is to represent cyclical fluctuations in demand, its ordinal accuracy is of greater importance than its cardinal accuracy. That is, its ability to fluctuate in phase with the economic cycle is more important than its ability to represent the level of economic activity. It might be thought that this is nothing more than a tautological requirement, since it is the fluctuations in the demand for labour that the index is designed to measure and this is itself a measure of economic activity. However, the unemployment rate was rejected as the measure of demand not because it is an unreliable barometer of the state of the labour market but for statistical reasons. In fact it shall be regarded as a good measure and the calculated index will be judged by its ability to reflect the general pattern of demand as described by the unemployment rate.

Throughout the period of this study monthly data were collected on the number of vacancies reported by employers to the National Employment Service – in more recent years, The Canada Manpower Centres – and also on the number of these reported vacancies which were unfilled at the end of each month. While these data are available at a fine level of disaggregation both geographically and occupationally, the coverage is limited because firms are not required to notify vacancies and would typically do so only if they thought that the NES (or, later, the CMC) could help them. This means that the count of both the notified vacancies during the month and of the vacancies unfilled at the end of the month is not only understated but that the understatement is of unknown dimensions. If this understatement could in some way be allowed for, then a corrected level of unfilled vacancies could be estimated and used to construct vacancy rates. This is what has been attempted in this study. Again it must be stressed that the purpose is not to obtain a true measure of the level of unfilled vacancies – this would be ideal but it is not necessary. Rather, since there is reason to believe that the practice of firms in their reporting habits may be different at different times in the economic cycle, the primary purpose of the exercise is to correct for cyclical variation in the amount of under or

over reporting. For example, in periods of high demand, firms may "load" their reported vacancies so as to increase their chances of recruiting and also to provide a selection of candidates from which they can fill their vacant position(s). On the other hand, they might "give up" and stop reporting some occupations altogether if they felt that there was little chance of getting applicants.

In order to make some allowance for this net under or over reporting, data from another survey are utilised. Until August 1966 monthly data on hirings and separations were obtained by a survey conducted by the Department of Labour. While this survey did not cover all establishments, all major industrial groups were included and the amount of under-representation within each industry group could be estimated.[29] Also the data were identified by region. This information, together with estimates of total employment, made it possible to calculate hiring and separation rates for Canada and the regions separately.

Two assumptions must be made in order to combine the unfilled vacancy data and the hirings data to construct an index of labour demand. First, it is assumed that each external hiring is the consequence of a vacancy and secondly that the rate of net under- or over-statement in unfilled vacancies at the end of the month is the same as the rate of under- or over-statement in the vacancies notified during the preceding month.[30]

With these two assumptions the index of demand for labour, X, can be calculated as an adjusted unfilled vacancy rate as follows:

$$X = \frac{H.W}{V}\ 100u\left\{\frac{H.W.u}{V} + E\right\}^{-1} = 100\tilde{V}\ (\tilde{V} + E)^{-1} \qquad (23)$$

Where H = The hiring rate
W = Number of paid workers
V = Vacancies reported
u = Vacancies unfilled at the end of the month
E = The total number in employment
$\tilde{V}$ = Adjusted unfilled vacancies

and where $\frac{H.W}{V}$ is an estimate of the inverse of the "statement ratio." This inverse of the "statement ratio" is plotted for Canada only for the years

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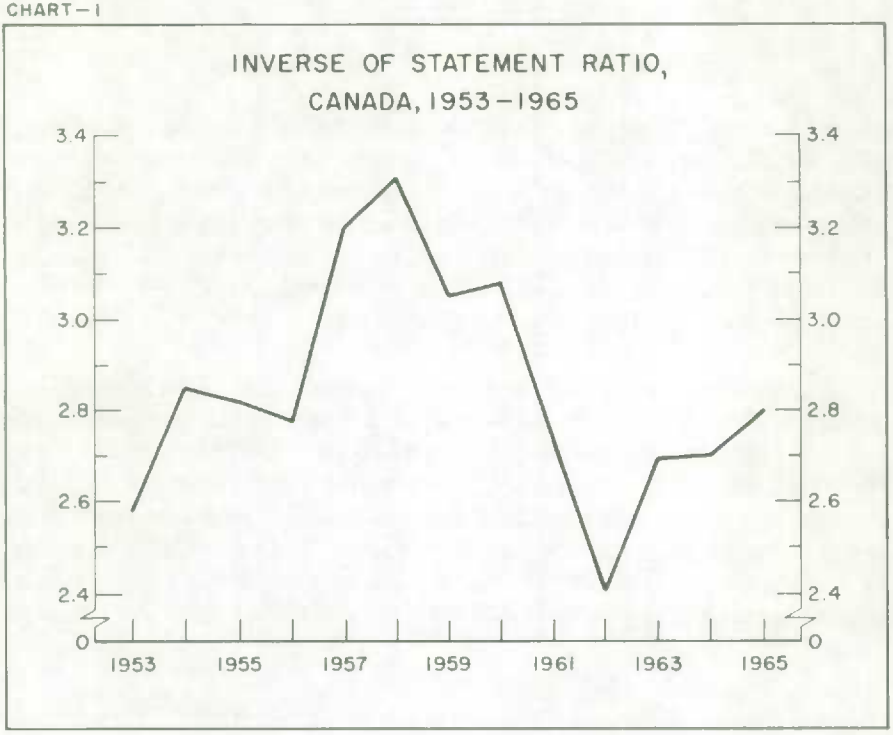
[29] See Dow, J.C.R. and Dicks-Mireaux, L.A., "Excess Demand for Labour", *Oxford Economic Papers*, Vol. 10, 1968 for a discussion on the use of turnover data to correct for mis-statement of vacancies.

[30] See a comment by Sylvia Ostry in *The Measurement and Interpretation of Job Vacancies*, A Conference Report of the National Bureau of Economic Research, New York, 1966, pp. 306-313.

1953-65 in Chart 1 which shows how the extent of under-reporting varied over the period. In 1958 it is estimated that the actual reported vacancies were only 30 per cent of the total, so that the vacancies unfilled at the end of the month have been multiplied by a factor of about 3.3; while in 1962 when over 41 per cent of vacancies were reported a correction factor of 2.4 has been employed.

CHART – 1



Before discussing the results obtained by applying the above formula to the Canadian data, the validity of the two assumptions will be considered. The first would not appear to be in doubt. It is true that for each external hiring to be a consequence of a vacancy is a matter of definition – in particular, on how one defines a job vacancy – but it is no more than that. The second assumption, however, is undoubtedly open to question. Given that some vacancies are more difficult to fill than others, it would not be surprising if firms were more likely to report their hard-to-fill vacancies to the government employment service because they wished to use all available recruiting media for such workers. But since the hard-to-fill

vacancies are also more likely to be unfilled at the end of the month, the unfilled vacancies could be closer to the "true" level of unfilled vacancies than the vacancies reported during the month are to the "true" level of vacancies arising in the month. If such were the case, then the second assumption made above would not hold. However, even if this situation did exist, the use of hiring data as described above would still be valid as an ordinal index of labour demand if over the period of our analysis:

$$\frac{V_T}{V_R} \cdot \frac{U_R}{U_T} = k$$

where V_T and V_R are the "true" and "reported" number of vacancies arising during the month, U_T and U_R are the true and reported level of unfilled vacancies at the end of the month, and k is either some constant or some variable which is distributed over time independently of the level of economic activity. There is no evidence one way or the other regarding the above relationship in the Canadian experience and to this extent the ordinal accuracy of the index is uncertain.

Vacancy rates were calculated using equation (23) for each month from January 1953 to August 1966 – the last month of the hirings and separations survey. Estimates for the period September 1966 to December 1968 were then obtained by first regressing the reported unfilled vacancies on the calculated unfilled vacancies for each month (January to December) separately over the period January 1953 to August 1966, and then using these twelve regression equations to estimate the missing values from the known reported unfilled vacancies for the period September 1966 to December 1968.

Six series of vacancy rates were calculated in this way – one for Canada and one for each of the five regions. They were then seasonally adjusted.[31] Table 1 below gives the annual rates for the period 1953-68 and the same data are plotted against the corresponding unemployment rates on Chart 2 using a logarithmic scale. The chart helps to illustrate how the two series describe similar proportionate movements over the economic cycle. From this chart it can be seen that the calculated vacancy rates at least meet the primary requirements of reasonably good ordinal accuracy.

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[31] By the U.S. Bureau of the Census X-11 variant of the Census method II Seasonal Adjustment Program as modified by the Bank of Canada and DBS. See Department of Commerce, Bureau of the Census, Technical Paper No. 5, February, 1967.

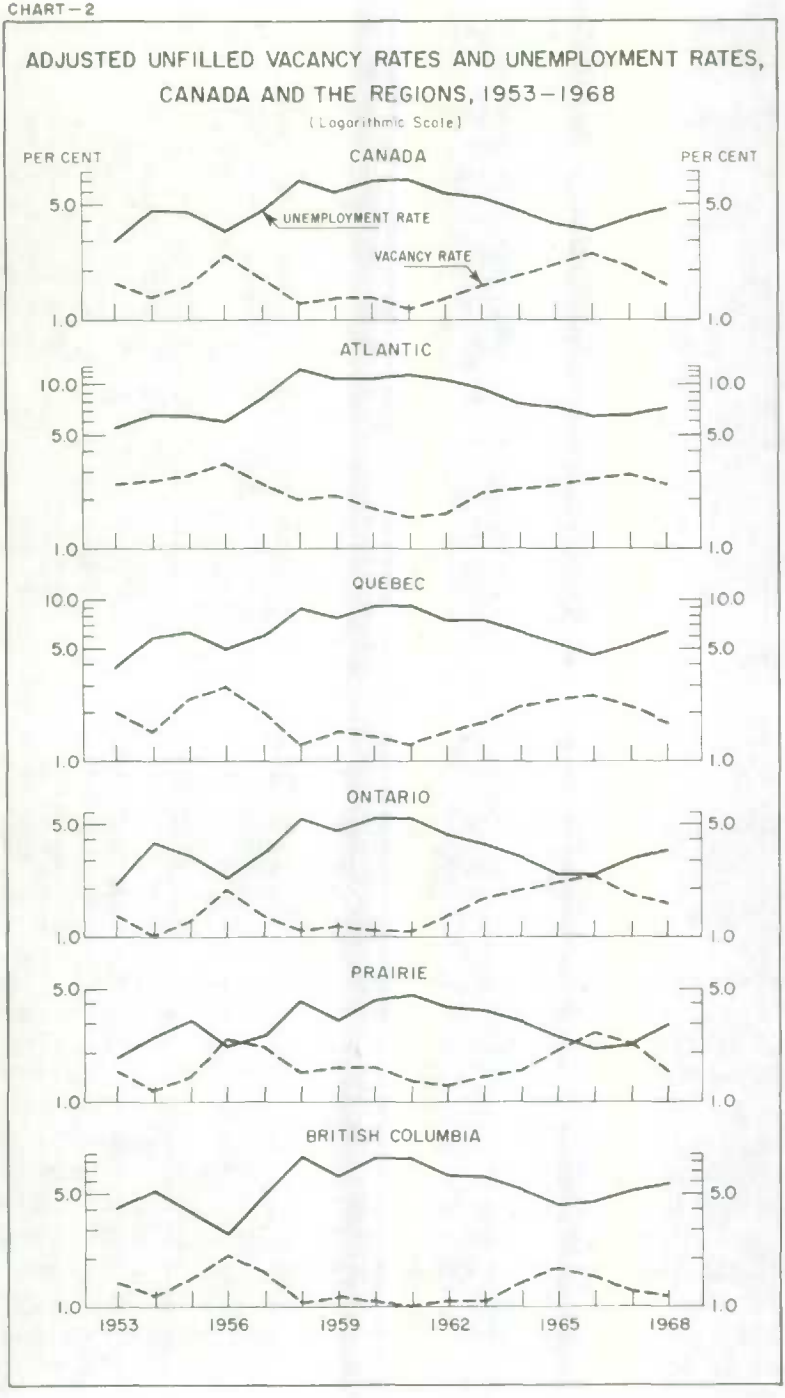
TABLE 1. Adjusted Job Vacancy Rates,[1] 1953-68

Year	Region					
	Canada	Atlantic	Quebec	Ontario	Prairie	British Columbia
1953	1.68	2.47	1.97	1.39	1.59	1.49
1954	1.35	2.70	1.60	1.04	1.25	1.21
1955	1.72	2.91	2.41	1.27	1.51	1.56
1956	2.43	3.26	3.04	1.96	2.41	2.08
1957	1.82	2.51	2.04	1.38	2.15	1.73
1958	1.28	1.95	1.26	1.08	1.62	1.09
1959	1.45	2.07	1.58	1.21	1.67	1.23
1960	1.37	1.84	1.47	1.14	1.68	1.10
1961	1.23	1.62	1.27	1.11	1.40	1.03
1962	1.42	1.73	1.60	1.40	1.31	1.08
1963	1.71	2.15	1.85	1.77	1.54	1.14
1964	1.94	2.29	2.19	1.97	1.65	1.52
1965	2.25	2.44	2.50	2.27	2.09	1.76
1966	2.50	2.74	2.74	2.50	2.70	1.65
1967	2.09	2.94	2.32	1.88	2.31	1.34
1968	1.74	2.51	1.84	1.74	1.61	1.17

[1] Calculated from equation (23).

At the same time the regional differences in the calculated vacancy rates appear to be in conflict with the regional differences in unemployment rates. The Atlantic region has both the highest unemployment rate and the highest vacancy rate. Similarly Quebec's calculated vacancy rate has been persistently higher than that of Ontario over the 16 year period, which is certainly in conflict with the generally accepted understanding of the state of the labour market in these two provinces. In addition, for Canada and each region, the vacancy rates are considerably lower than the unemployment rates. This could be interpreted as indicating that at least over the period 1953-68 a state of excess labour supply has prevailed across the country. While such a view of the situation in the Atlantic provinces would not be in conflict with conventional knowledge this would not be so in the case of, say, Ontario.

CHART – 2


ADJUSTED UNFILLED VACANCY RATES AND UNEMPLOYMENT RATES, CANADA AND THE REGIONS, 1953–1968
(Logarithmic Scale)
PER CENT
CANADA
PER CENT
5.0
1.0
UNEMPLOYMENT RATE
VACANCY RATE
ATLANTIC
10.0
5.0
1.0
QUEBEC
ONTARIO
PRAIRIE
BRITISH COLUMBIA
1953
1956
1959
1962
1965
1968

However, these conclusions would not take into account the extent of maladjustment in the Canadian labour market and the results should not be rejected out of hand. Arthur M. Ross[32] has reported that ". . . . . experimental job vacancy surveys in the United States indicate that vacancies and unemployment in the labour market area tend to be equal in the range of 2.0 to 2.5 per cent of the labour force." It is interesting to note that the calculated vacancy rates for Ontario, which is structurally the nearest of the Canadian regions to a United States labour market area, are consistent with this view. However, further support for the method used in the study as an estimator of historical job vacancy data must await the release on data from the new job vacancy survey now being developed by DBS[33] on behalf of the Department of Manpower and Immigration.

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[32] Ross, Arthur M., "Guideline Policy" in Shultz, G.P. and Aliber, R.Z., (eds), *Guidelines, Informal Controls and the Market Place*, Chicago, 1966.

[33] Ostry, Sylvia and Sunter, Alan, "The Canadian Job Vacancy Survey: A Measure of Labour Demand," A paper read to the International Statistical Institute, London, 1969.

PART II

ANALYSIS OF THE DATA

Data Considerations

In Part I of this study the response of the population to changing labour market conditions was discussed in terms of two competing hypotheses—the discouraged worker and additional worker hypotheses. A labour supply model was developed and indices of labour demand were calculated. Part II will now be devoted to an examination of the empirical evidence.

Because it is expected that the direction and intensity of response to cyclical variations in the demand for labour will be different for different age-sex groups, the population was divided into 10 such groups—ages 14-19, 20-24, 25-44, 45-64 and 65 and over for males and females separately.[34] Also, because it was thought that the cyclical response might vary across the country, similar data were obtained for the five standard geographic regions. However, only at the Canada level are reasonably good data on labour force participation available monthly for these age-sex groupings. For this reason, the analysis at the regional level has been made using only annual data, but for completeness the Canadian evidence is examined using both annual and monthly observations. Ignoring this duplication, a total of 72 data series are examined in this study—12 age-sex groups (including two aggregate series for males and females) for each of Canada and the five regions.

