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Cyclical and Demographic Factors in the Canadian Labour Market

by

(C) Jorge L. Canales

A THESIS

SUBMITTED TO THE FACULTY OF GRADUATE STUDIES AND RESEARCH

IN PARTIAL FULFILMENT OF THE REQUIREMENTS FOR THE DEGREE

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To K., J.A. and K.A.
who decided to trust
and share the uncertain
outcome of this adventure.

ABSTRACT

This dissertation provides evidence on the relative importance of demographic, cyclical and other factors in the explanation of the changing structure of employment and earnings in the Canadian labour market by examining the experience of fourteen age-sex labour groups over the last three decades.

A distinctive feature of this study is its departure from the traditional practice of analyzing the labour market without reference to changes in its supply side. A changing demographic composition especially raises questions concerning the employment, unemployment and earnings consequences for a cohort of workers of its changing size as well as any economy wide effects.

Since cyclical fluctuations in economic activity exercises their influence through both the demand and supply sides of the market, this study is also aimed at examining the simultaneous effects of the business cycle on the employment, labour force participation and relative earnings of individual groups and on the overall indices of market performance.

Separate models for employment and earnings behaviour are defined, with general specifications common to all age-sex labour groups. This parsimonious criteria in modelling is justified in view of the variety of problems posed by the high level of disaggregation employed in the analysis, the likely simultaneity involved in the determination of all

variables of interest and specific factors affecting the experience of each labour group.

The cyclical and demographic impacts on the groups' employment and unemployment rates are first modelled through an indirect approach that estimates employment and labour force participation equations jointly for each labour group. A separate examination of changes in the age-sex structure of relative earnings, earnings differentials and the extent of substitution among labour groups is then undertaken.

Estimates from the employment and labour force participation equations confirm the dominant cyclical features of the Canadian labour market and the need for a joint examination of these variables for individual groups. Misleading conclusions on the importance of business cycles are likely to be drawn if employment/unemployment rates are to be explained in isolation (they are rather inflexible to cyclical changes), since a pro-cyclical labour force participation behaviour across groups is found. The dominant *discouraged* worker effect suggests that the overall officially reported unemployment rates are biased downwards in periods of economic slack.

Demographic factors, as measured by the group's relative population, are found to have a negative impact on employment rates; thus, groups in relative (demographic) excess supply see their employment positions deteriorate. For the market, these estimates suggest that since the mid-1960's about 1.7 percentage points of the overall unemployment rate can be attributed to the changed demographic composition.

Institutional rigidities and lags in response prevent the price system from playing an active role in clearing imbalances between supply and demand of labour across groups. This assertion is confirmed by the generally insignificant impact of changing relative wages on groups' employment rates. With regard to labour force participation, however, some important regularities by sex are evident, i.e., male participation is dominated by the income effect while the substitution effect dominates the female decision to participate in the labour market.

The estimated models for the structure of earnings confirm that age-sex earnings differentials are sensitive to the state of the business cycle. These differentials tend to decrease over the peak of the cycle, with older and young male workers benefitting most from improved economic conditions. These findings are further confirmed by an estimated degree of substitution among workers which suggests that young and older males can be considered closer substitutes for prime-age male workers and middle-aged females are their best complements. These findings also support the hypothesis that a segmented labour market by sex and age prevails in the Canadian context.

The *overcrowding* demographic hypothesis receives strong support from the estimated results; that is, the evidence shows that increases in the relative size of a cohort of workers worsen its relative earnings position.

The results of this study suggest that changing demographic composition of the labour force (towards younger and female workers) have aggravated the current labour market problems, i.e., structural and cyclical features of unemployment have been enhanced, the natural unemployment rate has increased and the relative earnings of groups in relative excess supply has deteriorated.

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I. Introduction

In recent years increasing research effort has been devoted to understanding and explaining major developments in labour market performance. This interest is in part the consequence of the wide macroeconomic use of reported labour market indicators, i.e. employment and unemployment rates, indices of wages or/and earnings, etc. In fact, these indices are regarded not only as proxies for the tightness or loseness of labour markets, but they are often interpreted as proxies for overall economic performance. In other words, they are employed as measures of the degree of hardship in the population, loss in production and as key elements in discussing central questions of stabilization policy (including the trade-off between inflation and unemployment).

The above considerations make essential the understanding of how the labour market has evolved over time and how particular labour groups have reacted to changing economic and non-economic conditions. The identification of individual groups of workers and their relative experience is central to the design of policy and specific programs. If these programs, aimed at ameliorating the situation of some labour groups are to be efficiently implemented, the exact identification of target groups is crucial to ensure a correct allocation of resources.

A disaggregated analysis of the labour market by groups of workers is also suggested by theoretical and empirical research. Indeed, the non-homogeneous character of labour inputs may lead to different responses to either supply or demand shocks determining a particular structure of employment, unemployment and productive rewards. This changed composition, in turn, affects the reported overall indices of market performance and makes them meaningless and only weakly comparable over time, since a different significance can be attached to them due to the diverse *quality* involved in each particular situation. Thus, depending on the purposes considered, these indices and their meaning become questionable over time.

In discussing the main observed changes in employment, unemployment and earnings of the workforce, several hypotheses have been suggested in the literature. Most of them are related to specific aspects of interest which have not always been examined within a consistent general equilibrium framework. Nevertheless, among the main determinants of the performance and structure of labour market variables over time, the attention of researchers has been captured by the impact of the following factors:

a) Cyclical fluctuations in economic activity

b) Changes in the demographic composition of the labour force

c) Other socio-economic and institutional changes

The aim of this dissertation is to examine the relative contribution and validity of the above factors in light of the Canadian labour market experience of the last three decades. The emphasis is placed on the examination of their effects on the employment, unemployment, labour force participation and earnings of the various age-sex groups in the workforce.

The demographic disaggregation of labour inputs is considered to provide a more homogeneous categorization for workers having similar patterns of empirically observed behaviour. Demographic segmentation has been upheld in the literature as it has been found that it provides good proxies for a wide variety of behaviour and differences in human capital. In addition, it provides information on those groups of the population that can be clearly identified towards which policy measures can be guided and implemented.

This dissertation examines first, in Chapter II, the theoretical aspects of the labour market functioning that give support to the main hypotheses postulated in the literature. A simple labour market model is first developed so as to illustrate the main explanatory factors involved in the determination of employment and earnings over time. The consequences of heterogeneous labour are examined within that framework. Then, theoretical and empirical evidence is presented for a demographic segmentation of the workforce. In the last section a review of the main hypotheses suggested in the literature and their implications is accomplished.

In Chapter III, the historical record is reviewed. Changes in the size and composition of the labour force, population of working age and participation rates are first examined. Next, the focus is on the changes experienced by the employment and unemployment structure and, last, the transformations occurring in the relative earnings structure.

Chapter IV focusses on the joint determination of employment, unemployment and labour force participation. An examination of the relationship between the various labour market indices of performance is undertaken first, Models of employment and labour force participation, suitable for empirical purposes are then defined and results based on alternative techniques are presented and discussed.

The empirical examination of changes in the earnings structure, as a consequence of cyclical, demographic and other factors is considered in Chapter V. Age-sex differentials over time and the presence of market rigidities are first modelled and estimated. Labour-labour substitutability and relative earnings are examined within the framework of a production function. Alternative specifications are estimated and their results discussed.

The final Chapter summarizes the main empirical findings of the research and discusses some limitations and implications for policy purposes. It also suggests some directions for future economic research on this topic.

II. Theoretical Framework and Hypotheses

This Chapter reviews the main hypotheses suggested in the literature regarding the determinants of changes in the employment and earnings structure of the labour market over time.

An overview of the traditional neoclassical approach to the determination of wages and employment is discussed first, since it provides a useful and consistent theoretical framework that gives support to these hypotheses. A simple aggregate model of the labour market is specified and alternative results for the structure of earnings and employment are discussed when heterogeneous labour inputs are considered.

Section two reviews the arguments for a disaggregated analysis of the labour market based on various types of workers. The considerations relevant to the classification of labour according to the main demographic characteristics, age and sex, are discussed.

The final section summarizes the main working hypotheses suggested in the literature and their implications for the earnings, employment and participation behaviour of the workforce. These hypotheses include their response to cyclical fluctuations in economic activity, a changing demographic composition of the population and other factors that are likely to have played a significant role over time.

A. Aggregate and Heterogeneous Labour in the Labour Market

To highlight some of the causative factors involved in the explanation of the changes occurring in labour market behaviour over time, a simple aggregate model is developed first. The implications of this model are then qualified when the presence of heterogeneous labour is assumed. Under this assumption richer explanations for changes in the *structure* of employment, unemployment and wages can be drawn.

1. A Simple Aggregated Model of the Labour Market

Following the neoclassical tradition, consider a simple equilibrium model where the interactions of the labour supply and demand schedules determine the levels of employment and real wages in each period of time.

A typical representation of the aggregated labour market can be depicted by the following system of equations,

Labour Supply:

1) $S_t = \alpha W_t + s(t)$

Labour Demand:

2) $D_t = -\beta W_t + d(t)$

Wage Adjustment Mechanism:

$3)\ \dot{W}_t = -\eta(S_t - D_t)$

where, variables S and D represent the quantities of labour supplied and demanded; W the level of real wages. A dot over a variable denotes its change over time, i.e. $\dot{X}=\delta X/\delta t$. Exogenous factors provoking shifts over time in the supply and demand schedules are included in s(t) and d(t). The coefficients α and β measure the wage response of supply and demand and η is a coefficient representing the speed of wage adjustment to market disequilibrium.

By combining 1) and 2), the prevailing level of unemployment in the market, at any moment t, can be expressed as follows,

Unemployment Level:

$4)\ U_t = (S_t - D_t) = (\alpha+\beta)W_t + s(t) - d(t)$

If the change in unemployment over time is considered, then 4) becomes,

Unemployment Change:

$5)\ \dot{U}_t = \delta(S_t - D_t)/\delta t = (\alpha+\beta)\dot{W}_t + \dot{s}(t) - \dot{d}(t)$

or, substituting from 3) and 4),

$5')\ \dot{U}_t = -\eta(\alpha+\beta)U_t + \dot{s}(t) - \dot{d}(t)$

The above equations clearly show that changes in unemployment (and employment) depend upon not only on the degree of responsiveness of demand and supply of labour with respect to wages, i.e. coefficients α and β, and the degree of flexibility of wages, $\dot{W}$, but also on the relative shifts experienced by both schedules over time.

In particular, if in certain periods the market is dominated by exogenous outward shifts in the supply side, i.e. $\dot{s}(t)-\dot{d}(t)>0$, there will be forces driving the observed unemployment to higher levels. Conversely, when the market is dominated by outward demand side shifts, i.e. $\dot{s}(t)-\dot{d}(t)<0$, a lower pressure on unemployment would exist and its observed level is likely to decline. The actual changes in unemployment depend crucially on the degree of flexibility exhibited by wages, i.e. on the size of the adjustment coefficient η

With perfectly flexible wages ($\eta \to \infty$) no permanent changes in the level of unemployment occur, since as a consequence of imbalances between supply and demand, equilibrium in the market is restored through instantaneous price adjustment, i.e. a relative excess supply of labour would imply a lower wage level ($\dot{W}<0$) and no changes in unemployment ($\dot{U}=0$). At the other extreme, with wages perfectly inflexible ($\eta \to 0$, which implies $\dot{W}=0$), any imbalance in the market would only be cleared by variations in unemployment.

The market's long run equilibrium solution, i.e. when no further changes in unemployment occur, can be characterized by a certain level of unemployment known as *natural*, or *frictional*. Setting $\dot{U}=0$ in 5') yields the result,

Natural Unemployment Level:

6) $U^n_t = (s^n(t)-d^n(t))/(\alpha+\beta)\eta$

and, substituting in 3), yields the *natural* rate of change in wages,

Natural Change in the Wage Rate:

7) $\dot{W}^n_t = -\eta U^n_t$.

The *natural* level of unemployment in the long run is consistent with the steady state path of growth followed by the demand and supply schedules, i.e. ($s^n(t)$ and $d^n(t)$). Its existence ($U^n > 0$), it is argued, represents only *frictional* unemployment, which can occur even in a well functioning labour market.[1]

1.1 Institutional Rigidities and Wage Adjustments

The existence of institutional rigidities in the market, such as minimum wage and job security legislation, the increased degree of unionization, and any recognition and response lags of the agents involved in the market, generate a sluggish adjustment in the market clearing mechanism. The higher the level of rigidities, the lower the degree of flexibility of wages to adjust imbalances occurring in the market.[2]

Thus, in the presence of institutional rigidities, shifts in either the supply or demand schedules out of

---

[1] In other words, this is the case usually associated with job search activity within a labour market. Unemployment might exist even if jobs and idle workers are matched, in the sense that there exists an equal number of willing and qualified workers to fill the available number of job vacancies, but they simply have to be brought together.

[2] This situation is reflected in values closer to 0 for the speed of adjustment coefficient, i.e. $\eta \to 0$ in 3) and subsequent equations above.

their steady state path will tend to be reflected in slower wage changes and increased short and long run unemployment, with observed unemployment at a higher level than otherwise would be, i.e. higher than its *frictional* level.

