Estimation of Female Labour Force Participation

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ABSTRACT

The objective of this paper is to examine the predictive capacity of recent econometric models of female labour force participation in Canada. The studies examined, which include most of the time-series models, focus upon the cyclical sensitivity of participation to labour market and economic conditions. The general approach in these time-series analyses has been to relate short-term variations in participation rates to the behaviour of variables representing cyclical change in labour demand, such as an unemployment rate. The results of tests on four econometric models raise serious questions about this approach, however. While these models explain much of the variation in female participation during most of the post-war period, they completely fail to predict age-specific female participation over the 1968-1973 period.

There are important implications for several issues of public policy in the results. Attempts to assess both the importance of hidden unemployment and the impact of recent changes in the unemployment insurance program require a good knowledge of the determinants of female labour force participation decisions. The results suggest that we do not currently possess this knowledge.

Resumé

L'objectif de cet exposé est d'évaluer la qualité de prévisions obtenues à l'aide de modèles économétriques développés récemment pour estimer les taux d'activité de la main-d'oeuvre féminine au Canada. Les études en question, comprenant la plupart des modèles basés sur des séries temporelles, sont axées sur la variabilité cyclique des taux d'activité par rapport au marché du travail et aux conditions économiques en général. L'approche suivie dans l'élaboration de ces analyses de séries temporelles consiste à postuler une relation entre les variations à court terme dans les taux d'activité et le comportement de variables telles le taux de chomâge ou le taux d'emploi, représentant les variations cycliques dans la demande de main-d'oeuvre. Mais, en général, les résultats de tests effectués sur ces quatres modèles économétriques nous portent à croire que cette approche est tout à fait inadéquate. Quoique ces modèles parviennent à expliquer une grande part de la variation dans les taux d'activité de la main-d'oeuvre féminine durant la période d'après guerre, ils ne peuvent fournir des prévisions adéquates de ces même taux d'activité par groupes d'âge pour la période allant de 1968 à 1973.

Les résultats nous portent à formuler certaines suggestions importantes au sujet de plusieurs questions de politique économique et sociale. Afin d'évaluer l'importance du chomâge dû aux effets des

"travailleurs d'appoint" et des "retraits cycliques" et l'impact des changements récents à la loi régissant le programme d'assurance chômage, nous devons posséder une très bonne connaissance des facteurs déterminant, chez la main-d'oeuvre féminine, les décisions de participer au marché du travail. Les résultats suggèrent que, présentement, nous sommes loin de posséder les connaissances requises.

PREFACE

This thesis was prepared under the guidance of Professor Lee Soderstrom. I am sincerely grateful for his encouragement, guidance and enduring patience. I also appreciate the assistance given by the Department of Manpower and Immigration who sponsored my academic leave at McGill University. To my colleague, J.P. Moisan, a special thanks for his help in assembling data and clarifying material published in the French language. Any errors which remain in the paper are, of course, mine.

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CHAPTER 1

OBJECTIVES AND SUMMARY RESULTS

The objective of this paper is to examine the predictive capacity of recent econometric models of female labour force participation in Canada. The studies examined, which include most of the time-series models, focus upon the cyclical sensitivity of participation to labour market and economic conditions. The general approach in these time-series analyses has been to relate short-term variations in participation rates to the behaviour of variables representing cyclical change in labour demand, such as an unemployment rate or an employment rate. A time trend or another variable representing secular changes in economic and social conditions has frequently been used to account for the long-term trend in participation rates. The results of tests on four econometric models raise serious questions about this approach, however. While these models explain much of the variation in female participation during most of the post-war period, they completely fail to predict age-specific female participation over the 1968-1973 period.

It is not the object of this thesis to explain why the models examined fail to pass predictive tests. There are a variety of possible explanations. For example, the models may never have reflected behavioural relationships or the behavioural relationship may have altered during the late 1960's. The results of the tests conducted on these models do suggest that more attention must be given to the role of other determinants of female labour force participation.

There are important implications for several issues of public policy in the results. Attempts to assess both the importance of hidden unemployment and the impact of recent changes in the unemployment insurance program require a good knowledge of the determinants of female labour force participation decisions. The results suggest that we do not currently possess this knowledge.

The studies examined include time-series analyses authored by Officer and Andersen[1/], Proulx[2/], and the staff of the Bank of Canada's RDX2 model[3/]. The early time-series study of U.S. participation rates by Arthur Tella[4/] is re-estimated using Canadian data. The wide application of this model in the U.S. provides ample justification for an evaluation of its performance using Canadian data. Equations for female participation are examined to the exclusion of those for males, except in the case of the RDX2 equation which deals with total participation. The rationale for choosing females as the primary subject of study lies in the fact that most studies reviewed indicate greater sensitivity of female participation to variations in labour market conditions.

The purpose in conducting a study of this nature has been well stated by Jorgensen, Hunter and Nadiri in their examination of models of investment behaviour in the U.S.

"Only systematic comparisons among available alternatives can lead to accumulation of knowledge on the basis of the performance in empirical research. In the absence of such comparisons, economic research will continue to be characterized by a proliferation of still

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1/ Bibliography item number (20)
2/ Bibliography item number (22)
3/ Bibliography item number (1)
4/ Bibliography item number (25)

further alternatives, with no means of discrimination between explanations that are inferior to those already available and those that represent a genuine advance..."5/

Thus the rationale for evaluating the performance of econometric models is that this procedure is essential to providing a basis for further empirical research. In this regard,time-series models of labour force participation, in which heavy reliance has been placed on the explanatory powers of cyclical variables, deserve a systematic evaluation of their predictive performance.

The body of the paper begins with an overview of the theory of cyclical labour force participation behaviour and its applications in participation rate models. Chapter 3 describes and briefly analyses the models of participation examined in this paper, with particular reference to the cyclical variables used to explain female participation rates. Chapter 4 describes the methodology used to appraise the performance of the models, while Chapter 5 presents the results of testing the predictive performance of the models. Chapter 6 concludes that the models examined do not help us to understand the recent behaviour of female labour force participation and that at least part of the failure of these models is due to the stress laid on cyclical explanatory variables.

5/ Jorgensen, D.W. Gerald Hunter and M. Ishag Nadiri, "A Comparison of Alternative Econometric Models of Quarterly Investment Behaviour". Econometrica Vol. 38, No. 2, March 1970, p. 188.

CHAPTER 2

OVERVIEW OF THE LITERATURE

During the past ten years, considerable research in labour economics has been devoted to the study of labour force participation. The focus of this research has been on the determinants of cyclical variation in labour force participation; many attempts have been made to quantify the relationship between participation rates and cyclical variables using regression analysis. The research itself can be divided into two groups - that using cross-sectional analysis and that using time-series analysis. In the case of cross-sectional analysis, the general procedure has been to examine the labour force participation of different individuals or groups of individuals with regard to particular economic, social or demographic characteristics which apply to them at a point in time. In the case of time-series analysis the procedure has been to relate the participation of various demographic groups to a particular set of determinants which varies over time. The focus of this paper is on the latter type of analysis.

The objective of isolating the main determinants of participation and quantifying their effects is basically to lend some refinement to estimating the size of the labour force, given data on the size and demographic structure of the population. This is important from the standpoint of short-term forecasting and policy formulation where an accurate forecast of the size of the labour force is critical to estimating unemployment levels.

The question of how the participation rate behaves in relation to cyclical changes in the level of economic activity was first raised by Woytinsky[6/]. He argued that the increase in unemployment among household heads during the 1930's resulted in the labour force being swelled by family members seeking jobs in order to restore the income level of the household. The postulated phenomena became known as the "additional worker" hypothesis and has, as its result, an increased labour force and a relative overstatement of unemployment during periods of depressed economic activity. This hypothesis of an inverse relationship between the level of economic activity and the size of the labour force was countered by the "discouraged worker" hypothesis which states that the participation rate or size of the labour force is directly related to the level of economic activity. The discouraged worker hypothesis argues that during periods of depressed economic activity the probability of finding employment is reduced by both a decline in the number of jobs available and an increase in the number of unemployed persons seeking jobs. Thus, not only will persons fail to enter the labour market in search of jobs but some of those in the labour force who become unemployed will actually withdraw, discouraged by the poor employment possibilities. The result in this case is a decline in the size of the labour force and a relative understatement of the unemployment problem.

6/ Woytinsky, W.S., Three Aspects of Labor Dynamics, (Washington: Social Science Research Council, 1940).

In appealing to neoclassical price theory for the rationale of the additional worker and discouraged worker hypotheses, Jacob Mincer 7/ established the framework for the empirical analysis of short-term variation in participation rates. Using the household as the relevant unit of analysis, Mincer argues that if unemployment reduces the income level of a household, the "income effect" (additional worker effect) of traditional price theory motivates family members to reallocate their collective time toward additional labour force participation and away from leisure and non- market activities such as housework and education. However, to the extent that a higher unemployment rate reflects a decline in wages, the "substitution effect" (discouraged worker effect) acts to reduce the number of labour market participants in the household.

Mincer's framework for empirical analysis takes the following form: 8/

$$M = a + b_1 Y + b_2 W + c_1 y_1 + c_2 w_1 + e$$

Where M = labour force participation rate

Y and W = long-run levels of family income and wage rates, respectively

y_1, w_1 = short-run deviations in family income and wages from "normal", "full employment" levels.

e = other variables which influence participation.

7/ Jacob Mincer "Labour Force Participation of Married Women: A Study of Labour Supply", National Bureau of Economic Research, Aspects of Labour Economics, Princeton University Press, Princeton, 1962, pp. 63-97.

8/ Jacob Mincer, "Labour-Force Participation and Unemployment: A Review of Recent Evidence" in Conference on Unemployment & the American Economy, 3d, N.Y. 1965, edited by R.A. Gordon & M.S. Gordon, N.Y., Wiley, 1966, as Prosperity and Unemployment.

According to traditional price theory the sign of b_1 is expected to be negative, reflecting the "income effect", (supply declines with higher income levels), b_2, positive, reflecting the "substitution effect" (supply is increased by higher wages), c_1, negative, the short-run additional worker or income effect and c_2, positive, the short-run discouraged worker or substitution effect. Since both y_1 and w_1 are difficult to observe, they are subsumed under a relevant unemployment rate with which they are both assumed to be negatively related. Thus, the net effect of the short-run additional and discouraged worker behaviour is shown by the sign on the unemployment rate variable in an equation.

While Mincer's framework is applicable to cross-section analysis of groups it has been altered when applied to time-series analysis of cyclical changes in participation. The variables Y and W as well as host of other "long-run" factors are generally relegated to a time trend or other variable demonstrating a secular trend. It has been customary in time-series analysis to use an unemployment rate or an employment variable to capture the effect on the participation rate of short-run or cyclical variation in labour market conditions.

The causal relationship between the participation rate and the unemployment rate has been restated by Bowen and Finegan[9/]. They argue that the unemployment rate is more than just as a proxy for short-run variations in household income and expected wage rates. It is a measure in its own right of the benefits to be expected from job search. Since job search

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9/ Bowen, W.G. and T.A. Finegan, "Discussion" Conference on Unemployment and the American Economy, 3d, N.Y., 1965, edited by R.A. Gordon and M.S. Gordon, N.Y., Wiley, 1966 as Prosperity and Unemployment, p. 118.

generally has monetary as well as opportunity costs associated with it, a high rate of unemployment may well make investment in job search a bad gamble. This results in prospective entrants failing to enter the labour force and some among the unemployed actually withdrawing from job search and the labour force. The "job search" analysis of variations in participation seems particularly appropriate for the U.S. experience with female participation. The overwhelming evidence from both cross-section and time-series studies in the U.S. indicates a net discouraged worker effect among women, consistent with the notion that higher unemployment reflects poor employment prospects.

A rash of studies published in the 1960's and climaxed by the epic work of Bowen and Finegan provides evidence that relatively greater sensitivity of participation to employment conditions exists among the "secondary labour force", including women as a whole and the extreme age groups of both sexes.[10/] While differences exist between the estimates of the discouraged worker effect from cross-section analyses and those from time series analyses, the larger discouraged worker effect indicated by cross-section analyses using geographic areas has been explained to the satisfaction of most students of the subject. In using an area labour market as the unit of cross-section analysis, the employment possibilities in that area may represent a long-term condition rather than a short-term labour market situation. Moreover, the propensity for participation of the population group in an area may have itself been altered through migration in response to the longterm local employment conditions. In comparing cross-section results with those of time-series analysis, Bowen and Finegan make the observation that in time series analysis of participation the magnitude of the net discouraged -

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10/ Bowen, W.G. and T.A. Finegan, The Economics of Labour Force Participation, Princeton, Princeton University Press, 1969.

additional worker effect depends critically on both the independent variable used to represent the demand for labour as well as the period of estimation chosen for the study[11].

The evidence presented in studies of Canadian participation rates leans, on the whole, toward conclusions opposite to those for women in the U.S. labour market. The additional worker effect appears to dominate among women in Canada, although for some age groups the discouraged worker effect appears to be present.

The reasons for the apparent difference between U.S. and Canadian findings have not been well documented. Conjectures have been made that lower levels of income in Canada necessitate greater continuity in the income stream of the household thus pushing the wife or other family member into the labour market when unemployment strikes the main breadwinner. Another conjecture is that since recessionary periods in Canada have tended to be longer than in the U.S., "temporary" falls in income in Canada tend to last longer, providing greater impetus for additional workers to enter the labour market[12]. Moreover, the higher level of female participation in the U.S. reduces the scope for additional workers and increases the scope for the discouraged worker effect[13]. Since the results presented here cast doubt on the reliability of the Canadian models an explanation of the differences between the results of U.S. and Canadian models may be irrelevant.

11/ Op.cit. pp. 511-515.

12/ Proulx, P.P., La variabilité cyclique des taux de participation à la main-d'oeuvre au Canada, C.J.E., II, No.2 (May, 1969) pp. 276-277.

13/ This restriction on the scope for the additional worker effect in the U.S may be complemented by a lower propensity for participation among those not in the labour force.

CHAPTER 3

FOUR MODELS OF LABOUR FORCE PARTICIPATION IN CANADA

This chapter provides a brief description and analysis of the models examined in this study. These models illustrate the manner in which the theory of cyclical movements in participation has been applied in empirical analyses. In all four models the cyclical variables are the key variables for explaining participation. The models are described in order of increasing complexity.

(I) TELLA

The framework of Tella's model in which seasonally adjusted U.S. labour force data was used, is

$$\frac{(L + A)}{(P)}_t = a + b_1 \frac{(E + A)}{(P)}_{(t-1)} + b_2 (\log T)_t$$

where L, A, E and P are the labour force, number of armed forces personnel, employment and population in a particular age-sex group. T is a time trend beginning with 100 and increasing by 1 for each observation on the other variables.

The coefficient b_1 on the cyclical variable $\frac{(E + A)}{(P)}$ measures the sensitivity of the participation rate for a particular age-sex group to changes in the employment conditions of the group. It is a measure of the net outcome of the discouraged and additional worker effects operating within a group when their employment conditions change. If the sign on b_1 is positive, the discouraged worker effect is dominant; if negative, then the additional worker effect is dominant. The armed forces are included in the $\frac{(E + A)}{(P)}$ and $\frac{(L + A)}{(P)}$ variables to avoid distortions in the dependent variable during and after the Korean War which falls in Tella's estimation period, 1947.4-1962.2. It was assumed that in the absence of the war, the additional people in the armed forces would have obtained civilian employment.