Before turning to an examination of the results a question arises of whether, when using monthly observations, to use original or seasonally-adjusted data. If the response of seasonal participation to short-run changes in labour market conditions was being considered as part of the analysis, then clearly original data should be used. While this is not a meaningless question it is not considered in this study and all data series have therefore been seasonally adjusted in order to avoid the possibility that correlation between the seasonal components will statistically swamp all other effects.

This approach is not entirely without its problems. It has been shown that standard techniques for obtaining seasonally-adjusted data which allow for both an additive and multiplicative effect and which incorporate adjustments for trend in the seasonals do not as yet allow for short-run changes in seasonal variation. And as Fairbarns has shown,[35] labour force participation is not without such an effect. If, therefore, the demand series

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[34] Ideally, groupings based on skills and other socio-economic characteristics would be preferable but in the absence of such data foruse in time series analysis, age-sex groups are employed to act as proxies for these.

[35] Fairbarns, David, "On Fluctuations in Seasonal Components of Economic Time Series", A paper prepared for discussion at the CPSA Conference on Statistics, Ottawa, June 1967.

employed in this study also has a seasonal component which is not invariant in the short-run, the regression coefficients derived from standard seasonally-adjusted data will be biased according to whether short-run variation in the seasonals of the two series are procyclically or contracyclically related. While recognising this problem, it would be beyond the scope of this study to investigate it.

Cyclical Response – The Canadian Experience

In this section data for Canada over the period 1953-68 are fitted to the labour supply model developed earlier using the classical linear regression estimating procedure. The regression model which was developed is:

$$P_t = \xi_0 + \xi_1 \sum_{t=1}^{T} (X_t - \bar{X}) + \xi_2 X_t + \xi_3 T + \epsilon_t$$

where P_t stands for the labour force participation rate for a particular age-sex group; X_t is the indicator of labour demand calculated in Part I of this study as an imputed vacancy rate; $\bar{X}$ is the average level of demand over the period examined and T is a linear trend variable taking a value of one at January 1953 when monthly data are employed. A problem now arises concerning the assumptions which can be made about the nature of the disturbance term ϵ_t. When using the classical linear regression estimating procedure the variance of ϵ_t must be constant for all t, and cov (ϵ_s, ϵ_t) must be zero for $s \neq t$, if the best linear unbiased estimates are to be obtained. Unfortunately the Monthly Labour Force Survey (see Appendix A at the end of this study) from which the labour force participation rates are obtained yields estimates whose sampling errors are not independent over time. Also, since a participation rate is a binomial variable, their variances will not be constant but some function of the true but unknown participation rates – and these will typically vary over the period examined.

This latter problem can be largely discounted since for most series the range of observations will not be unduly large. However, the autoregressiveness introduced into the series by the survey design cannot be ignored completely. Ideally, if the autoregressive structure were known, then a generalised least-squares estimating procedure could be used. But this is not the case as only limited information is available. It is for this reason that classical regression analysis has been employed but in Appendix B a critical examination of the results obtained from monthly data will be given in the light of what is known about the sampling variabilities and their nature.

Analysis of Monthly Data

The regression results are given below in Table 2. Because neither of the coefficients of the demand variables was significant for males 45-64, the results for this age-sex group are not included. As was to be

expected, the trend coefficient was significant for all age-sex groups at the Canada level. The participation rates of all male age groups declined over the sixteen year period while for females the opposite prevailed, with the exception of the 14-19 age group in which female participation also declined. This strong trend effect is undoubtedly the major factor contributing to the high explanatory power of the model. This effect is illustrated in Table 3 below in which the variation explained by a model with only a time trend variable is compared with the total explained variation as given by the full model. This table is self-explanatory and no comment is called for.[36]

[36] Note the use of $\bar{R}^2$ in Table 2 and R^2 in Table 3.

TABLE 2. Regression Results – Canada (Monthly Data)

Age-sex group	Coefficient of					Durbin-Watson statistic	Variance of estimates
	Constant term	Cumulative demand	Demand	T	$\bar{R}^2$		
Males							
Totals	**83.67**	**0.037 (10.05)**	**−0.108 (−1.58)**	**−0.033 (−57.23)**	**.964**	**0.357**	**0.1456**
14-19 years	49.97	0.175 (16.25)	0.768 (3.89)	−0.070 (−42.53)	.946	0.710	1.211
20-24 "	94.11	−0.037 (−4.10)	−0.254 (−1.54)	−0.044 (−31.60)	.869	0.301	0.8410
25-44 "	97.69	−0.012 (−5.15)	0.003 (0.08)	−0.002 (−5.04)	.156	0.426	0.0608
65 years and over	35.18	0.059 (7.04)	0.239 (1.54)	−0.057 (−43.95)	.938	0.339	0.7461
Females							
Totals	**22.21**	**0.037 (9.81)**	**0.073 (1.065)**	**0.064 (112.04)**	**.988**	**0.384**	**0.1459**
14-19 years	33.67	0.077 (9.39)	0.049 (0.32)	−0.013 (−10.52)	.643	0.643	0.704
20-24 "	42.43	0.117 (8.13)	1.136 (4.30)	0.066 (29.75)	.857	0.177	2.163
25-44 "	21.52	0.042 (8.15)	0.048 (0.501)	0.079 (98.07)	.985	0.456	0.284
45-64 "	16.94	−0.027 (−4.43)	−0.270 (−2.381)	0.106 (112.22)	.989	0.350	0.397
65 years and over	4.36	−0.014 (−3.44)	−0.270 (−3.63)	0.013 (21.51)	.774	0.502	0.172

Note: Figures in parentheses are the "t" values of the coefficients.

TABLE 3. Variation in Labour Force Participation Rates Explained by Two Models

Age-sex group	With time trend only	With time trend plus demand variables
	per cent	
Males		
Totals	**94.6**	**96.5**
14-19 years	85.7	94.6
20-24 "	85.6	87.1
25-44 "	5.8	16.9
65 years and over	92.0	93.9
Females		
Totals	**98.2**	**98.8**
14-19 years	47.8	64.9
20-24 "	78.5	85.9
25-44 "	97.9	98.5
45-64 "	98.7	98.9
65 years and over	74.3	77.8

All coefficients of the cumulative demand variable, $\Sigma (X_t - \bar{X})$ were significant, except for males 45-64, at well above the one per cent level. But only for males 14-19 and females 20-24, 45-64 and 65+ was the coefficient of the level of demand variable also significant.

The coefficients of the cumulative demand variable for both total males and total females were positive and significant, suggesting that during periods when the level of demand was below the average for the period – the condition required for the cumulative demand variable to be falling – labour force participation will also be falling relative to trend. This finding can be interpreted as evidence of the dominance of a cumulative discouraged worker effect. Given this interpretation, it also can be concluded, from the sign of the coefficient for the individual age groups, that the cumulative discouraged worker effect dominates for males aged 14-19 and 65 years of age and over and for all female age groups up to ages 25-44, while the cumulative additional worker effect dominates for males aged 20-24 and 25-44 and for females 45-64 and 65 and over.

By similar reasoning a significant positive coefficient of the level of demand variable is evidence of a dominant **transitory** discouraged worker effect, and with a negative sign as a dominant **transitory** additional worker effect. Dominant transitory discouragement was found for males aged 14 - 19 and females 20 - 24, whereas the transitory additional worker effect appears to be stronger among women 45 years of age and over.

The effect of these two variables in the model can be illustrated by examining more closely the participation rates of males aged 14 - 19. For this age-sex group both coefficients were highly significant. It is recognised that for this particular age group the alternatives open to the population are not necessarily ones of deciding whether to stay or not to stay in the labour force but also of whether to enter or remain out of the labour force. However, the term discouraged worker, rather than discouraged entrant, is retained in discussing the significant responses that have been observed.

In Chart 3 below are plotted:

1. The departures from the observed participation rates of the sum of (i) the constant term (ii) the trend effect and (iii) the effect associated with the average level of demand. This is equivalent to the observed cyclical plus residual components in the series.

2. The sum of the cumulative demand effect plus the effect associated with deviations from the average level of demand.[37] In other words, the point estimates of (1) obtained from the regression equation.

3. That part of (2) due to the estimated cumulative demand effect.

4. That part of (2) due to the estimated effect of deviations from the average level of demand.

5. The residuals, i.e. (1) – (2).

To simplify the presentation, annual values have been plotted; these were obtained from calculations based on the monthly observations. The first two lines are plotted together and illustrate the good predictive power of the model in capturing the overall cyclical variation in participation rates. This also illustrates, as does the plot of residuals, the nature of the positive serial correlation in the error term indicated by the significantly low Durbin-Watson statistics (see Table 2). This is a point that will be discussed in Appendix B.

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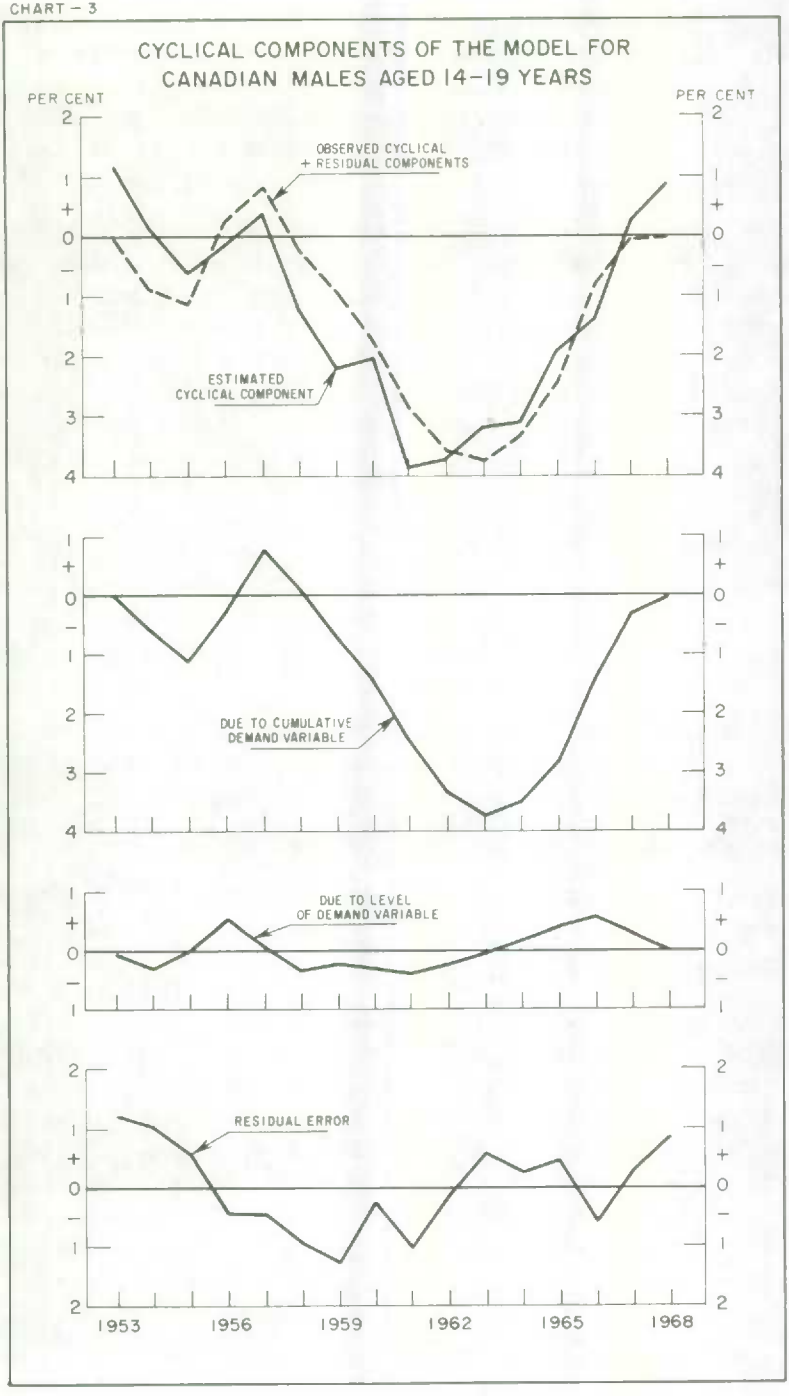
[37] This gives the result that would have been obtained if the level of demand variable had been included as deviations from its mean with a consequent adjustment to the constant term.

CHART – 3


CYCLICAL COMPONENTS OF THE MODEL FOR
CANADIAN MALES AGED 14–19 YEARS
PER CENT
PER CENT
OBSERVED CYCLICAL
+ RESIDUAL COMPONENTS
ESTIMATED
CYCLICAL COMPONENT
DUE TO CUMULATIVE
DEMAND VARIABLE
DUE TO LEVEL
OF DEMAND VARIABLE
RESIDUAL ERROR
2
1
+
0
–
1
2
3
4
1953
1956
1959
1962
1965
1968

The strong net discouragement effect associated with the cumulative demand variable is clear. In particular, it captures well the turning points in the early years of the period and also the decline in participation rates from 1958 to 1961 when demand was fairly stable but at a low level. Unfortunately, the period of analysis is too short to see the full interplay of the two variables over a whole cycle. However, for this particular age group (i.e., males 14-19 years) it can be seen that when, in 1962, the demand for labour began to rise, the effect of the transitory discouraged worker response was to exert an upward influence on participation, while the cumulative discouraged worker effect worked in the opposite direction for a further two years. It was not until 1964, when demand was back to a level above the average for the period, that both the cumulative and transitory demand variables were moving in the same direction.

It should also be mentioned, however, that insofar as the cumulative demand variable can also be thought of as a measure of the cumulative departure from labour force expectations (including such things as wage rates and job opportunities), then some allowance might have been made for the length of labour market experience on which such expectations could have been based. School-leavers, for example, will possess knowledge through experience of only that period since their entry into the labour force. They may be expected therefore, to regard any existing level of labour demand as high or low to the extent that it departs positively or negatively from their limited experience levels. Older workers on the other hand, will have had extensive experience, perhaps over several business cycles, and will therefore evaluate a current level of demand vis-a-vis some long run average.

So far the examination of the results has been confined to their statistical interpretation on which has been superimposed a shorthand for the general economic interpretation. But the estimates should also be judged by the "sense" that they make. On this score, certain of the results clearly stand up to such a "test". For the 14-19 age groups, for both males and females, it does not seem unreasonable to expect that deteriorating economic conditions would on balance discourage them from looking for work. The assumption is that they would prefer to stay on at school or to return to school, either to improve their chances at a later date or to wait for conditions to improve or – more likely – both. And it is perhaps not surprising that this discouragement effect is stronger than the desire or necessity, in the aggregate, to help supplement the family income which could be reduced at such times. One would also expect a tight labour market to discourage older males, over 65 years of age, from seeking employment on the assumption that many of them would have access to other incomes such as retirement pensions.

For females of 45 years and over, the observed net additional response is certainly consistent with the possible desire among members of this group to help make up any short-fall in family income during an economic downturn. But for the other age groups no simple interpretation offers itself. Moreover, one should clearly treat as suspect a result supporting net additional worker response for males aged 25-44. Whose income is being supported when more men in this age group go out to work? Also, is it possible that males aged 20-24 are drawn into the labour force to support their "discouraged" sisters in the same age group?

The regression results cannot answer this type of question or be used to test this type of hypothesis, but they do provide other evidence which can be used to examine the reliability of the results. The regression coefficients and their significance have been considered only on the assumption that the model met the usual requirements necessary for a standard least-squares solution. From the comment made in the introduction to this section concerning autoregressiveness in the series of labour force participation rates, it is clear that these requirements have not been met. As was expected, the Durbin-Watson statistics indicate that significant serial correlation is present in the calculated residuals obtained in all the regressions.