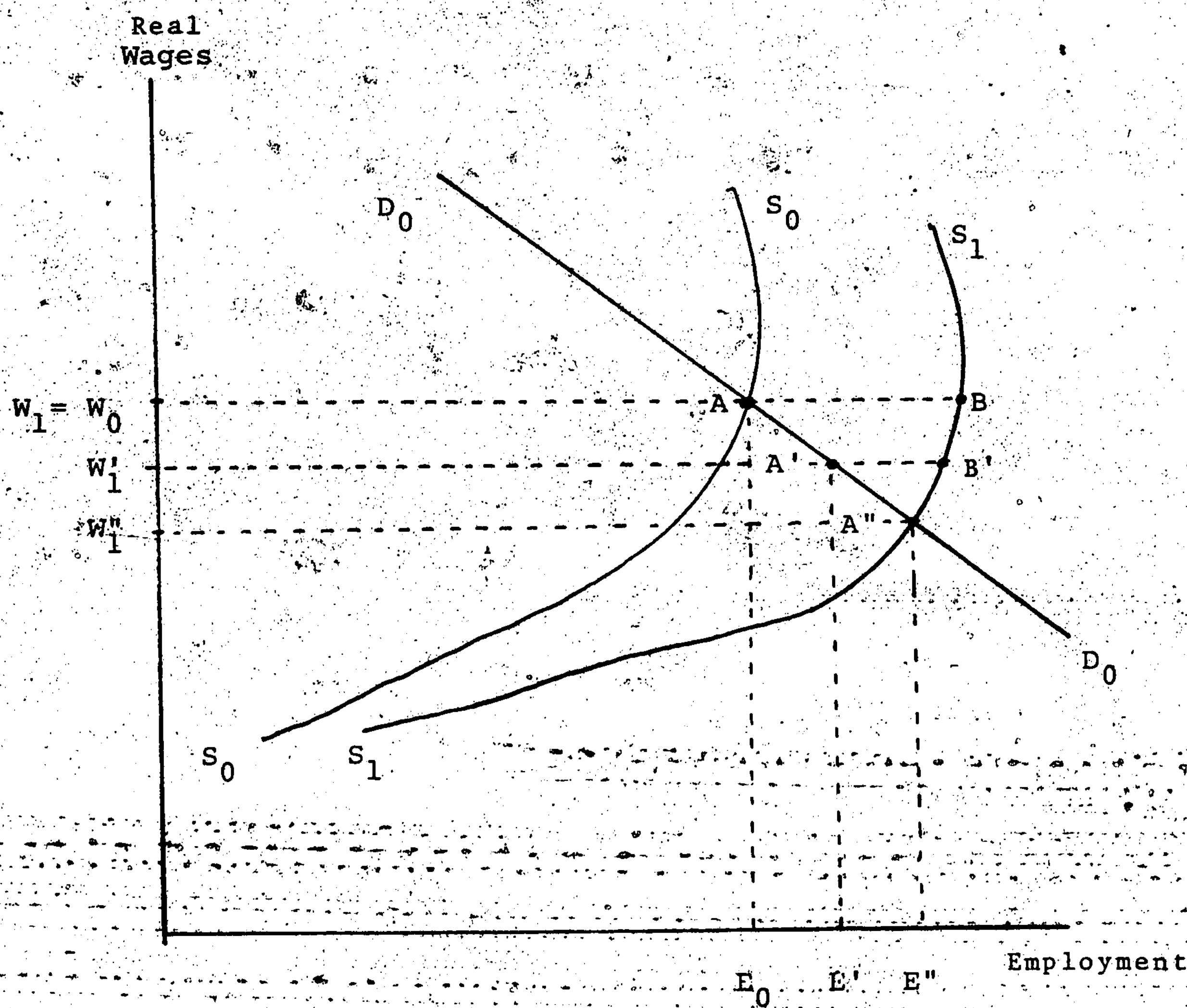
Instantaneous price adjustments to restore equilibrium in the market are only possible in the absence of these rigidities ($\eta \to \infty$). In this case no unemployment could ever be observed, at least no unemployment over the *frictional* level, since the responsibility of clearing temporary imbalances in the market would rely entirely on the price mechanism, with wages flexible enough to move to the necessary level to ensure a new equilibrium.

Figure II.1 illustrates alternative results for wages and unemployment when an exogenous shift in supply is assumed, i.e. the supply schedule moves outwards as a consequence of increased working age population or a greater participation rate and the market is characterized by different level of rigidities, i.e. $\eta=0$, $\eta \to \infty$ and $0 < \eta < \infty$.

An initial equilibrium in the market is assumed, described by point A, with demand and supply schedules given by D_0 and S_0, and level of wages and employment W_0 and E_0 respectively.[3] After the exogenous shift in supply occurs, moving S_0 outwards to S_1, the market can

[3] For the sake of clarity the Figure assumes a nul level of frictional unemployment.

FIGURE II.1 Wage Adjustment Rigidities and Unemployment



reach a new equilibrium characterized by:

1. point A", with a low level of wages (W''_1) and no unemployment, situation that is compatible only with absolute wage flexibility and no rigidities ($\eta \to \infty$) or,
2. original point A, when $\eta=0$ holds, implying that no wage adjustments are possible and no employment gains occur. Unemployment would ultimately increase by the total amount of the shift in the supply schedule (AB), or most likely,
3. point A', where a lower level of wages ($W'_1 < W_0$) and positive unemployment (A'B') occur; the actual size of the adjustments required by both variables depends upon the wage responsiveness of the demand and supply curves, as given by their respective slopes or elasticities. This outcome is the most realistic one given the existence of some, but not extreme rigidities in the market, i.e. with $0 < \eta < \infty$.

2. Heterogeneous Labour and Substitution

Consider now the existence of different types of labour inputs. In this case the resulting *structure* of employment, unemployment and earnings, as a consequence of exogenous shifts in demand and supply schedules, will depend crucially on the degree of substitution that may occur among labour inputs.

A trivial case holds when these types of workers are unique, i.e. no substitution possibilities exist in the production process. This situation can be assigned to the existence of a completely *segmented* labour market and would be equivalent to having *n* separate replications of the simple aggregated model of the preceding section. Thus, changes in the relative position of earnings and unemployment for any two type of workers, i and j, would only be possible as a consequence of shifts in their relative supply/demand mix composition or variation in specific structural factors affecting them. This particular result depends on the assumption that the prevailing production function of the economy is the Leontief type, with fixed coefficients of production.

At the other extreme, any imbalance resulting from supply or demand shocks affecting any particular type of labour i, would tend to have no impact on the structure of employment and earnings, only if perfect substitution, competitive conditions and complete labour mobility hold. Indeed, a relative excess supply of the ith labour type *ceteris paribus*, would initially increase its relative unemployment and reduce its relative wage. This, in turn, would generate incentives to substitute the relatively more expensive jth labour input for the cheaper ith type. Since perfect substitution is assumed possible, relative unemployment and wages would be finally restored to original levels.*

The above result is not surprising given that an infinite degree of substitution among any pair of labour inputs implies that they are essentially hommogeneous, i.e. equally skilled and able to perform the required productive tasks. Therefore, they can be treated as a single input as in the aggregated model, with a unique structure of earnings and unemployment. The individual levels of these variables might only differ depending upon specific structural rigidities affecting them.

Finally, as it is more likely to occur in reality, if neither perfect substitution among different labour inputs nor similar level of rigidities for each submarket holds, changes in their relative supply or demand schedules over time would tend to affect simultaneously their relative employment and earnings position. A relative excess supply of the ith input would imply a greater deterioration in its relative unemployment and earnings position, the greater the level of rigidities and the lower the degree of substitution with other labour inputs.

The degree of substitution among labour inputs remains, in any event, a matter for empirical investigation. Estimates for various pairs of inputs are possible if it is assumed that the underlying production function of the economy can be represented by any of the various flexible functional forms discussed in the literature.

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*Note that this is not to say that individual levels of these variables would remain the same.

B. Labour Demographically Differentiated

The need for a disaggregated analysis of the labour market stems from various sources. The explicit recognition of labour force heterogeneity, the related aspects of substitution and the growing interest in dual-segmented, internal/external labour markets, among others, have provided strong theoretical reasons for more detailed analysis.

On the other hand, practical considerations in the design and evaluation of macroeconomic policy and specific programs oriented to alter undesirable situations in the market require a clear identification of individual groups of people that would be affected or benefited. Clear cases are the policy debates on the appropriate fiscal and monetary restraint policies and on programs designed to assist the casualties of recession where it is crucial to identify the groups of people who have been most harmed.

Although it is well known that a variety of personal characteristics such as, level of education, skill, experience, personal ability, age, sex and IQ, play an important role in the determination of individual work experience and earnings, they are less relevant in dealing with the determination of aggregate unemployment and earnings. In fact, if the focus is on the employment and earnings of a group of workers, as is the case here, one could expect that any effects of these characteristics are likely to net out as a result of their plausibly random (and temporally stable) distribution among the members of that group.*

In sum, the inclusion of the above mentioned factors is highly relevant for the purpose of explaining levels and differentials in the earnings and employment at the individual level at one moment of time, i.e. a cross-sectional sample of individuals, but they are likely to have a negligible impact if ignored in explaining the relative market performance of an aggregate group of workers over time.

Demographic classifications of labour have been usually employed in the disaggregated analysis of the market. Broad categorizations of labour by age-sex have proved to be useful, since these variables act as proxies for a wide variety of differences in human capital. In addition, empirical observation provides ample evidence of regular behaviour for the employment and earnings of groups of workers defined by age and sex. An overview of this evidence follows.

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* Consider, for example, the cases of IQ, skills, ability. Their distribution within and between the various aggregated labour groups are unlikely to experience significant changes over time. The case is weaker, however, if education is considered; in fact, the significant changes occurred in the educational background of the various groups of workers have changed their *quality* in a relative short period of time.

1. Labour Differentiated by Sex: Employment and Earnings

Despite the regulations against and generalized concern about sex discrimination, there is an overwhelming body of evidence suggesting that male and female workers tend to participate very differently in productive processes. Based on US data, Zellner (1972) reports on the importance of sex stratification in many occupations. In studying Canadian unemployment data, Ostry and Zaidi (1972, 133) conclude that *females tend to be concentrated in white collar work and service-producing industries*.

Although substitution between sexes is theoretically possible, in practice, firms' personnel policies, institutional barriers and traditional beliefs have been obstacles to effective substitution, thus in practice the labour of different sexes become entirely different types of inputs for productive purposes.

The evidence on sex-earnings profiles also supports differentiating labour by sex. The earnings profiles of women are found to be consistently flatter than those for males, even when they are derived for similar characteristics, i.e. age, level of education, occupation, etc. These differentials persist over time, even in presence of the increased education of female workers and improved communications and information in the market. According to Becker (1971), these developments should have served to reduce both prejudice and ignorance, which determine *the taste for discrimination* (Becker (1971, 17)). These differentials have also proved to be immune to the considerable changes in the occupational and industrial mix of the economy, which have worked towards an increased demand for females relative to male workers.

To the extent that these differentials do not reflect intrinsic differences in skills between sexes, but mostly discrimination, the distinction between sexes ought to be explicitely recognized as affecting wage behaviour in the market. In a competitive world these differences would diminish over time, but as Arrow (1973,20-3) has pointed out, it may take considerable time because of *adjustment costs and imperfect information*.

Although several studies have been conducted to verify the existence of these sex-earnings differentials in Canada almost none of them, the exception being the work by Gunderson (1976), were specifically designed to analyse the time pattern of male-female earnings differentials. Among the others, comparisons have been made for selected years and/or occupations and no clearcut results have been found (see, for example, Archibald(1970), Ostry (1968) and Robson and Lapointe (1971)).

2. Labour Differentiated by Age

The variable 'age' has been considered as a good proxy for the degree of experience, skill and human capital accumulated by different labour force groups, to the extent that it makes them distinct in the production process and rather imperfect substitutes for each other.

Younger workers are viewed as unskilled, inexperienced, with less on-the-job training and, in general, with less incorporated human capital investment. On the other hand, older workers presumably have the opposite characteristics and as well typically enjoy institutional arrangements, such as seniority, which makes them a very distinct type of labour input, with a higher degree of fixity in productive activities.

Age, as well as sex, has also served as a criterion for disaggregation in the analysis of dual/segmented markets, since the reported evidence seems to strongly support the hypothesis that teenagers and adult females tend to work in what is called *the secondary market*, while adult males work predominantly in the so-called *primary labour market* (see Edwards (1975) and Cain (1976), among others).

The distinction by age also finds strong support in the stable and well defined age-earnings profiles that have been frequently reported in the literature. These profiles are usually characterized by a sharp increase up to 40-50 years old, roughly, and then a sustained decline. The latter part is related to the oldest group of workers, who may suffer from the disadvantages associated with their technical obsolescence and lower productivity. These regular age-earnings profiles can be interpreted as the normal market rewards to a variety of characteristics that are suitably proxied by the ages of workers.

It is worthwhile to mention that, although the choice of disaggregation criterion imposed on the labour market is usually dictated by the specific aim of the study,* the particular choice of age and sex criterion has become increasingly popular since the early works dealing with employment and unemployment of Tella (1966) and Dernburg and Strand (1966). More recent investigations include the works of Feldstein (1976), Gordon (1977), OECD (1980) Clark and Summers (1981) and, using recent Canadian data, the work by Schaafsma and Walsh (1983).

In examining the changes in earnings profile and labour substitution, similar categorizations are employed in the works of Freeman (1979.a), Welch (1979) and other studies reviewed by Hammermesh and Grant (1976; 1979), while the work by Merrilees (1982) on the substitution of labour inputs seems to be the first Canadian evidence reported in this vein.

For the purposes of the present work the age-sex categorization of the labour inputs is highly relevant, since one of the aims of this research is to explicitly examine the role played by demographic forces in shaping the observed changes in the employment and earnings structure of the workforce.

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* Alternative criteria employed in the literature consider labour categorized by educational and occupational standards, as in the cases of Blaug (1967), Blaug, Layard and Woodhall (1969), Bowles (1970), Dougherty (1972; 1974), Johnson (1970), Psacharopoulos (1973), Psacharopoulos and Hinchliffe (1972) and Fallon and Layard (1975), among others.

C. Review of Main Hypotheses

A review of theoretical and empirical works examining the expected impacts that changes in cyclical, demographic and other institutional and socio-economic factors have on the employment and earnings structure of the workforce is undertaken in this section. It begins with an examination of the arguments concerning the effects that cyclical fluctuations in economic activity have on the demand, supply and relative earnings position of specific labour groups. It next considers the intermediate run effects on the labour market's employment and earnings composition by discussing the effects of demographic swings on the size and age-sex structure of the workforce and their connection with major labour market indicators and the expected relative performance of individual labour groups in the market. It concludes by examining other slowly changing socio-economic and institutional factors and their possible effects on the relative employment and earnings behaviour of some labour groups.

1. Cyclical Fluctuations and the Labour Market

The differential impact of the expansionary and recessionary phases of the business cycle on the relative employment and earnings position of the various age and sex groups in the labour force is first considered in this section. Next, the cyclical response of supply is examined by reviewing the *added* and *discouraged* worker hypotheses and the concept of *hidden* unemployment suggested in the literature. Since the importance of the latter concept is enhanced in the presence of a pro-cyclical labour force participation behaviour, its meaning and implications are discussed in the final section.