The variable $\frac{(E + A)}{(P)}$ is lagged one period to reduce bias in the coefficient b_1[14/]. This bias can arise out of the fact that the labour force, L, is arrived at as the sum of the estimates of employment, E, plus unemployment, U, collected from the U.S. Census of Population. Any sampling or response errors in the estimate of E for a particular period will, therefore, be contained in the estimate of L for that period. An equation relating L to E, using coincident observations may therefore have a biased coefficient on the variable containing E. Moreover, an equation of that sort would not be strongly identified because of the fact that the estimate of L is dependent upon the estimate of E.

It is difficult to judge whether an estimated relationship between variations in $\frac{(L + A)}{(P)}$ and $\frac{(E + A)}{(P)}$ involves a tautology or a causal relationship, even when $\frac{(E + A)}{(P)}$ is lagged one quarter. Since estimates of both L and E from quarter to quarter are likely to be serially related, lagging the $\frac{(E + A)}{(P)}$ variable does little to remove the possibility of a tautological relationship between L and E. The likelihood that Tella's model contains a tautology would seem to be strengthened if it is observed that the relationships between $\frac{(L + A)}{(P)}$ and $\frac{(E + A)}{(P)}$ are unstable with changes in the period of estimation.

14/ In his paper, Proulx (Bibliography Item (22)) shows that there is no way of knowing whether this bias is positive or negative.

The long-term secular movements in participation are captured by the log of T. After having tried a variety of log-linear trend variables with different numerical origins, Tella decided upon the origin of 100 as being the most compatible with the secular movements of participation for all age-sex groups.

Tella's results for the U.S., shown in Table 1, pages 28 and 29, indicate that the discouraged worker effect predominates for all female age groups and increases in strength with increasing age of women. These results imply that the older a woman is, the more marginal is her attachment to the labour force. When the probability of obtaining employment rises (as signified by a rise in the proportion of her age group who obtain employment), the more likely she is to enter the labour market. Conversely, when her employment is lost she is more likely than a younger woman to withdraw from the labour force.

(II) Proulx

The framework for Proulx's study of cyclical variation in annual female participation rates over the 1953-67 period is similar to Tella's, in that he uses an employment demand variable to capture the net of discouraged worker and additional worker effects. The employment demand variable used in a set of equations for women in the age groups 14-19, 20-24 and 45-64 is the index of excess demand, De, calculated by M. Gérald Marion[15/]. The coefficient on this variable measures the effect

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15/ Marion G., "La demande excédentaire de travail et la variation des salaires dans l'industrie manufacturière au Canada", Canadian Journal of Economics I, 3 (August, 1968). An outline of the steps used in calculating De is as follows: Using the function in $Et = a + b_1 t + b_2 \ln Q_t + \ln E_{t-1}$ as developed by Ball and St. Cyr, Marion substitutes the appropriate parameters into his equation 10 (p. 525), to obtain, $\ln Et^* = a_1 + b_3 t + b_4 \ln Q_t$ where E = total employment in manufacturing, Q = industrial production, t = time and E* = desired employment. To calculate his index of desired employment, De, the following equation is used:

$$De = (E_t^* - E_t) / (E_t + U_t) + U_t / (E_t + U_t)$$

Where U is the aggregate unemployment rate.

which cyclical variations in the demand for labour have on the participation rate. It is expected to have a positive sign if the discouraged worker effect predominates and a negative sign if the additional worker predominates. In a second equation for women 20-24, Proulx regresses the deviations from trend in their participation rate against the unemployment-population ratio of men 25-44, C/P. The C/P variable represents short-run employment conditions and like De, is an aggregate variable in that it is supposed to capture the net of the discouraged and additional worker effects operating on the participation rate. In the case of the C/P variable, a negative coefficient indicates a predominance of the discouraged worker effect while a positive coefficient indicates the predominance of the additional worker effect.

Proulx's rationale for the use of De and C/P to represent cyclical variations in employment conditions is that they cannot contain the same sampling errors which exist in the dependent variable of the equations 16/. Regressing the participation rate of a group against a variable such as its own employment-population ratio $(\frac{E}{P})i$, may result in a bias in both the coefficient on $(\frac{E}{P})i$ and in the coefficient of determination of the equation. This bias stems from the fact that estimates of E are added to estimates of unemployment, U, to arrive at estimates of L. Therefore, sampling errors in E will be contained in L and will bias estimates of the causal relationship between these two variables. The use of De and C/P as indicators of variations in employment conditions thus avoids the interpretive problems caused by common sampling errors in the dependent and independent variables.

16/ The rationale for estimating two equations for females 20-24, one using De and the other using C/P, as an independent variable is not stated in Proulx's paper - it may have been done to compare results with male age groups where C/P was used as an independent variable.

A time trend, beginning with 0 is used in each of the equations to capture the long-run behaviour of the participation rate. In this way the cyclical variance in the participation rate is isolated from the long-run trend and is picked up by De or C/P.

Proulx's published results are shown as equations (1) , (5), (9) and (13) in Table 2 page 32. Using De as the indicator of short-term employment conditions, a net "discouraged worker" effect is indicated for women 20-24 and a net "additional worker" effect is indicated for women 45-64 and 65 years and over. The interpretation of the results for women 20-24 is that, as labour demand increases, new employment opportunities will tend to increase the flow of entrants to the labour market by more than it increases the outflow of "additional workers" who were seeking employment to restore income levels in the household. For women 45-64 and 65 and over, an increase in overall labour demand apparently leads to more of them leaving the labour market than entering it.

Since the flows both into and out of the labour market occur simultaneously when employment conditions change, it is feasible to capture the magnitude of each of the discouraged and additional worker effects only with the use of two separate variables. The coefficient on a single variable such as De will indicate only the net change in the participation rate and does not indicate the magnitudes of the two effects taking place simultaneously. This is the case also with the coefficient on C/P in the equations for deviations from trend in the participation rate of women 20-24. Here again, the net effect of a decline in labour market conditions, indicated by the negative coefficient on C/P, is to discourage labour force participation.

Proulx's use of annual data to determine the response of labour force participation to cyclical changes in labour market conditions raises some questions. The recessions in the period of estimation used by Proulx lasted little more than five quarters at most and were, in many cases, spread over two calendar years. Thus, not only does the use of annual data neglect the timing of the response in participation rate to labour market conditions, but it may also cloud the degree of response. A change of labour market conditions in the last quarter of one year may not have its effect on labour force participation until the first or perhaps the second quarter of the following year.

(III) Officer and Andersen

Using raw data over the 1950-'67 period, Officer and Andersen relate the quarterly participation rates of each female age group to cyclical as well as long-term determinants. To quote from their study;[17/]

> "Econometric studies of labour force participation have concentrated on the *cyclical* variation in participation. In this study we consider, jointly, the short-and-long-run factors that determine Canadian labour force participation and measure explicitly what others might relegate to a simple trend term."

To measure cyclical change in participation of women over 19 years of age male unemployment variables are used. Numbers of unemployed men separated according to duration of unemployment are expressed either as a fraction of the male labour force or as a fraction of total male unemployment.

17/ Officer, L.H. & Peter R. Andersen, "Labour Force Participation in Canada", Canadian Journal of Economics, II, No.2 (May, 1969) p. 279.

The authors' rationale for using unemployed men by duration as a variable is that while potential additional workers may not be sensitive to total male unemployment, they may be stimulated by male unemployment of longer duration. The average duration of unemployment is typically short during an expansionary period since frictional unemployment accounts for a relatively large part of the total. Conversely, during a recessionary period, frictional unemployment accounts for a smaller proportion of the total relative to demand deficient unemployment. The latter type of unemployment is characterized by longer average duration. Longer duration unemployment among males thus represents the prolonged deterioration in household income to which the additional worker is likely to be more responsive as the authors' suggest; but if female labour market conditions are correlated with that of males these duration variables may also represent conditions to which discouraged workers are more responsive!

The variable used to represent short-run or cyclical labour market conditions for girls 14-19 is their own unemployment rate. Quite clearly, the coefficient on the variable will reflect the magnitude of the discouraged worker effect among girls as a response to their own employment conditions. However, the presence of another variable with a cyclical component, per capita real GNE, may confuse a ready interpretation of the <u>net</u> cyclical behaviour of the participation rate.

Per capita real gross national expenditure (GNE) is included as a variable in all equations. The stated rationale for the inclusion of this variable is that it represents the long-run effects of the standard of living and sociological changes on participation.

"High income allows the young to remain in school and the old to retire early. It may also represent general sociological factors inducing female participation in the labour force.... This trend (in participation) is especially strong for the mid-range groups (of women). The standard of living in this case represents both the desire for economic betterment and the increasing acceptance of the idea of married women in the labour force[18/]."

This variable has, however, in addition to its trend element, a cyclical component. Its coefficient may reflect, therefore, not only the trend element in the participation rate, but also cyclical variation. The point is, that in each equation there are at least two cyclical variables, GNE and unemployment, each of which may capture, in part, variations in participation but neither of which reflects the net effect of a cyclical change in the labour market. Calculating the net effect of a cyclical change in labour market conditions could be done by estimating a further simultaneous equation between real per capita GNE and the unemployment variable used in each equation. Substituting the value for GNE back into the original equation allows the calculation of the net effect of a given change in the unemployment variable on the participation rate.

Another variable used in the equations for women 20-24, 25-34, and 35-44 is the birth rate led one quarter. This variable is included to represent the negative effect on participation brought about by the birth of children. Leading it one quarter captures the negative effect of advanced pregnancy on participation.

18/ Op.cit. p. 283.

The results from the Officer and Andersen model are shown as "Original" in Table 3, page 36. For girls 14-19, there is a negative coefficient on both their own unemployment rate and the GNE variable. In the case of women over 19 the signs on the male unemployment variables and on the GNE variables are both positive. One cannot, therefore, say what net effect cyclical variations have on participation rates in these equations. The presence of two cyclical explanatory variables does not allow for an obvious conclusion on the net effect. The negative signs on the birth rate variable in the equations for women 20-24, 25-34 and 35-44 reflect the expected decrease in participation related to advanced pregnancy and childbirth.

It should be noted that while the signs on the cyclical labour marketvariables in both Officer & Andersen and Proulx are the same for women 45-64 and 65 and over, the signs on the labour market variables in their respective equations for women 20-24 are opposite. It is not evident, however, whether the net effects from the Officer and Andersen equations would be the same or different from the net effects indicated by the Proulx equations because, as has been stated, the Officer and Andersen equations contain two cyclical variables while the Proulx equations contain only one. The sign on the coefficient of the single cyclical variable in the Proulx equations indicates, of course, the net effect on participation.

(IV) RDX2

In the Bank of Canada RDX2 model, an equation used to forecast first differences in the aggregate (male and female) participation rate is estimated. The equation contains a variety of variables not commonly used, particularly in early participation rate studies. Along with three dummy variables to alter the intercept for seasonality, the authors enter the first difference in the proportion of the non-institutional population 14 years and over (the defined working age population) enrolled in educational institutions. This time series is first multiplied by $Q_1 + Q_2$, the seasonal dummy variables of the first and second quarter, then by $Q_3 + Q_4$, the 0,1 values for the third and fourth quarters of the year. The resulting two variables are designed to capture the effect on the participation rate of education as an alternative to employment. The coefficients on these variables (see page 42) are negative, as expected, but larger for the second half of the year "because the academic year starts about the end of the third quarter," 19/ and employment and labour force participation among students is generally much lower in the third quarter of the year than in the second quarter.

The second variable of some novelty is the first difference in the nineteen quarter moving sum of net immigration. This variable has a positive coefficient as would be expected, since immigrants seem to have a higher average participation rate than native Canadians. The authors may somewhat understate the proxy role which this variable serves when they state,

> "To some extent this variable may be picking up, indirectly, the influence of unemployment on the participation rate, because net immigration is negatively related to recent unemployment rates."20/

19/ Bank of Canada, The Structure of RDX2, Part 1, Bank of Canada Staff Research Studies, No. 7, Bank of Canada, Ottawa, 1971, p. 105.

20/ Ibid. p. 106.

The extent of this understatement can be judged by the fact that in 1961, when the average annual unemployment rate was 7.1 per cent, estimated net immigration amounted to 16,000 persons whereas in 1966, when the rate was 3.6 per cent, net immigration is estimated at 132,000.[21/]

The RDX2 equation, like the equations for women in the Officer & Andersen study, contains an income variable with a positive coefficient. Thus, while not specified to measure explicitly the discouraged or additional worker effects, this income variable, as well as the immigration variable, would seem to capture the variation in aggregate participation related to cyclical change in economic and labour market conditions. The income variable used in the RDX2 equation is real disposable income per member of the labour force population - somewhat closer in concept to a wage variable than Officer & Andersen's ratio of real GNE to total population. To quote from RDX2:

> "The income variable helps the equation, whereas, two more defensible alternatives - the degree of capacity utilization, and the unemployment rate - do not. Thus, we have a personal income variable supposedly standing for the marginal benefits of labour force participation."[22/]

As expected, the sign on the coefficient of the income variable is positive.

Other Canadian studies of female participation include the model by Neil Davis (see bibliography item (30)) and the equations from CANDIDE 1.0 (see bibliography item (31)). While the Davis model, is similar in approach to the Proulx model, it relies on a data series which was terminated in 1966. Thus predictive tests on the model for the period after 1968 were not possible. As for the equations in CANDIDE 1.0, again the lack of a calculated data series past 1968, plus the fact that the equations were being re-specified at the time of writing, warranted its exclusion from this study.

21/ Source: Bank of Can., General Economic Statistics Book, Section III-7 for emigration estimates and Immigration Review, various annual issues, Department of Manpower and Immigration, for immigration estimates.

22/ Ibid, as 19, p.109.

CHAPTER 4

METHODS OF EVALUATION

Having described the structure and economic rationale for the use of the variables in each model, the next step was to use empirical methods to evaluate these models. All four models were subjected to two related predictive tests, a plotting of predictive errors and calculation of Chow Tests.

First, each model was re-estimated using the time period chosen by the author. This was done to attempt to determine if the assembly of the data was the same as that used by the author.

Next, each model was re-estimated using a common period of estimation. The conclusions of Bowen and Finegan with regard to the observed sensitivity of participation rate equations to changes in either periods of estimation or the explanatory variables representing labour market conditions, suggests a common period of estimation is necessary in order to make a definitive comparison of predictive performance between models for the time period in question. The time period chosen for the re-estimation of the equations of each model was first quarter 1953 to fourth quarter 1967. In the case of the RDX2 equation, the length of lag on some variables necessitated a shorter period, from second quarter 1957 to fourth quarter 1967. The period chosen coincides as closely as possible with the time periods used in the original estimation of the equations. In the case of Officer and Andersen, the period used was 1950.1-1967.2 (1950 first quarter to 1967 second quarter); for Proulx, 1953-1967; for Tella, 1947.4-1964.2; and for RDX2, 1957.2-1968.4.

Retaining a period of 21 quarters, between 1968.1 and 1973.1 allowed a sufficient number of observations for predictive tests on the equations. The period of re-estimation, 1953-1967, contains three recessions, in '53-'54, '57-'58, '60-'61 and what is popularly referred to as a "growth recession" in 1967. The period of prediction contains one recession, that of 1970-71 and approximately two years of recovery to the first quarter of 1973.