It was for this reason that the results were subjected to a critical examination in the light of the known statistical properties of series generated by the Monthly Labour Force Survey (see Appendix B). It is a conclusion of the examination, however, that while the questions raised cannot be completely answered there is sufficient evidence to suggest that the results obtained above should be accepted. But because when annual data are used the sampling variances will be smaller, while at the same time the expected serial correlation will be greatly reduced, the next part of this section examines the same model applied to annual data for Canada.

Analysis of Annual Data

The regression results obtained by fitting annual data to the labour supply model are given in Table 4. The full list of results are given in this table. This has been done for two reasons: first, so that a more complete comparison can be made with the results using monthly data; secondly, so that a more detailed comparison can be made with the results of the Proulx study. In general, these results confirm the findings based on monthly observations except for the fact that the significance of the results has been reduced, so that some coefficients which were previously significant at the five per cent level are no longer so. This is particularly the case for males where only for the total and for the 14-19 age group is the coefficient of the cumulative demand variable significant, whereas significant

results were obtained in all age groups (except 45-64) when monthly data were employed. The rather unexpected additional worker response among males aged 20-24 and 25-44 which was observed earlier is no longer significant, but there is still some evidence at the ten per cent level of significance of a discouraged worker response among males 65 and over. It is, of course, possible that in using annual data some of the cyclical variation has been smoothed out. While this is true, the periodicity of the economic cycle over the sixteen years examined in this study is such that the amount of smoothing of the series would be small relative to any "real" cyclical variation. Moreover, such an effect may well have been more than compensated for by the reduced amount of "noise" in the series.

TABLE 4. Regression Results – Canada (Annual Data)

Age-sex groups	Coefficient of						Variance of estimates
	Constant	Cumulative demand	Demand	T	$\bar{R}^2$	D.W.	
Males							
Totals	84.28	**0.450** (2.93)	**-0.354** (-1.30)	**-0.393** (-17.26)	**.970**	**0.581**	**0.1270**
14-19 years	51.65	2.092 (5.97)	0.142 (0.23)	-0.862 (-16.57)	.971	0.959	0.6623
20-24 "	93.78	-0.467 (-1.48)	0.067 (0.12)	-0.525 (-11.16)	.914	1.329	0.5409
25-44 "	97.54	-0.140 (-1.35)	0.062 (0.34)	-0.163 (-1.05)	.206	0.681	0.0586
45-64 "	92.31	-0.019 (-0.10)	-0.094 (-0.286)	-0.027 (-0.96)	.125	0.731	0.1875
65 years and over	36.13	0.706 (1.94)	-0.085 (-0.13)	-0.688 (-12.70)	.943	1.143	0.7189
Females							
Totals	22.25	**0.456** (3.29)	**-0.138** (-0.56)	**0.773** (37.51)	.992	**0.858**	**0.1039**
14-19 years	34.43	0.969 (3.94)	-0.339 (-0.78)	-0.154 (-4.22)	.791	1.507	0.3266
20-24 "	43.33	1.610 (2.60)	0.490 (0.45)	0.792 (8.62)	.866	0.593	2.0624
25-44 "	21.37	0.525 (2.34)	-0.106 (-0.266)	0.941 (28.20)	.986	0.879	0.2727
45-64 "	16.21	-0.403 (-1.93)	-0.232 (-0.63)	1.277 (41.18)	.994	1.140	0.2352
65 years and over	4.03	-0.283 (-2.03)	-0.085 (-0.34)	0.151 (7.31)	.852	1.275	0.1044

Note: Figures in parentheses are the "t" values of the coefficients.

For females, the use of annual data has also resulted in a loss in the number of age – group regressions yielding significant coefficients to the cumulative demand variable. Whereas, when using monthly observation, all age groups gave evidence of either some discouraged and/or additional worker response, only for the three age groups up to and including females 25 - 44 does the annual data provide results at the same high level of significance. Again, however, the additional worker response (to the cumulative demand variable) is still indicated at a 10 per cent level of significance for the two older age groups. But in contrast to the earlier evidence, in no case do the results using annual data indicate any significant response to changes in the level of demand.

Notwithstanding these differences, the two sets of results give clear support to the view that for both males and females there is in total a significant discouraged worker response to labour market conditions, and that this discouragement is related to the cumulative effect of the level of demand rather than to changes in the current labour market situation. It is also interesting to note that this aggregate net effect is also almost exactly the same for the two sexes, a one percentage point increase or decrease in the cumulative demand variable being associated with a little less than a one-half percentage point change in labour force participation. This result again confirms that found earlier using monthly data (see Table 2) when the same coefficients were identical for total males and total females.

Returning now to the results for individual age-sex groups, males aged 14 - 19 are again found to be the most responsive. From Table 4 it can be seen that for these teen-age males, when the cumulative demand variable falls by one percentage point there is a two percentage point drop in their participation rate. Under similar labour market conditions the participation rates for females aged 14 - 19, 20 - 24 and 25 - 44 would decline by 1.0 per cent, 1.6 per cent and 0.5 per cent respectively. If the evidence in support of an additional worker response among females age 45 - 64 and over is accepted, then these same labour market conditions would tend to increase their labour force participation rates by 0.4 and 0.3 per cent respectively.

Comparison with the Proulx Study

So far this study has provided clear support for the view that, in the Canadian experience, it is the discouraged worker effect which dominates

in determining the cyclical behaviour of labour force participation. A comparison will now be made between these results and those of another study which used similar data over almost the same period. This is the study by Pierre-Paul Proulx[38] published in 1969 which seeks to explain cyclical variation in annual labour force participation rates for Canada with the same age-sex breakdown used in this study. Proulx employed data for the periods 1948-67 and 1953-67. He also avoided using employment or unemployment data directly as a demand variable in his regressions for 1953-67 by making use of the labour demand component of the index of excess demand for labour constructed by Professor Marion.[39] As in the present study, Proulx set out to test for evidence of the dominance of either a discouraged worker or an additional worker effect. However, the Proulx model only included one demand variable, that for the current level of demand, and since no lagged relationship was employed he was not able to test for the effect of the past levels of demand or for any cumulative effect.

This major difference in the models employed makes it virtually impossible to make direct comparisons of the results. Nevertheless, since Proulx's conclusion based on his results – that it is a net additional worker response that prevails in Canada – is clearly contrary to the conclusion reached in this study, some explanation is called for.

In trying to explain this difference in conclusions it is natural to look first at the difference in the three basic dimensions of the studies: the data used, the models employed and the time periods covered. In this respect, a comparison will be made with Proulx's work on data for the period 1953-67. On the first of these differences no direct comparison can be made of the two demand series employed because the exact form of Proulx's data has not yet been published, but it must be assumed that the series of labour force participation rates are common to both studies. Moreover, differences between the models employed and the time periods covered can be reconciled and this has been done by rerunning the Proulx model for the period 1953-67 but using the demand series employed in this study. The results from this exercise together with a comparison with those obtained by Proulx are shown in Table 5. Only age-sex groups whose regression results had a significant demand coefficient in either study are included in the table.

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[38] Proulx, Pierre-Paul, *op. cit.*
[39] Marion, Gerald, *op. cit.*

TABLE 5. Comparison of Regression Results Obtained by Proulx and Davis, 1953 - 67

Dependent variables	Coefficients of					
	Standard error		Constant		Demand variable[1]	
	Proulx	Davis	Proulx	Davis	Proulx	Davis
Labour force participation rates of:						
Females:						
20 - 24 years	0.74	1.40	45.53	40.87	+14.363 (3.18)	+ 2.206 (2.25)
45 - 64 "	0.32	0.37	16.99	16.85	- 5.209 (2.63)	- 0.722 (2.83)
65 years and over	0.23	0.30	3.76	4.47	- 3.582 (2.5)	- 0.398 (1.90)
Males:						
14 - 19 years	0.757	1.18	51.37	48.50	+ 10.057 (2.18)	+ 2.222 (2.70)
20 - 24 "	0.48	0.60	93.12	94.52	- 7.923 (2.73)	- 0.516 (1.23)

	Coefficients of					
	Trend variable		R^2		Durbin-Watson	
	Proulx	Davis	Proulx	Davis	Proulx	Davis
Labour force participation rates of:						
Females:						
20 - 24 years	+ 0.619 (8.25)	+ 0.577 (6.33)	0.888	0.847	1.891	0.768
45 - 64 "	+ 1.299 (40.5)	+ 1.344 (56.7)	0.9969	0.997	1.7118	1.390
65 years and over	+ 0.183 (7.95)	+ 0.191 (9.85)	0.9466	0.894	1.7990	1.429
Males:						
14 - 19 years	- 1.085 (14.0)	- 1.107 (14.5)	0.9788	0.948	1.6860	1.129
20 - 24 "	- 0.507 (12.25)	0.443 (11.3)	0.9338	0.933	2.1626	1.837

[1] For methods of calculating the demand variables see: *La variabilité cyclique des taux de participation à la main-d'oeuvre au Canada* by Pierre-Paul Proulx, "The Canadian Journal of Economics", May 1969 and page 24 ff of this study.

Note: Figures in parentheses are the "t" values of the coefficients.

What these results show is that had the period 1953-67 been used in the present study, together with the Proulx model, results very similar to those obtained by Proulx would have been obtained. Clearly, the demand variable employed in this study and that used by Proulx have the same shape over time. This is not really a surprising result since they purport to be measuring the same thing. The new demand coefficients have the same sign and in three of the five age groups the coefficients are significant in both sets of regressions. However, the generally weaker predictive power of the demand series employed in this study (see the coefficient of multiple correlation), with associated lower "t" socres, left the coefficients in the regression for males aged 20-24 and females 65 and over not significant at the 5 per cent level. Apart from a question of emphasis, therefore, the same conclusions would have been reached. This is not to say that these results are also in support of Proulx's general conclusion that it is the additional worker hypothesis which dominates in Canada in contrast to the earlier results of this study. The strength of Proulx's conclusions come not so much from his analysis of the period 1953-67 but from his work covering the period 1948-67.[40]

In order to compare the results from models which include and exclude the cumulative demand variable, a Proulx-type model was also fitted to data for the period 1953-68. Table 6 shows the estimated demand coefficients and "t" statistics from this equation, together with those obtained earlier from the model which includes the cumulative demand variable. This table is of particular interest for two reasons. First, a comparison of the coefficients in the model without the cumulative demand variable with those given in the previous table indicates that the small increase in the period covered (from 1953-67 to 1953-68) results in such a weakening in the significance of the coefficients of demand that none remain so at even the 10 per cent level. This point will be further considered below. The second point of note is that when the cumulative demand variable is included, what strength had remained in the demand coefficient virtually disappears, while, as indicated earlier, good results are obtained for the coefficient of the cumulative demand variable. Since the "t" test is a test for the additional contribution of a variable when all other variables are included in the equation, these results show that what significance was attached to the coefficient of demand, when only it was included in the model, is largely because of its correlation with the cumulative demand

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[40] For his analysis over the period 1948 to 1967 Proulx uses as his demand variable the ratio of the number unemployed to the population for males age 25-44. His conclusions based on these results may, therefore, be unduly influenced by the experience of the earlier years not covered in this study or by the correlation between sampling errors in his dependent and independent variables.

variable. In contrast, it is quite clear from these results that the cumulative demand variable in general makes a real additional contribution to the explanatory power of the model over and above the contribution which is common to both the demand and the cumulative demand variables. This point is illustrated below in Table 7 where the variation in the participation rates of males aged 14-19 for Canada is allocated to its source as estimated by the model.[41] This table shows that a model with only a time trend variable would have explained 88.8 per cent (R^2) of the total variation. The inclusion of the two demand variables increases the explanatory power of the model by 8.8 percentage points, of which 1.9 percentage points was due to the association between the two variables and the remainder to the cumulative demand variable. The individual contribution of the demand variable is negligible. However, if the cumulative demand variable is not included in the model, then the association effect is picked up by the demand variable. Similarly, if the demand variable is excluded then this effect is included with that of the cumulative demand variable.

[41] For a discussion of this approach to the analysis of regression results see Newton, R.G. and Spurrell, D.J., "A Development of Multiple Regression for the Analysis of Routine Data," *Journal of the Royal Statistical Society*, Series C, Applied Statistics, Vol. 16, No. 1, 1967 and "Examples of the Use of Elements for Clarifying Regression Analyses", by the same authors in the *Journal of the Royal Statistical Society*, Series C, Applied Statistics, Vol. 16, No. 2, 1967.

TABLE 6. Comparison of Results from Models Including and Excluding the Cumulative Demand Variable, 1953-68

Age-sex groups	With demand variable only		Including cumulative demand variable			
			Cumulative demand		Demand	
	Demand coefficient	t statistic	Coefficient	t statistic	Coefficient	t statistic
Males						
14-19 years	+ 1.737	+ 1.62	+ 2.092	+ 5.97	+ 0.142	+ 0.23
20-24 "	- 0.290	- 0.55	- 0.467	- 1.48	+ 0.067	+ 0.12
25-44 "	- 0.109	- 0.39	- 0.019	- 0.10	- 0.094	- 0.29
65 years and over	+ 0.434	+ 0.71	+ 0.706	+ 1.94	- 0.085	- 0.13
Females						
14-19 years	+ 0.399	+ 0.70	+ 0.969	+ 3.94	- 0.339	- 0.78
20-24 "	+ 1.717	+ 1.45	+ 1.610	+ 2.60	+ 0.490	+ 0.45
25-44 "	+ 0.294	+ 0.71	+ 0.525	+ 2.34	- 0.106	- 0.27
45-64 "	- 0.540	- 1.47	- 0.403	- 1.93	- 0.232	- 0.63
65 years and over	- 0.300	- 1.21	- 0.283	- 2.03	- 0.085	- 0.34

TABLE 7. Source of Variation in Annual Participation Rates of Males Aged 14 - 19 in Canada, 1953 - 68

Source of sum of squares	S of S	%
Due to cumulative demand variable	23.6	6.9
Due to demand variable	–	–
Due to association between cumulative demand variable and demand variable	6.3	1.9
Due to trend variable and association between the trend and the demand variables	302.0	88.8
Residual = unexplained sum of squares	7.9	2.3
Total sum of squares	**339.9**	**100.0**

Note: – Denotes less than 0.05.
Figures do not add because of rounding.

This approach to the interpretation of regression results enables one to conclude that if the demand variable is excluded from the model, since it makes no additional contribution, then the significance of the coefficients of the cumulative demand variable will be generally increased (because of the positive association between the two variables). We can therefore have some confidence in including the results for males 65 + and females 65 + among those which have a significant cumulative demand coefficient.

This information on the effects of collinearity between the two demand variables suggests that certain patterns may emerge when using only the demand variable, as in the case of the Proulx study, but when working with different time periods. Given the method by which the cumulative demand variable was constructed, it is almost certain that the correlation between the two variables would have varied systematically over time. In a certain sequence of years the two variables will be moving in the same direction and this is likely to be followed by a number of years when they move in opposite directions. In the first case, the correlation between the two variables would rise as the period of analysis was increased, while in the latter case it would decline. If now, as in the case in this study, it is known that the strength of the demand variable, when it alone is included in the model, is because of its association with the cumulative demand variable, then this would suggest that the significance of the regression coefficients would also vary systematically when different time periods are

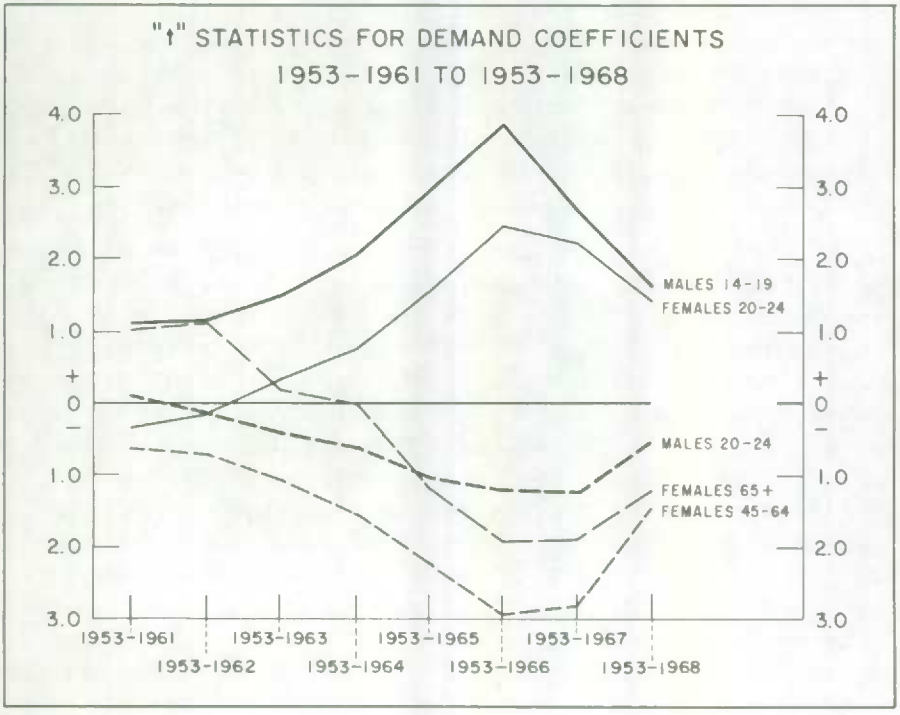
employed. That this is in fact the case can be seen from Chart 4 on which are plotted the "t" statistics for the demand coefficients estimated for different age group regressions for all periods 1953-61 to 1953-68. These are the same age groups in which Proulx found a significant response to his demand variable.