1.1 The Effects of Cyclical Fluctuations on Earnings and Employment

Since the demand for factors of production, particularly labour, is derived from output demand, fluctuations in the level of economic activity around its long run growth path tend to have direct impact on employment and earnings. In periods of economic expansion more of every input is required by the increased production, thus an improvement in the level of earnings and employment can be expected to occur; while in demand deficient periods increased unemployment and the deterioration of real wages are likely to be observed.

These fluctuations, however, cannot be expected to have the same impact on all individual groups of workers, given their heterogeneous nature. Therefore, the composition of earnings and employment are likely to change over the stages of the cycle.

Various theories have been developed on the direction of these changes in composition as a consequence of cyclical impacts. Early in the 1950s, Bell (1954) quoting W.J. Oi, argued that over the cycle the existence of differential shifts in factor demand imply *greater inequality* of employment and earnings during periods of recession than expansion; this result being the consequence of the different *degree of fixity* which the various labour inputs exhibit in the production process -*fixity* being defined in relationship to the fixed capital input. Therefore, the more complementary a factor is with the fixed input, the lower its elasticity of demand would be and the less affected by cyclical fluctuations its employment and wage income.

More detailed arguments focus on the observed behaviour of firms over the cycle. Gunderson (1976, 61) for example, argues that firms are reluctant to lay off their skilled workers during recessionary periods for fear of being unable to re-hire them when an expansionary phase begins. In consequence, skilled workers are kept employed at unskilled tasks while unskilled workers are laid off, thereby, widening the employment and unemployment differentials. In turn, the increased reserve of unskilled unemployed depress further their earnings, hence, the wage gap also widens.

In the upswing stage of the cycle, firms tend to compete for all types of labour. Jobs standards are relaxed and firms are forced to upgrade the unskilled to perform skilled tasks. Mobility up the occupational ladder occurs that increases the supply of skilled workers and thereby reduces the existing differentials. This process is strengthened by the increased demand for unskilled labour, resulting from the longer and continuous production activity of firms.[7]

For our purposes, the reasons given above suggest that greater cyclical variations in employment, unemployment and earnings can be expected among the younger and female segments of the workforce (usually considered less skilled), than among the adult (skilled) male workers. Consequently, during economic downturns it is possible that a disproportionate share of the burden is distributed among the *secondary workers*, i.e. youngest and oldest segments of the male workers and women of all ages.

1.2 The Effecets of Cyclical Fluctuations on Labour Supply

Labour market researchers have devoted much effort to studying the reaction of labour supply, especially the participation rates of age-sex groups, to changes in economic activity. Two basic hypotheses have been postulated for the behaviour of the various labour groups: the *added-worker* and *discouraged-worker*

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[7]Reder (1955) has noted that the increased demand for unskilled workers is facilitated in expansionary periods since uninterrupted and stable growth in production allows firms to increase the division of work which requires workers to perform single specialized tasks.

hypotheses.

The *added-worker* hypothesis states that in periods of low levels of economic activity and employment some people out of the labour force tend to enter the market, seeking jobs, to supplement the family income that may have deteriorated. However, when economic recovery occur, these workers abandon the labour force as their additional effort is no longer required. This hypothesis has been attributed to Woytinsky (1940) while discussing the 1930's Great Depression experience.*

The *discouraged worker* hypothesis, on the other hand, is usually explained through the opposite behaviour. In periods of declining business activity, people may become 'discouraged' from looking for work since they believe jobs are not available. Thereby they postpone entry into or drop out of the labour force and remain with or return to their non-market activities (household work, school, etc) or perhaps even decide to take an early retirement. Only when the level of economic activity improves (unemployment is low) do they return to the market, 'adding' themselves to the rank of those seeking jobs.

Both *added* and *discouraged* worker effects can co-exist and occur simultaneously. Following standard demand theory as applied to the labour-leisure decision

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*In its simplest form it states that unemployment of the family head is likely to create pressure on the rest of the family members to enter the labour force.

faced by workers, both effects can be simply interpreted as the short run income and substitution effects respectively; this interpretation has acquired formal recognition in labour economic literature, see for example Mincer (1966, 74), Fleisher (1970) and Ben-Porath (1973).

In the above framework, an increased level of economic activity can be perceived as increased expected rewards in wage and income by labour participants. That is, when low unemployment prevails, opportunities in the labour market are increased temporarily and the price of leisure -opportunity cost of forgone income from not working- rises. Hence, people *substitute* labour market activity for leisure, i.e. 'encouraged' effect. But since low unemployment also means that family income is increased temporarily, additional members may not have to enroll themselves in job seeking activity to maintain their desired standard of living, i.e. a 'subtracted' worker effect, and more leisure is demanded as predicted by the *income* effect.

Which of the two effects dominate in balance and who are the labour groups more prone to adopt a particular behaviour?. These type of questions have been central to the several empirical studies conducted to study labour participation. These studies have followed two main approaches. On the one hand stands the approach suggesting that potential workers react to job opportunities open in the market and has been generally associated with the works of Tella (1964; 1965), Dernburg and Strand(1966) and Bowen and Finegan (1969).[9]

A different, though not unrelated, approach derives from the neoclassical view of the work-leisure choice and emphasises the role of the wage rate associated with jobs. The origins of this approach can be found in the works of Mincer (1962; 1966). Rapid developments occurred and participation equations allowed for the impacts of transitory and permanent wages and expected inflation as in Lucas and Rapping (1969), and Fair (1971), or for the impact of relative income, Wachter (1972), following the original formulations by Duesenberry (1949) in consumption models and Easterlin (1968) for fertility models.

1.3 Hidden Unemployment

The notion of hidden unemployment became popular during the 1960's in connection with empirical findings which showed that labour force movements were dominated by *discouraged-worker* effects over the different stages of the business cycle.[10]

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[9] The traditional studies for Canada include the works of Officer and Anderson (1969), Proulx (1969) and Swidinsky (1973). Gunderson (1977) provides logit estimates of participation while Swan (1974) reports differences in participation behaviour among regions. More recently, Kuch and Sharir (1978) report a successful attempt to isolate discouraged and added worker effect across groups of workers.

[10] In particular the evidence from the works of Tella

These findings suggest a certain ambiguety in meaning of the reported overall employment and unemployment rates and the reported count of the unemployed.

In fact, if on balance the labour force shows a net discouraged-worker effect, then in times of low employment there would be a number of workers who would be considered out of the labour force. They would not be working or actively seeking jobs -a condition that must be satisfied if workers are to be included among the measured unemployed- as they believe jobs are not available. However, because they would be actively participating in the market were it not for the high unemployment, they are considered as *hidden unemployed*.

In other words, the argument is that these people are missed in the reported count of labour force and unemployed and they should be included as a 'normal' part of them. If this is so, the reported indices of labour market performance over the cycle would be giving a misleading indication of the actual performance, by missing the net discouraged workers, i.e. rates of unemployment (employment) would be understating (overstating) the true rates in periods of high unemployment or economic downswing.

This finding has resulted in efforts to estimate the level of *hidden unemployed*, to generate a corrected series of employment and unemployment rates, and to

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[1] (cont'd)(1965), Dernburg and Strandt (1966) and Bowen and Finegan (1969).

estimate a *full-employment* level of unemployment and associated measures of potential output, once account is taken of the hidden unemployed.[11]

Although most researchers would agree on the existence and, to some extent, on the direction of cyclical labour force variation and the need for some correction, little agreement exists on the estimated levels and changes in hidden unemployed over time. This is not surprising since the results depend crucially on the specification of the cycle and other variables, functional forms utilised and even on the notion of full-employment, all of which are debatable.

Even if all the above aspects were clear enough, there still remains a conceptual conflict: What is the exact meaning that can be attached to the hidden unemployed?. This question arises in part because the potentially discouraged workers are usually found among the *secondary or marginal* workers. They are characterized by their low level of attachment to the market, moving in or out depending on the changing

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[11] The usual procedure is to set the overall unemployment rate to a level compatible with full-employment, say 4%-5%, which in turn is fed into the estimated labour force participation equations to generate an estimated full-employment level of the labour force. The difference between this estimate and the recorded labour force provides estimates for the hidden unemployed. For more insights and criticisms see Mincer (1973, 27-28). With some variation in model specification and the definition of variables, the procedure has been used by many authors; among others see Tella (1965), Simler and Tella (1968) and updated by Vroman (1970), Dernburg and Strand (1966), Bowen and Finegan (1969) and Butler and Demopoulos (1972).

economic conditions. As Mincer (1966) has pointed out, they have a wider range of substitution possibilities in non-market activities (homework, schooling, etc).[12] Then the decision to include them as unemployed or to leave them definitely out of the workforce is not absolutely clear. Effort oriented to identify the reasons for their discouragement is now believed to be important if a more accurate meaning is to be attached to the hidden unemployed concept.[13]

2. Demographic Swings and the Labour Market

Among the various changes in non-cyclical factors that have affected the performance of the labour market indicators[14] and the relative position of the various groups in the workforce, the phenomenon of most interest in recent years has been the changing demographic character of the labour force.

This interest can be understood in light of the sizeable changes observed in the age-sex composition of the labour force. Particularly important have been the increased female participation and the large increase of young workers' share in the workforce, resulting from the arrival

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[12] This is mainly the case of teenagers and married women, groups that constitute an important fraction of the secondary workers.
[13] Among the works in this direction, dealing with discouraged workers classified by 'market' and 'personal' reasons, see Finegan (1981), Flaim (1973) and Ondeck (1978).
[14] For comprehensive studies of the effect of non-cyclical factors on unemployment rates see Cagan (1977) and Leveson (1977).

of the matured post-War baby boom in the market.

These compositional changes are believed to explain an important part of the intermediate run behaviour of employment and earnings as well as the current problems in the market. To a great extent they are accounted for by exogenous shifts in the relative supply of workers stemming from rapid fluctuations in past fertility rates.[15]

In Wachter's view (1981, 36) the rapid, historically unprecedented, swing in past fertility is the main exogenous change occurred in the market which has provoked imbalances in the relative size of the different age-cohorts of workers and the consequent employment and earnings adjustment problems for the economy as a whole.

Recognition of this phenomenon has led researchers to analyze the impact of demographic changes on the labour market. Two main approaches have been followed. Initially, the efforts were oriented to isolate and measure the impact of compositional changes on the major aggregate labour market indices. More recently, the focus has shifted to assigning an explicit role to demographic variables in models explaining relative changes in employment and earnings for the various age-sex cohorts of workers.

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[15] In fact the swings in fertility rates rather than their levels determine the changes in the age composition of any population and its labour force. Extended periods of either high or low rates would eventually yield stable and similar uniform structures; see Keyfitz (1968).

2.1 Demographic Changes and Major Indices

It is argued that historical comparisons of the overall employment, unemployment rates and other major indices has become almost meaningless in the presence of major changes in the composition of the labour force. In fact, an extreme case of an entirely demographic phenomenon occurs when rates, say unemployment, differ over time even if the conditions affecting individual groups remain unchanged, i.e. no structural group unemployment has occurred. Differences in the overall rates, in this case, would be only the reflection of changing weights assigned to the various labour subgroups.

The sizeable shifts in the labour force composition towards youth and females have activated the controversy on the meaning and reliability of the uses these reported indices have. Consider, for example, the case of government policy aimed at full-employment with a target of unemployment based on past observed rates. Persistent efforts oriented to satisfy the stated goal would increase inflationary pressures in the economy, since the groups increasingly represented in the market are those with higher level of *frictional* unemployment. Thus historical levels for the *natural* rate of unemployment are likely to be shifting upwards.[14]

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[14] Other examples supporting these criticisms are related with the use of unemployment rates as index of 'hardship' of the population and historical comparisons of overall earnings and wages. In the former case, it can be argued

The increased criticism directed to the use of the overall reported indices has stimulated work to isolate pure demographic effects. The conventional method devised to measure the impact of demographic changes on the aggregated rates involves the construction of an alternative standarized rate, by applying actual individual group rates to a constant basic distribution of the labour force. Thus, differences between the published and standarized ones are attributed to the 'compositional' impact.[17]

This procedure to isolate demographic changes is now considered an acceptable one in various labour market studies, see for example Perry (1970) and Wachter (1976) for US data and Peston (1972) with British unemployment data. However, recognition of the possible interaction between composition and unemployment changes has led to further corrections in order to isolate a 'pure' measure of compositional impact (Cain (1977) and Flaim (1979)).[18]

The major merits of this approach are its recognition of the impact of demographic changes on the

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[16](cont'd)that higher unemployment due to secondary workers cause less harm than among primary workers (prime age male workers), while in the latter, lower levels of the index, or slower growth, can be considered acceptable given the traditional and 'natural' lower earnings of the groups with increased share in the market.

[17]For details of these calculations see Flaim (1979, pp. 14-15)

[18]The method and assumptions underlying the calculations of the 'pure' demographic impact have not been exempt of criticisms. For a critical review see Hughes and Perlman (1982).

reported indices and its attempts to provide some estimates of these effects; the major weakness is its lack of explanation on how these demographic changes affect the behaviour and market performance of the different subgroups of workers. That is, are individual group rates affected and what are the possible mechanisms in operation?.

2.2 The Cohort-Overcrowding Hypothesis

In explaining changes in the structure of employment and earnings the need for an explicit inclusion of demographic shifts in the labour force composition has been advocated in an early work of Easterlin (1968) and formally stated and modelled later by Wachter (1977; 1982), Easterlin (1980), Freeman (1979) and Welch (1979), among others.

The *cohort-overcrowding* hypothesis in essence states that changes in the relative supply of a cohort of workers has a twofold effect. First, a direct negative impact on the relative employment position of the cohort, given the existence of relatively fixed factors of production in the short run, imperfect wage adjustment and limited possibilities of substitution among workers since workers differentiated by age and sex differ in their specific or job-related training and productive skills. Thus, a cohort of workers in relative excess supply would face adverse employment adjustment, exerting upward pressure on their relative unemployment rates.

This view has been widely held in recent research of the youth labour market (see for example Freeman (1979b; 1980), Freeman and Medoff (1980), Barnow (1979) and OECD (1980)). A focus on this segment of the market is of major importance in light of the massive arrival of the baby boom generation to the labour force during the late 1960's and the associated social and economic consequences of joblessness.