Third, after each model was estimated using 1953-1967 data and then using 1953-'73 and 1968-'73 data the predictive tests were performed. To illustrate the predictive performance of the equations estimated for the 1953-1967 period, the parameters of these equations were applied to data for the independent variables from the 1968-1973 period to obtain predicted values of the dependent variable. The predicted values were then subtracted from the actual values of the dependent variable to obtain the errors of prediction. These errors are plotted along with those from the period of fit to illustrate the particular pattern of errors during the period of prediction.

To determine whether the relationships obtained with the 1953-1967 data fit the 1968-'73 data in approximately the same fashion a Chow Test[23/] was calculated. This test indicates whether the parameters of the equations estimated for the 1968-'73 period are significantly different from the parameters estimated using the 1953-'67 data.

The logic of these two predictive tests is to determine whether the relationships using the data for the 1968-'73 period were about the same as those estimated using the 1953-'67 data. The inspection of the predictive errors of the equations allows us to determine whether the magnitudes and

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23/ Chow, G.C., "Tests of Equality Between Sets of Coefficients in Two Regressions", Econometrica Vol. 28, July 1960, pp. 591-605.

pattern of these errors is about the same as the errors for the period of fit. The Chow Test provides a statistical test for a change in the parameters of the equation when the period of estimation is altered. If a particular equation or model fails the usual inspection and Chow Test neither procedure will tell us why. Among the possibilities are that the model was incorrectly specified or that a structural change occurred. In either case, additional information is required.

Estimation Problems

In the original estimation of the equations in each model, ordinary least squares regression was used. However, in neither of the Tella, Officer and Andersen or Proulx models is it stated which particular ordinary least squares program was used. While differences in the algorithms of widely used ordinary least squares programs may not give rise to large differences in results, any differences which do arise can lead to confusion for persons attempting to reproduce or otherwise use the results[24/]. In correspondence with Professor Officer, he stated that the Massager program of the Bank of Canada was used in the paper authored by himself and Peter Andersen.

In reproducing the models the APL program 32 STP2 of I.P. Sharp Associates (August, 1973) was used. To cross-check the results obtained, the equations from the Officer and Andersen model were re-estimated using the Massager program of Systems Dimensions Limited (April, 1974). Only slight differences in results were noted.

24/ For a discussion of this issue, see James W. Longley, "An Appraisal of Least Squares Programs for the Electronic Computer from the Point of View of the User," Journal of the American Statistical Association, Vol. 62, No. 319, September 1967.

Another difficulty encountered in reproducing the Officer and Andersen, and Proulx models arose because sources given for data were not specific as to date of issue. Since the labour force data used in the models was either raw quarterly or annual data, revisions to these series was not an issue. However, in the case of the real per capita gross national expenditure variable (Y), used in the Officer and Andersen study and the disposable income variable $\frac{KY}{NPOP}$ used in RDX2, revisions to data are very much an issue. Gross national expenditure data for 1967, for example, underwent at least four revisions between originally published estimates and those currently published. In 1967, publication of National Accounts was suspended in order to carry out conversion of historical and current data to United Nations concepts. A further major revision of National Accounts data was carried out by Statistics Canada during the first half of 1972. In addition, recent revisions to population series arising out of the 1971 Census have altered the denominator in the income variables used in Officer and Andersen and RDX2.

In the case of the Proulx study, revisions have also been frequent in the index of industrial production for manufacturing, used in the calculation of De[25/], the index of excess demand for labour. After noting post-1968 revisions to this data for the 1961-1968 period an attempt was made to duplicate the De time series calculated by Professor Marion. This attempt, using data published during 1968, proved somewhat successful in that estimates of desired minus actual employment, $(E^*-E_t/E_t)x100$, were virtually identical to the published

25/ See footnote 15 page 12 .

series[26/]. The data was therefore used in attempting to reproduce the equations for participation published by Professor Proulx. This was done to ensure that the specification of the equations used to evaluate the predictive capacity of this model was the same as his. The attempt at reproducing Proulx's equations proved unsuccessful, as both the magnitudes and signs of coefficients in equations differed from those published. In conversations with Professors Proulx and Marion and in correspondence with Mr. N. Hung, Professor Proulx's research assistant for the study, the source of the differences in the equations could not be determined.

In re-estimating the published equations from Officer and Andersen and RDX2 currently available data was used since, for the most part, the signs and magnitudes of the coefficients and descriptive statistics of the equations estimated using this data were similar to the published results. Specification and assembly of data did not appear, therefore, to be an issue, bearing in mind the revisions to National Accounts and population data used in some variables.

26/ See Marion (17) pp. 529, 530, Table III Method I

CHAPTER 5

EMPIRICAL RESULTS

Re-estimation of Models

The results of re-estimating the models are presented in the tables beginning on pages 28, 32, 36 and 42. Included in these tables are the published equations from the original studies, a replication of each of these equations using the time periods as stated in the studies, and the equations re-estimated for the period 1953.1-1967.4 and 1953.1-1973.1. Sources of data for each of the variables used follow the table of results for each model. In the case of the RDX2 equation for the first differences in the total participation rate, the periods of estimation used for purposes of analysis are 1957.2-1967.4 and 1957.2-1971.4. The 19 quarter lagged value of the net immigration variable dictated the starting date and the lack of readily available complete data past 1971.4 dictated the termination date for this model. The description and analysis of the re-estimated models is followed by the results and analysis of predictive tests performed on the models.

(1) TELLA

Tella's results for the U.S. over the 1947-64 period (Table 1, page 28) indicate a progressively greater discouraged worker effect with increasing age of women. This pattern is not evident in the Canadian equations for the 1953-'67 period. While the coefficients on $(\frac{E}{P})t\text{-}1$ tend to rise between the 14-19 and the 25-34 year age groups they do not continue to rise in the case of middle-aged and older women. There may be little reason to expect Tella's results for the U.S. and those obtained here to be the same. Different functional forms are used in the equations (dummy variables to adjust for seasonality instead of Tella's seasonally adjusted data) and the period of estimation is different not to mention differences in institutional and socio-economic factors which may be reflected in the data.

Like the results for the U.S., coefficients on the log-linear time trend are positive for all age groups (excluding the 14-19 group) in the 1953-67 equations for Canada. Presumably, the negative trend in participation of teenage women reflects increasing school enrolment rates over the periods of estimation.

When the period of estimation is extended for the Canadian data from '53.1 - '67.4 to '57.1 - '73.1, the most noteworthy observation is the systematic rise in the coefficients on $(\frac{E}{P})t-1$. While the instability in these coefficients may be consistent with a structural change in the factors influencing female participation it may also indicate mis-specification of the equation. The consistently higher standard error of estimate on the equations for each age groups as well as the lower Durbin-Watson statistics indicate that the equations are performing less well during the longer 1953-73 period of estimation.

TABLE 1

TELLA STUDY

	FEMALE AGE GROUP PARTICIPATION		CONSTANT	Q_1	Q_2	Q_3	$\frac{(E)}{(P)}$ t-1	LOG T	R^2	S.E.E.	D.W.
(1)	14-19	1953.1-1967.4	.2715	.0015 (.22)	.0251 (2.72)	.0821 (10.42)	.5056 (4.33)	-.0620 (1.80)	.92	.0093	1.85
(2)		1953.1-1973.1	.1518	.00434 (0.65)	.0329 (3.55)	.087 (11.51)	.52 (4.61)	-.088 (-0.32)	.90	.0107	1.74
(3)	U.S.	1947.4-1964.2	.3511				.401 (3.97)	-.251 (3.49)	.65	.0091	
(4)	20-24	1953.1-1967.4	-.1958	- 0034 (1.11)	-.0059 (1.94)	-.0128 (4.16)	.8129 (14.49)	.1447 (4.85)	.94 .96	.0083 .0107	1.75 1.58
(5)		1953.1-1973.1	-.3035	-.0008 (0.25)	.0131 (3.87)	-.0059 (1.72)	.8494 (14.64)	.1862 (5.10)			
(6)	U.S.	1947.4-1964.2	.012				.445 (3.90)	.122 (6.78)	.46	.0097	
(7)	25-34	1953.1-1967.4	-.1354	.0110 (6.26)	-.0026 (1.57)	.0101 (5.93)	.8663 (12.92)	.0882 (2.59)	.98	.0046	2.23
(8)		1953.1-1973.1	.0073	-.057 (7.67)	-.0062 (3.05)	-.0158 (7.79)	1.09 (27.05)	-.0064 (0.21)	.99	.0063	2.23
(9)	U.S.	1947.4-1964.2	-.0578				.517 (5.88)	.112 (8.00)	.80	.0058	
(10)	35-44	1953.1-1967.4	-.5246	-.0133 (7.12)	.0004 (.25)	-.0083 (4.59)	.6588 (7.74)	.3007 (4.49)	.99	.0049	2.21
(11)		1953.1-1973.1	-.5059	-.0136 (6.67)	-.00014 (.07)	-.0111 (5.61)	.709 (8.37)	.2876 (4.04)	.99	.0062	2.00
(12)	U.S.	1947.4-1964.2	-.236				.512 (7.11)	.212 (9.22)	.96	.0048	
(13)	45-54	1953.1-1967.4	-1.194	-.0094 (4.48)	.0028 (1.34)	-.0065 (3.09)	.3747 (3.33)	.6593 (5.76)	.99	.0055	2.05
(14)		1953.1-1973.1	-.536	-.0124 (5.92)	.0017 (.83)	-.0097 (4.65)	.7039 (10.29)	.3017 (4.83)	.99	.0065	1.97
(15)	U.S.	1947.2-1964.2	-.489				.688 (7.17)	.302 (3.92)	.98	.0071	
(16)	55-64	1953.1-1967.4	-.8073	-.0037 (1.88)	.0017 (.89)	-.0037 (1.90)	.5009 (4.42)	.4359 (4.50)	.99	.0052	1.85
(17)		1953.1-1973.1	-.4247	-.0035 (1.71)	.0010 (.49)	-.0068 (3.29)	.7121 (9.83)	.2338 (4.14)	.99	.0064	1.66
(18)	U.S.	1947.2-1964.2	-.5532				.627 (6.67)	.322 (4.60)	.98	.0065	
(19)	65+	1953.1-1967.4	-.0656	-.0028 (2.59)	-.0012 (1.15)	-.0039 (3.62)	.7021 (6.80)	.0399 (2.66)	.90	.0028	2.22
(20)		1953.1-1973.1	.0076	-.0040 (3.93)	-.0021 (2.05)	-.0047 (4.70)	.9392 (17.81)	-.00839 (3.93)	.86	.0032	2.36
(21)	U.S.	1947.4-1964.2	-.0136				.700 (8.05)	.0215 (2.07)	.64	.0047	

TELLA

DATA: Quarterly (average of three months) raw, from 1953 first quarter to 1973 first quarter.

DEPENDENT VARIABLES:

Female labour force participation rates by age groups to three decimal places (i.e., .243)

SOURCE:

CANSIM (Canadian Socio-Economic Information Management System) Statistics Canada, as of April 1974.

14 - 19:	Matrix	1800,	Series	D	756130
20 - 24:	"	"	"	"	756224
25 - 34:	"	"	"	"	756268
34 - 44:	"	"	"	"	756288
45 - 54:	"	"	"	"	756334
55 - 64:	"	"	"	"	756354
65 +	"	"	"	"	756380

INDEPENDENT VARIABLES:

Q1 - first quarter 0,1 seasonal dummy variable.
Q2 - second quarter 0,1 seasonal dummy variable.
Q3 - third quarter 0,1 seasonal dummy variable.

E/P - Total employment to total working age population ratio to four decimal places (i.e., .4874)

SOURCE:

						E	P
14 - 19	CANSIM	Matrix	1800,	Series	D	756199	756117
20 - 24	"	"	"	"	"	756213	756211
25 - 34	"	"	"	"	"	756263	756261
35 - 44	"	"	"	"	"	756283	756281
45 - 54	"	"	"	"	"	756329	756327
55 - 64	"	"	"	"	"	756349	576347
65 +	"	"	"	"	"	756369	756367

LOG T Base 10 logarithm of a times series beginning with 100 to 179.

S.E.E. Standard error of estimate.

D.W. Durbin-Watson statistic.
t scores in brackets beneath coefficients.

(II) PROULX

The coefficients in replicated equations of the Proulx study (line 2 of each group in Table 2 page 32) bear little resemblance to his published results. The exception is the equation relating the deviations from the trend in participation of 20-24 year olds to C/P, the unemployment-population ratio of men 25-44, and T, the time trend. In the case of the replicated equations using De, the index of excess labour demand, and T as the explanatory variables, the coefficients on De are 2.3 or 2.4 times the size of the coefficients on De in the published study. The coefficients on T in these equations are approximately the same size as in the original study but are of opposite sign in all three equations. It should be noted that in replicating these equations, the procedures followed, as far as could be determined, those outlined in Professor Proulx's study.[26]

The results of the re-estimated equations for the 1953-67 period (line 3 in each set of equations) show that the discouraged worker effect predominates among women 20-24. This is indicated by the negative sign on C/P and the positive sign on De in the respective equations. For women 45-64 and 65 and over, the positive coefficients on De indicate a net additional worker effect. For each age group the signs on De and C/P in the re-estimated equations are the same as in the original study.

26/ See pages 24 to 25 for a statement of the problem in determining what data sources were used in calculating De for Professor Proulx's paper.

It should be noted that the revisions to the data used to calculate De, namely the index of industrial production and the employment indices for total manufacturing, do make a difference in the behaviour of the De data series. This is illustrated in examining equation (6) for women 20-24 using unrevised data. In this case the coefficient on De falls from .33376 in equation (6) to .24329 in equation (7). Differences in the coefficient on De are evident between equations (10) and (11) as well as between equations (14) and (15). This is an illustration of the importance of clearly stating the sources of data used in published studies. Each of the equations for the same period of estimation, 1953-67, bears different coefficients on De, because of different (but known) data sources in the case of the reestimated equations, or because of different data sources or methods of calculating De in the case of the original published equations.