What this chart shows is that had Proulx worked with data for 1953-68, instead of for 1953-67, he would likely have had results that were very much less significant than those which he did obtain. Alternatively, if he had used the period 1953-66 his results would have looked even better. Clearly, however, there can be little confidence in results which are so sensitive to the period of analysis.

A Final Comment

In the analysis of annual data no comments have been made so far on two statistics which were discussed at some length in the analysis of monthly data, namely the Durbin-Watson statistic and the variance of the estimates.

CHART – 4



As regards the latter, estimates of the variances of annual averages calculated from the sample for Canada, in comparison with variances of the estimates from the regressions, indicate that the variation that has been "explained" by the model is not sampling variation. Thus, even though the estimated coefficients using annual data have a lower level of significance compared with those estimated from monthly data, more confidence can be had that no spurious correlation with sampling errors has been picked up in the results. This is also confirmed to a certain extent by the values of the Durbin-Watson statistics. These indicate that some autocorrelation remains in the residuals. But this was expected since even with annual averages the sample design still produces some year to year correlation. While the problem should also have been allowed for in the estimating procedure, the evidence of serial correlation in the residuals is not regarded as entirely unsatisfactory in this study. It would be more disturbing if none were present. However, it is still desirable to make the usual qualifications concerning results with low D.W. values even though they are thought to be not important in the context of this study and when using annual data.

Cyclical Response – The Regional Experience

The previous section was devoted to the analysis and interpretation of the results for Canada only, using both monthly and annual data. In this section an examination will be made of the experience of the same age-sex groups within each of the five standard regions of Canada using annual data.

Atlantic Region

Table 8 below contains the results for this region which contained significant demand coefficients. This practice will be adopted for the other regions also. The cut-off for significance is at the 5 per cent level, although for a number of age-sex groups in this and other regions demand coefficients which were significant at the 10 per cent level were also found. These will only be referred to when they appear in conjunction with coefficients of higher significance and where their interpretation is meaningful in the context of the set of regressions for that region.

The first point that should be noted is that no significant response to changing labour market conditions was observed in the participation rates of females, either in total or for any of the age-specific subgroups. This is perhaps a surprising result since the theory would suggest that it is among

females that the largest number of secondary workers is to be found and that cyclical variation in labour force participation, if present, should be found in these age-sex groups. However, it would seem reasonable to suggest that in the Atlantic Region the persistent structural deficiencies in job opportunities have had the effect of hardening the response of female workers to changing short-run conditions. Also it would be expected that, with the high level of unemployment in the region, there is a sufficient reserve within the labour force for gross movements between labour force and non labour force activity to be less important as a market regulator in these provinces.

The results for men in the Atlantic provinces indicate that, in the aggregate, they are drawn into the labour force in response to a downturn in the level of labour market conditions, a 1.1 per cent fall in the "vacancy" rate being significantly associated with a one per cent rise in labour force participation. But there is also weaker evidence, at between the 5 and 10 per cent levels of significance, which suggests that when demand falls to below the average level of recent years, such that the cumulative demand variable will be falling, a discouraged worker response is also present. Results for individual age groups show that this aggregate response is the result of transitory additional worker effect among the 65 and over age group and a cumulative discouraged worker response among 14 - 19 year olds.

Labour force participation in the Atlantic provinces would therefore appear to be fairly insensitive to changing levels of demand. Only among the oldest and youngest male age-groups is there any significant response.

TABLE 8. Regression Results – Atlantic Region

Age-sex groups	Constant	Coefficient of			$\bar{R}^2$	D.W.	Variance of estimates
		Cumulative demand	Demand	T			
Males							
Totals	**78.46**	**0.332** (1.71)	**–0.898** (–2.72)	**–0.435** (–10.72)	**.938**	**1.694**	**0.3378**
14 - 19 years	44.09	0.882 (2.13)	–1.022 (–1.44)	–0.619 (–7.12)	.888	1.554	1.5498
65 years and over	40.79	0.510 (1.70)	–2.637 (–5.14)	–0.925 (–14.68)	.965	1.835	0.8135

Note: Figures in parentheses are the "t" values of the coefficients.

Quebec

In Quebec the picture is somewhat different although, as in the case of the Atlantic Region, it is among males that the most significant results were found. For total males, see Table 9, there is a very strong cumulative discouraged worker effect while, at the same time, there is also a significant net additional worker response to the changing level of demand. The regression equation for total males explained 99.4 per cent of the total variation in participation rates and although the trend effect clearly accounts for the largest part of this explanatory power (see Chart 5) the ability of the two demand variables to capture the cyclical component is well illustrated.

Again it is in the two extreme male age groups that the most significant coefficients were found. The results show that, both for the 14-19 and 65 and over age groups, labour force participation would decline relative to the trend by about two percentage points in every year that the level of demand, as measured by the vacancy rate, was one percentage point below the period average. Conversely, when the level of demand was one percentage point above the average, a two per cent increase in the labour force participation rates of these age groups would be expected.

TABLE 9. Regression Results – Quebec

Age-sex groups	Constant	Coefficient of			$\bar{R}^2$	D.W.	Variance of estimates
		Cumulative demand	Demand	T			
Males							
Totals	**86.09**	**0.850**	**–0.304**	**–0.523**	**.994**	**1.798**	**0.0537**
		(10.51)	**(–2.43)**	**(–36.67)**			
14-19 years	58.44	2.357	–0.433	–1.481	.979	1.285	1.3961
		(5.71)	(–0.68)	(–20.37)			
45-64 "	93.33	0.537	–0.022	–0.161	.798	2.360	0.2620
		(3.00)	(–0.08)	(–5.11)			
65 years and over	36.09	2.001	–0.546	–0.493	.896	1.077	1.3237
		(4.98)	(–0.876)	(–6.96)			

Note: Figures in parentheses are the "t" values of the coefficients.

Quebec, however, is different from all other regions in one respect. Only in this region was a significance coefficient present in the 45-64 age group for males. This is rather surprising since most men in this age group have a near-permanent attachment to the labour force and little sensitivity to changing labour market conditions would be expected. What this result suggests is that some men in this age group become discouraged from seeking employment when faced with a deficient demand situation. It is also interesting to note that only in Quebec was there a significant downward trend in participation rates for males in this age group. This evidence would support the view that in Quebec it is the higher-than-average unemployment experienced which has caused the steady decline in labour force participation of this age group.[42] The general interpretation of the trend coefficient as representing the effect of long-run social factors may therefore not be applicable in this case and some "long-run" discouragement may have been in evidence over the period.

[42] A possible reason why a similar experience was not found in the Atlantic Region is that this region has witnessed a large outflow of workers to other regions over the period covered by this study.

CHART – 5

Although as mentioned above a significant net additional worker effect in response to changes in the **level** of demand was also observed for total males, the standard errors of the estimates were sufficiently large that none of the associated coefficients in the separate age group regressions was significant.

As in the Atlantic Region, labour force participation of Quebec females does not appear to be sensitive to changes in labour demand. But there is weak evidence at just below the 5 per cent significance level that females aged 14-19 are increasingly discouraged from looking for work when the level of demand remains depressed.

Ontario

The results for Ontario given in Table 10 show that in half of the ten age-sex groups examined a significant coefficient to the cumulative demand variable was obtained, and in one other age group the same coefficient was very close to being significant. No coefficient of the demand variable was significant. While it can be concluded from this that, in terms of their labour force attachment, the Ontario population is highly responsive to the cumulative demand situation, the absence from the table of any significant results for either total males or total females indicates that this responsiveness cancels out in the aggregate.

Considering males first, and always referring to the cumulative demand variable, a dominant net discouraged worker effect among the 14-19 age group is partially offset by a net additional worker response in the 25-44 age group. This latter result is unexpected since this is a high participation age group in which, on *a priori* reasoning, one would expect to find little cyclical sensitivity. However, the significance of this result is supported by the two further pieces of evidence. First, the presence of a net additional worker response in the 20-24 age group which was almost significant would, since these age groupings are to some extent arbitrary, support the view that net "discouragement" in the younger ages is transformed to a net additional worker response as age increases. Secondly, and more interestingly, the trend coefficient, although small, was significantly negative for males age 25-44 in Ontario. This effect may again be attributed to long-run social and economic factors.[43] But since demand for labour has been typically high in Ontario, the effect of an additional worker response to the cumulative demand situation would be progressively to reduce the

[43] Examples are the growth of further education opportunities and retraining, increasing wealth and welfare, declining work ethic and declining mortality of the chronically ill.

size of the labour force. It should again be recalled that in the construction of the cumulative demand variable the average level of demand over the period was used such that any departures of this average from the "true" zero excess demand level will mean that the trend effect will also include a long-run noncyclical demand component. For the majority of age groups it can be assumed that long-run demand effects will be small compared with other trend effects, but for males 25-44 (as in Ontario) and 45-64 (as in Quebec – see above) this may not be the case and it is for this reason that special emphasis has been placed on the significant trend coefficients for these age-sex groups in the two provinces.

TABLE 10 Regression Results – Ontario

Age-sex groups	Coefficient of						Variance of estimates
	Constant	Cumulative demand	Demand	T	$\bar{R}^2$	D.W.	
Males							
14-19 years	53.57	1.819 (4.59	0.074 (0.07)	-0.918 (-9.66)	.931	1.753	1.6600
25-44 "	98.54	- 0.249 (-4.331)	0.156 (1.05)	-0.054 (-3.93)	.680	0.753	0.0348
Females							
20-24 years	48.41	1.973 (5.13)	0.741 (0.74)	0.547 (5.95)	.870	1.880	1.5608
45-64 "	19.42	- 0.759 (-3.20)	0.370 (0.60)	1.246 (21.98)	.984	1.977	0.5923
65 years and over....	5.23	- 0.591 (-2.91)	-0.039 (-0.07)	0.062 (1.26)	.418	1.385	0.4371

Note: Figures in parentheses are the "t" values of the coefficients.

As in the case of males, there is no significant evidence to suggest that either of two competing effects dominates among females in Ontario. But there is strong evidence that within individual age groups cyclical sensitivity is present although offset in the aggregate. Since unemployment in Ontario has been generally low, it may be more appropriate to interpret the coefficients of the cumulative demand variable in a situation of excess demand. In this situation females age 20-24 are clearly "encouraged" to

seek employment (interestingly, no similar significant effect was found in the 14-19 age group). On the other hand, older women (i.e. 45 to 64, and 65 and over) would on balance be less inclined to seek employment in similar circumstances. Clearly in the case of the older females this is support for the view that it is the greater family financial security resulting from a high level of demand for labour that reduces the attraction of work on her decision to enter or not to enter the labour force. It may be further suggested that for females aged 20-24 it is their own increased earning power at a time of excess demand for labour that dominates their decision.

Prairie Region

Of all the regions in Canada the Prairies is the one in which the level of labour force participation appears to be least influenced by labour market conditions. As Table 11 shows, only for females aged 20-24 was either of the demand coefficients significant at the five per cent level and, as in Ontario, entry into the labour force rises, or withdrawals decline, as cumulative demand increases. A similar result was found for females in the 14-19 age group at just below the 5 per cent level of significance.

While a study of this kind can provide no clues as to the reason for the observed insensitivity of labour force attachment in this region, certain observations can be made. The industrial mix of this region, relative to other regions, includes a higher concentration of agriculture. Insofar that employment in agriculture is characterized by both the presence of a strong downward trend and a cyclicality which may not move in phase with the rest of the economy, its weight in the overall economy of the region could give some cyclical stability to labour force participation.

TABLE 11. Regression Results – Prairie Region

Age-sex groups	Coefficient of						Variance of estimates
	Constant	Cumulative demand	Demand	T	$\bar{R}^2$	D.W.	
Females							
20-24 years	41.96	2.461 (3.35)	−0.812 (−0.793)	0.998 (11.83)	.913	2.168	2.0464

Note: Figures in parentheses are the "t" values of the coefficients.

A further factor which might be mentioned as possibly contributing to these results is again that of migration. The known outward movement of persons from the Prairie Region (in particular from Manitoba and Saskatchewan) may be such as to transfer the effect on labour force participation and on employment, due to changing labour market conditions, from the Prairies to other regions – notably British Columbia and Ontario. Thus, shortages of jobs which might have discouraged students from seeking employment or encouraged wives to find employment may instead have caused the family to seek their fortune in another part of Canada. This is a point which is also relevant to the level of, and trends in, labour force participation to be discussed in the next section.

British Columbia

The regression results for British Columbia are shown in Table 12. As in Ontario and Quebec there is evidence that in British Columbia participation in the labour force on the part of males is influenced by the state of the labour market and in particular is procyclically related to the pressure of demand as calculated by the cumulative demand variable. This support for the dominance of a "cumulative" discouraged worker effect is relatively weak, at just over the five per cent significance level, but from the results for individual age groups the reason for this is seen. For males aged 20 - 24, the negative sign of the coefficient indicates that a period of depressed labour market conditions is likely to cause a net inflow into the labour force from this age group. For the over 65 age group the opposite effect is strongest and under the same conditions older men would leave the labour force. Since the population of persons 65 and over in British Columbia is considerably greater than that of persons aged between 20 - 24, this would account for the dominance of discouraged worker effect in the population as a whole.

For females, only among the 20 - 24 age group was there any statistical evidence of cyclical response in labour force participation to changing labour market conditions. The discouraged worker effect again dominates but this time it is in response to short-run changes in the level of demand, a one per cent increase in the vacancy rate being associated with no less than a 6 percentage point rise in labour force participation.

The above results for British Columbia do not in general conflict with the earlier findings of Montague and Vanderkamp. They concluded that their results ". . . . . clearly support the notion that, on balance, higher unemployment tends to discourage people from participating in the labour force." Despite the differences in the periods covered and models employed, the findings of this study also support this conclusion.

TABLE 12. Regression Results – British Columbia

Age-sex groups	Coefficient of						Variance of estimates
	Constant	Cumulative demand	Demand	T	$\bar{R}^2$	D.W.	
Males							
Totals	**76.05**	**0.667** (2.29)	**0.646** (1.57)	**-0.013** (-0.47)	**.418**	**1.135**	**0.2130**
20-24 years	89.62	-4.329 (-3.62)	3.247 (1.92)	-0.482 (-4.36)	.608	2.249	3.6064
65 years and over	22.59	1.713 (2.64)	0.491 (0.54)	-0.347 (-5.77)	.800	1.873	1.0599
Females							
20-24 years	35.86	-0.652 (-0.33)	6.246 (2.27)	0.359 (1.99)	.283	1.689	9.5911

Note: Figures in parentheses are the "t" values of the coefficients.