Second, a cohort's relative excess supply would exert downward pressure on its wages and earnings since it is likely that wages, although only imperfectly responsive to imbalances, are not perfectly rigid either. The fall in relative earnings may have a further impact on the cohort's decision to participate in the market. In fact, if labour participation is guided by workers' desired or anticipated standard of living, a fall in current income relative to their desired level would lead to additional workers entering the market in order to achieve their anticipated standard. This behaviour, in turn, would aggravate further the relative position of the cohort.

Wachter (1977) has termed this effect the *relative income* hypothesis. His empirical findings for the US labour market provide strong support for this hypothesis, particularly among adult females and younger workers; these groups have recently shown a sharp increase in their participation behaviour. Wachter's conclusions (1977) are strongly critical of the traditional labour force participation studies that exclude demographic variables: "...the traditional practice of modelling participation by considering only cyclical factors and time trend variables leads to unwarranted results if variables that reflect intermediate swings arising from demographic forces are omitted" (see Wachter (1977, p.545)).

The negative effects on employment and earnings of cohorts in excess supply are believed to accompany these workers throughout all their productive life (see Easterlin (1980)). The greatest impact occurrs at the earlier stages of their working life while the market digests their entrance.

3. Other Factors: Institutional and Socioeconomic

Over time several developments have taken place among institutional and socioeconomic factors that are likely to have greatly influenced the composition of employment and earnings of the workforce.

Slow but regular transformations in the socioeconomic structure and tastes have gradually affected workers' relative position with different degrees of intensity. These transformations, however, have been complex, highly interdependent and with an ambiguous direction of causality which has precluded the isolation of specific impacts through empirical research, not to mention the problems of adequate measurement and the associated lack of suitable data on a continuous time series basis.

Nevertheless, efforts to characterize and clarify the impacts of those changes on the functioning of the labour market have been done elsewhere in the literature (among others, see Long(1958), Mincer (1962), Cain (1966), Ostry (1968) Peitchinis (1970) and Gunderson (1976; 1980); the last three specially referred to the Canadian experience) and a brief review of the main factors, without pretending to be exhaustive, follows.

3.1 Effects on the Demand for Labour

On the demand side of the labour market, changes in the industrial and occupational mix of the economy have been viewed as important factors in shaping the structure of employment of female and younger workers. In fact, the sharp and sustained decline of agricultural employment and the rapid expansion of work opportunities in urban areas, mainly in the tertiary sector, have meant that younger and female workers have seen their employment and earnings opportunities widened with the expansion of the service sector, where improved working conditions and greater flexibility in hours of work are especiallly predominant.''

''These changes have led to wider opportunities in white-collar and clerical positions, positions typically held by women and young workers. See for example McInnis (1971), Swan (1972) and Meltz (1965) for Canada. Further evidence is provided by the occupational and industrial

The above trends, however, are somewhat offset by the existence of and changes in the minimum wage legislation which fix the floor of labour compensation. Indeed, minimum wages are usually seen as compressing the wage structure and increasing labour costs in production, which in turn generate adverse employment effects. The negative impact on employment is believed to produce more harm among those workers the legislation is allegedly designed to help; that is, the adverse employment impact is likely to be greater for low wage, unskilled workers since their demand is fairly elastic with respect to wages, reflecting the availability of numerous substitutes. Paradoxically, the groups who suffer disproportionately the impact of the legislation are those most in need of work experience, i.e. young and female workers.

The literature on this topic has reported an overwhelming body of empirical evidence that, in general, tend to favour the above predictions. This is particularly true among the studies focussing on the employment experience of teenagers[20] as reported by Donner and Lazar (1975; 1976) and Swidinsky (1980), among others for Canada. The recent study by Schaafsma and Walsh (1983) confirms the significant negative

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[19] (cont'd) distribution of the workforce divided by sex given by Statistics Canada, Census Reports.
[20] For results based on the US experience see Lovell (1972), Kosters and Welch (1972), Katz (1973), Welch (1976) and Mincer (1976) among others.

effect of minimum wages not only on the employment but also labour force participation levels of most age-sex groups and a significant positive effect on the unemployment rates of all age groups.[21] The effects of increased unions strength and activity on employment are usually seen as being similar to the effects of minimum wages, since unions seek to maintain and even increase the benefits of their affiliated members, thereby increasing labour costs to levels that otherwise would be lower. More important, however, is the fact that the action of unions is likely to be more effective among skilled workers -workers with a lower degree of substitutabilityhence, adverse employment effects would be greater among the less organized, unskilled workers, again the younger and female workers.

3.2 Effects on the Supply of Labour

On the supply side of the labour market, a variety of factors have been considered in explaining the main trends in the decision to participate of the age-sex groups.

Expansion in the educational system, extension of the length of school year and higher legal school entrance and leaving age may, undoubtedly have exerted a pressure to retain longer the younger fraction of the population out of the market, decreasing their

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[21] In this study the authors also suggest that previous studies have underestimated the true impact due to specification errors in their equations.

participation rates. Similarly, the increased involvement of government supporting programs that facilitates human capital formation -training,education and labour market information- may have reduced the opportunity cost of remaining inactive for some individuals.

The recent upsurge in participation of youth, however, has proved that these factors alone are insufficient to explain their behaviour. Other offseting factors might have well played an increasing role, such as the changed educational contents towards more work oriented activities, greater flexibility in hours of work (notably the augmented possibilities of part-time jobs) and a changing industrial and occupational demand mix in the economy. They have improved the employability and earnings capacity of the youth, as well as their real productive possibilities in the market. Thus, the opportunity cost of remaining out of the labour market today has risen compared to earlier periods.

The continuous declining trend of participation among older workers has been usually associated with the expansion of social insurance benefit programs and greater availability of public and private pension funds over time; these developments would have facilitated early retirement decisions. Other authors see this trend as a simple wealth or income effect, as predicted by standard demand theory, that is older workers have become wealthier over time and they buy more of all goods, including leisure by earlier retirement.

With regard to the observed sharp upward trend in female participation the emphasis has been on finding those factors that have altered their opportunity cost of not working, as well as those underlying the increased social acceptance of females at work.

Among the first, the arguments include the greater access to educational institutions and job-oriented training programs, expansion of the continuing education programs, improved material conditions at workplaces, changes in the job contents and the availability of jobs in service activities, particularly white collar type and part-time jobs. All of these factors have raised women's opportunity cost of not working outside of the home. On the other hand, household and childbearing responsibilities have been increasingly facilitated as a consequence of technological and institutional developments that have widened the number of substitutes for activities such as childcare, cleaning, food preparation, etc., making household activities easier and less time intensive for women. Fertility behaviour favouring fewer children has, additionally, helped to reduce the alternative cost of active engagement in the labour market.

Thus, in the case of females all factors have exerted their influence in the same direction, facilitating their active participation in the labour market, by increasing the opportunity cost of remaining at home.

Among other institutional changes that have merited the attention of researchers are the transformed social system of values towards a greater acceptance of women working outside home. It has been argued that these improvements are, in part, consequence of legislative enforcement against discrimination -the equal pay and equal employment legislation- which has encouraged higher female participation since, now, they are more protected. Others (Becker (1971)) attribute this increased acceptance of women in the market to improved communication and information, as they help to reduce the degree of ignorance usually responsible for prejudice and the taste for discrimination.

Last, but not the least in importance, are changes in the unemployment insurance benefits system (UIB). In theory it is well recognized that increased UIB tend to lower the opportunity cost of being unemployed, which in turn may act as an incentive for longer periods of job search, for an increased labour supply of the various secondary groups of workers and for higher frequency of job quits which make the employment and unemployment structure more fluctuating. In Canada major revisions to the UIB program, including an extended coverage, were enacted in 1971. Since then, several theoretical and empirical studies on this issue have been conducted -for a comprehensive review see Gunderson (1980).[22]

The above summary review of other developments affecting the labour market behaviour highlights the complexities and the variety of the changes which have occurred over time. Although, there is a general agreement that these factors have played an important role in shaping the relative composition of employment and earnings of the workforce, they have not been explicitly included in most studies of the market.[23] It has been customary in this type of research to register the net impact of these changes over the age-sex groups of workers through a time trend variable, which in part is no more than a recognition of our relative ignorance of the exact influence exercized by the various factors.

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[22] The work of Munts and Garfunkel (1974) provides a clear review of the theoretical and empirical effects of unemployment insurance for the American experience. Empirical evidence for the effects of the UIB program can be found in Green and Cousineau (1976) and Grubel, Maki and Sax (1975).

[23] There are various reasons that justify this decision. In part they are, the inability to disentangle the separate influence of each factor since most of them have moved together simultaneously; the lack of reliable time series for them which makes empirical studies (on this issue) a futile exercise; strong interdependence among the behavioural variables to be explained (employment, participation, earnings) that would require an explicit complex simultaneous system of equations plus specifications that incorporate not only specific forms for the postulated relationships but also consider the unknown lags in response to these effects, among others.

III. Review of the Record

This chapter reviews some of the main transformations undergone by the Canadian labour market during the period 1950-1980. In the first section, the observed changes in the labour force (LF) growth and composition are examined in relation to the changing demographic structure and growth of the population in working age, the potential labour force (PLF), and variations of the participation behaviour of the various population groups. Section B focus on the changing characteristics of employment and unemployment by considering their pattern of growth and composition by sex and age. The aim of this section is to provide evidence on the relative employment and unemployment performance of the various worker groups in view of the sizeable changes occurring in the LF composition. A final section examines the variations experienced by the earnings structure of the workforce as a consequence of the changing age-sex composition of the labour force and employment.

A. Actual and Potential Labour Force and Participation Rates

The potential labour force (PLF) refers to the population in working age which, traditionally, is considered as the 'potential' manpower reservoir available to any country. This concept varies among countries and over time, since its exact content is a matter of specific legislative and institutional arrangements regarding eligibility to work.[24] In Canada, the PLF is defined as the civilian, non-institutional population, 15 years of age and over,[25] excluding members of the armed forces, inmates of institutions, Indians living in reserves and residents of the Yukon and Northwest Territories.

The composition, size and growth of the PLF depends crucially on demographic forces. Indeed, fluctuations in past fertility behaviour, changes in mortality patterns and net migration shape not only the size and structure of the population but, also, of the PLF.[26]

The Labour Force (LF), on the other hand, is defined by the fraction employed and unemployed of the PLF whose members are able and willing to work. Thus, the same demographic determinants of the PLF exert their influence over the LF, by shaping its size and composition.

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[24] It should be noted, however, that this concept provide only a general reference for the 'potential' labour force available at any moment of time. In fact, not all members of the PLF can be considered readily available, at any moment, for participation in economic activity, i.e., deductions might be made for those unable to work because age, permanently disabled, women with household and childbearing responsabilities, etc.

[25] This age limit has changed over time. Up to 1939 the official definition included only the members of the civilian, non-institutional population aged 10 years and over. This limit was then raised to include those aged 14 and over, and remained in effect up to 1966. In that year, major revisions of the LF Survey were done including the current definition of the PLF.

[26] In addition to these factors, definitional changes and variations in the size of the excluded groups, might affect the size of the PLF.

Although these demographic forces usually tend to act in a regular fashion determining a relative smooth and stable pattern of growth in both variables over time,[27] sizeable differences between these variables may occur as a consequence of changed participation behaviour. In fact, cyclical fluctuations in economic activity and changes socio-economic conditions might induce short and medium run changes in the decision to participate of the various subgroups of the population.

Thus, only in the absence of significant changes in participation will the LF follow closely the pattern of growth and composition of the PLF.

The extent to which both variables, PLF and LF, have been linked is considered next in examining the Canadian labour market experience of the last three decades.

1. The Labour Force and Potential Labour Force

Over the entire period sizeable changes in the LF and PLF have occurred. Evidence on these changes, in absolute magnitudes and in terms of annual growth rates, is presented in Table III.1. It is seen that today LF size has more than doubled if compared to thirty years ago, increasing to 11.4 million workers from about 5.1 million in 1950. In the same period, the PLF has increased by 87%, i.e., to 18.0 million from 9.6 million in 1950.

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[27] This pattern is likely to be altered only by abrupt changes in the size of the immigration flows.

The LF has been growing, on the average, at an annual rate [24] of 2.7 percent, while the PLF only grew at a rate of 2.1 percent. Thus, over the whole period about 4/5 th (82%) of the LF growth can be attributed to the changes experienced by the PLF; the remaining one-fifth (18%) to the changed overall participation behaviour of the population.

Examination of the various subperiods (see Table III.1.b) reveals that these changes have not occurred in a smooth and uniform fashion. Indeed, the link between the growth of them has weakened throughout the period due to the substantial and increasing variability of the LF.

Up to mid 1960's, LF and PLF followed a similar pattern, growing at annual rates of 2.2 and 2.1 percent respectively. In that period, the growth rate of the PLF constituted on the average almost 96% of the LF growth, since the overall participation rate (PR) experienced little variation around the low level of 54%.

During the second part of the period two major developments occurred in the labour market that accelerated the LF growth. On the one hand, the rapid growth of the PLF and LF due to the continuous arrival of the Post-War Baby Boom into the working age population. The market began to show the effects of this arrival during the early 1960s, as confirmed by the high rates of growth shown by the younger groups (Y), aged 15-24, of the LF and PLF. On the other

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[24] The estimated rates of growth referred in this chapter were calculated on the basis of annual observations, i.e. average of annual rates of growth.