TABLE 2

PROULX STUDY

	Female Participation By Age Group	Constant	De	C/P	T	R^2	S.E.E.	D.W.
	Deviations From Trend							
	20 - 24							
(1)	Original 1948 - 67	0.0248		-0.91691 (4.82)	-0.00141 (2.71)	.58	0.0113	1.40
(2)	Replication 1948-67	0.0261		-0.91718 (5.38)	-0.00114 (2.42)	.63	0.0109	1.34
(3)	1953-67	0.036		-0.767 (3.82)	-0.000069 (0.10)	.55	0.0111	1.40
(4)	1953-72	0.036		-0.786 (3.15)	-0.000039 (0.07)	.37	0.0141	0.74
	Levels of Participation							
	20 - 24							
(5)	Original 1953 - 67*	0.4533	0.14363 (3.16)		-0.00619 (8.25)	.89	0.0074	1.89
(6)	Replication 1953-67*	0.4635	0.33376 (2.13)		0.0057 (6.24)	.85	0.014	0.93
(7)	1953-67	0.458	0.24329 (1.17)		0.0066 (7.07	.81	0.016	0.64
(8)	1953-72	0.453	0.340 (1.70)		0.0083 (12.97)	.91	0.016	0.51
	45 - 64							
(9)	Original 1953-67*	0.1699	-0.05209 (2.63)		-0.01299 (38.43)	.997	0.032	1.71
(10)	Replication 1953-67*	0.1653	-0.12441 (3.36)		0.01349 (61.64)	.997	0.0033	1.40
(11)	1953-67	0.1665	-0.11321 (2.16)		0.01319 (56.19)	.996	0.0039	0.91
(12)	1953-72	0.1773	-0.12784 (0.80)		0.01108 (21.66)	.965	0.0130	0.22
	65 +							
(13)	Original 1953-67*	0.0376	-0.03582 (2.52)		-0.00183 (7.96)	.95	0.0023	1.80
(14)	Replication 1953-67*	0.0351	-0.08495 (2.40)		0.00204 (9.74)	.89	0.0032	1.08
(15)	1953-67	0.0361	-0.07544 (1.61)		0.00183 (8.74)	.87	0.0035	0.76
(16)	1953-72	0.042	-0.07471 (0.83)		0.00072 (2.51)	.28	0.0073	0.30

* Unrevised data used in calculating De.

PROULX

DATA: Annual data from 1948 to 1972

DEPENDENT VARIABLES:

Labour force participation rates of women 20-24, 45-64, 65- to three decimal places (i.e., 354) and deviations from trend of participation rates of women 20-24 to ten decimal places.

SOURCE:

20 - 24 -	CANISM,	Matrix	1800,	Series	D	756224
45 - 54 -	"	"	"	"	"	756334
65 + -	"	"	"	"	"	756380

- as of August 1973.

INDEPENDENT VARIABLES:

De - index of excess demand for labour calculated from G. Marion, Bibliography item (17) using for:

1948-'67 equation: indices of employment in manufacturing, seasonally adjusted from Dominion Bureau of Statistics, Review of Employment and payrolls Catalogue, No. 72-501 and 72-201 (1968) and indices of industrial production, total manufactu - ring, seasonally adjusted from Dominion Bureau of Statistics, Index of Industrial Production,Supplement, 1968. Catalogue No. 61-005.

1953-'67 and 1953-'72 equation: seasonally adjusted indices of employment in manufacturing - CANSIM, Matrix 45, Series D 1330, and seasonally adjusted index of industrial production, total manufacturing - CANSIM, Matrix 16, Series D 5850, as of August 1973.

C/P - Unemployment to population ratio of males, 25-44 years of age

C - CANSIM, Matrix 1800 Series D 755729

P - CANSIM, Matrix 1800 Series D 755724 - for data from 1953- 1972 and from staff of Labour Force Survey Division for data from 1948-1952.

T - Time trend beginning with 0

S.E.E. - Standard error of estimate

D.W. - Durbin-Watson statistic
t scores in brackets beneath coefficient.

(III) OFFICER AND ANDERSEN

The equations replicated from the Officer and Andersen study, (Table 3, pages 36, 37 and 38) have a common feature in that the coefficients on each of the explanatory variables - Y, BRT and the unemployment variable(s) - have smaller coefficients than in the original study. However, the replicated equations also have higher coefficients of determination and lower standard errors of estimate than the original equations. One explanation for the consistent difference in coefficients may lie in the revisions which were made to National Accounts data from which Y, the per capita real disposable income variable is derived[27/].

Overall, however, the results of attempting to replicate the published equations and the results of re-estimating the equations using 1953-67 data are similar to those obtained by Officer and Andersen. The coefficients on the male unemployment variables are positive for women over 19 years of age while for girls 14-19, the sign on the coefficient of their own unemployment rate is negative. The signs on the per capita GNE variable, Y, are positive for all age groups over 19 years. While this variable may be capturing a positive trend in participation of these age groups, its cyclical variations may also be capturing procyclical variations in the participation of these age groups. That is, the positive signs of the coefficient on this variable may indicate

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27/ See page 24.

the presence of a discouraged worker effect which may offset, to some extent, the additional worker effect indicated by the coefficients on the male unemployment variables in the equations for women over 19. To calculate the net effect for each group would require the estimation of simultaneous equations between the unemployment variables and Y as outlined on page 17.

TABLE 3

OFFICER AND ANDERSEN

	FEMALE AGE GROUP	CONSTANT	Q_1	Q_2	Q_3	UNEMPLOYMENT VARIABLE		Y	BRT_{t+1}	R^2	S.E.E.	D.W.
(1)	14 - 19 Original 1950.1 - 1967.2	0.407	-0.024 (5.77)	-0.009 (2.29)	0.062 (14.55)	-0.257 (3.36)	UF 14-19 / LF 14-19	-0.000155 (5.55)		.88	.0140	1.17
(2)	Replication 1950.1-1967.2	0.393	-0.024 (5.79)	-0.010 (2.61)	0.060 (14.74)	-0.194 (2.47)	"	-0.00012 (5.45)		.88	.0109	1.07
(3)	1953.1 - 1967.4	0.394	-0.025 (5.27)	-0.011 (2.61)	0.061 (13.37)	-0.197 (2.19)	"	-0.00012 (4.77)		.88	.0116	0.98
(4)	1953.1 - 1973.1	0.346	-0.024 (5.24)	-0.007 (1.53)	0.060 (14.05)	-0.037 (0.43)	"	-0.00005 (2.62)		.85	.0133	0.84
(5)	20 - 24 Original 1950.1 - 1967.2	0.547	0.017 (5.16)	0.015 (4.62)	0.024 (5.81)	0.499 (1.68)	S^6M/LM	0.000213 (5.38)	-0.00568 (9.18)	.91	.0092	1.37
(6)	Replication 1950.1-1967.2	0.558	0.016 (5.14)	0.017 (5.45)	-0.021 (5.73)	0.177 (0.58)	"	0.00017 (5.75)	-0.00555 (9.25)	.92	.0089	1.24
(7)	1953.1 - 1967.4	0.660	0.016 (4.98)	0.018 (5.47)	-0.013 (2.81)	0.336 (1.12)	"	0.00007 (1.33)	-0.00730 (8.18)	.94	.0083	1.14
(8)	1953.1 - 1973.1	0.654	0.014 (4.05)	0.019 (5.51)	-0.009 (2.18)	0.360 (1.11)	"	0.00009 (1.77)	-0.00740 (8.28)	.97	.0100	1.32
(9)	25 - 34 Original 1950.1 - 1967.2	0.275		0.006 (2.21)	-0.023 (5.47)	0.490 (9.90)	SM/LM	0.000258 (7.26)	-0.00505 (8.57)	.92	.0086	1.73
(10)	Replication 1950.1-1967.2	0.261		0.006 (2.55)	-0.023 (6.51)	0.375 (7.77)	"	0.00023 (8.99)	-0.00432 (7.80)	.94	.0077	1.70
(11)	1953.1 - 1967.4	0.237		0.004 (1.63)	-0.022 (6.04)	0.387 (8.88)	"	0.00026 (6.59)	-0.0041 (6.05)	.96	.0064	1.46
(12)	1953.1 - 1973.1	0.091		-0.002 (0.06)	-0.042 (7.03)	0.404 (4.91)	"	0.000424 (6.96)	-0.0021 (1.82)	.95	.0136	1.73

OFFICER & ANDERSEN -
CONT'D. ----

		CONSTANT	Q_1	Q_2	Q_3	UNEMPLOYMENT VARIABLE		Y	BRT_{t+1}	R^2	S.E.E.	D.W.
						U_M/L_M	S^6M/LM					
(13)	35 - 44 Original 1950.1 - 1967.2	0.103			-0.049 (8.06)	0.825 (10.58)	0.176 (4.49)	0.00057 (9.71)	-0.00527 (5.66)	.91	.0147	1.58
(14)	Replication 1950.1-1967.2	0.099			-0.049 (9.28)	0.604 (8.42)	0.165 (4.81)	0.00047 (11.71)	-0.0042 (4.84)	.94	.0128	1.40
(15)	1953.1 - 1967.4	0.141			-0.040 (7.58)	0.643 (9.55)	0.178 (5.42)	0.00043 (6.71)	-0.0050 (4.71)	.96	.0106	1.15
(16)	1953.1 - 1973.1	0.295			-0.028 (5.22)	0.483 (6.22)	0.150 (3.78)	0.00024 (3.64)	-0.00620 (5.36)	.96	.0137	0.41
(17)	45 - 54 Original 1950.1 - 1967.2	-0.279	0.027 (3.35)	-0.015 (1.83)	-0.092 (10.66)	6.607 (9.31)	S^6M/LM	0.00109 (20.39)		.88	0.0226	1.92
(18)	Replication 1950.1-1967.2	-0.194	0.0173 (2.65)	-0.006 (0.85)	-0.078 (11.47)	4.890 (8.40)	"	0.00084 (25.53)		.93	0.0185	1.62
(19)	1953.1 - 1967.4	-0.232	0.020 (3.39)	-0.009 (1.47)	-0.073 (12.28)	5.398 (10.30)	"	0.00090 (29.33)		.94	0.0151	1.48
(20)	1953.1 - 1973.1	-0.035	0.011 (1.20)	-0.004 (0.40)	-0.045 (4.96)	2.538 (2.90)	"	0.00057 (18.06)		.85	0.0283	0.19
(21)	55 - 64 Original 1950.1 - 1967.2	-0.263	0.025 (3.59)	-0.014 (2.07)	-0.074 (10.21)	5.589 (9.35)	"	0.00089 (19.80)		.88	0.0190	1.85
(22)	Replication 1950.1-1967.2	-0.194	0.016 (2.90)	-0.007 (1.21)	-0.063 (10.78)	4.160 (8.34)	"	0.00069 (24.36)		.92	0.0158	1.53
(23)	1953.1 - 1967.2	-0.232	0.019 (3.62)	-0.008 (1.48)	-0.059 (10.95)	4.614 (9.70)	"	0.00075 (26.80)		.94	0.0137	1.62
(24)	1953.1 - 1973.1	-0.069	0.014 (1.73)	-0.001 (0.15)	-0.036 (4.51)	2.190 (2.89)	"	0.00047 (17.29)		.84	0.0246	0.22

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CONT'D. ----

		CONSTANT	Q_1	Q_2	Q_3	UNEMPLOYMENT VARIABLE		Y	BRT_{t+1}	R^2	S.E.E.	D.W.
(25)	65+ Original 1950.1-1967.2	-0.015	-0.002 (1.19)	-0.006 (3.09)	-0.012 (6.13)	0.486 (7.38)	S^3M/LM	0.00013 (10.75)		.71	0.0050	1.12
(26)	Replication 1950.1-1967.2	-0.0052	-0.003 (1.42)	-0.004 (2.49)	-0.010 (6.01)	0.391 (6.32)	"	0.00010 (11.88)		.76	0.0047	0.94
(27)	1953.1 - 1967.4	-0.153	-0.003 (1.87)	-0.006 (3.35)	-0.011 (6.39)	0.490 (7.64)	"	0.00011 (13.02)		.79	0.0042	0.87
(28)	1953.1 - 1973.1	0.041	-0.003 (1.07)	-0.003 (0.89)	-0.004 (1.57)	0.153 (1.38)	"	0.00002 (2.08)		.11	0.0080	0.17

OFFICER AND ANDERSEN

DATA: Quarterly (average of three months) 1950-1973, raw data.
CANSIM Data as of August 1973.

DEPENDENT VARIABLES:
Female participation rates by age group (i.e., .354)

14 - 19 -	CANSIM,	Matrix	1800	Series	D	756130
20 - 24 -	"	"	"	"	"	756224
25 - 34 -	"	"	"	"	"	756268
35 - 44 -	"	"	"	"	"	756288
45 - 54 -	"	"	"	"	"	756334
55 - 64 -	"	"	"	"	"	756354
65 + -	"	"	"	"	"	756380

for 1953-73 data and Labour Force Survey Division, Statistic Canada, for data from 1950-1952.

INDEPENDENT VARIABLES:

Q1, Q2, Q3 - quarterly 0,1 seasonal dummy variables.

$\frac{UF\ 14\text{-}19}{LF\ 14\text{-}19}$ - unemployment rate of females 14-19.

Source: CANSIM, Matrix 1800, Series D 756131

S^6M/LM - males seeking work more than six months divided by male labour force.

Source: SM^6 - Labour Force Survey Division, Statistic Canada.
LM - CANSIM, Matrix 1800, Series D 755536.

SM/LM - total males seeking work divided by male labour force.

Source: SM - Labour Force Survey Division, Statistics Canada.

UM/LM - total males unemployed divided by male labour force. (Male unemployment rate.)

Source: UM - CANSIM, Matrix 1800, Series D 755576

S^3M/LM - total males seeking work more than three months divided by male labour force

Source: S^3M - Labour Force Survey Division, Statistics Canada.

Y - Constant dollar Gross National Expenditure divided by total Canadian population.

Source: constant dollar Gross National Expenditure - CANSIM, Matrix 1010, Series D 40239
population - CANSIM, Matrix 1, Series D 1

$BRT_{t\pm1}$ Number of births per thousand population of women 14-44

Source: births - CANSIM, Matrix 4, Series D 87
female population 14-44 - calculated from CANSIM, Matrix 1800, Series D 756407 and D 756237

S.E.E. - Standard error of estimate

D.W. - Durbin-Watson statistic
t scores in brackets beneath coefficients.

(IV) RDX2

The re-estimation of the RDX2 equation for first differences in the total labour force participation using the data series incorporating the latest revisions to February 1974, provides coefficients of the same sign but slightly different magnitude than those appearing in the 1971 version of the RDX2 model.28/ Revisions to population series arising out of the 1971 Census have altered the time series variables ER12, ER34, and $\frac{KY}{NPOP}$ which are respectively, the enrolments of persons 14 years and over divided by the population 14 years and over, and real disposable income divided by population over 14 years. As has been mentioned previously substantive revisions have also been made to National Accounts data - this data is used in the numerator of $\frac{KY}{NPOP}$. In spite of these revisions the replicated equation for 1957.2-68.4 displays goodness-of-fit statistics similar to the original equation. The positive coefficient on the cyclical variable $\frac{KY}{NPOP}$ in Table 4 indicates a net discouraged worker effect for the aggregate (male plus female) participation rate. If any cyclical movement remains in the NEI variable its positive coefficient would tend to support the conclusion that the discouraged worker effect is dominant for the total participation rate.

28/ Bank of Canada, The Structure of RDX2, Part 2, Bank of Canada Staff Research Studies, No.7, Ottawa, 1971, equation 5.5, p.41.

TABLE 4

RDX2 EQUATION

FIRST DIFFERENCES IN TOTAL PARTICIPATION RATE

	CONSTANT	QC_1	QC_2	QC_3	ER12	ER34	$\frac{KY}{NPOP}$	NEI	R^2	S.E.E.	D.W.
Original 1957.2 - 68.4	0.13462	-0.76533 (9.18)	0.53182 (5.29)	1.0125 (12.89)	-0.53264 (5.49)	-0.89777 (7.36)	0.01688 (2.43)	29.599 (2.32)	.982*	0.187	1.79
Replication 1957.2 - 68.4	0.17743	-0.79094 (8.79)	0.63230 (6.47)	0.94999 (11.57)	-0.27294 (4.52)	-0.94860 (7.38)	0.01995 (2.71)	36.30 (2.89)	.984	0.197	2.31
1957.2 - 67.4	0.22016	-0.86497 (10.65)	0.62279 (7.31)	0.81325 (10.60)	-0.22746 (4.02)	-1.22540 (9.57)	0.02087 (3.25)	36.19 (3.37)	.988	0.165	2.10
57.2 - 71.4	0.16456	-0.71070 (7.92)	0.58510 (5.69)	0.96694 (12.93)	-0.35985 (6.40)	-0.85261 (7.61)	0.01870 (2.57)	28.87 (2.16)	.980	0.220	2.54

*$\bar{R}^2$

RDX2

DATA: Quarterly (average of three months) raw data, 1952-1971.
CANSIM Data as of February 1974.