Summary

The foregoing regional analysis may be summarized by reference to Table 13. With two sexes, five regions and five age groupings, a total of 50 regression results have been examined excluding those for total males and females in each region. In 14 of these, demand coefficients were observed which were significant at the five per cent level. The signs of nine of these were in support of the discouraged worker hypothesis, with five in support of some additional worker response. But the evidence, in the ratio of 12 to 2, is also in support of the view that labour force participation is most sensitive to the cumulative demand situation rather than to changes in the current level of demand. The conclusion that is perhaps most surprising is that at the regional level it is male labour force participation which appears to be most sensitive. However, this result may be due to the fact that because, age for age, labour force participation among females is lower than that of males, and therefore sampling errors for the females rates are sufficiently large to mask much of the cyclical movement that may be present. There is some support for this view. (In the previous section, in which the results for Canada were examined, this "regional" picture was reversed in that, at the national level, it was among females that the greatest cyclical sensitivity was found.)

TABLE 13. Number of Regression Equations with Significant Demand Coefficients

	Discouraged worker response to		Additional worker response to		Total
	Cumulative demand	Demand	Cumulative demand	Demand	
Males	6	0	2	1	9
Females	2	1	2	0	5
Totals	**8**	**1**	**4**	**1**	**14**

Trends in Labour Force Participation

The primary purpose of this study was to examine the extent of cyclical variation in labour force participation in response to changing labour market conditions. However, a prerequisite for such an examination was that the effects of short-run trends should be isolated by the inclusion of a trend variable in the model. In the section dealing with the specification of the model the form which this trend variable should take was briefly discussed, with the conclusion that over the short-period examined in this study no great loss in efficiency would be encountered if this trend effect was assumed to be a linear function of time. It has also been shown in the immediately previous sections that, notwithstanding the significance of the demand variables, the short-run trend was the factor explaining most of the variations in labour force participation.

This section is devoted to an examination of these trends. In any time series analysis which includes a trend variable this variable is necessarily ill-defined. It is typically included as a "catch all" variable to pick up all kinds of long and medium-term social, economic or cultural effects. In the context of this study the case of, say, the 20-24 age group, may be taken for illustrative purposes. Such factors as the increasing emphasis on and need for higher education, the tendency for the average age at marriage to decline, the changing social mores with respect to family planning, to working wives in general and to working mothers in particular will all operate in such a way as to affect the trend of the supply of labour in this age group. Some will tend to increase the supply of labour while others will reduce the flow of persons seeking employment. But there are also long-run and medium term factors which will operate on the demand

side. A low level of demand for labour relative to the available supply, as in the case of Quebec, may have contributed to the trends in labour force participation in this province. Similarly, a changing industrial mix will affect the job opportunities for different age-sex groups differently.

A further cautionary note seems indicated at this stage to ensure that the situation of high or increasing participation rates is not necessarily equated with a high level of labour demand. This can be illustrated with the case of the Prairie Region where labour force participation increased at noticeably more than the national average although, as shown in Table 14, the region had the second lowest rate of growth in employment over the period 1953-68. Quebec, on the other hand, experienced declining labour force participation and high unemployment and at the same time had an employment growth rate not much below the national average and significantly above the Prairies'. These two divergent patterns appear to reflect, at least in part, the differences in population growth rates which also are shown in the table. Quite clearly, the relatively slow growth of employment on the Prairie has been more than compensated for by net out-migration from the region, and thus labour force participation could increase with only a modest increase in labour demand. By the same token, the employment increase in Quebec was larger but not enough to keep pace with the growth in population.

It is beyond the scope of this study to examine reasons for these different population growth rates and no attempt is made to isolate the trend determinants. This section will be limited to a descriptive analysis of the differences among the regions in trends in labour force participation by age groups.

TABLE 14. Growth of Population and Employment, 1953-68

Region	Per cent increase 1953-68		Average unemployment rate 1953-68
	Population	Employment	
	per cent		
Atlantic	24.0	24.7	8.4
Quebec	44.4	41.5	6.6
Ontario	44.0	48.4	3.7
Prairie	26.9	36.5	3.1
British Columbia	60.1	73.6	5.7
Canada	**40.3**	**44.0**	**5.0**

In Chart 6 below are plotted the trend lines for the age specific participation rates of males in each region and for Canada as a whole. The lines that have been plotted were obtained from a model with only a time trend variable together with the constant term. This was necessary because had we used the trend coefficient and constant term which was estimated using the full regression model, this constant term, which fixes the level of demand, would have excluded the average effect of the demand variables. It can be seen that while within each age-sex group there is in general a similarity in the trends for each region, there are also the noticeable differences referred to earlier. What follows is a closer examination of each age group, for males and females separately.

Males aged 14 - 19

For Canada as a whole the trend of labour force participation in this age group has been markedly downward. In 1953 half of all teenage males were either working or looking for work. By 1968 the trend participation rate had fallen to little more than one third (36 per cent). But of all the age-sex groups this, together with the corresponding one for females, is the one which shows the greatest disparities among regions both in the level and slope of the trends.

The most marked departures from the national average are found in Quebec and British Columbia. In the former case the trend participation rate of teenage males has fallen from nearly 57 per cent to less than 32 per cent, while for British Columbia it has risen slightly from a little under to just over 40 per cent. Another development of significance in this age group is that in the Prairie region the decline in participation rates has been only modest compared with the average, falling only from 49 per cent in 1953 to 45 per cent in 1968. At this level, proportionately more teenagers in the Prairie Region are working today than in any other region in Canada, compared with an average position 16 years ago. With British Columbia moving up from last place to that of the region with the second-highest labour force participation and Quebec moving down through the ranking from first place to join the Atlantic Region as the area with the lowest participation rates, a clear geographic pattern appears to have developed. The regions to the east of Ontario are now characterized by a low level of labour force participation relative to the average, while those to the west of Ontario have above-average rates in this age-sex group. The picture for Ontario both with regard to the level and slope of the rate is virtually no different from that for Canada as a whole. As was mentioned earlier, an examination of trends in participation rates can provide no clues as to the reason for any pattern which has developed. However, the picture which has emerged for the 14 - 19 age group is to a lesser extent also repeated among older males.

CHART – 6a

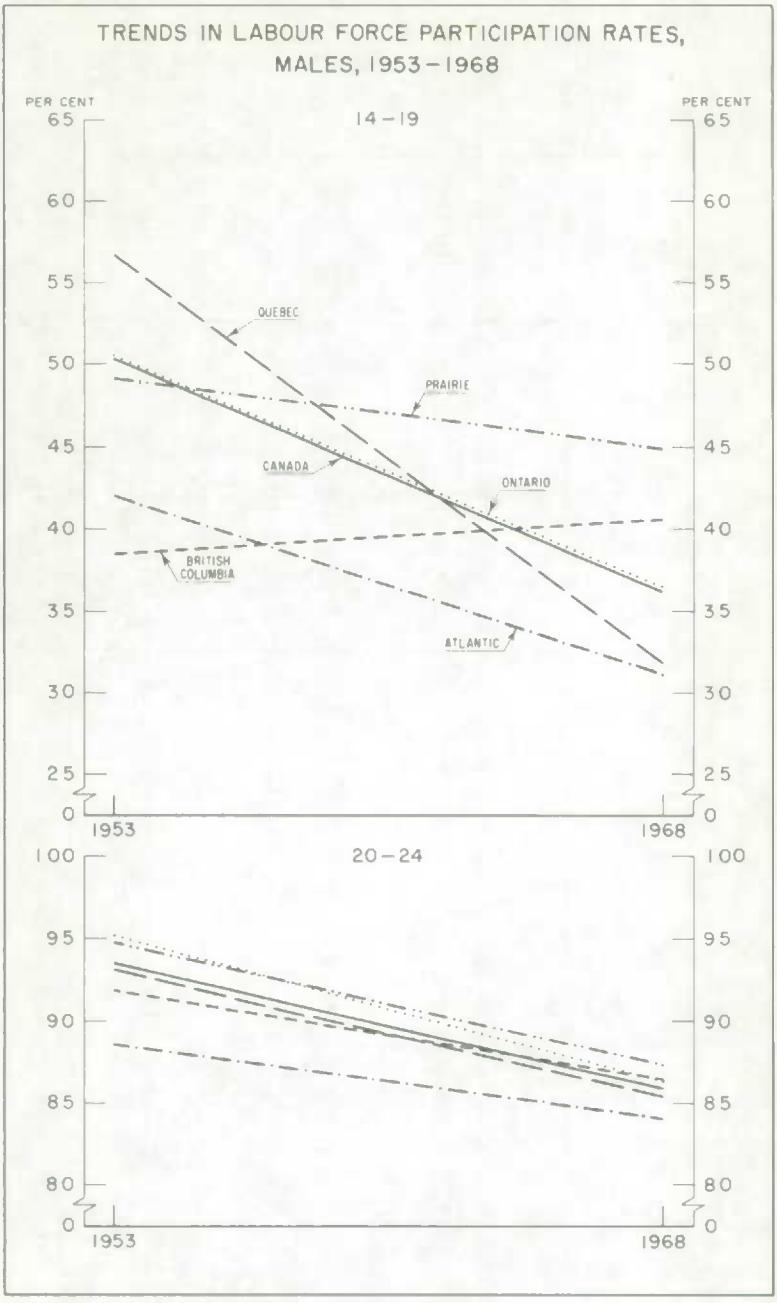
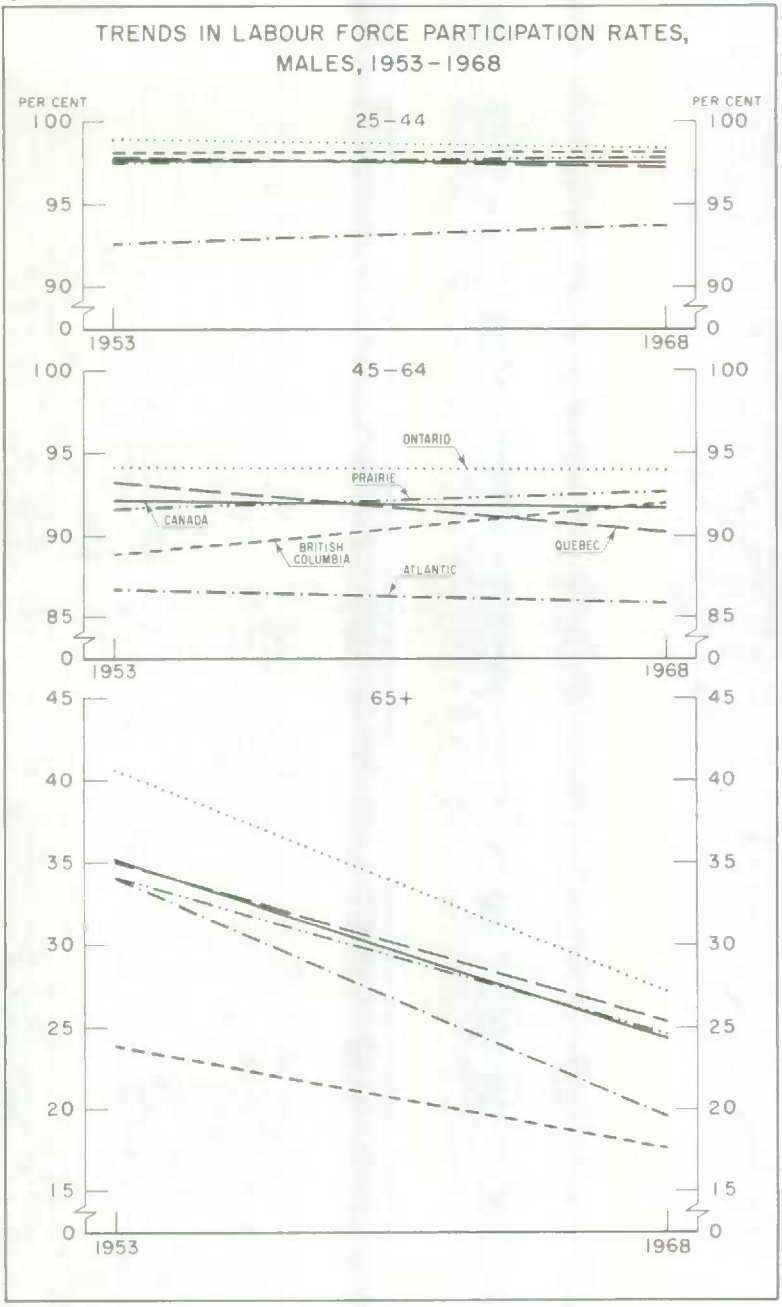

TRENDS IN LABOUR FORCE PARTICIPATION RATES,
MALES, 1953 – 1968
PER CENT
14 – 19
65
60
55
50
45
40
35
30
25
0
1953
1968
QUEBEC
PRAIRIE
CANADA
ONTARIO
BRITISH COLUMBIA
ATLANTIC
20 – 24
100
95
90
85
80

CHART – 6b


TRENDS IN LABOUR FORCE PARTICIPATION RATES, MALES, 1953–1968
PER CENT
25–44
45–64
65+
ONTARIO
PRAIRIE
CANADA
BRITISH COLUMBIA
QUEBEC
ATLANTIC
1953
1968

Males 20 - 24

In all regions the trend among males in this age group has been that each year relatively fewer of them have been employed or have been seeking employment. At the national level the decline has been approximately of the order of one percentage point every two years. What little difference there has been between regional trends has tended to narrow the regional disparities. In 1953 participation rates varied between 95 per cent in Ontario to less than 89 per cent in the Atlantic region. By 1968 this gap had been halved so that only 3 percentage points separated the five regions. However, as in the case of the 14 - 19 age group, a pattern has developed such that by 1968 the Atlantic Provinces and Quebec had the lowest participation rates and the Prairie Provinces and British Columbia the two highest rates.

Males 25 - 44

For males in this age group trends were, as expected, generally not very significant. However, the chart clearly shows the relatively low level of participation in the Atlantic Region which, despite a slight rise over the 16 years, was still three and one half percentage points below the next lowest province – Quebec.

Males 45 - 64

In many respects the picture among the 45 - 64 year old males is similar to that found in the 14 - 19 age group. In the western regions, particularly in British Columbia, participation rates have been rising both in absolute terms and relative to the national trend. In contrast, declining participation is evident in the eastern provinces, particularly Quebec. In 1968 Ontario had the highest trend participation rate for this age group at nearly 94 per cent and the Atlantic region had the lowest with 86 per cent. This gap of 8 percentage points is only a half percent less than it was between these same two regions 16 years earlier. But as in the case of the three younger age groups the changed ranking has meant that Quebec has joined the Atlantic provinces in having one of the two lowest levels of labour force participation while both the Prairie Region and British Columbia now have rates above the average in contrast to the position in 1953.

Males 65 and Over

For these older males the results generally conform to expectations. Greater economic prosperity and the increased provision of retirement benefits have no doubt been the main factors contributing to the decline

in participation rates which is evident in all regions. Because of the dominance of these economic factors regional differences in the trends appear to be small in comparison with those for other age groups. Only for the Atlantic Region where the decline in participation has been greater than in the rest of Canada is there any noticeable departure from the national trend. However, the same cannot be said for the level of participation. In 1968 trend participation in Ontario at a little over 26 per cent was nearly 10 percentage points higher than in British Columbia. These differences almost certainly include demographic effects such as variations in the age distributions within this older age group and also of the tendency for retired people to migrate to certain parts of Canada, particularly to the West coast. Since the effects of the trend towards earlier retirement and of demographic factors are likely to dominate the pattern of participation rates for this age group, the summary of trends in male participation which follows will be limited to young and prime-age men.

In summary, the main finding of this examination of trends in male labour force participation is that excluding the Atlantic Region the current trend participation rates in Quebec are lower than in any other region of Canada.

The differences are not always large but, insofar as they represent a reversal of the position at the beginning of the period, special factors are clearly at work in Quebec which either encourage non-market activity or discourage job seeking. There is unfortunately real evidence that it is the latter effect which likely dominates. In the analysis of cyclical response in the previous section Quebec was unique in providing evidence of a significant cumulative discouraged worker effect among males aged 45-64. It was suggested in that section that since only the cyclical response could be picked up by this variable any long or medium run effects would be included in the trend variable. It was further suggested that this might in fact be the case given the significant negative trend in participation of this age group. A discouraged worker response was also in evidence among the 14-19 year old males in Quebec and ,following the reasoning given above it is also possible that for this age group the calculated trend includes a long-run discouragement effect. Although the opportunity to stay on at school has improved in Quebec over the past decade – contributing to the overall decline in labour force participation – the fact that the participation rate for this age group rate is now lower than in Ontario is unlikely to be due to regional differences in educational opportunity. What is known is that employment grew more slowly in Quebec (Table 14) and a shortage of employment opportunities is likely to be most keenly felt by young workers.