TABLE III.1 Actual and Potential Labour Force by Sex and Main Age Groups

Changes in Size and Rates of Growth
Selected Years

a. Labour Force(LF), Potential(PLF) and Participation Rates(PR)

	Size (ths.)							Variations (%)		
	1950	1955	1960	1965	1970	1975	1980	1951-80	1951-65	1966-80
LF	5162	5611	6410	7142	8262	9966	11521	100.0	31.1	68.9
PLF	9615	10596	11832	13128	14158	16[illegible]07	17993	100.0	41.9	58.1
PR	53.7	53.0	54.2	54.4	56.9	61.1	64.0	100.0	6.8	93.2

b. Average Annual Rates of Growth (%)

Average Period	Labour Force LF	Males	Females	Y	A	O	Potential Labour Force PLF	Males	Females	Y	A	O
1951-80	2.72	1.80	4.87	2.96	2.82	1.78	2.22	2.15	2.28	2.71	1.91	2.44
1951-65	2.19	1.50	4.20	1.74	2.42	1.99	2.10	2.01	2.18	2.74	1.78	2.22
51-55	1.67	1.40	2.66	-0.25	2.74	0.37	1.96	1.86	2.05	0.76	2.43	2.12
56-60	2.70	1.83	5.47	1.90	2.95	2.88	2.22	2.18	2.25	2.96	2.00	2.17
61-65	2.19	1.28	4.63	3.58	1.58	2.71	2.12	2.00	2.25	4.51	0.90	2.37
1966-80	3.24	2.09	5.49	4.17	3.21	1.57	2.33	2.28	2.38	2.67	2.04	2.66
66-70	2.96	2.02	5.12	4.22	2.61	2.34	2.65	2.61	2.68	4.[illegible]5	1.78	[illegible]
71-75	3.83	2.34	6.72	5.[illegible]1	3.75	0.68	2.35	2.29	2.41	2.49	2.38	2.03
76-80	2.94	1.91	4.62	2.68	3.28	1.68	1.99	1.94	2.04	1.27	1.95	3.03

Source: Based on data from Statistics Canada, The Labour Force (unpublished annual estimates). Y: Young (-25 yrs); A: Adult (25-54) yrs old; and O: Older (55+ ...

hand, the considerable change in the decision to participate in the workforce, beginning during the mid-1960's, contributed to the further acceleration of the LF growth. As shown in the Table, it is in the 1966-80 period that PR increased sharply, i.e., 93% of the total change in participation occurred in this period.

The year by year changes in the LF and PLF rates of growth, divided by sex and main age groups, are illustrated by various graphs in Figure III.1. The positive differences between the LF and PLF growth (the shaded area) correspond to the fraction of the LF growth that can be attributed to increased participation behaviour.

Some interesting features of the growth pattern followed by both variables are revealed by the various portions of the Figure. First, it is evident the high response of LF to cyclical developments in economic activity. The economic expansion in the years 1956-57, mid-1960's, and in the early and late 1970's are accompanied by large fluctuations in LF. The growth of the PLF, on the other hand, changed only smoothly following the swing in past fertility rates; this is particularly noticeable among the younger segment of the population (Figure III.1.d). The sharp growth in the mid 1950's can be, additionally, explained by the unusual large inflow of immigrants to Canada, with almost 4/5 of them directed to the LF.[2]

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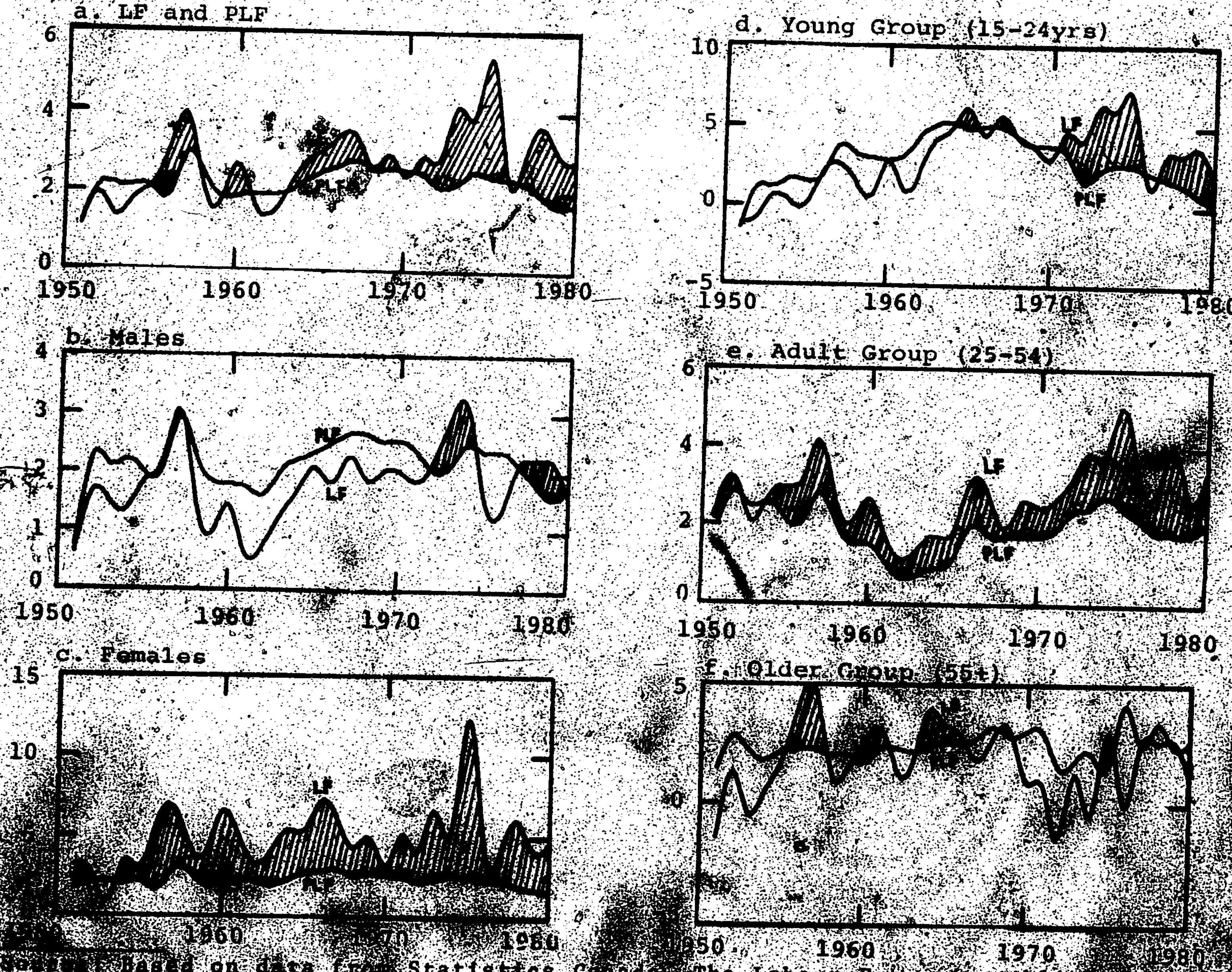
[2] Over the period 1956-60, an annual average of 121,039 immigrants in working age entered Canada. This figure represented an increment of 26% and 60% with respect to similar figures in the adjacent periods, 1951-55 and

FIGURE III.1 Growth of Actual and Potential Labour Force by Sex and Main Age Groups
Annual Average Rates of Growth 1951-1980



Source: Based on data from Statistics Canada, The Labour Force (unpublished annual estimates)

Second, the increased importance of participation in the explanation of the LF growth during the second half of the period (see Figure III.1.a) can be attributed to the combined effect of the recent upsurge of participation among the young (see Figure III.1.d) and increased involvement of adult workers in the market, especially females whose participation raised sharply throughout the entire period (see Figure III.1, graphs d and e respectively).

With regard to the sex division, it is seen that for males the impact of PLF growth on that of the LF has been offset by the declining participation trend of the male workforce, while for females the opposite behaviour is observed, with increased participation making the LF growth substantially larger than that of the PLF. For the entire period, decreased participation reduced the rate of growth of the male LF by about one fifth, while increased participation virtually doubled the rate of growth of the female LF beyond that attributable to demographic growth alone.

Among the young (Y) and adults (A) aged 25-54 years old, the demographic component of their rates of LF growth account on the average for 91% and 68% respectively; these components lose their relative importance in the explanation during the second half of the period. This is particularly noticeable for the young group, where only 62% of its LF

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*(cont'd) 1961-65. In relationship to the PLF and LF the number of immigrants represented 1.1% and 2.0% respectively. For more details see Peitchinis (1970, 14-5) and Economic Council of Canada (1976), Table A-20.

growth can be explained by the growth of their PLF.

In sum, demographic forces acting through the growth of the PLF, although playing an important role in shaping the size and changes of the LF over the entire Post-War period, began to lose relative importance in the explanation during the mid 1960's, when the changed participation behaviour of subgroups of the population -mainly females and younger workers- constituted an important determinant of the changing labour force.

2. Participation Behaviour

The need for a closer examination of the changes occurring in the participation behaviour of the LF arises from the notable differences in the decision to actively participate in the market exhibited by the various subgroups classified by sex and age.

As shown in Table III.2, sex distinction is important because the proportion of the female PLF participating in economic activity is considerably lower than that for males. The ratio of male to female participation rates (PR) is about 2.5 for the entire period, varying in the range of 3.1 to 1.5 times for 1950 and 1980, respectively. In spite of the important increase in female participation -one out of four members of the population in 1950 versus one out of two today- the sex differential continues to be significant, with men participating almost 50% more than women.

TABLE III.2 Participation Rates by Sex and Main Age Groups
Selected Years

Average Period	PR	Y	A	O	Males	Y	A	O	Females	Y	A	O
1950-80	56.5	54.9	66.4	34.8	79.7	64.9	96.5	56.1	33.6	45.1	36.5	14.5
1950-65	53.8	51.8	61.9	35.8	81.2	64.8	97.2	59.6	26.6	39.0	26.9	11.8
1965-80	59.1	58.1	70.8	33.8	78.2	65.0	95.8	52.6	40.6	51.2	46.1	17.3
Years												
1950	53.7	55.7	59.3	37.2	84.0	72.6	97.1	64.2	23.2	39.3	21.5	8.7
1955	52.9	53.0	60.2	34.1	82.1	67.5	97.1	58.7	23.9	38.9	23.4	9.1
1960	54.2	50.3	63.0	35.6	80.7	61.9	97.4	58.3	27.9	38.9	28.9	13.1
1965	54.4	48.1	65.2	36.2	77.9	57.2	97.1	57.3	31.3	38.9	33.9	16.2
1970	56.9	54.1	67.9	35.2	78.2	61.9	96.3	55.2	36.2	46.3	39.8	17.2
1975	61.1	62.9	72.6	32.9	78.4	68.9	94.8	51.5	44.4	56.8	50.5	17.4
1980	64.0	67.3	77.4	31.0	78.3	71.9	94.8	46.3	50.3	62.6	60.1	18.2

PR:Participation Rates; Y:Young (less than 25 years old); A:Adults (25-54 yrs. old); O:Older (55+ yrs. old)

Source: Based on data from Statistics Canada, The Labour Force (unpublished annual estimates).

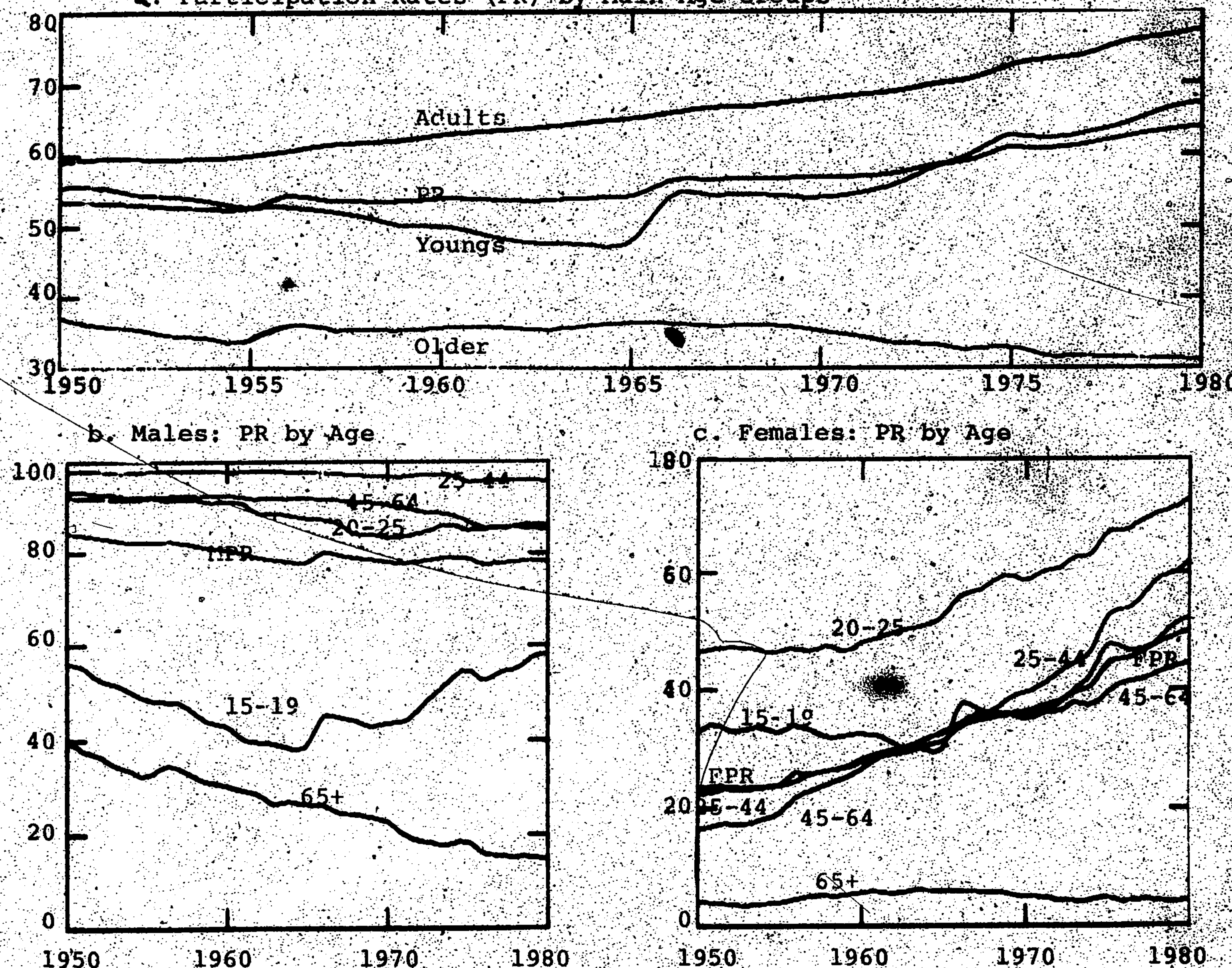
If sex and age division are jointly considered, striking differences are revealed. Adult male workers constitute the group with highest (and most stable) attachment to the market. The average level of PR for this group over the period is about 2.9 times greater than that of females, 6.6 times if compared to older females, and 50% and 70% greater than those of young and older males respectively. These quantitative variation and secular changes in the subgroups PR's merit a disaggregated analysis, by age and sex, to gain a better understanding of the changes in the main aggregate indicators of the Canadian labour market.

Figure III.2 illustrates the changes in participation behaviour of the various groups. The upper portion of the Figure displays the pattern followed by the overall and main age groups PR's, while the lower portions refer to both sex and age groups.