DEPENDENT VARIABLE:
First differences in total labour force participation rate.

SOURCE:
CANSIM, Matrix 1800, Series D 755040

INDEPENDENT VARIABLES:

QC1 - first quarter seasonal dummy variable, taking a value of 1 for a first quarter observation, 0 for second and third quarters and -1 in the fourth quarter.

QC2 - second quarter seasonal dummy variable, taking a value of 1 in the second quarter, -1, in the fourth quarter and 0 for first and third quarters.

QC3 - third quarter dummy variable taking the value of 1 in the third quarter, -1, in the fourth quarter and 0 in the first and second quarters.

ER12, ER34 - first differences in the ratio population 14 years of age and over enrolled in educational institutions divided by working age population; multiplied by 1 for first and second quarter observations and by 0 for third and fourth quarter observations to form ER12; multiplied by 1 for third and fourth quarter observations and by 0 for first and second quarter observations to form ER34.

SOURCE:
Enrolments of population 14 years of age and over - RDX2 staff, Research Department, Bank of Canada.

$\frac{KY}{NPOP}$ First differences in real per capita personal disposable income; formed by dividing personal disposable income by the product of the Consumer Price Index and the non-institutional working age population.

SOURCE: personal disposable income - CANSIM, Matrix 1004, Series D 40057 consumer price index - CANSIM, Matrix 193, Series D 602001 working age population - CANSIM, Matrix 1800, Series D 755000.

NEI First differences in (the 19 quarter moving sum of immigration minus emigration, divided by total population).

SOURCES: immigration - CANSIM, Matrix 2, Series D 27
emigration - General Economic Statistics Book, Section Section III-7 Research Department, Bank of Canada
population - CANSIM, Matrix 1, Series D 1

S.E.E. - Standard error of estimate

D.W. - Durbin-Watson statistic
t scores in brackets beneath coefficients.

Predictive Tests

The predictive tests on the equations of each study consist of, first, the calculation of predictive errors from applying the parameters estimated for the 1953-67 period to 1968-73 data and second, the calculation of the Chow Test. The predictive performance of the models of disaggregated participation are also compared on the basis of the root mean squared predictive errors of each of their age-specific equations.

The results of plotting the residuals of the equations for the 1953-'67 period and the predictive errors for the 1968-'73 period are shown in Charts 1 to 4 (pages 46 to 57). These results indicate very clearly that the errors in prediction from these models are generally larger than those in the 1953-'67 period of fit and systematic. This key result applies to almost all the equations despite the fact that most of them meet the conventional criteria for judging equations, namely a high R^2. For example, in the Tella model the participation rates of girls 14-19 are generally underpredicted in a systematic fashion with larger errors than in the period of fit. Indeed for all age groups under 35 there is a pattern of underprediction in which the errors are both systematic and apparently larger than those of the 1953-'67 period. Conversely for those age groups over 44 there is a striking pattern of overprediction by the Tella equations.

Comparing the errors of prediction for age-specific equations between models reveals that the pattern of underprediction for women under 35 and overprediction for women over 44 evident in the Tella model is common to all the models. Thus, we observe a pattern in the errors of prediction between models in which the participation rates are systematically underpredicted or overpredicted for comparable age groups with errors generally larger than those in the 1953-'67 equations which are used to predict.

CHART 1

TELLA

RESIDUALS AND PREDICTIVE ERRORS

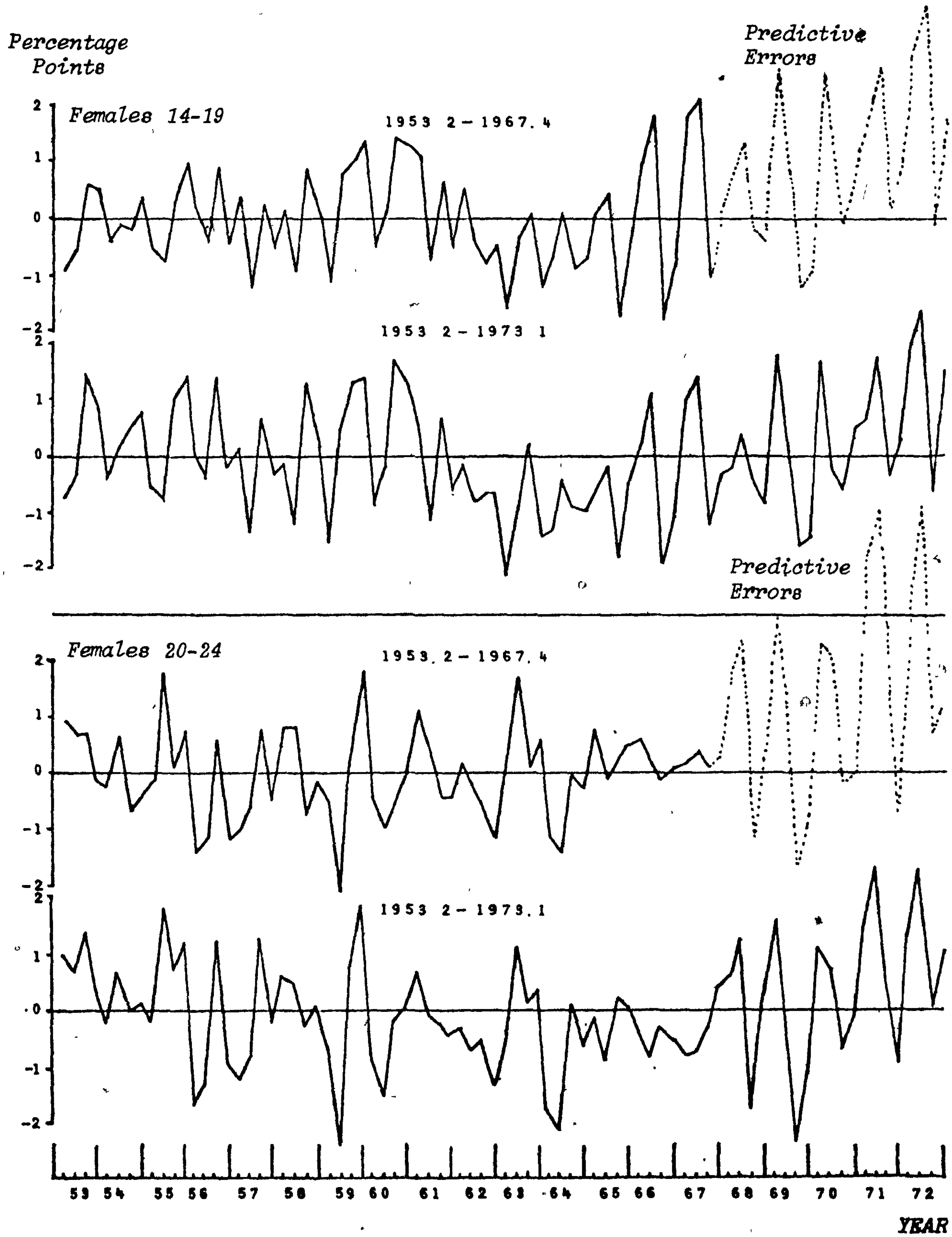


CHART 1

TELLA

(CONTINUED)

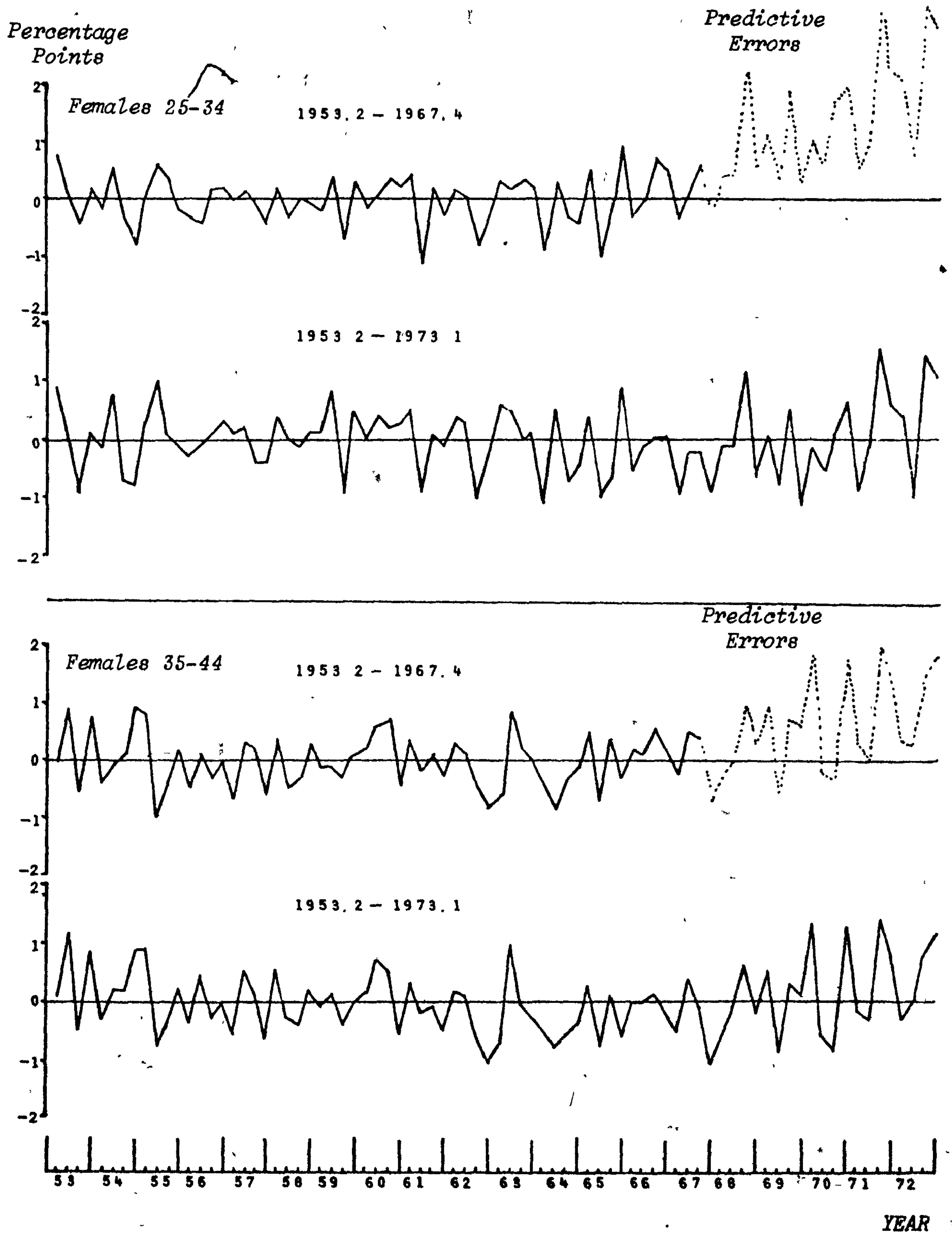


CHART 1

TELLA

(CONTINUED)

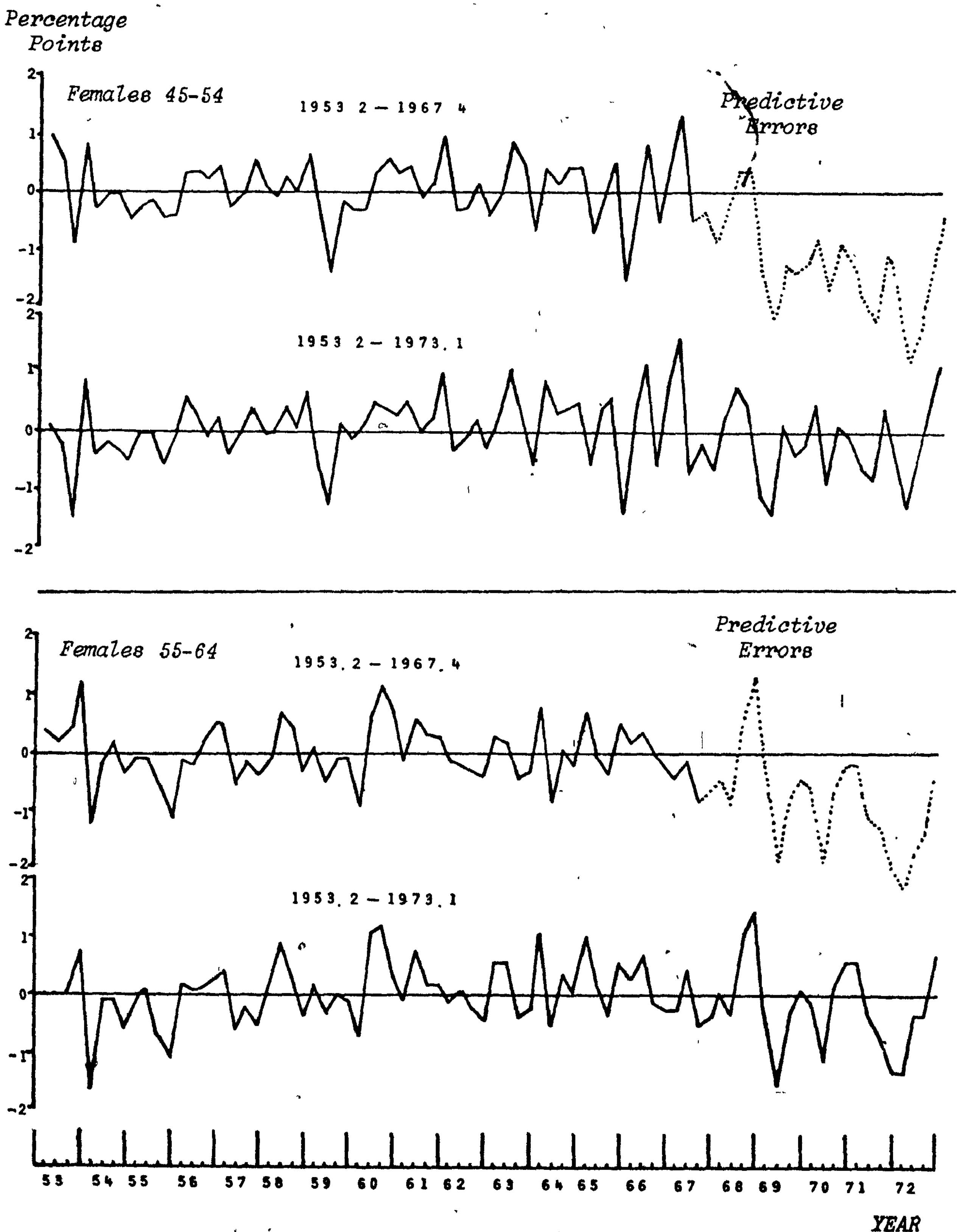


CHART 1

TELLA

(CONTINUED)