The conclusion for Quebec as a whole is that while for a number of age groups, participation rates are still significantly higher than those in the Atlantic Region, there is real evidence to suggest that one of the effects of relatively poor job opportunities has been increasingly to make Quebec's participation rate structure more like that of the eastern provinces.

In contrast the picture in the west is one of increasing labour force participation. In British Columbia among the 14 - 19, 20 - 24 and 45 - 64 age groups the participation rate not only increased relative to the national average but in two of the age groups increased in absolute terms as well. A similar situation was also present in the Prairie Region. There is, however, no evidence, as there was in Quebec, that the same forces which determine the short-run participation behaviour also influence the long run trend. Indeed it was shown in the previous section that for Prairie males no significant cyclical response could be detected while in British Columbia it was the discouraged worker effect which dominated.

It is beyond the scope of this study to pursue this further and in particular its implications for general economic and political stability. However, an earlier study in this series[44] did investigate in considerable detail the question of manpower utilisation over an almost identical period (1953 - 67) in which the effects on underutilisation of both low participation and high unemployment were considered and quantified. Tandan's approach was to consider what the level of manpower underutilisation would have been if all regions had had the same unemployment rates as obtained in Ontario in 1952 - 53 and the same target participation rates — the target being the linear trend for age-sex specific subgroups in Ontario between 1952 - 53 and 1965 - 66. Ontario was chosen because of its typically high participation rates and the period 1952 - 53 because of its low and presumably attainable unemployment rate. This approach allowed the "participation" and "unemployment" effects to be calculated separately. Although the calculations over the 1953 - 67 period were based on actual rather than trend participation rates in each region, the results of the participation effect provide a clear insight into some of the developments observed so far in this section. Thus, for males, 47 per cent of the underutilisation of manpower due to "less than Ontario participation" in 1953 was found in the two western regions. By 1967 this had fallen to less than 15 per cent.

In Chart 7 are plotted the trends in female labour force participation by age groups. As in the case of males our primary interest is to see to what extent regional differences exist within age groups.

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[44] See DBS Special Labour Force Studies, No. 8, *Underutilisation of Manpower in Canada*, by Nand K. Tandan, Ottawa, 1969.

CHART – 7a

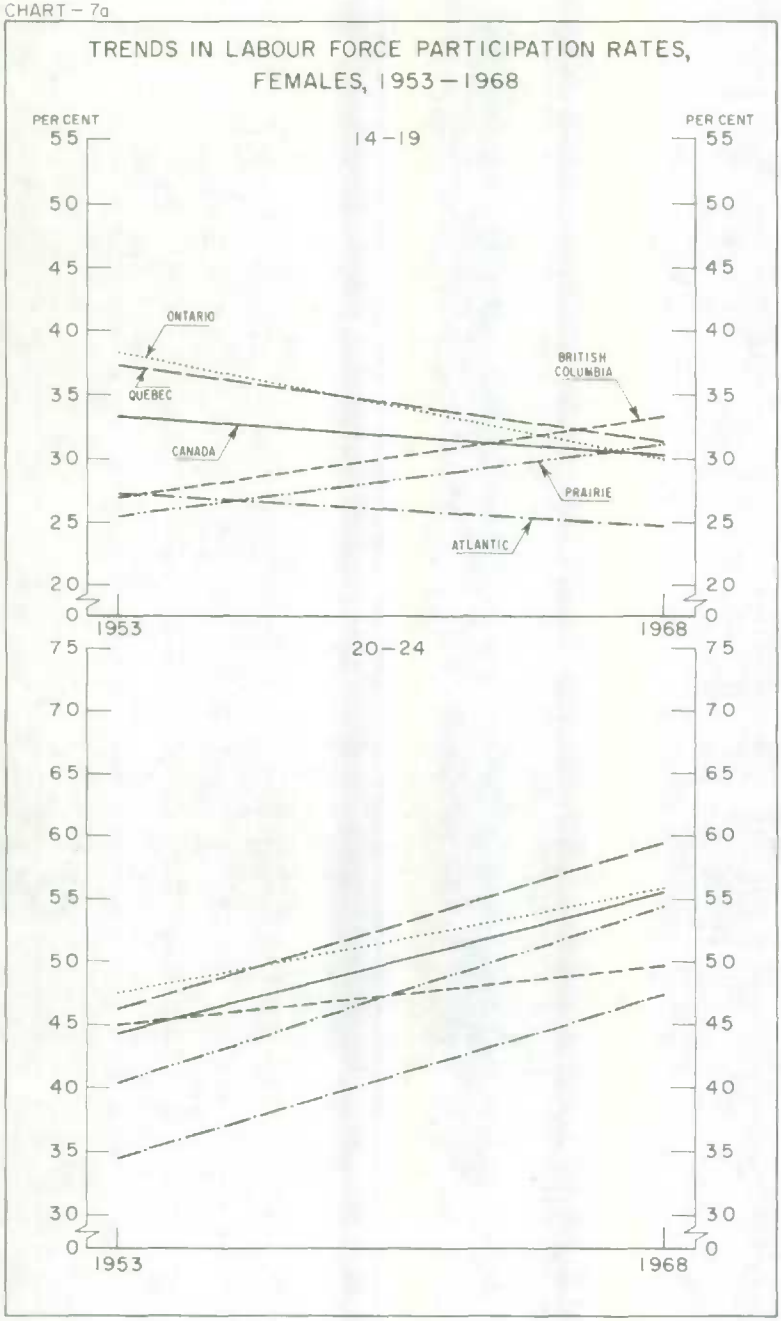
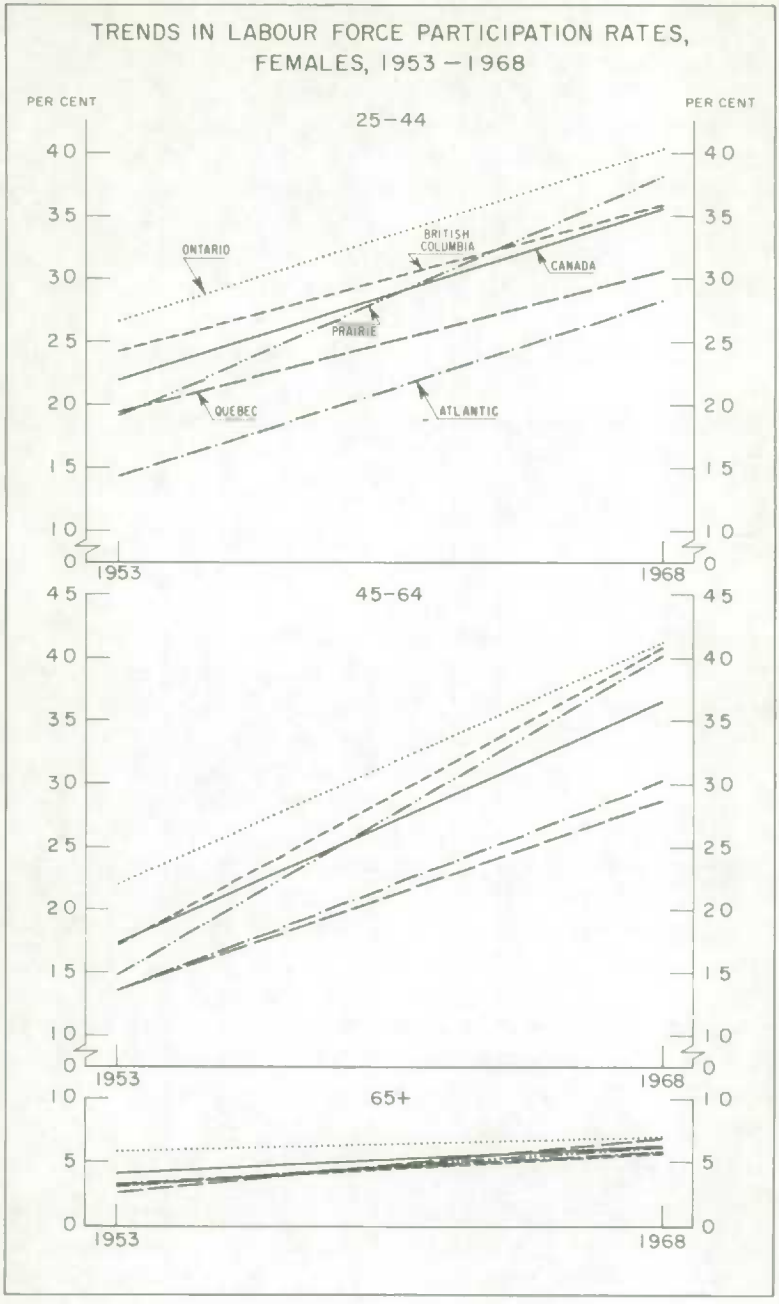

TRENDS IN LABOUR FORCE PARTICIPATION RATES,
FEMALES, 1953 – 1968
PER CENT
14 – 19
ONTARIO
QUEBEC
CANADA
BRITISH COLUMBIA
PRAIRIE
ATLANTIC
55
50
45
40
35
30
25
20
0
1953
1968
20 – 24
75
70
65
60
55
50
45
40
35
30

CHART – 7b


TRENDS IN LABOUR FORCE PARTICIPATION RATES,
FEMALES, 1953 – 1968
PER CENT
PER CENT
25–44
ONTARIO
BRITISH COLUMBIA
CANADA
PRAIRIE
QUEBEC
ATLANTIC
40
35
30
25
20
15
10
0
1953
1968
45–64
65+
5

Females 14-19

In 1953 the regional pattern of female labour force attachment in the 14-19 age group was that of high participation in two regions – Ontario and Quebec – and low rates in the remaining three regions. Within these two regional groups the differences were small. By 1968 the picture had changed considerably. The Ontario and Quebec rates had declined from 37-38 per cent to 30-31 per cent. At the same time the proportion of teenagers at work or seeking work in the two western regions has increased from a trend point of 25.5 per cent in the Prairies and 27.0 per cent in British Columbia to over 31 per cent and 33 per cent respectively. The result of these developments is that the West has now either caught up to or overtaken the central provinces as the ones with the highest level of participation. At the same time while the disparity between the Atlantic region and the rest of Canada has in fact narrowed slightly, it has become more noticeable because of the comparative isolation of the trend position of the Atlantic Region.

Females 20-24

In general the trends in labour force participation of females in this age group conform to expectations. In all regions there is evidence of an increasing attachment to labour force activity. Significantly, however, and in contrast to participation in any other age-sex group, proportionately more females in this age group in Quebec were working in 1968 compared to other regions. This result has been observed elsewhere and has been attributed among other reasons to the later age of marriage in this province. Also of interest is that the growth of participation in British Columbia has been markedly lower than in the rest of Canada. This again is in contrast to the general pattern which has developed over the period and also in contrast to the Prairie Region where labour force participation has been rising fast at close to 1 percentage point a year. The effect of these various movements is that, although participation in the Atlantic region throughout the period has remained significantly below that of other parts of Canada, no other geographical pattern has developed.

Females 25-44 and 45-64

Because of the similarity in the experiences of these two age groups they will be reviewed together. A considerable literature already exists on the growth in, and determinants of, the labour force attachment of married women. This has been the most important factor influencing the long-run upward trend in participation of these two age groups. The principal

observation to be made here is that, while over the period Ontario has been the province with the highest labour force participation rates in these two groups, the gap between Ontario and the western provinces has virtually been closed – particularly for women aged 45-64. On the other hand there is no evidence of a narrowing of the gap between Ontario on the one hand and Quebec and the Atlantic regions on the other. By 1968, when the trend participation rate of women in this age group for total Canada was a little over 36 per cent, the rates for Ontario, the Prairies and British Columbia were in the range of 40-41 per cent. The average rate in Quebec and the Atlantic Region in the same year was less than 30 per cent. Although the pattern of participation rates in the younger, 25-44 age group is a little more open, the same type of situation is in evidence. These two age groups combined contain the largest proportion of the female population and the low level of labour force participation in the Atlantic and Quebec regions in this age range is a measure of the underutilisation of manpower in these two regions.

Females 65 and Over

Very few females 65 years of age and over are working and although the tendency in all regions is for more women in this age group to seek employment the national average participation rate in 1968 as indicated by the trend position was only a little over 6 per cent – a rise of 2 percentage points from 1953. Within what are necessarily very small limits the most noticeable increase has been in Quebec from less than 3 per cent in 1963 to nearly 7 per cent in 1968 – the same as in Ontario.

These observations on trends in female participation rates show that, even though as was to be expected, they differ in the aggregate from those of males, the regional differences about these trends for specific age groups have much in common with the male experience. This was particularly evident in the case of the western provinces in which the level of labour force participation in 1968 was with a few exceptions above that of Canada as a whole, compared with the situation in 1953 when their rates were generally at or below the national average. The study on underutilisation which was cited earlier[45] can again be used for comment on the aggregate effect of these developments. Tandan estimated that for the Prairie Region in 1953 the lower level of female participation (relative to Ontario) was equivalent to an underutilisation rate of 26 per cent. By 1967 this rate had declined to only 6 per cent. The corresponding decline in British Columbia over the same period was from 10 to 3 per cent. Thus, the gap between

[45] *Ibid.*

Ontario and the western provinces has substantially declined. For the provinces east of Ontario, however, the results are rather different. Quebec, with a 1953 underutilization rate that was close to British Columbia's, reveals very little change in the fourteen year period (from 13 to 12 per cent). The Atlantic provinces have seen more improvement – the underutilization rate dropping from 35 per cent in 1953 to 22 per cent in 1967 – but the amount of underutilization is still substantial.

Putting these results in another way and combining the calculations for males and females, Tandan found that if the level of labour force participation in Ontario is regarded as a reasonable goal that all provinces might achieve, then four out of every five persons who are underutilised according to this measure are in Quebec and the Atlantic Region.

Summary and Conclusions

The primary purpose of this study has been to test certain hypotheses concerning the responsiveness of the Canadian and regional populations in terms of labour force participation rates to changing labour market conditions. In addition, and in part as a by-product of this analysis, an examination of trends in labour force participation was also made. Three main conclusions emerge.

(1) The level of labour force participation in Canada over the period 1953-68 was cyclically sensitive to the general level of and changes in labour market conditions, and of the two competing hypotheses the evidence supports the overall dominance of the discouraged worker effect. That is, when unemployment is high, the number of workers or potential workers who are discouraged from seeking employment is greater than the number who decide to join the labour force to help supplement the family's income. It was found, however, that it was not the changes in the current level of demand but rather the cumulative effect of current and past levels of demand which explained most of the cyclical variation in labour force participation.

(2) There were marked regional differences in the extent of variation in labour force participation about the long-run trend and in the responsiveness of the two sexes to the level of labour demand.

(3) Regional trends in labour force participation rates over the period examined have been one of the factors tending to increase the economic disparity between Quebec and the Atlantic provinces on the one hand and Ontario and the western provinces on the other.

The analysis that has been made hitherto has been carried out in terms of percentages – participation rates and vacancy rates. In this summary an attempt will be made to translate the conclusions, referred to above, from percentage movements to estimates of numbers of persons.