Up to the end of the 1960's the declining trend in male participation was shared by all the groups without exception. The fastest rate of decline corresponded to those in both extremes of the age spectrum (those aged less than 25 and 55+ years). At the beginning of the 1970's, however, the declining trend in the PR of the young reversed, mainly among the youngest group (from 43% in 1970 up to 58% in 1980 for the youngest group, 15-19 years). The relative stability in the level of the overall male PR in the last decade, around 78%, reflects the offseting effect of the recent

FIGURE III.2 Participation Rates by Age and Sex 1950-1980

a. Participation Rates (PR) by Main Age Groups



Source: Based on data from Statistics Canada, The Labour Force (unpublished) upward trend of the young group against the on-going decline in the participation of other male groups.

The dramatic increases in the overall female PR has been shared by all age groups throughout the period, with the partial exception of the youngest (15-19 years old), whose PR declined up to the early 1960's by 3 points from 33% in 1950, but then rose sharply thereafter to reach 52% in 1980. The most remarkable change, however, occurred for the adult female group (25-54 years old). This group increased steadily its PR from 21% at the beginning of the period to 60% in 1980.

The above changes clearly indicate that, despite the declining trend in the adult males PR's, the recent upsurge in the overall PR, starting in the mid 1960's, can be attributed to the increased involvement of women and young people in the LF. Today, these groups represent more than half (about 55%) of the total LF as compared with only 38% in the early 1950s.

3. **Labour Force Composition**

The combined effects of rapid and variable growth among the various subgroups of the LF and the diverse changes in participation behaviour discussed above have brought about a remarkable change in the composition of the LF.

The evidence on the age-sex composition of the LF for selected years (see Table III.3) shows a tendency for the LF to become younger and female dominated.

TABLE III.3 Labour Force Composition by Sex and Main Age Groups
Selected Years

Average Period	LF	Y	A	O	Males	Y	A	O	Females	Y	A	O
1950-80	100	24.4	62.0	13.6	70.3	20.6	64.2	15.2	29.7	34.2	56.0	9.8
1950-65	100	23.3	62.4	14.3	75.2	19.2	64.9	15.9	24.8	36.1	54.5	9.4
1965-80	100	25.6	61.5	12.9	65.5	22.1	63.5	14.4	34.5	32.3	57.5	10.2
Years												
1950	5162	25.1	60.0	14.9	78.4	20.5	62.7	16.8	21.6	41.5	50.6	7.9
1955	5611	22.8	63.3	14.0	77.4	18.5	65.9	15.6	22.6	37.5	54.3	8.2
1960	6410	21.9	64.0	14.1	74.2	18.0	66.5	15.5	25.8	33.0	56.9	10.1
1965	7142	23.4	62.2	14.4	70.9	19.7	64.6	15.7	29.1	32.5	56.1	11.4
1970	8262	24.9	61.1	14.0	67.8	21.0	63.6	15.4	32.2	33.0	55.9	11.1
1975	9966	27.1	60.9	12.0	63.1	23.6	62.8	13.5	36.9	33.1	57.6	9.4
1980	11521	26.8	61.9	11.3	60.0	24.1	63.0	12.9	40.0	30.7	60.2	9.1

Source: Based on data from Statistics Canada, The Labour Force (unpublished annual estimates). Y:Young (-25 yrs old); A:Adult (25-54 yrs old) and O:Older (55+).

With regard to sex, the data show that for every ten workers in the early 1950's there were only two women enrolled in the LF, whereas by the end of the 1970's the importance of women had doubled and four out of ten LF members were females.

If age groups are considered, it is seen that since the early 1960's the importance of young workers has increased from about one fifth up to one quarter by the end of the period, with close to half of them being young women. The relative stability of the adult workers share, around 61% over the whole period, hides the fact that its sex composition has been greatly altered. Indeed, while adult females only represented about 19% of the group in the early 1950's its share of the group has today increased to almost 40%.

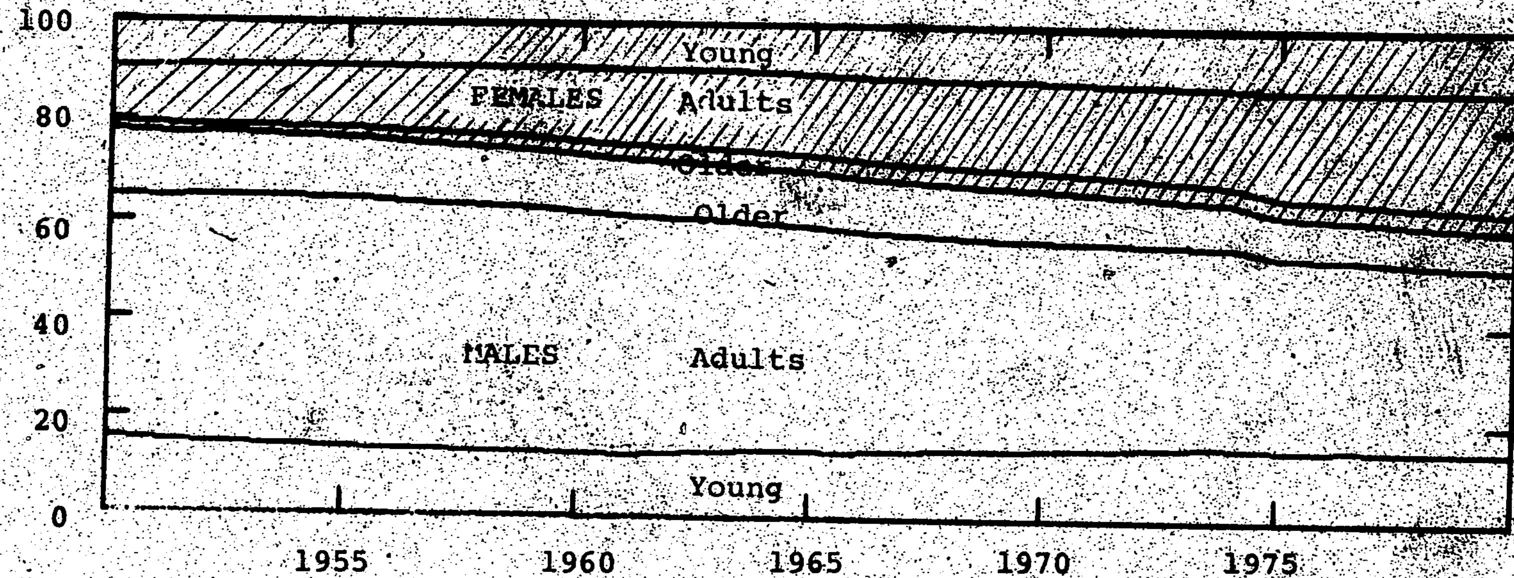
Further evidence of these changes in the LF composition by sex and detailed age groups on annual basis is presented in Figure III.3. It can be seen that there has been a remarkable change in the relative importance of women as well as the various age groups in a relatively short period of time.

B. Changes in Employment and Unemployment

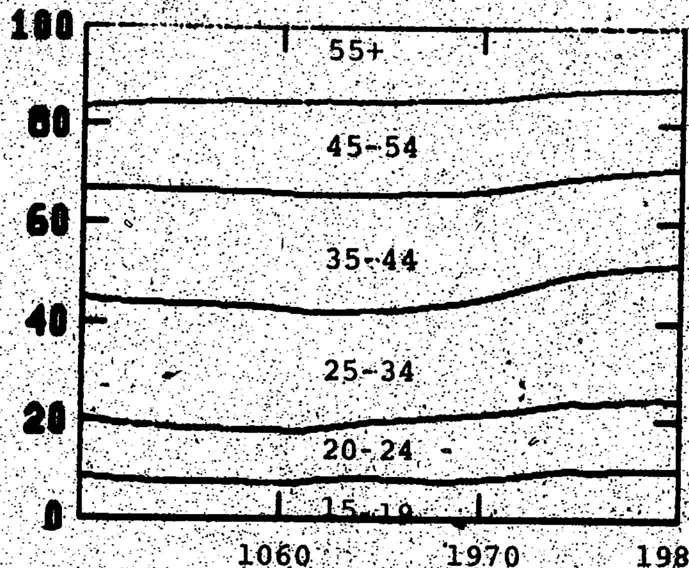
The sizeable changes in the LF composition towards females and young workers, groups that have been

FIGURE III.3 Labour Force Composition by Sex and Age. 1950-1980

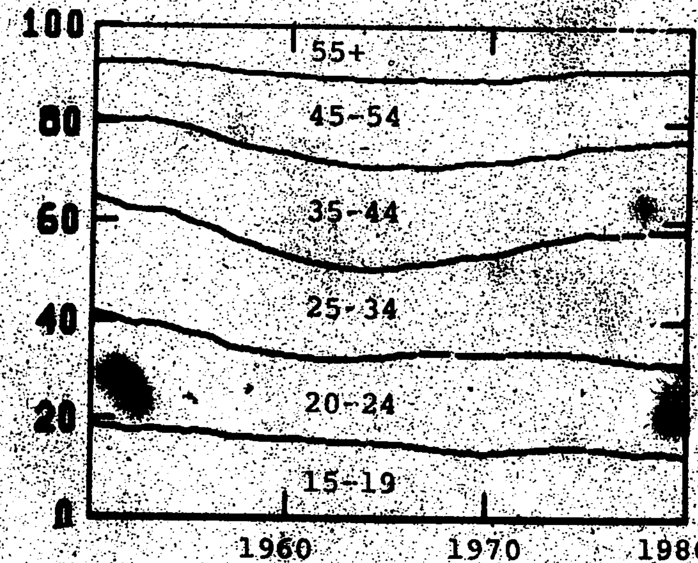
a. LF Composition by Sex and Main Age Groups



b. Males: LF Composition by Age



c. Females: LF Composition by Age



Source: Based on data from Statistics Canada, The Labour Force (unpublished annual estimates).

traditionally considered with a weak and irregular attachment to the market and with higher employment turnover, might well help to explain the observed higher responsiveness of LF to cyclical fluctuations in the level of economic activity as well as the persistent higher unemployment rates prevailing during the 1970's, as shall be seen in what follows.

1. Employment Growth and Composition

One of the outstanding features of the Canadian labour market has been its capacity to generate productive jobs at a rate paralleling the rapid growth of the LF. Total employment has been growing over the period at an average annual rate of 2.58 percent, with a number of new positions of about 5.7 millions. This growth, however, was more pronounced during the second half of the period, at an annual rate of 3.0 percent as compared to only 2.2 during the first half.

More striking yet has been the flexibility shown by the employment structure to accommodate the sizeable changes in the composition of the LF. The increased employment opportunities for females and young workers, as Table III.4 and Figure III.4 illustrate, has been the distinctive feature of the labour market.

Female employment has been growing at a rate that has been more than double the rate for males, i.e., 4.7% for females versus 1.7% for males. Such differentials have been

TABLE III.4 Employment by Sex and Main Age Groups. Growth and Composition Selected Years

a. Average Annual Rate of Growth (%)

Average Period	E	Y	A	O	Males	Y	A	O	Females	Y	A	O
1951-80	2.6	2.7	2.7	1.8	1.7	2.1	1.8	0.9	4.7	3.5	5.3	5.3
1951-65	2.2	1.7	2.4	1.9	1.5	1.2	1.7	1.0	4.2	2.5	5.0	6.9
51-55	1.5	-0.5	2.6	0.2	1.2	-1.1	2.2	-0.2	2.6	0.5	4.2	3.3
56-60	2.2	1.0	2.5	2.5	1.2	0.1	1.4	1.1	5.3	2.3	6.4	10.0
61-65	2.8	4.6	2.2	3.1	2.1	4.7	1.4	2.0	4.8	4.6	4.5	7.2
1966-80	3.0	3.7	3.0	1.6	1.9	3.0	1.8	0.8	5.1	4.5	5.6	3.8
66-70	2.6	3.3	2.3	2.2	1.6	2.2	1.4	1.5	4.8	4.9	4.8	4.5
71-75	3.6	5.2	3.6	0.9	2.4	4.8	2.2	0.2	5.9	5.8	6.5	2.7
76-80	2.8	2.4	3.2	1.7	1.7	2.1	1.8	0.8	4.6	2.8	5.6	4.1

b. Employment Composition (%)

	E	Y	A	O	Males	Y	A	O	Females	Y	A	O
1950-80	100	23.5	62.7	13.8	70.1	19.6	65.1	15.3	29.9	33.4	56.6	10.0
1950-65	100	22.7	63.0	14.3	74.8	18.5	65.6	15.9	25.2	35.5	55.0	9.5
1950		24.6	60.5	14.9	78.2	20.0	63.1	16.9	21.8	41.1	50.9	8.0
1955		22.2	63.8	14.0	77.0	17.8	66.5	15.7	23.0	37.1	54.7	8.2
1960		21.0	64.8	14.2	73.2	16.9	67.4	15.7	26.8	32.1	57.6	10.3
1965		22.8	62.8	14.4	70.6	19.1	65.3	15.7	29.4	31.8	56.7	11.5
1965-80	100	24.3	62.5	13.2	65.5	20.8	64.6	14.6	34.5	31.2	58.3	10.5
1970		23.7	62.1	14.2	67.3	19.7	64.7	15.6	32.7	31.9	56.8	11.3
1975		25.6	62.0	12.4	63.6	22.0	64.1	13.9	36.4	31.9	58.4	9.7
1980		25.1	63.1	11.8	60.3	22.3	64.4	13.3	39.7	29.3	61.3	9.5

Source: Based on data from Statistics Canada, The Labour Force (unpublished estimates). Y:Young (-25 yrs); A:Adult (25-54 yrs); O:Older (55+ yrs) repeated in every major age group category, with rates of growth for female employment ranging from 1.6 to almost 6 times the rates for males in the young and older age groups, respectively.