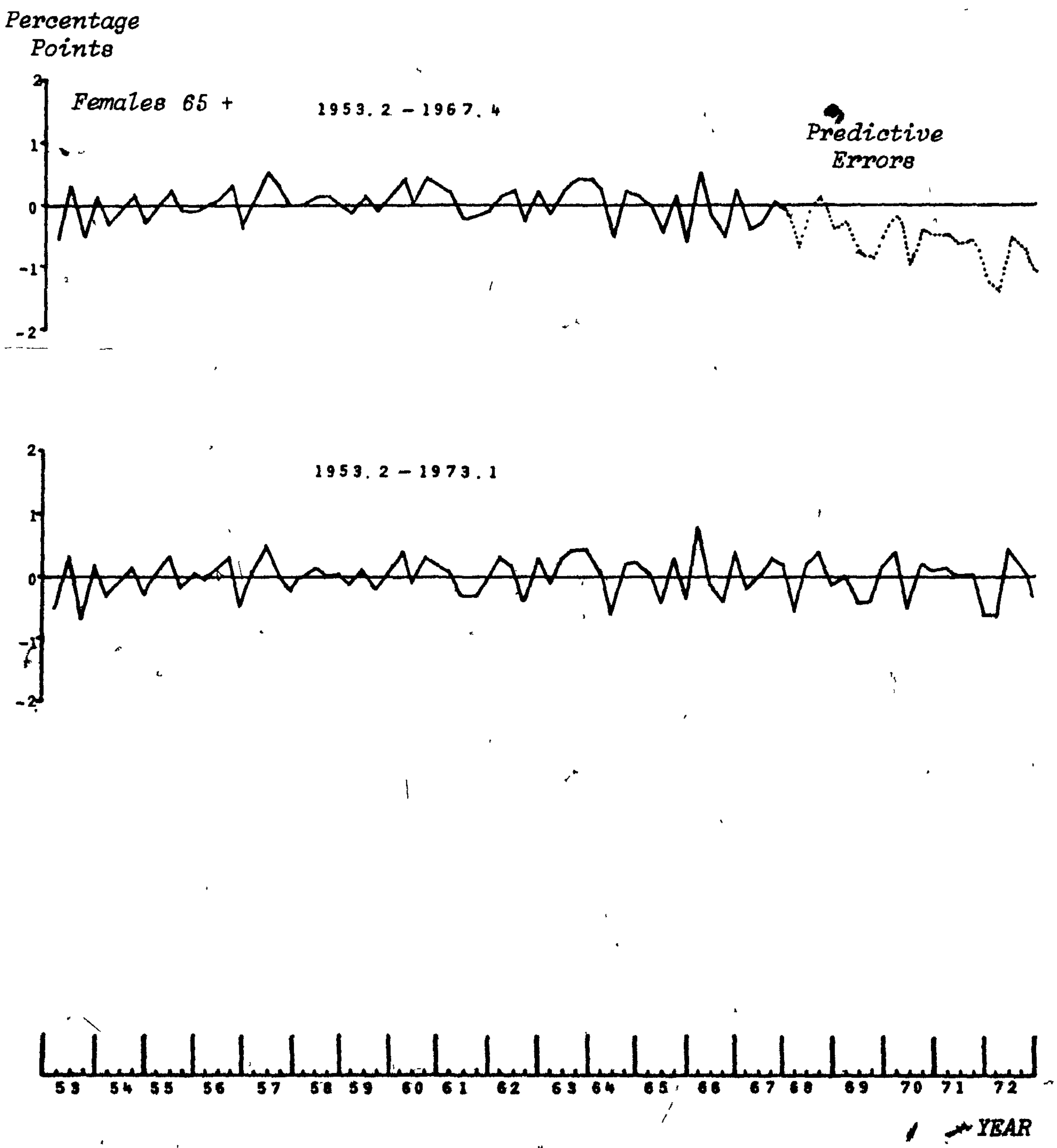


CHART 2

PROULX STUDY

RESIDUALS AND PREDICTIVE ERRORS

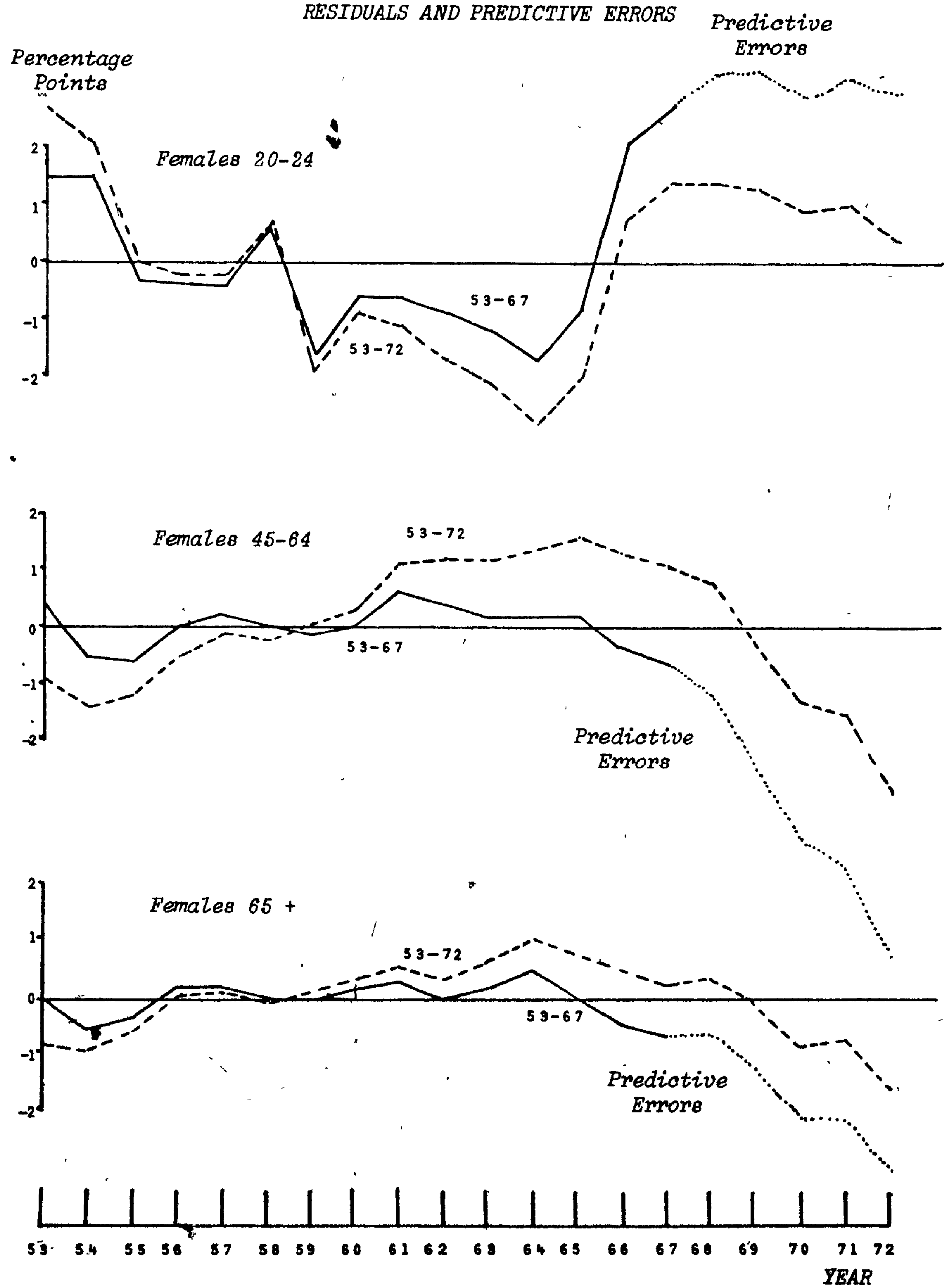
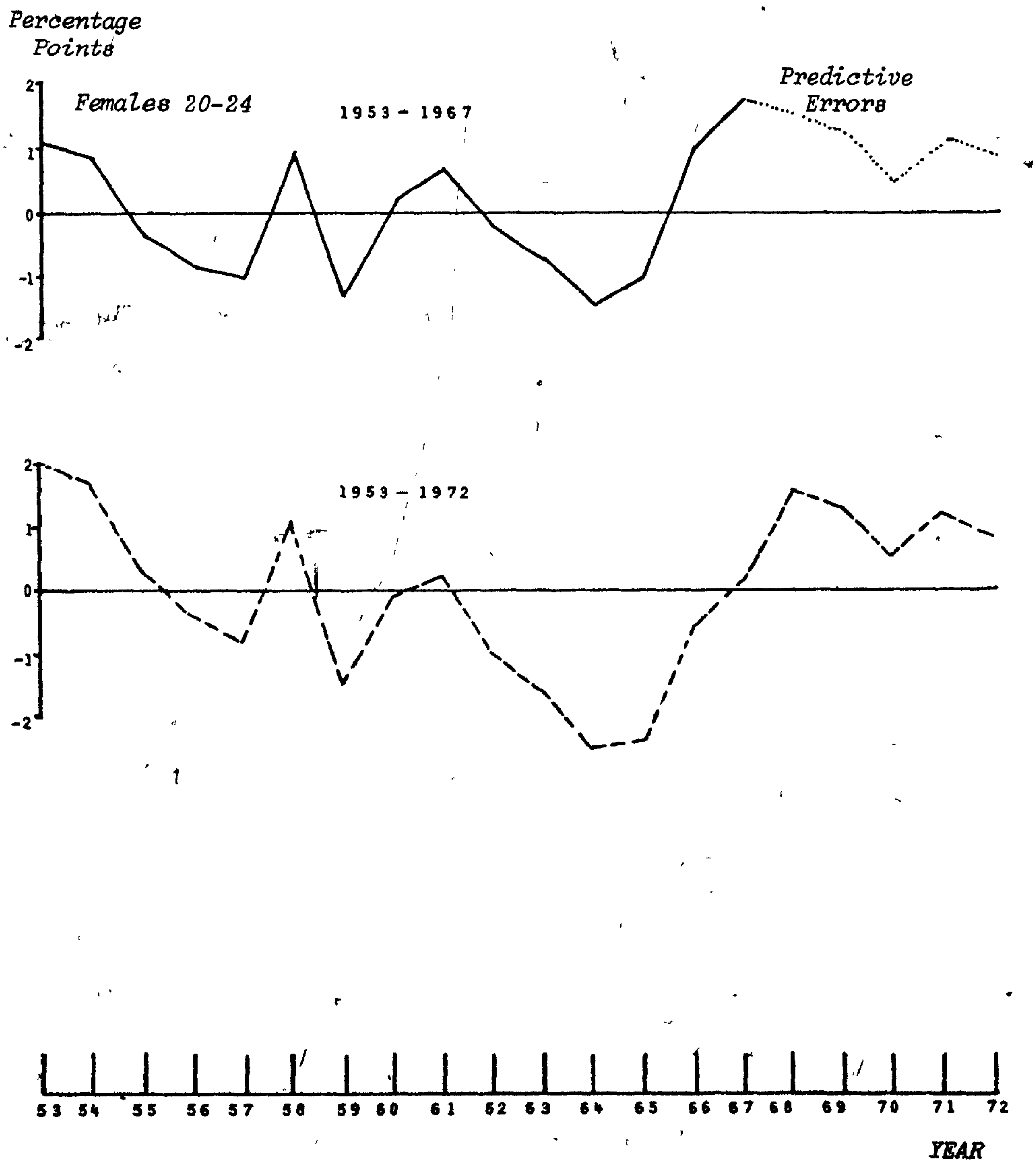


CHART 2

PROULX STUDY
(CONTINUED)

DEVIATIONS FROM TREND IN PARTICIPATION RATE USING C/P*



*C/P - UNEMPLOYMENT RATE OF MEN 25-44 YEARS.

CHART 3

OFFICER AND ANDERSEN

RESIDUALS AND PREDICTIVE ERRORS

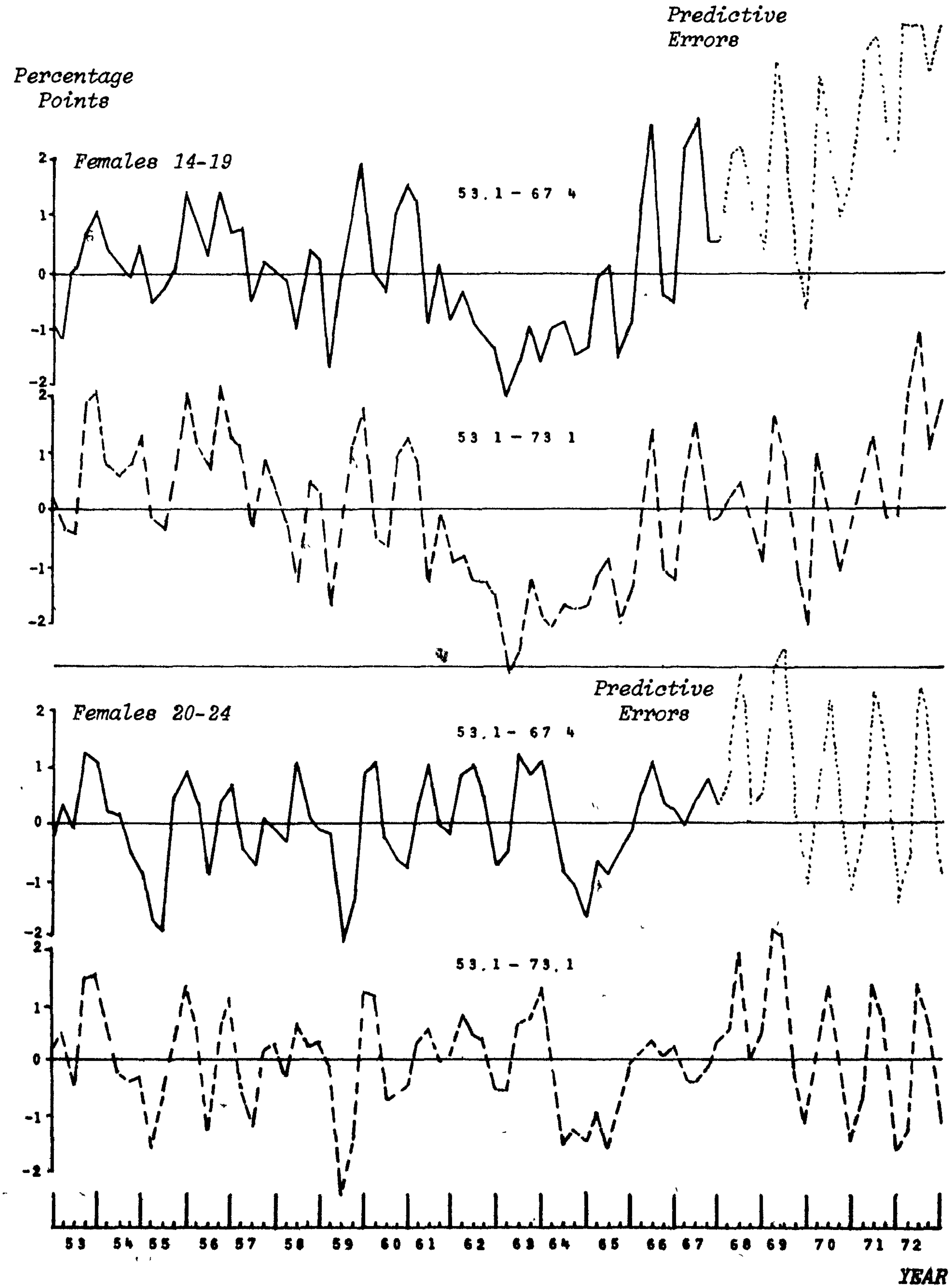


CHART 3

OFFICER AND ANDERSEN

RESIDUALS (CONTINUED)