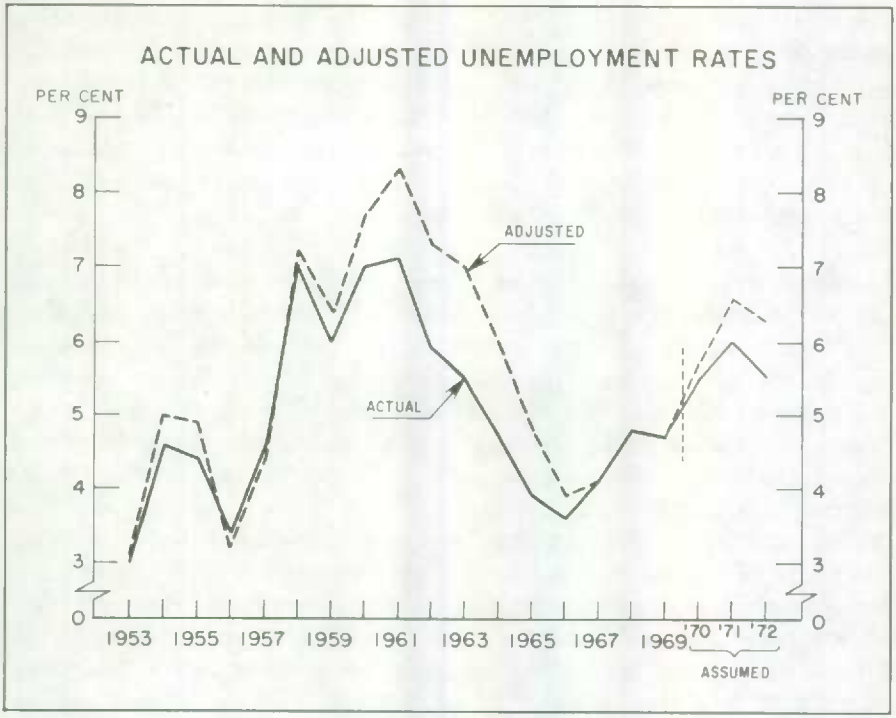
From the regression models for Canada as a whole, it is estimated that in 1963, when the cumulative demand variable was at its largest negative value, some 100,000 persons were discouraged from seeking employment. In the same year the observed unemployment rate was 5.5 per cent, but corrected for these "discouraged workers" it would have been close to 7.0 per cent. Earlier, in 1961, the unemployment rate itself was 7.1 per cent. Had there been no discouraged worker effect, so that all persons without jobs remained in the labour force, the unemployment rate in Canada would have been 8.3 per cent.

Chart 8 below traces the actual and adjusted unemployment rates for the period 1953-68 together with some indication of what might happen over the next three years. These projections through 1972 are not forecasts; they are simply the results obtained when certain assumptions are made to illustrate how the discouraged worker effect might operate over the next three years. The assumptions are that the recorded level of unemployment rose to an average rate of 5.5 per cent in 1970 and to 6.0 per cent in 1971. It is then assumed that it falls back to a rate of 5.5 per cent in 1972. Given these assumptions, it is estimated that apart from any trend effects the level of labour force participation will be some 0.4 to 0.5 percentage points or 70,000 persons lower than it would have been if unemployment had not risen above the 1968-69 level. These calculations assume that the population 14 years of age and over in 1972 will be in the region of 15.5 million, of whom 8.5 million will be in the labour force. On this figuring the loss of 70,000 workers to non-labour force activity would represent about 0.8 per cent of the total and this is the amount which is added to the assumed unemployment rate of 5.5 per cent in 1972 to arrive at the adjusted rate.

Still focusing on the potential loss to the labour force of 70,000 persons by 1972, given the assumptions made above, an examination of sex differences indicates that the net decline would be the same for both males and females – about 35,000. But as indicated by the regression results using annual data, the age composition of this decline would vary between the sexes. Among males, nearly all the loss would be among the 14-19 age group, perhaps some 30,000 of the total, with the remaining 5,000 found among men 65 years of age and over. In contrast the expected

experience among females is that in each of three younger age groups – 14-19, 20-24 and 25-44 – about 15,000 potential workers would be discouraged from seeking employment but that this combined reduction of 45,000 would be partially offset by an increase of 10,000 in the number of women 45 and over in employment or seeking employment.

CHART – 8



While these figures indicate that, given a certain increase in the level of unemployment over the next two to three years, some net discouragement to participation in the labour force may be felt, the magnitude of such response will not only be small but will be spread over a number of age-sex groups. More teenagers, particularly males, will likely stay on at school or return to full-time schooling, and some young women, particularly those with young children, may prefer to stay at home rather than seek employment as they might have otherwise done. The smallness of the net movements ranging from minus 30,000 to plus 10,000 for age groups of often over 1 million persons, while judged statistically significant, justifies the attention which was paid earlier in the study to the sampling variability in the data.

It will be borne in mind that this particular outcome is related to certain assumed levels of unemployment. It would also be a conclusion of this study that if the observed level of unemployment should rise to 6.5 or 7 per cent, instead of 6 per cent, and remain at these higher levels for one extra year, then the picture would be very different. Under these circumstances the loss to the labour force because of the net discouraged worker effect would be close to double the number estimated above.

A closer look at possible developments in the regions must be premised on some assumptions about the variations in labour market conditions across the country. The only assumption that can be reasonably made in the context of this study is that the past relationship between unemployment in the regions and the national level will hold for the short run future. This assumption ignores the possibility of any selective measures to control inflation or create employment which might change previous regional patterns during periods of slackening demand. However, unless forecasts were being made for a considerable number of years ahead, and these years were also expected to be ones of persistent slack demand, these assumptions are not too important.

Given the assumptions made in this study, the net discouragement effect would be most felt in Quebec. In this province a loss to the labour force of 25-30,000 persons could be expected, corresponding to hidden unemployment of the order of a little over one percent. Some decline could also be expected in British Columbia, at 5,000 to 10,000 persons. This loss to the labour force would also correspond to a hidden unemployment rate of about one per cent. The balance of the estimated total reduction of 70,000 would be spread over the remaining regions but the effect would be small.

In the case of Ontario all the evidence suggests that while some response within particular age groups might be felt the net effect would be a cancelling out i.e. some decline in labour force participation by young men and women being largely offset by an accelerated increase in the proportion of older women returning to work. As suggested earlier, labour force participation in the Atlantic and Prairie regions appears to be relatively insensitive to changing labour conditions, although almost certainly for different reasons. If unemployment does increase, some cyclical decline in participation can be expected among males aged 14-19 in the Atlantic provinces but the largest effect in this age group is likely to be felt in Quebec where, if past relationships hold, a fall of over 4 percentage points in the proportion of teenage males working or seeking

work could be expected. This would be in addition to the long run trend decline in participation by this age group which in the past has been particularly strong in Quebec.

What this summary has shown so far is that while there is good evidence that labour force participation in Canada is cyclically sensitive to changing labour market conditions, only when the demand for labour departs quite markedly from the average, and also remains for some time in a state of excess or deficient demand, does the effect manifest itself in numerically significant terms. Such was the position in the years 1958 to 1962 and the indications are that until a similar recessionary situation occurs again (with recorded unemployment rising to a rate of 7 per cent and remaining at that level for two or three years) cyclical variation in labour force participation will not be a strong factor influencing the level of labour supply in Canada.

Finally in this summary the various trends in participation rates which have been observed within the regions are combined so as to arrive at measures which can be compared one with another and against the national average. It would, of course, have been possible to calculate for each region a trend based on the actual aggregate regional participation rates; however, such a measure would necessarily have included the effect of both the level of and changes in the age structures within the region. In other words, the effect of different and changing weighting patterns would have been included. What has been calculated, therefore, are trend participation rates for each region standardised on the age-sex distribution of the total Canadian population in 1968. In this way overall trends can be compared which are free of weighting effects.

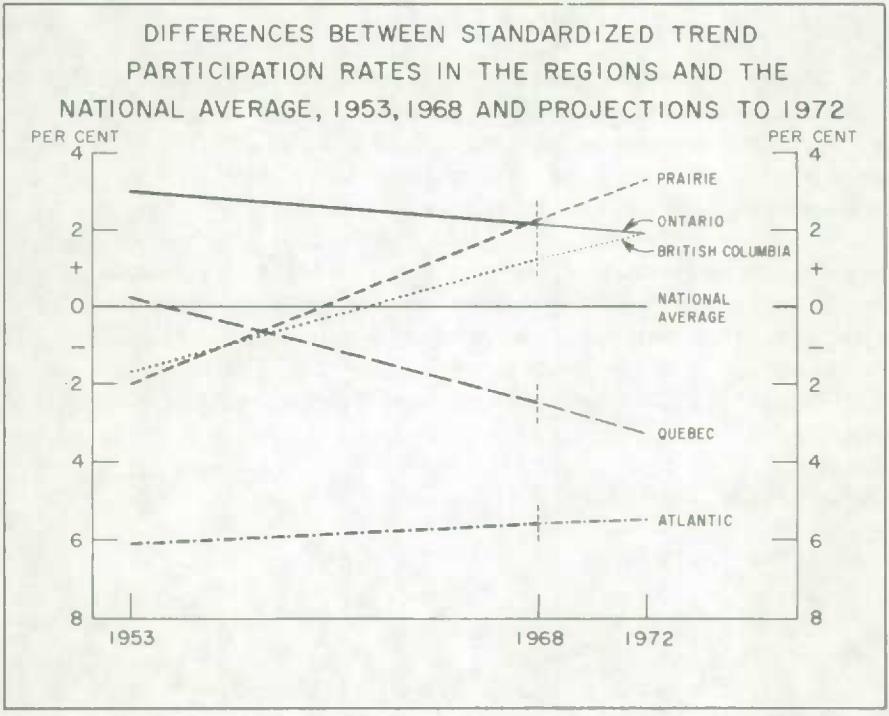
While the age groupings used for this exercise are generally satisfactory there is one exception. The age group of 65 and over will include sub-age-groups, say 65-69, with relatively high participation rates while the rates for persons over 70 will be much lower. The observed participation rates for the 65 and over age group will therefore be influenced to a considerable extent by regional differences in the age structure within this group. This effect cannot be removed by standardising on the Canadian age distribution and for this reason the standardised rates compared below have been calculated only from age-specific rates in the age range 14-64.

In examining the effect of cyclical variations, projections to 1972 were also made given certain assumptions. The same procedure is adopted here in the case of trends. All that is assumed is that past trends based on 1953-68 evidence continue up to 1972. It should be stressed that there is

no particular significance in the year 1972 and to some extent 1973 might have been better so as to give a 20 year comparison. However, the picture that would emerge would be little different from that over the slightly shorter period. Also there is some merit both in not stretching trend projection too far into the future and also in being consistent in time with the cyclical projections made earlier.

On Chart 9 below are plotted the **differences** between the standardised trend participation rates (males and females combined) for each region and the corresponding national average rates for 1953 and 1968 together with the 1972 projections. The overall effect of the trends in different age groups which was alluded to at the end of the previous section can now be clearly seen. In 1953 Ontario had the highest regional participation rate at 3.0 percentage points above the national trend rate. The Quebec rate was then also slightly above the average. In both the Prairies and British Columbia the rate was close to 2 percentage points lower while in the Atlantic Region the trend level of lahour force activity was over 6 points off the national rate and over 9 points less than in Ontario. By

CHART – 9



1968 the picture had changed considerably. Labour force participation in the western regions had risen relative to the national average, to a point where both could be regarded as high participation regions at over one per cent (British Columbia) and over two per cent (Prairies) above the national rate. In contrast, participation in Quebec had declined to a point where in 1968 it was two and a half percentage points below the trend rate for Canada. For the two regions which were at the extreme ends of the participation range in 1953, the relative advantage in the case of Ontario and disadvantage in the Atlantic Region appears to have moderated – in the case of Ontario to a point where it was slightly below that of the Prairie Region.

If these trends continue to 1972 the polarization of the country into two groups – Ontario and the west with high labour force participation rates and Quebec and the east with low rates – will become more marked. By then the Prairie Region may well have a standardised trend participation rate 3.5 percentage points above the trend rate for Canada as a whole, and British Columbia may have caught up with Ontario at some two points higher than the national average. On the other hand, labour force participation in Quebec could by then be between 3 and 3.5 points below the projected Canadian level and only 2 percentage points above the rate for the Atlantic Region.

In interpreting these trends it will be recognized that high participation rates are not necessarily a reflection of strong economic growth (see page 61 above). Nor would one wish to minimize the desirability of declining participation on the part of young persons seeking further education and older workers able to enjoy an earlier retirement. But a high participation rate – in total terms – is a good indication of successful adjustment between population and economic opportunity and is likely to be associated with greater production and higher income. In the Canadian context, the above-noted trends in participation rates appear very closely associated with persistent spacial inequalities in job opportunities, together with economic and social barriers to inter-regional mobility. This kind of polarization, dividing the country both economically and politically, is obviously undesirable.

APPENDICES

APPENDIX A

MONTHLY LABOUR FORCE SURVEY

The purpose of this appendix note is to draw attention to certain features of the design of the Monthly Lahour Force Survey which have a direct bearing on the use of data for time series analysis. In order to do this it is first necessary to describe in some detail the method by which the units (households) are selected for inclusion in the sample and the way in which households are rotated into and out of the sample. The following are two short sections from the Canadian Labour Force Survey[46] which cover these topics.

Design and Selection of Sampling Units

Basic Design

The Labour Force Survey is a multi-stage probability sample of the civilian, non-institutional population of age 14 and over of Canada excluding the Northwest Territories and Yukon. The survey is comprised of two distinct parts: non-self-representing units and self-representing units.

Non-self-representing Units

The non-self-representing units are the areas lying outside the self-representing units. Due to the relatively low density of population in these areas and consequently the increased distances involved in travelling, the non-self-representing units are sampled in four stages. The first stage unit is called the primary sampling unit—(p.s.u.). It consists of contiguous rural enumeration areas and reasonably nearby urban areas associated with them. Its size varies from province to province depending upon the density of population, but within a province the size is fairly constant. In contrast to the self-representing areas, enumeration is conducted only in a sample of the primary sampling units. Each primary sampling unit in the sample represents several other primary sampling units in the population; hence the name of "non-self-representing units." Each primary sampling unit is divided into second stage units called segments which are made up of one or more enumeration areas. The area was assigned to a single enumerator during the 1961 Census of Canada and is the smallest area for which census data are available. Consequently, the first and the second stages

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[46] Dominion Bureau of Statistics, *Canadian Labour Force Survey: Methodology*, Sampling and Survey Research Staff, Ottawa, 1965.

of selection are made on the basis of census data, while the subsequent stages of selection are based on current field counts and listings. The selected segments are divided into third stage units called clusters. Clusters are well defined areas with boundaries identifiable on maps as well as in the field. They usually contain four or five households. Clusters are formed by sub-dividing selected segments on the basis of a current field count of households. The fourth and the final stage unit is of course the household.

Self-representing Units

The self-representing units are cities whose population exceeds 15,000 persons or whose unique characteristics demand their establishment as self-representing units. All of these cities are sub-sampled directly and so each is represented in the survey by a sub-sample of its own population; hence the name "self-representing."

The larger self-representing areas are divided into sub-units which in turn are self-representing (i.e. directly sub-sampled). For administrative purposes, the sub-units are referred to as primary sampling units, although this is not strictly consistent with sample terminology. The sub-units are further sub-divided into segments, which are areas with well defined boundaries and consist normally of a city block. The segment is the first stage of selection within sub-units of self-representing units, the second and the final stage being the household.

The purpose of a multi-stage sample, as described above, is to concentrate the entire sample in a relatively few selected areas such as primary sampling units, in a few segments within selected primary sampling units, etc. The effect of such concentration of the sample is a reduction in the travel cost which would otherwise be excessive. Since each selected primary sampling unit represents several other primary sampling units, it is essential that the socio-economic characteristics of similar groups of primary sampling units not in the sample are represented by selected primary sampling units of the same kind.

Rotation of the Sample

Rotation of the sample is a complete or partial replacement of the sample unit. It is conducted in a systematic way every month at certain defined intervals. The rotation of the sample must be such that every month the sample is a probability sample of the population

covered by the survey. The main purpose of rotation is to relieve survey respondents from the burden of reporting after six months in the survey. It is quite possible that if the same respondents were asked to provide information month after month it might substantially increase the refusal rate thus reducing the efficiency of the sample. Furthermore, through rotation of the sample information is accumulated from additional households each month. This may be utilized to reduce the sampling error through the application of a procedure known as "composite estimation."