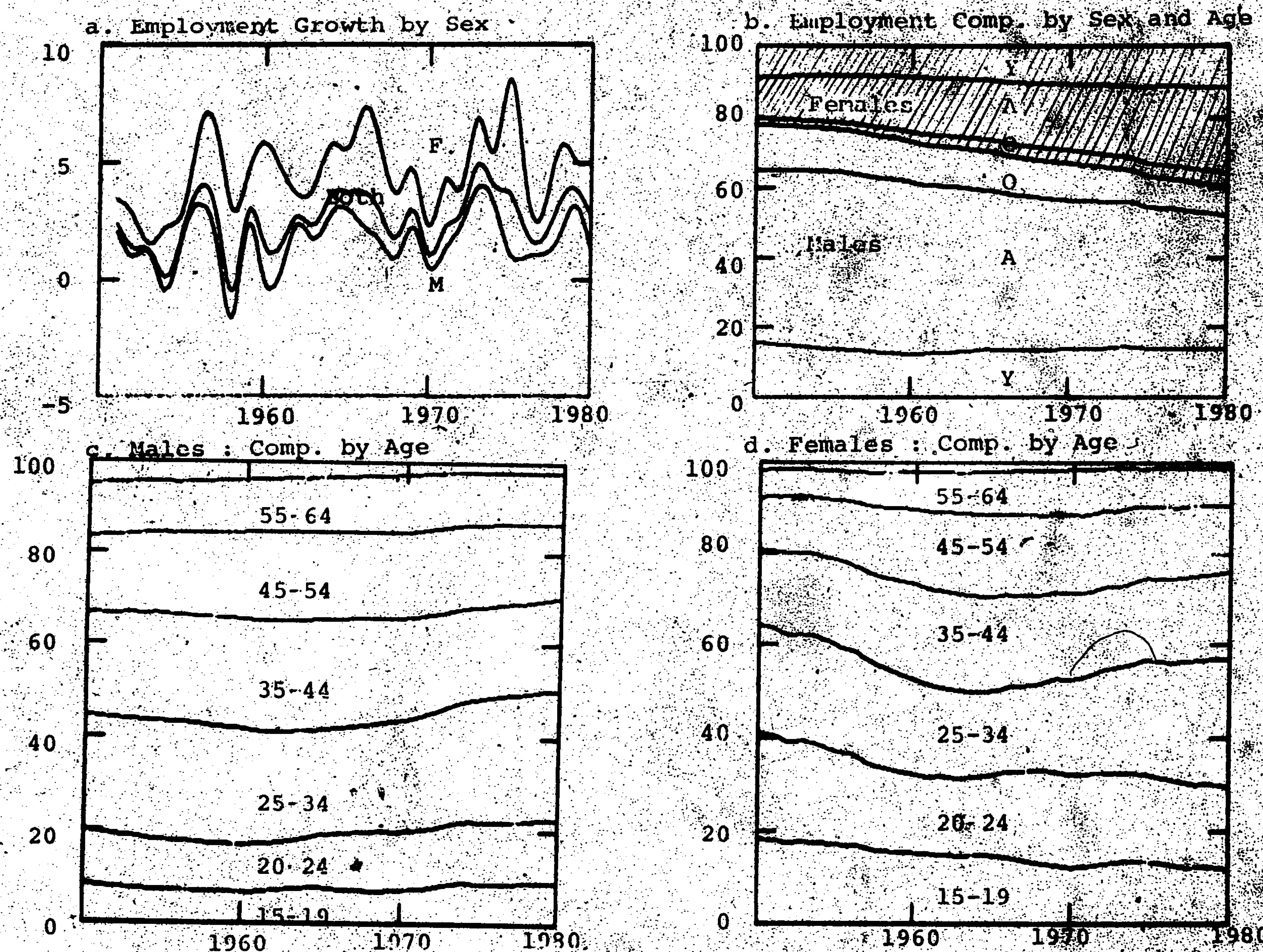
As a consequence of the uneven employment growth between the various age-sex groups of the LF, the employment structure today has changed notably with respect to what it was during the 1950's. The lower section of Table III.4 shows the composition of employment, by age and sex, for selected years of the period.

The share of young workers in total employment decreased up to the early 1960's (from about one quarter in 1950 to one fifth in 1960), but then returned to one quarter by the mid 1970's. The most important change, however, occurred in the sex composition of this group. Females, who represented only 19% of the employed young workers in 1950, increased their share to 50% in 1980.

Among the adult employed workers, a pattern similar to that of the young groups is observed. In fact, although the group's share of total employment remained relatively constant (around 63%) throughout the period, its composition by sex was greatly altered. Indeed, while in 1950 one in every 5 adult workers employed was female, in 1980 two were females.

To further comprehend the combined effects of the sizeable changes, in level and composition, of employment and LF over the various workers subgroups, the examination of

FIGURE III.4 Employment Growth and Composition by Sex and Main Age Groups



Source: Based on data from Statistics Canada, The Labour Force (unpublished annual estimates).

their relative behaviour over time can be accomplished by focussing on their unemployment experience.

2. Unemployment Rates and Composition of the Unemployed

Despite the rapid expansion of employment opportunities and several years of strong economic growth, the measured unemployment rate has shown a clear upward trend throughout the time period of interest. During the 1950's an annual average rate of unemployment of about 4.5% prevailed, in the 1960's it shifted to a level of 5.0%, while in the 1970's it rose to 6.9%.

Table III.5 summarizes the average levels of the unemployment rates (URs) for workers by sex and age groups along with a similar breakdown for the composition of the unemployed in selected periods. For the complete period the behaviour of unemployment rates by age-sex groups are illustrated in Figure III.6.

There is no doubt that the recent periods of slack aggregate demand have contributed to the observed upward trend in the overall unemployment rate. However, this explanation is incomplete unless the changed character of the LF is considered. In fact, although the unemployment rates of young and adult workers have more than doubled over the period, these changes are not homogeneously distributed by sex.

Young workers have traditionally experienced a higher unemployment rate than the overall rate, i.e. about two

TABLE III.5 Unemployment Rates and Composition of Unemployed by Sex and Main Age Groups Selected Years

a. Unemployment Rates

Average Period	UR	Y	A	O	Males	Y	A	O	Females	Y	A	O
1950-80	5.5	9.2	4.3	4.2	5.9	10.8	4.5	4.7	4.4	6.9	3.3	[illegible]
1951-65	4.8	7.6	4.0	4.3	5.5	9.6	4.6	4.8	2.8	4.5	1.9	1.7
51-55	3.5	5.3	2.9	3.1	3.8	6.5	3.2	3.4	2.2	[illegible]	1.6	1.3
56-60	5.6	8.8	4.7	4.6	6.5	11.3	5.4	5.2	2.9	4.8	2.0	1.6
61-65	5.4	8.8	4.4	5.1	6.3	10.9	5.1	5.9	3.2	5.6	2.1	2.2
1966-80	6.1	10.8	4.5	4.2	6.2	11.9	4.4	4.5	6.0	9.3	4.6	3.9
66-70	4.6	7.9	3.4	4.0	5.2	9.4	3.9	4.8	3.4	5.8	2.3	1.9
71-75	6.1	10.9	4.4	4.1	6.3	12.3	4.5	4.5	5.7	9.1	4.2	3.2
76-80	7.7	13.6	5.8	4.4	7.0	14.1	4.8	4.2	8.9	13.0	7.4	4.8

b. Unemployment Composition

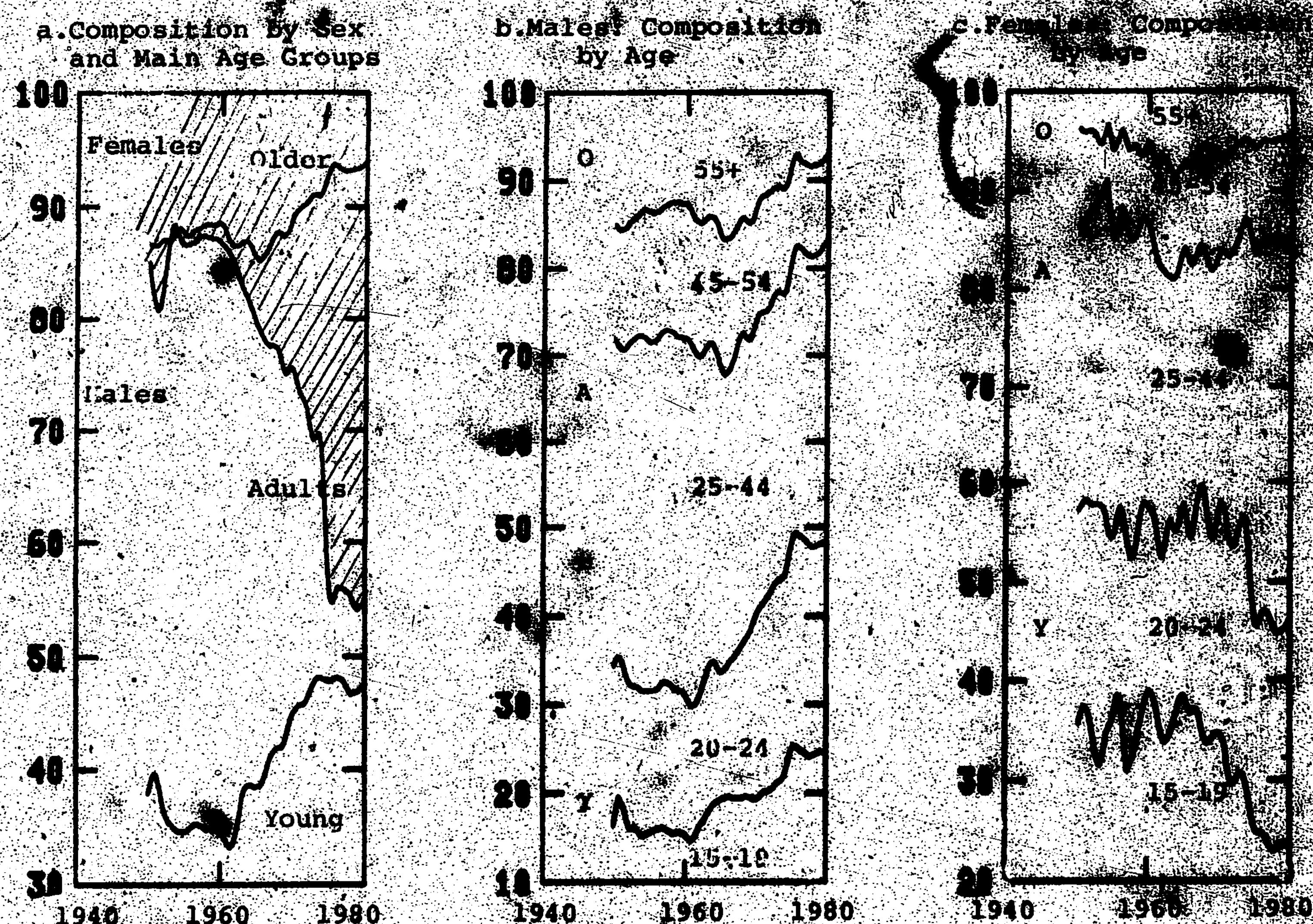
Average Period	UR	Y	A	O	Males	Y	A	O	Females	Y	A	O
1950-80	100	40.6	48.5	11.0	75.8	37.1	49.9	12.4	24.2	54.1	40.3	5.6
1951-65	100	35.9	51.5	12.7	85.1	32.3	53.8	13.9	14.9	56.2	38.0	5.7
51-55		36.4	50.8	12.8	85.2	32.9	52.8	14.3	14.8	57.1	38.5	4.4
56-60		34.9	50.8	12.8	87.1	31.8	55.6	12.6	12.9	56.0	38.7	5.3
61-65		36.3	50.2	13.5	82.9	32.3	53.0	14.7	17.1	55.6	36.9	7.5
1966-80	100	45.3	45.4	9.3	66.6	43.1	45.9	10.9	33.4	51.9	42.5	5.6
66-70		41.6	45.7	12.7	76.8	37.0	48.3	14.7	23.2	56.7	36.9	6.4
71-75		46.9	44.3	8.8	67.8	44.1	45.6	10.3	32.2	52.9	41.6	5.5
76-80		47.3	46.2	6.5	55.2	48.4	43.8	7.8	44.8	46.0	49.1	4.9

Source: Based on data from Statistics Canada, The Labour Force (unpublished annual estimates).

thirds higher over the entire period, which reflects, as it is usually argued, the normal difficulties this group faces while seeking work for the first time as well as the high employment turnover as they search for more satisfying jobs. However, what makes the situation of this group particularly interesting is the secular tendency for the youth UR to deteriorate in light of the fact that this group today represents more than a quarter of the total LF. As shown by Table III.5, the recent level of the youth UR is almost 2.6 times its level during the 1950's. Moreover, if compared to the overall UR rate, its level during the 1950's was only 58% greater while by the end of the 1970's is 78% higher. Today, young workers constitute almost half of the unemployed as compared to about one third in the early 1950's (see Table III.5, lower part).

Among women, the historically lower levels of their UR's than those for males in similar age categories have changed substantially. Beginning in the mid-1960's, their rates have risen steadily, becoming at the end of the period greater than the respective rates for males, i.e., during the 1950's the female UR's were about one half of those for males, while in the late 1970's they were on average 30% higher. The main changes occurred among the young (actual rates are 4.6 times the level in the 1951-55 period) followed by the adult group. If, in addition, it is considered that their share in the LF has increased from one fifth up to 40% over the same period, the impact of female

FIGURE III.5 Unemployment Composition by Sex and Age. 1950-1980



Source: Based on data from Statistics Canada, The Labour Force (unpublished annual estimates)

unemployment of the overall [illegible] importance of women among the [illegible] accordingly: in the early 1950 [illegible] one in [illegible] unemployed workers was female, but by the end of the [illegible] about one in two of the unemployed were female.

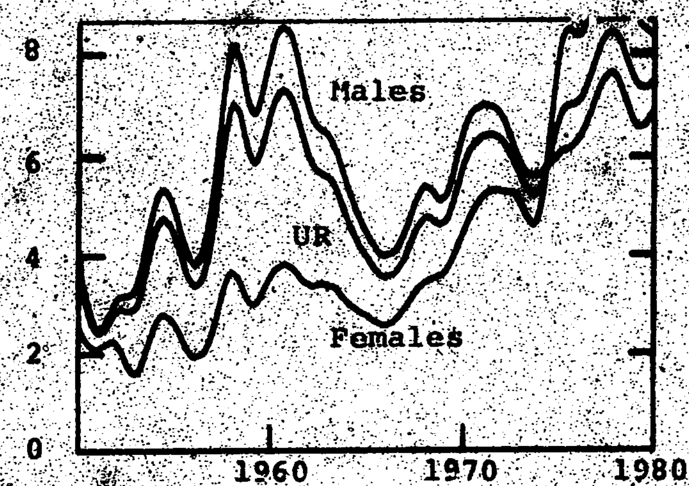
In sum, the above evidence allows us to conclude that the upward trend shown by the overall UR over the [illegible] stems mainly from the increased deterioration of the relative unemployment situation of the young and female workers . The effects of these changes is today even more important given the even higher share of the total LF that these groups represent.