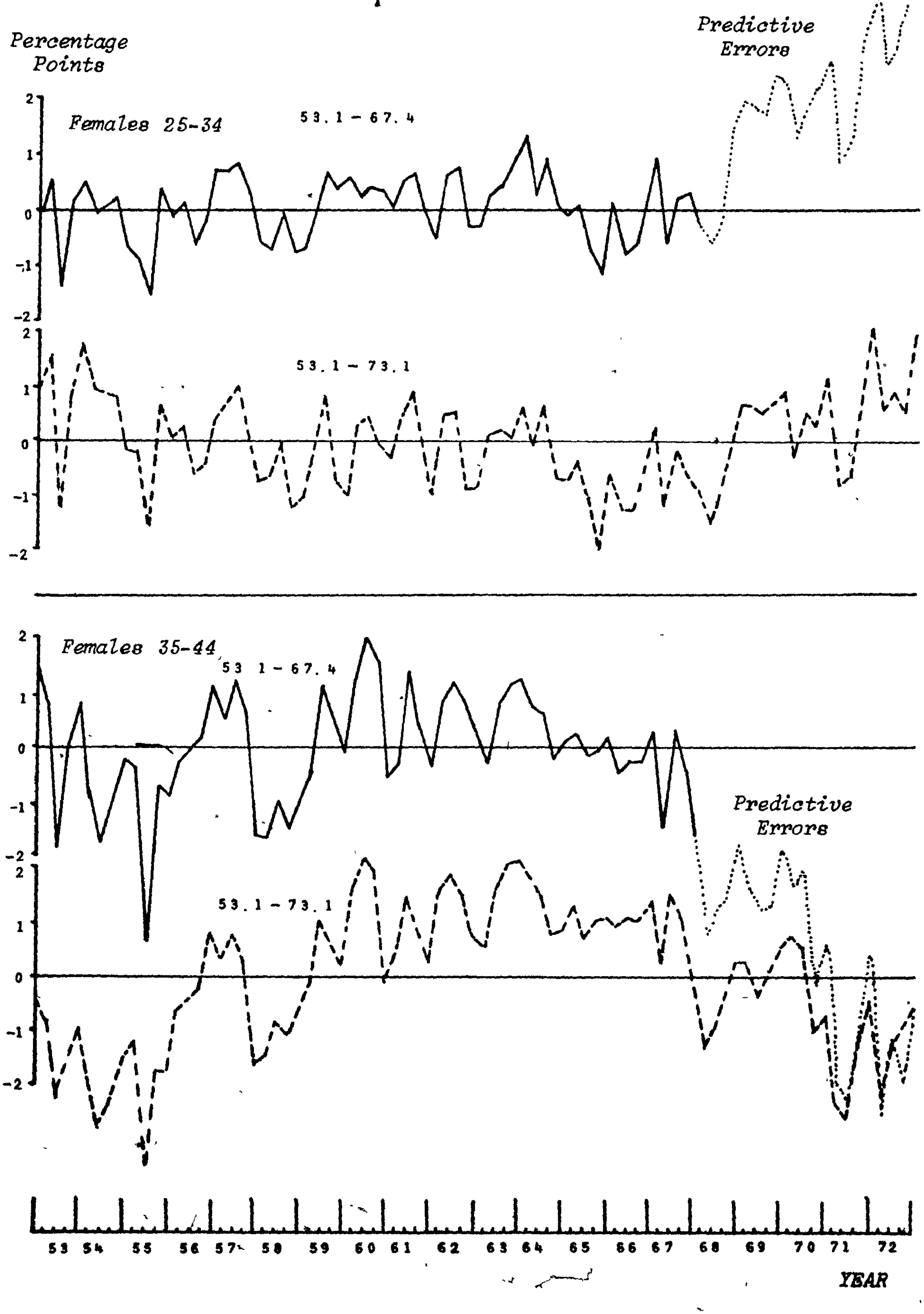


CHART 3

OFFICER AND ANDERSEN

(CONTINUED)

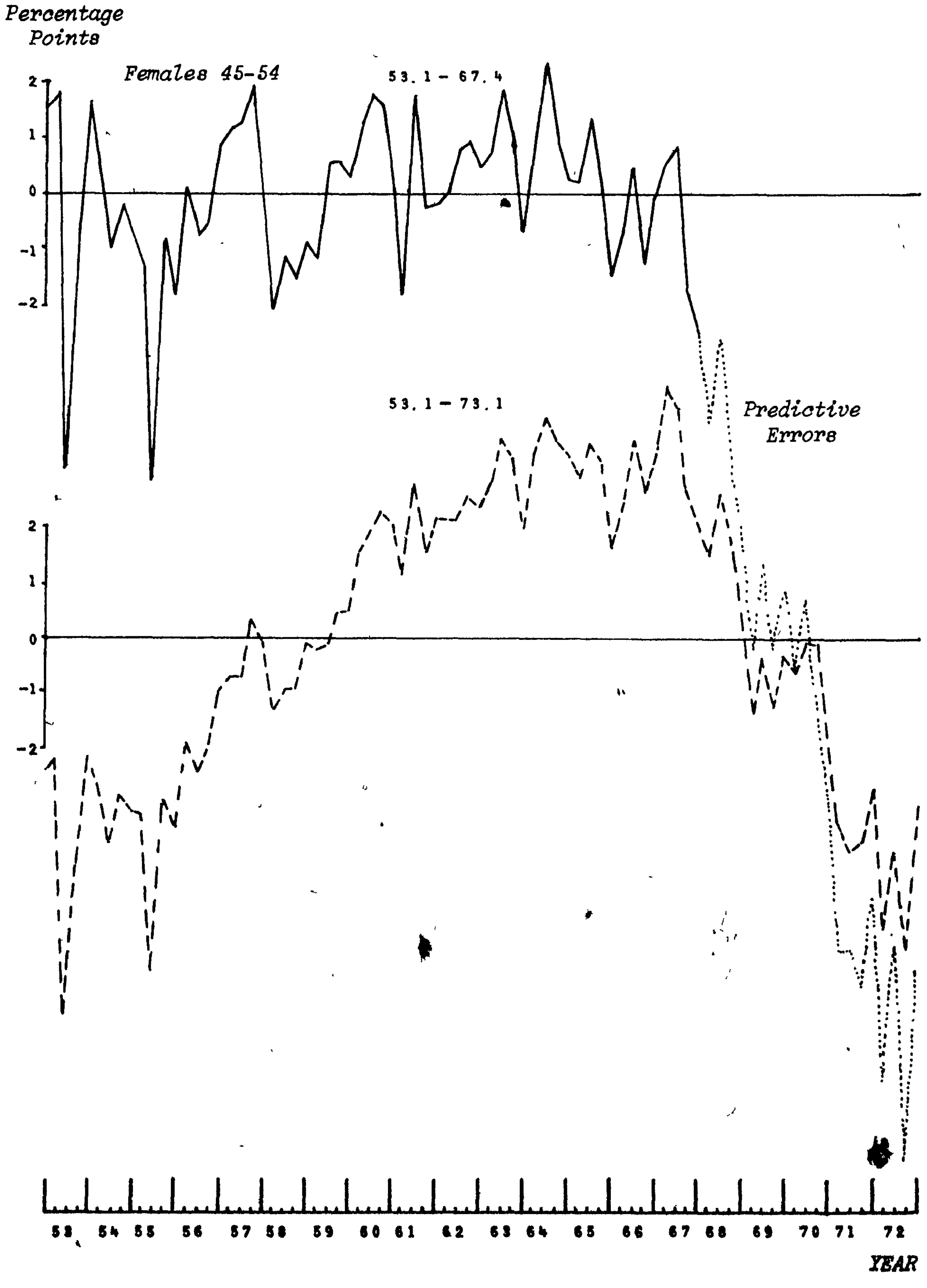


CHART 3

OFFICER AND ANDERSEN

(CONTINUED)

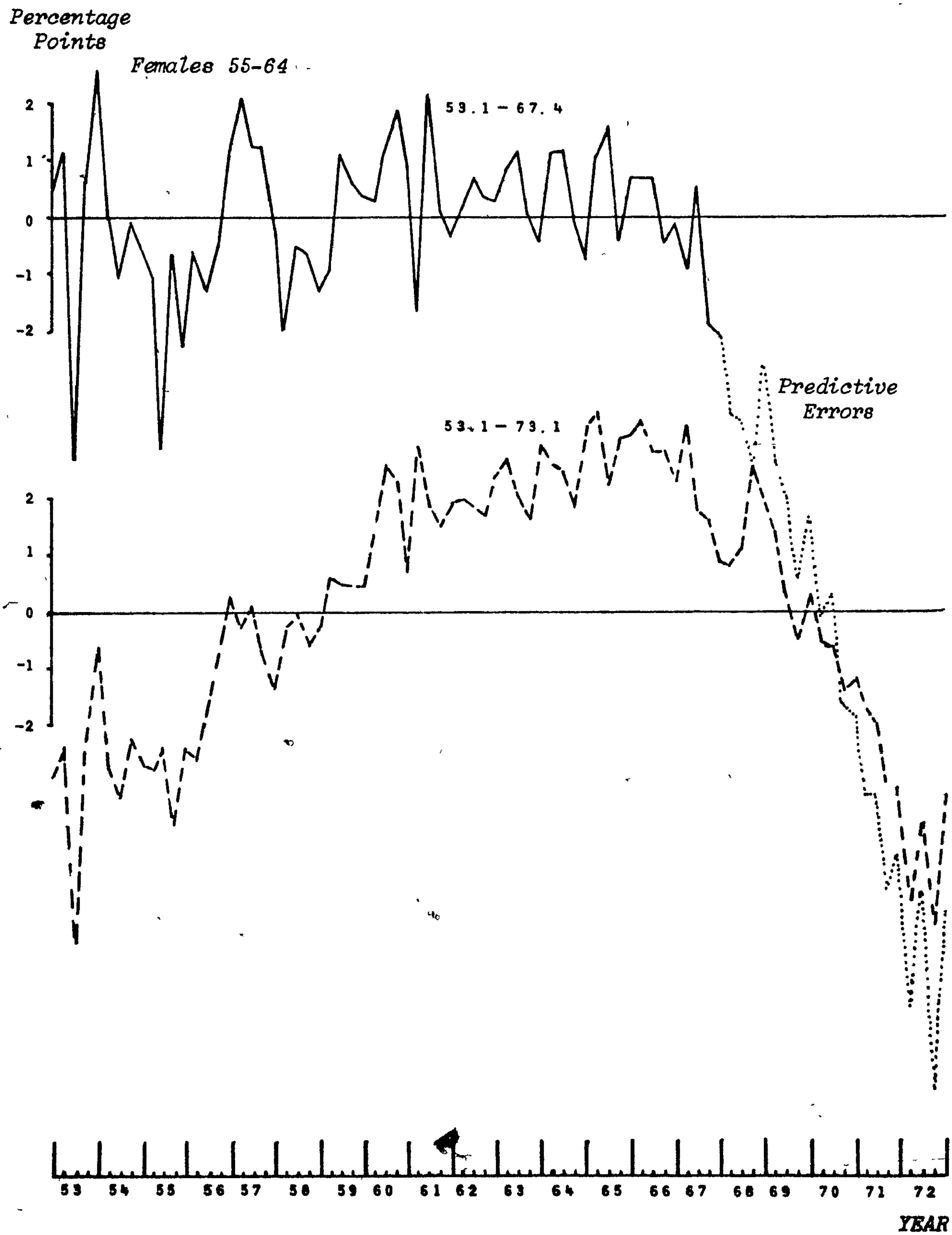


CHART 3

OFFICER AND ANDERSEN
(CONTINUED)