Non-self-representing Units

When selected segments have been clustered, they are numbered in a serpentine way starting with 01, 02, 03, etc. All these clusters are listed by "size" (number of households contained within the clusters). The clusters are systematically divided into as many samples as is indicated by the denominator of the segment sub-sampling ratio. For example, if the segment sub-sampling ratio is $\frac{1}{4}$, then each month one-fourth of the clusters in that segment are to be in the sample. Thus there are four different samples of clusters in that segment. One sample of clusters is selected and the households within these clusters are enumerated for six consecutive months, then the clusters are replaced by the next sample of clusters which remain in the sample for six months, etc. It is clear that the households in a particular segment always rotate in the same two months of the year, which are six months apart. Thus the segment belongs to one of six rotation groups (1, 2, 3, 4, 5, or 6). These numbers specify the months in which the households in the segments, belonging to these groups, rotate, e.g. group 1 rotates in January and July, group 2 rotates in February and August, etc. In constructing the six rotation groups, the sampled segments have been distributed in such a way that each group of segments rotating at the same time provides a representative sub-sample of all the sampled segments within a province. Thus, each of the six rotation groups constitutes a sub-sample of approximately 1/6 of both the urban and the rural population. Eventually, all the households in the segment will be enumerated and in this case it is said that the segment is exhausted. When a segment is exhausted it is replaced by another segment from the same primary sampling unit. The segment group number not only specifies the month for the rotation of households within a segment, but also in conjunction with the sampling ratio provides the date for the replacement of exhausted segments. It is seen from the foregoing description that in the rotation process households are replaced every six months but the segments within a primary sampling unit are replaced at a much slower rate (about 2 years).

Self-representing Units

As in the non-self-representing unit, segments in the self-representing units are assigned to either group 1, 2, 3, 4, 5 or 6. These group numbers, like the group numbers for segments in the non-self-representing unit, specify the months in which the households within the segments or segments themselves rotate. The selected households within each segment remain in the sample for six consecutive months and after that period they are replaced by a group of households from the same segment. When all the households within a segment have been enumerated six times, the segment is considered exhausted and it must be replaced by the next segment on the list from the same sub-unit and with the same group number.

. . . . . .

The fact that the sample is rotated in the way described above means that of the households interviewed in any month, say January, five-sixths will remain in the sample in February, two-thirds in March, a half in April and so on. Not until July would the sample be free of all households interviewed in January. If this were the only kind of rotation then, while it would be expected that the sampling errors of estimates two months apart would be highly correlated, this correlation would be progressively reduced as the interval between observations increased until it would disappear with intervals of six months or more. But because when a household is replaced after six months its replacement is drawn from a new cluster within the same segment some correlation between the characteristics of households rotated out and those rotated in would also be expected. The serial correlation generated in this way will therefore be superimposed on that caused by the inclusion of households for a six month period. As indicated above this rotation within segments will last until the segment is exhausted and replaced by a new segment after about two years.

Rotation of households and of clusters is common to both the self-representing and non-self-representing units in the sample. However, for the non-self-representing units an additional source of serial correlation is present. It may be recalled that a primary sampling unit, P.S.U., is selected from within a non-self-representing area to represent the whole of this area. Thus a small rural community might be selected to represent a number of such communities in the same area. But after some time this P.S.U. will also become exhausted; in other words all the households in the P.S.U. will have been sampled. In the old survey design which was in operation until 1963, or for the first eleven years of the period examined in this study, P.S.U.'s became exhausted, on average after about four

years and were then replaced. This means that for the non-self-representing units three sources of serial correlation were present in the old design compared with only two in the case of self-representing units.

The importance of this difference is that prior to 1963 as much as 75 per cent of the total sampling error of estimates from the survey could be attributed to the greater heterogeneity of the population in these non-self-representing areas even though they comprise only about one-third of the population.

As a result of the redesign of the Survey in 1963 the sampling variation attributable to the non-self-representing areas was reduced considerably and this was a major factor reducing the total sampling error of the estimates. Also with the new design no rotation of P.S.U.'s within the non-self-representing areas was necessary during the period examined in the study, thus removing this source of serial correlation from estimates for the period after 1963.

While no complete study has been made to quantity the full extent of serial correlation in estimates from either the old or new design so that it could not be explicitly taken into account in the estimating procedure, this appendix has shown that there is at least good cause why some *ex post* consideration should be given to the possible influence that serial correlation may have had on the results and this is done in Appendix B.

APPENDIX B

THE REGRESSION RESULTS AND THE QUALITY OF THE DATA – A CRITICAL EXAMINATION

This appendix is an examination of the results for Canada based on the analysis of monthly data, which were discussed on page 36 ff in the light of the known statistical properties of series generated by the Monthly Labour Force Survey. As suggested earlier a full consideration of the question would have imposed prior conditions on the model and on the estimating procedure in particular. However, because only limited information is available, it is doubtful whether many of the theoretical problems introduced by the use of such survey data could have been satisfactorily resolved. For this reason a frankly empirical approach of *ex post* consideration has been adopted.

With the exception of some work by Kaliski,[47] this is a subject which has received little attention in the literature, but it is one which becomes progressively more important as the data are used to gain an ever increasing insight into the operations of the labour market. It is hoped that future researchers may be stimulated to look into the topic in greater detail. The approach employed here is premised on the assumption that if the variance estimated from the observed series is significantly larger than the sample variance then this could be regarded as evidence that additional explainable variation is present in the series. It should be pointed out, however, that the alternative situation does not necessarily mean that no additional variation is present. This is because the observed series is in effect only one sample of all possible series that could have been generated and that the sampling "noise" in observed series may well have been less than expected.

In order to proceed it is necessary to make two other initial assumptions. The first is that the sampling variance of a seasonally adjusted series is close to that of the original observations, and the second is that variation in the observations over time has three components, sampling variation, non-sampling variation, and a linear time trend effect. Given these assumptions the trend effect can be removed from the seasonally adjusted series, such that the variance calculated from the residuals from this trend will comprise the effect of the remaining two sources of variation. Variances obtained in this way for ten age-sex groups are compared with those estimated directly from the sample in Table B.1.

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[47] Kaliski, *op. cit.*

Because the survey design has changed over the period and because the sample variances are not independent of the size of the estimate, which has also varied, two sampling variances are given. One based on the old, pre-1964, design using 1958 participation rates and one based on the new design with 1968 participation rates. But because the majority of observations (11 out of 16 years) relate to a period prior to 1964, the observed variances should be compared more against the variance estimated from the old sample design rather than from the new one.

While the data contain too many departures from the conditions required to perform a variance ratio test it can be seen that for the age group 65 and over, for both males and females, the variances of the detrended observations are very close to the sampling variance in the old survey design. For four other age groups they were less than twice as large so that only in four of the ten series were the observed variances more than twice as large as that expected from sampling reasons only.

TABLE B 1. Variance Estimates of Labour Force Participation Rates

Age-sex groups	Sample variances		Variance of detrended observations Jan. 1953 to Dec. 1968
	Old design	New design	
Males			
14 - 19 years	0.90	0.40	3.17
20 - 24 "	0.38	0.33	0.93
25 - 44 "	0.02	0.02	0.07
45 - 64 "	0.14	0.08	0.22
65 years and over	0.97	0.53	0.96
Females			
14 - 19 years	0.81	0.38	1.04
20 - 24 "	1.22	0.60	3.27
25 - 44 "	0.23	0.19	0.38
45 - 64 "	0.36	0.25	0.45
65 years and over	0.21	0.14	0.20

While these comparisons are clearly inconclusive in a general sense they do point to the fact that much of the observed variation about the trend may be attributable to sampling variation. And for the over 65 age groups the earlier results (see Table 2 on page 37) must be regarded as suspect on the grounds that while one or both of the demand coefficients

were significant by the standard test, the variances of the estimates were lower than those which were expected to be present in the original observations.

There are a number of weaknesses in the approach employed above. The variances of the detrended series will include the effect of any serial correlation in the original series, while the sample estimates refer to a point in time. Moreover the process by which the trend line was obtained was that of "least-squares" which by definition minimized the variance of the residuals. In order to remove the effect of serial correlation and to avoid the necessity of having to estimate the trend from the observed series, variances were calculated for each series after taking first differences. The results together with the variances of first differences estimated from the survey are given in Table B.2. These show that, with the exception of males aged 14 - 19, the variances of the observed month to month changes are not noticeably higher and in some cases are considerably lower than the corresponding sample variances. In the light of this it was not surprising to find that only for one age-sex group was a demand coefficient significant when a regression equation was fitted to first differences of the observations. However it is almost certain that, by taking first differences, the autoregressiveness introduced into the series by the survey design has been over corrected for. Such a procedure implies that the month to month relationship follows a simple Markov scheme in which $\rho = 1$. This condition

TABLE B 2. Variance Estimates of First Differences of Monthly Labour Force Participation Rates

Age-sex groups	Sample variances		Variances of 191 first differences Feb. 1953 to Dec. 1968
	Old design	New design	
Males			
14 - 19 years	0.45	0.24	0.84
20 - 24 "	0.19	0.20	0.24
25 - 44 "	0.01	0.01	0.02
45 - 64 "	0.07	0.05	0.06
65 years and over	0.48	0.32	0.26
Females			
14 - 19 years	0.41	0.22	0.45
20 - 24 "	0.61	0.36	0.34
25 - 44 "	0.11	0.11	0.13
45 - 64 "	0.18	0.15	0.14
65 years and over	0.10	0.08	0.08

does not hold. Also it is not impossible that some of the results given in Table 5 might have arisen from a series in which a significant cyclical response was superimposed on an underlying autoregressive structure. It is for these reasons that a model in first differences was not used to test the hypotheses examined in the study. It has been included here only to illustrate both some of the problems encountered in the use of data generated by the Monthly Labour Force Survey and to gain further insight into the interpretation of the results actually obtained.

So far in this discussion the only type of disturbance in the series introduced by the survey design that has been considered is the sampling variation in a single month's estimate, together with some allowance that month to month observations are also correlated. We now turn to an examination of the point made above that significant cyclical response may be superimposed on an underlying autoregressive structure. To undertake a complete examination of this kind presupposes that a quantitative knowledge of the autoregressive system generated by the survey design exists such that it could be removed from the series. But this is not the case. Only certain aspects of the system are known in a general sense. It has been estimated, for example, that over a twelve month period the average correlation between errors in the estimates of labour force participation rates one month apart is of the order of +0.7 for the new survey design and perhaps as high as +0.8 under the old design. While some calculations have been made of the correlations between observations more than one month apart, no precise estimates are available which take into account variations over a year. However it is thought that because of the special features of the survey design the average correlation falls by above 0.05 a month as the time difference between observations increases from one month to six months. After remaining relatively stable for a number of months it then gradually declines. While it is not impossible that the correlation between lagged observations may at times drop below zero, the plot of the autocorrelation coefficients (correlogram) would in general be asymptotic to zero.

This then is the general picture. The "true" shape of the correlogram for different age-sex groups will undoubtedly depart from the average pattern and with the further inclusion of a regional dimension even greater variation would be expected. No adequate prior knowledge of the expected autoregressive structure of estimates of labour force participation rates for age-sex groups is available to permit a direct comparison with the observed serial correlations. However the fact that it is known to exist means that if demand induced cyclical variation is also present then, as suggested earlier, the autoregressiveness in the original series will contain

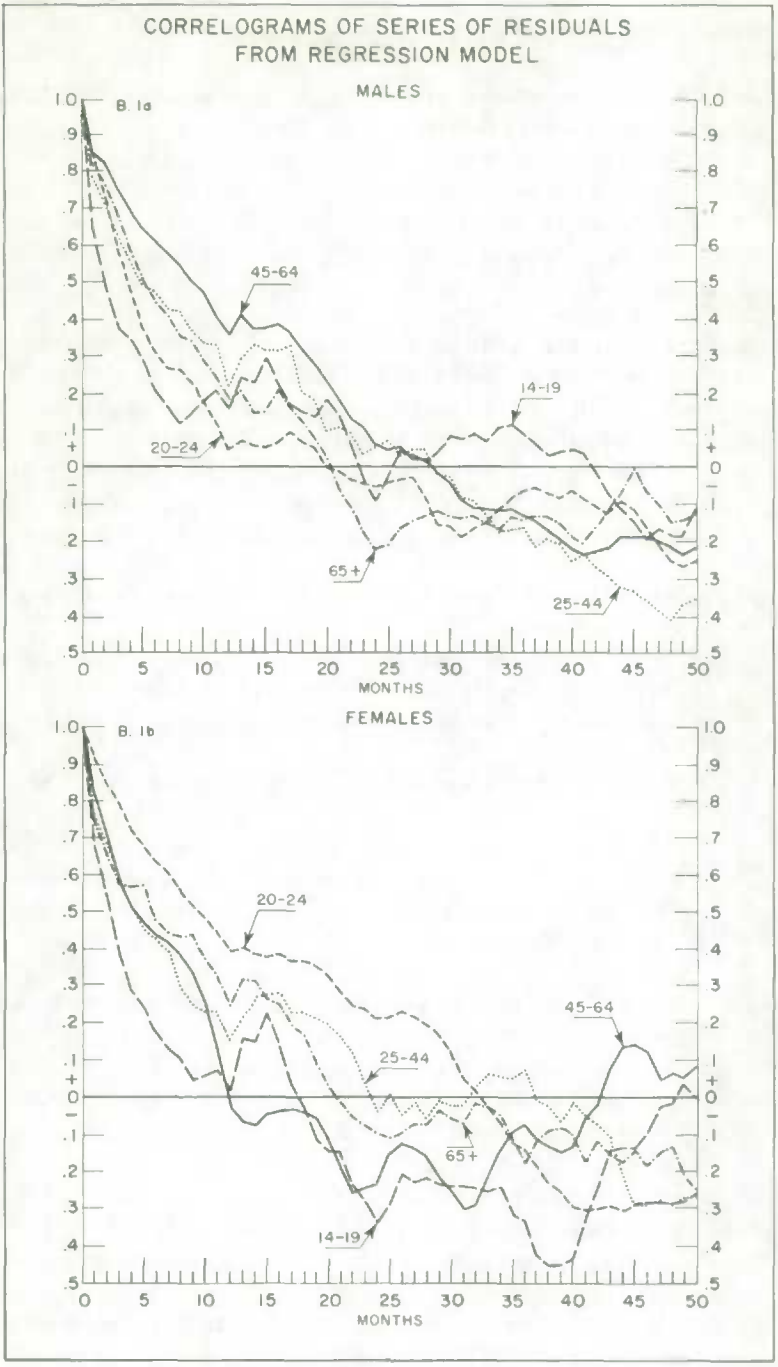
two components – that generated by the sample design and that due to the cyclical variation. Now if the model that has been put forward to explain the demand induced cyclical component has in fact done no more than this then the correlogram of the residuals estimated from the model should at least have some of the general characteristics of the expected correlogram described above – even allowing for uncertainty about the magnitudes of the autocorrelations for different age-sex groups. In addition if there is some cyclical component not picked up by the model then evidence of this might also be observed.

Serial correlations of the series of residuals from the full regression model have been calculated, up to a lag of fifty months, for each of six series (total and five age groups) for males and females separately. These are plotted on charts B.1a and B.1b. Also calculated were the corresponding serial correlations of the original series with only the time trend removed. These are not plotted but in each case where the regression model gave evidence of a significant cyclical response – all series except males 45-64 – the low order serial correlations of the detrended series were appreciably higher.

Turning now to the charts it can be seen that with a lag of one month the serial correlations vary from a low of about 0.65 to a high of over 0.9. These are of course in agreement with the Durbin-Watson statistics given in Table 2 on page 37. Lagged 12 months, the correlations fall to within the range of zero to over 0.4. While, as has been mentioned, there is no way of knowing whether these observed correlograms are significantly different from the "true" correlograms the picture that emerges is one which is not inconsistent with the generally expected pattern, at least for low order lags.

From the point of view of the interpretation of the regression results this is encouraging since there is good reason to believe that those results did not arise out of a spurious relationship between the time path of the explanatory variables and the autoregressiveness in the series introduced by the survey design. In fact, from the longer run picture, there is evidence that for some series additional variation is still present. For females aged 14-19 the high negative serial correlation observed with a lag of about three years suggests that cyclical variation in the series of residuals is present that might have been captured with an improved model. Similarly for females aged 20-24, the high positive serial correlations in the series for lags of even up to two years and more suggest that for this age group also the model has not captured all of the explainable variation.

CHARTS — B. 1a and B. 1b



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