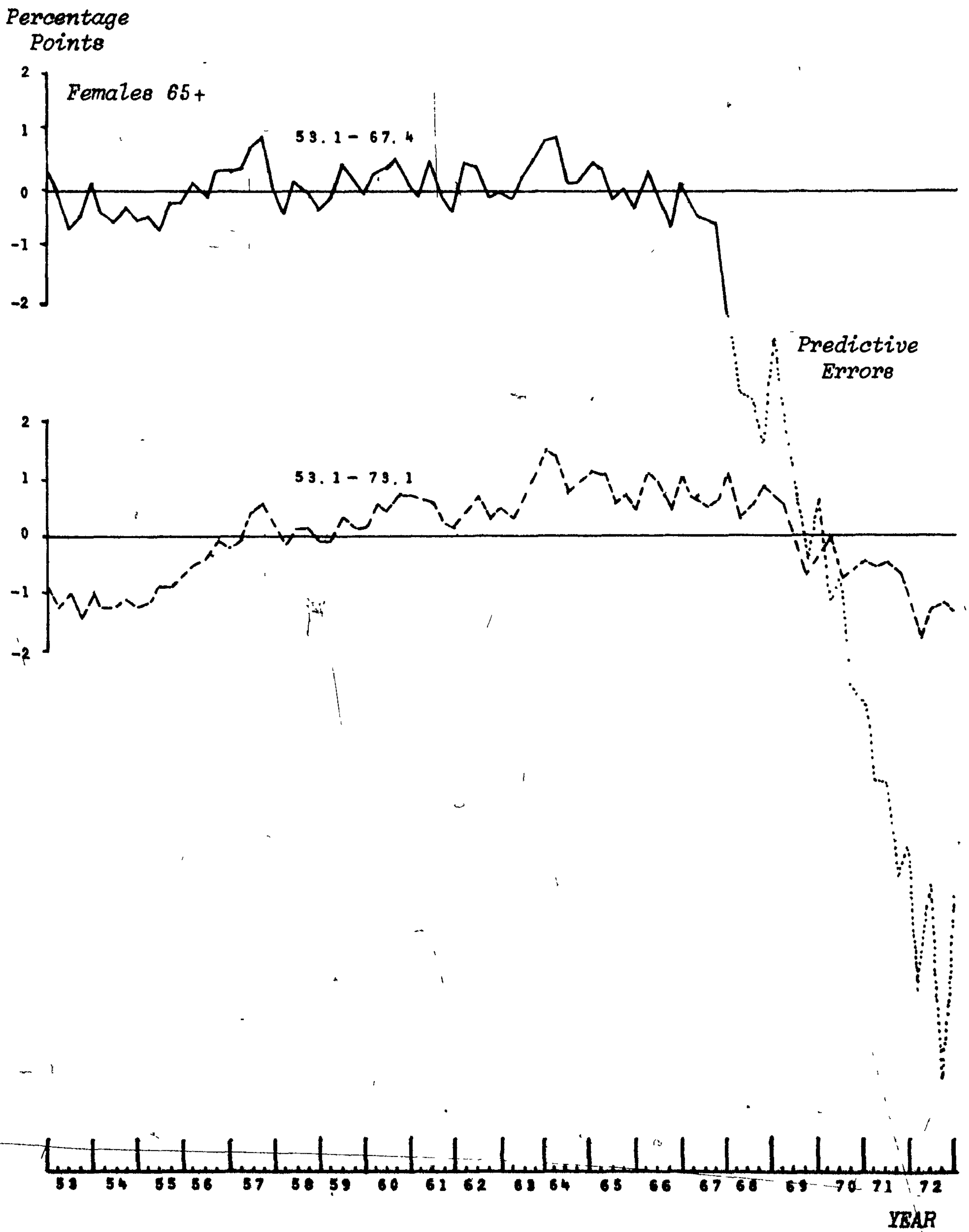
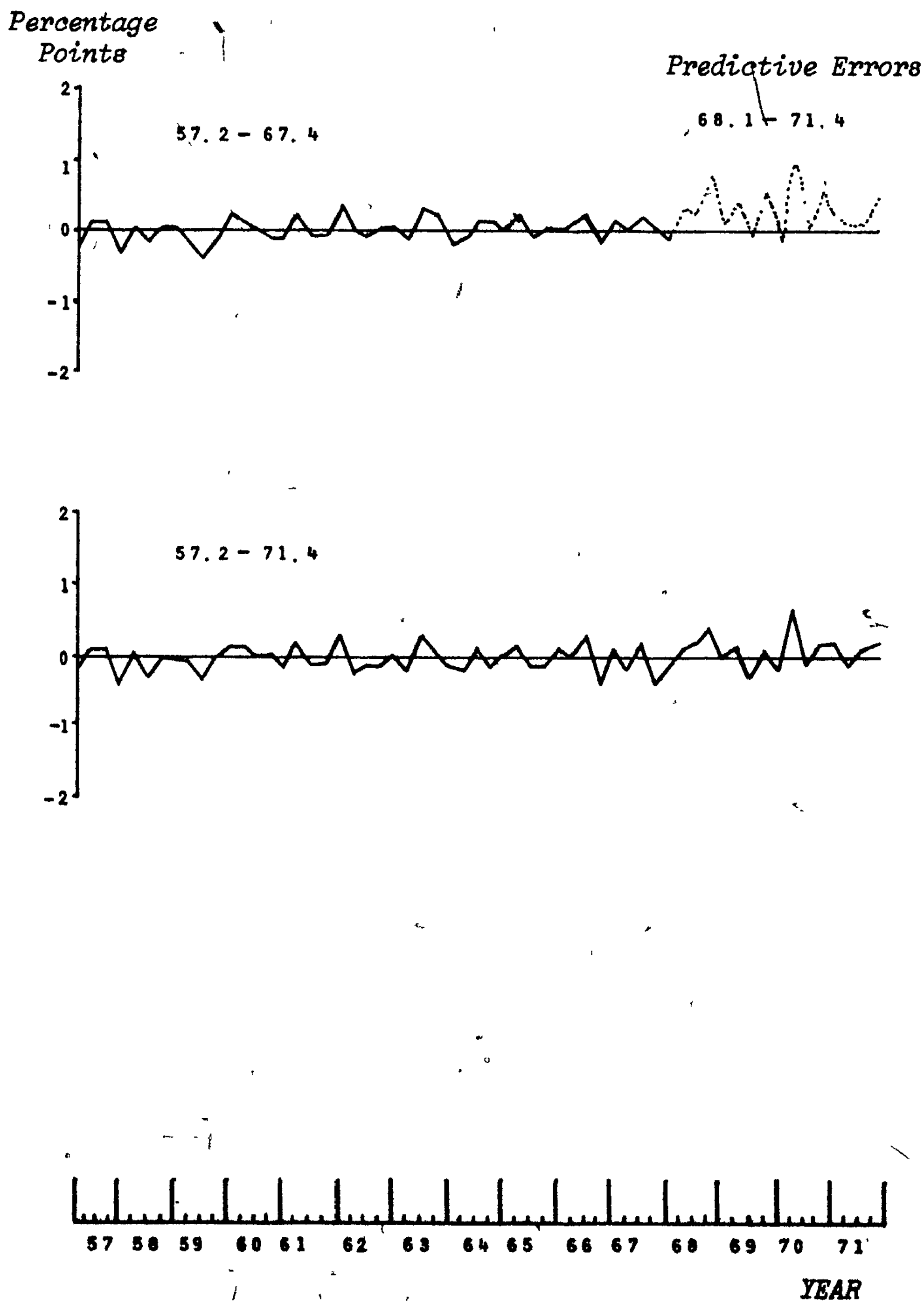


CHART 4

RDX2 EQUATION
RESIDUALS AND PREDICTIVE ERRORS
FROM EQUATION FOR FIRST DIFFERENCES
IN TOTAL PARTICIPATION RATE



In predicting the first differences in the total (male plus female) participation rate, the RDX2 equation displays a visible pattern of underprediction for the 1968-71 period 29/.

The results of the key Chow Test are shown in Table 5 (page 59). It is quite apparent that for all of the equations in each model (excepting Proulx's second 20-24 equation) the observed prediction errors are not random errors. For example in the Proulx study the critical value of the F-score is 3.34 while the calculated value for women 45-64 , shown in the extreme right column of Table 5, is 60.14. The non-random or systematic nature of the predictive errors can be due to a variety of causes. While it is not the intent to investigate these causes here, the equations in these models may never have reflected behavioural relationships present during the 1953-'67 period. Alternately, a structural change in the relationships between variables may have occurred during the 1968-'73 period.

When taking a close look at the coefficients of the equations for the 1953-'67 period and comparing them with the coefficients in the 1953-'73 equations, it becomes evident that there is a systematic change in the coefficients which is consistent with the observed pattern of residuals. The general rise in the magnitude of coefficients on cyclical variables in the 1953-'73 equations for younger women indicates an increased sensitivity of their participation rates to cyclical variations. Conversely, for older women the smaller coefficients in the 1953-'73 equations indicate a decline in the cyclical sensitivity of their participation rate.

29/ In the recently re-estimated version of RDX2 this equation has been re-specified.

TABLE 5

CALCULATION OF CHOW TEST FOR EVIDENCE OF STABILITY IN EQUATIONS

STUDIES	Sum of the Squares of Residuals Q_2		Q_1	k	n	m	n+m	$\frac{Q_2}{m+n-2k}$	$Q_3 = Q_1 - Q_2$	$\frac{Q_3}{k}$	$F = \frac{Q_3/k}{Q_2/(m+n-2k)}$
	53. - 67	68 - 72	53 - 72								
PROULX											F(3.34)*
Deviations From Trend 20 - 24	.0014735	.0000418	.003365	3	15	5	20	.0001082	-.001850	-.0006166	5.70
Levels 20 - 24	.002935	.0000073	.004556	✓	✓	✓	✓	.00021016	.0016137	.0005379	2.56
45 - 64	.00018511	.0000234	.002895	✓	✓	✓	✓	.00001489	.002686	.001343	60.14
65 +	.0001474	.00001352	.0009100	✓	✓	✓	✓	.00001149	.0007491	.000250	21.76
OFFICER AND ANDERSEN	53.1-67.4	68.1-73.1	53.1-73.1								F(2.23)*k=6 F(2.14) k=7
14 - 19	.007296	.000724	.013211	6	60	21	81	.0001162	.005191	.0008652	7.44
20 - 24	.003680	.000647	.007439	7	✓	✓	✓	.00006458	.003112	.0004446	6.88
25 - 34	.002220	.0009823	.005894	6	✓	✓	✓	.0000464	.0026917	.0004486	9.67
35 - 44	.006120	.000847	.014101	✓	✓	✓	✓	.0001009	.007134	.001189	11.78
45 - 54	.012323	.001011	.060477	✓	✓	✓	✓	.0001932	.047143	.007857	40.67
55 - 64	.0101456	.001175	.045523	✓	✓	✓	✓	.0001641	.034202	.0057004	34.74
65 +	.0009528	.000280	.004848	✓	✓	✓	✓	.00001787	.0036152	.0006025	33.72
TELLA											F(2.23)*
14 - 19	.00462	.00946	.000856	6	59	21	80	.000207	-.00552	-.000920	4.44
20 - 24	.00366	.000851	.00850	✓	✓	✓	✓	.000179	.003989	.000665	3.71
25 - 34	.00113	.000479	.00301	✓	✓	✓	✓	.000024	.001401	.000234	9.73
35 - 44	.00129	.00055	.00281	✓	✓	✓	✓	.000027	.000970	.000162	5.99
45 - 54	.00162	.00085	.00313	✓	✓	✓	✓	.000036	.000660	.000110	3.06
55 + 64	.00146	.00090	.00306	✓	✓	✓	✓	.000035	.00070	.000117	3.33
65 +	.00040	.00016	.00074	✓	✓	✓	✓	.000008	.00018	.000030	3.75
RDX2	0.95319	0.58613	2.46451	8	43	16	59	.035798	.92519	.11565	F(2.16)* 3.21

* 5% probability level that F will be exceeded.

Although it is evident that the models examined completely failed to pass the predictive tests, in some cases displaying exorbitant predictive errors, they were never-the-less compared to determine which displayed the best relative performace. This comparison was based upon the relative size of the root mean squared predictive error of each equation, a measure analagous to the variance as a measure of dispersion in conventional statistical analysis. The results of these calculations are shown in Table 6. For the age group 14-19 years, the Proulx equation containing the prime aged male unemployment ratio is superior, while for the 20-24 year age group, the equation from Officer and Andersen has the smallest average predictive error. For the remaining five age groups, however, the simply specified Tella model is clearly superior.

TABLE 6

COMPARISON OF ROOT MEAN SQUARED PREDICTIVE ERRORS

CALCULATED IN PERCENTAGE POINTS

Study / Age Group	14-19	20-24	25-34	35-44	54-54	55-64	65+
Tella	1.075	1.939	1.691	1.022	1.555	1.218	0.692
Officer and Andersen	2.957	1.629	2.424	4.161	10.509	8.711	2.878
Proulx	1.16*/ 3.48				3.90 (54-54 and 55-64 combined)		

* Equation using C/P instead of De as the labour market variable.

CHAPTER 6

CONCLUSIONS

The three key results arising out of the preceding analysis were as follows:

(1) the four models examined failed to pass the predictive tests performed on them;

(2) the equations of each model displayed systematic predictive errors; and

(3) the systematic pattern of predictive errors for each age group was common to all three disaggregated models.

One must conclude, on the basis of the first result, that these models provide no clear understanding of the factors underlying variations in female labour force participation. The fact that the equations do not fit the data for the 1968-'73 period in about the same way as they fit the 1953-'67 data leaves one questioning whether there was a structural change during the late 1960's, or whether the equations fail to reflect the behavioural relationships existing in the 1953-'67 period.

With regard to the second result, one may conclude that the systematic pattern of predictive errors in each equation reflects the inability of these models to capture either the marked slowdown in the growth of participation among older women or the acceleration in the participation among women 20-34 during the 1968-'73 period. The systematic underprediction of participation among young women may be due, in part, to the failure of these models to reflect the effect of a significant and unprecedented rise in their unemployment during the 1968-1972 period. For example the unemployment rate of women 20-24 rose from 3.2 percent in 1967 to 6.6 percent in 1972; for women 25-34 the increase was from 2.4 percent to 4.7 percent. The fact that the acceleration in participation and the rise in unemployment among young women began as early as 1968 or 1969 has implications for current research on the labour market effects of the 1972 changes in Unemployment Insurance regulations. Since the evidence in this paper indicates that these models do not satisfactorily explain female participation rates, other alternatives must be explored in an effort to isolate the effects of those factors which do account for the behaviour of female labour force participation before 1972 from the effects of Unemployment Insurance changes.

The third key result, namely that the systematic pattern of predictive errors for each age group was common to all the models, indicates that the concentration on cyclical factors in the models examined is not sufficient to explain female labour force participation. The problem common to each of these models may lie in their failure to take into account other important variables. A fact which is somewhat striking in a comparison of participation rate models using time-series analysis with those using cross-section analysis is that cross-section analyses generally rely on a much broader range of variables. For example, in Spencer and Featherstone 30/, the authors include such income-wealth variables as debt, assets, and total income of the family excluding wife's earnings, the labour force status of the husband and child status by age of children. In other cross-sectional studies by Allingham 31/

30/ Married Female Labour Force Participation: A Micro Study, Dominion Bureau of Statistics, Special Labour Force Studies, Series B, No.4, by Byron G. Spencer and Dennis C. Featherstone (Ottawa: Queen's Printer, 1970)

31/ Dominion Bureau of Statistics, Special Labour Force Studies, No.5, Women Who Work: Part 1, The Relative Importance of Age, Education and Marital Status for Participation in the Labour Force, by John D. Allingham, (Ottawa, Queen's Printer, 1967).

and Allingham and Spencer[32/] factors such as educational attainment, child-bearing status, marital status and residence are examined for their effect on female labour force participation. In addition, perhaps variables such as the birth rate by age group[33/] and housing costs might play an important role in determining the participation rates of younger female age groups - the birth rate having a negative influence on participation and housing costs possibly having a positive influence, particularly among women in their late 20's and early 30's, the age when the size of their families and their demand for housing space have tended to reach a maximum.

While the cross-section studies may not provide all the answers for explaining female participation rates they do suggest the importance of other variables[34/]. Clearly the periods of estimation used in the studies examined are so long that one cannot ignore both demographic and socio-economic changes which occurred. The key point is that the heavy reliance placed on cyclical variables to the exclusion of demographic and socio-economic variables in the studies examined would seem to be inappropriate. That is to say, while cyclical variables are important, other variables must be taken into account in order to isolate the effect of cyclical variables.

32/ Dominion Bureau of Statistics, Special Labour Force Studies, Series B, No. 2, Women Who Work: Part 2, Married Women in the Labour Force: The Influence of Age, Education, Child-Bearing Status, and Residence, by John D. Allingham and Byron G. Spencer, (Ottawa: Queen's Printer, 1968).

33/ While the total birth rate is included in the Officer and Andersen study there are major differences in the rate between particular age groups.

34/ Predictive tests were not made on the cross-section studies mentioned here because of the difficulty in obtaining the complete range of data used by the authors.

After evaluating the performance of four models of labour force participation in Canada, one may conclude that public policy cannot be based on evidence arising out of the approaches taken in these models. Clearly the results of testing these models indicate that significant elements of the female participation decision are left unexplained. A clear understanding of the female labour force participation decision has important implications for several issues of public policy. The estimation of the net number of hidden unemployed or additional workers present during a particular phase of economic activity is essential to the formulation of appropriate economic policies. For instance, if policy planners could estimate reliably the number of additional workers among the unemployed during a recessionary period, they would be able to gear economic policy toward a particular unemployment goal without the risk of overheating the economy. However, without isolating the net impact of cyclical economic activity from other demographic and socio-economic factors acting on labour force participation, one cannot reliably estimate what impact a particular set of economic policies will have in reducing unemployment. Likewise, when assessing the impact on labour force participation of recent changes in the unemployment insurance program, one must have a clear understanding of what other factors are operating on participation in order to isolate the impact of changes in the unemployment insurance program from these other factors. The results of this thesis suggest that we do not currently possess this knowledge.

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