C. The Earnings Structure

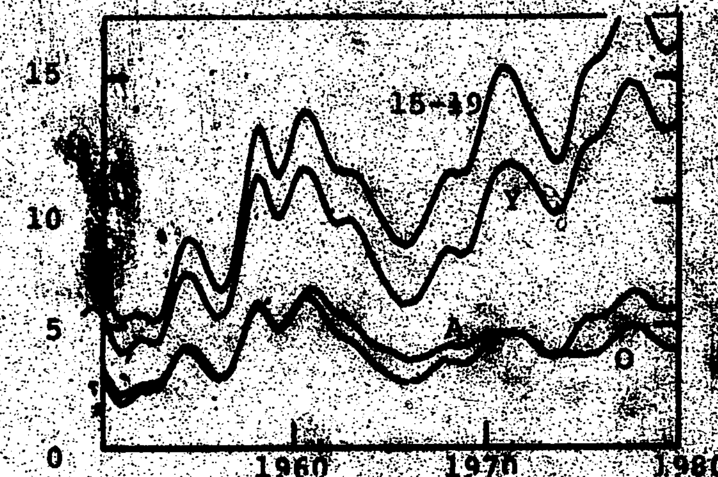
The review of the major transformations occurring in the labour market is concluded with an examination in this section of the changes experienced by the age-sex earnings structure of the workforce.

The observed demographic changes in the composition of LF and employment raise several questions on the relative earnings performance of the various groups of workers participating in the market. In fact, given the increasing share of young and female workers in the LF, questions relating to the degree of flexibility of the structure of earnings to accommodate these groups are of the main

FIGURE III.6 Unemployment Rates by Sex and Age Groups. 1950-1980

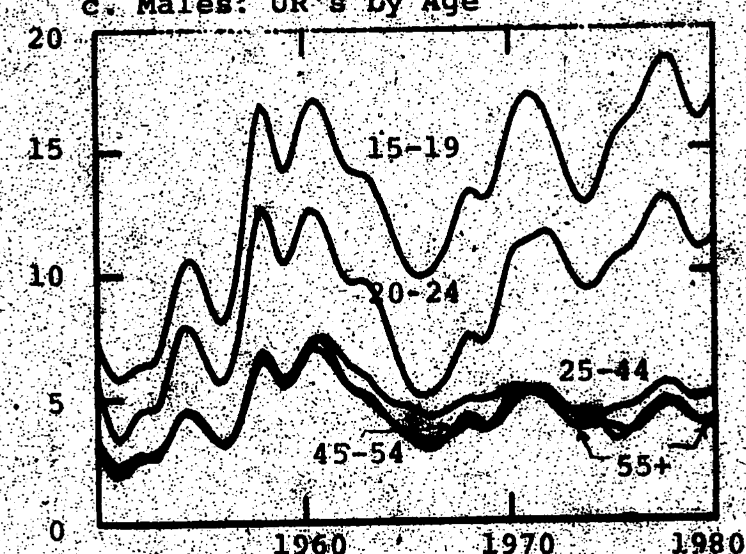


a. URs by Sex

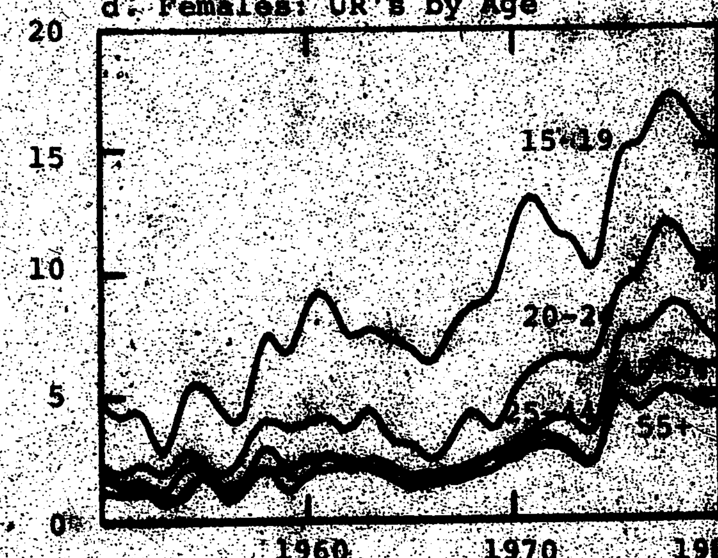


b. URs by Main Age Groups

c. Males: UR's by Age



d. Females: UR's by Age



Source: Based on data from Statistics Canada, The Labour Force (unpublished annual estimates)

importance.

Has the [illegible] of earnings [illegible] the structure of relative earnings [illegible] toward young workers?. How cyclically responsive is the earnings structure? and, in general, how have the relative earnings of the various groups performed over time? In what follows the available evidence is examined to provide [illegible] answers to these questions.

Since the concern is with market earnings, i.e., the reward for the productive contribution of those workers engaged in the market, the annual average income of those whose main source is wages and salaries [illegible] the measure of earnings for the different age-sex groups of workers. A set of data, taken from Statistics Canada, *Income Distribution by Size in Canada*, provides the basis [illegible] analysis. The series at the level of disaggregation required and for the entire period were reconstructed from various annual issues of the above publication.

1. Earnings Differentials by Sex

The observed large differential of earnings by sex has been a matter of increasing concern among labour market researchers and policy makers. Although efforts have been made to isolate the specific factors determining the existence of such differential**

** These efforts usually include standardization of data to control both, for individual differences in human capital (age, experience, level of education and other formal training, skills, etc.) and characteristics related to the through adequate standardization, the evidence shows that such differentials remain, suggesting that males enjoy a preferential treatment in the market.

Given the limited scope of this section, a review of the evidence that documents the existence of this differential and its change over time will be made, without attempting to provide explanations or to measure the relative importance of these determinants.

The ratio of male-female earnings by age groups provides an indication of the magnitude of the sex-differential Table III.6 summarises this information for the whole period and selected subperiods. It is seen that the overall male earnings, average of the period, has remained at a level of more than twice that for females; with earnings of the young and adult male workers being about 45% and 120% higher than their respective female counterparts.

If the distribution of earnings differentials by detailed age groups is considered, it is noticed that this distribution follows an inverted U shape; the differential increases rapidly from about 20% among the youngest up to 150% among the adult workers aged 35-44 years old, declining smoothly thereafter.

In other words, if earnings do in fact represent rewards for the productive contribution of workers, the

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..(cont'd) jobs (type of position, hours of work, type of sector, etc.). For detailed information on the type of data collected, see Labour Canada, *Women In the Labour Force: Facts and Figures*, published annually.

significant differentials by sex for the older [illegible] might well represent differences in [illegible] accumulated by both sexes, given that [illegible] continuity and attachment to careers and to the market than females. This observation, however, does not rule out the possibility of preferential treatment for males in obtaining seniority positions. On the other hand, the insignificant differential among the youngest accords well with the low level of skills required by the type of jobs they are likely to perform, where experience is not a significant factor, making them better substitutes. In addition, their earnings are more likely to reflect the minimum wage legislation rather than their contribution to production, thus the insignificance of the differential.

Over time the sex earnings differential shows a declining trend. This reduction, however, is rather modest and today's gap still remains at a high level, i.e., women's average earnings have increased to only 52% of men's earnings in the late 1980's from about 44% in the early [illegible]. The differential has been reduced for all age groups but the youngest; for the latter a continuous deterioration starting in the mid 1960's is observed.

The improvements in the relative earnings of females occurred mainly among the young-adult workers (females aged 20-24 and 25-34 years old).[illegible] Among contributing factors [illegible]

[illegible] While at the beginning of the period the earnings of these groups represented only [illegible] and [illegible] of the earnings for males in similar ages, at the end they have raised to [illegible] and 56%.

TABLE III.6 Earnings by Sex and Main Age Groups, Selected Periods 1951-1980

a. Male/Female Earnings Ratio

Period	All	Young	Adult	Older	- 20	20-24	25-34	35-44	45-54	55-64	65 +
					Age Groups						
1951-80	2.13	1.45	2.17	1.94	1.23	1.48	1.97	2.36	2.23	2.00	1.72
1951-65	2.18	1.52	2.18	2.02	1.19	1.57	2.00	2.35	2.22	2.06	1.84
51-55	2.25	1.49	2.15	2.16	1.19	1.57	1.95	2.26	2.27	2.20	2.13
56-60	2.09	1.48	2.09	2.08	1.11	1.57	1.91	2.2	2.17	2.08	2.16
61-65	2.20	1.57	2.31	1.81	1.27	1.57	2.13	2.59	2.21	1.90	1.54
1966-80	2.08	1.39	2.16	1.86	1.27	1.39	1.84	2.37	2.23	1.94	1.51
66-70	2.21	1.42	2.33	1.83	1.21	1.41	2.12	2.53	2.34	1.93	1.46
71-75	2.11	1.40	2.17	1.89	1.29	1.40	1.92	2.41	2.26	1.96	1.59
76-80	1.93	1.36	1.99	1.86	1.31	1.36	1.79	2.47	2.10	1.94	1.47

b. Relative Earnings

Period	All	Young	Adult	Older	- 20	20-24	25-34	35-44	45-54	55-64	65 +
		Males									
1951-80	1.20	0.43	1.00	0.94	0.22	0.57	0.91	1.10	1.10	0.97	0.84
1951-65	1.20	0.47	1.00	0.93	0.26	0.61	0.92	1.10	1.10	0.97	0.81
51-55	1.20	0.49	1.00	0.95	0.30	0.63	0.92	[illegible]	1.10	1.00	0.84
56-60	1.20	0.49	1.00	0.97	0.28	0.63	0.92	1.10	1.10	1.00	0.88
61-65	1.20	0.42	1.00	0.85	0.20	0.58	0.91	1.10	1.00	0.90	0.72
1966-80	1.10	0.39	1.00	0.96	0.17	0.52	0.91	1.10	1.10	0.98	0.86
66-70	1.20	0.39	1.00	0.91	0.16	0.53	0.91	1.10	1.10	0.94	0.76
71-75	1.10	0.38	1.00	0.95	0.16	0.51	0.91	1.10	1.10	0.97	0.89
76-80	1.10	0.40	1.00	1.00	0.19	0.53	0.91	1.10	1.10	1.00	0.93
		Females									
1951-80	0.55	0.29	0.47	0.49	0.18	0.38	0.47	0.47	0.48	0.49	0.50
1951-65	0.56	0.31	0.47	0.46	0.22	0.39	0.46	0.46	0.48	0.47	0.49
51-55	0.55	0.33	0.48	0.44	0.25	0.40	0.47	0.48	0.48	0.45	0.40
56-60	0.60	0.33	0.49	0.47	0.25	0.40	0.48	0.49	0.50	0.48	0.41
61-65	0.54	0.27	0.44	0.47	0.16	0.37	0.43	0.42	0.46	0.47	0.47
1966-80	0.53	0.28	0.48	0.51	0.14	0.38	0.47	0.47	0.49	0.50	0.57
66-70	0.52	0.28	0.44	0.50	0.13	0.38	0.43	0.43	0.45	0.49	0.52
71-75	0.52	0.27	0.47	0.50	0.13	0.37	0.47	0.46	0.48	0.48	0.57
76-80	0.55	0.39	0.52	0.54	0.15	0.39	0.51	0.52	[illegible]	0.53	0.64

Source: Based on data from Statistics Canada, Income Distribution by Size in Canada.
Young: aged 24 yrs. and less; Adult: aged 25-54 yrs; Older: aged 55 yrs. and over. The estimates for relative earnings of the various age-sex groups are referred to Adult males.

the sharp rise in their levels of education [illegible] training oriented to market activities [illegible] the early 1960's. Indeed, figures on the [illegible] of the LF reveal that while in 1960 only [illegible] of the [illegible] in the LF had post-secondary education, by 1971 this percentage increased to 24% and up to 34% in 1979.[32]

Cyclical fluctuations in the level of economic activity have a definite impact on the earnings differential by sex. The extent and direction of this impact is revealed by the annual variations in the ratio of male-female earnings, as Figure III.7.a illustrates. It is seen that major gains in reducing the differential coincides with periods of strong economic growth (shaded areas in the Figure). The most pronounced and regular gains are for adult females, a group that today not only has an important share of the market but also a more permanent presence. This evidence suggests that efforts towards reducing differentials of earnings by sex might succeed only under conditions of strong and sustained economic growth, otherwise the women's relative earnings position remains weak with a higher likelihood of [illegible]

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[32] For complete evidence on the level of schooling of the LF by sex see Statistics Canada, *The Labour Force*. Although some differences in the definition of post-secondary schooling should be noted (only formal [illegible] included in 1960, university and some other [illegible] post-secondary education in 1971, and starting in [illegible] of post-secondary schooling are included) the [illegible] trend of female education is a well proven [illegible]. For example, see the comprehensive study by [illegible] and C.J. Wenaas (1970), particularly [illegible] provides detailed data on the increased [illegible] females in Canadian educational institutions [illegible] 1951-66.

to discrimination in [illegible] demand.

2. Transformations in the Relative Earnings Structure

A review is needed of the modifications experienced by the structure of relative earnings in connection with the observed changes in the relative size of the various age-sex groups of workers. Relative earnings are defined with respect to the earnings of the adult male workers, aged 25-44 years old. This group was selected as the basic reference given its stable employment, participation and earnings behaviour over the period.[11] Table III.6.b shows the average structure of relative earnings by sex and age groups for the overall and selected subperiods.

If compared by sex, the information in the Table reveals three interesting features on the structure of earnings. First, the age distribution of female earnings is much flatter than that for males, i.e., the ratio of highest to lowest earnings among women is only 2.7 times compared to 5.1 times among men. Second, the level of female relative earnings is at most about one half of the male reference group. Thus, females enjoy a more even distribution of earnings by age, but only at a significantly lower level than males. Third, the structure of earnings for males is much more rigid than its female counterpart over time, especially when the youngest and oldest men are excluded.

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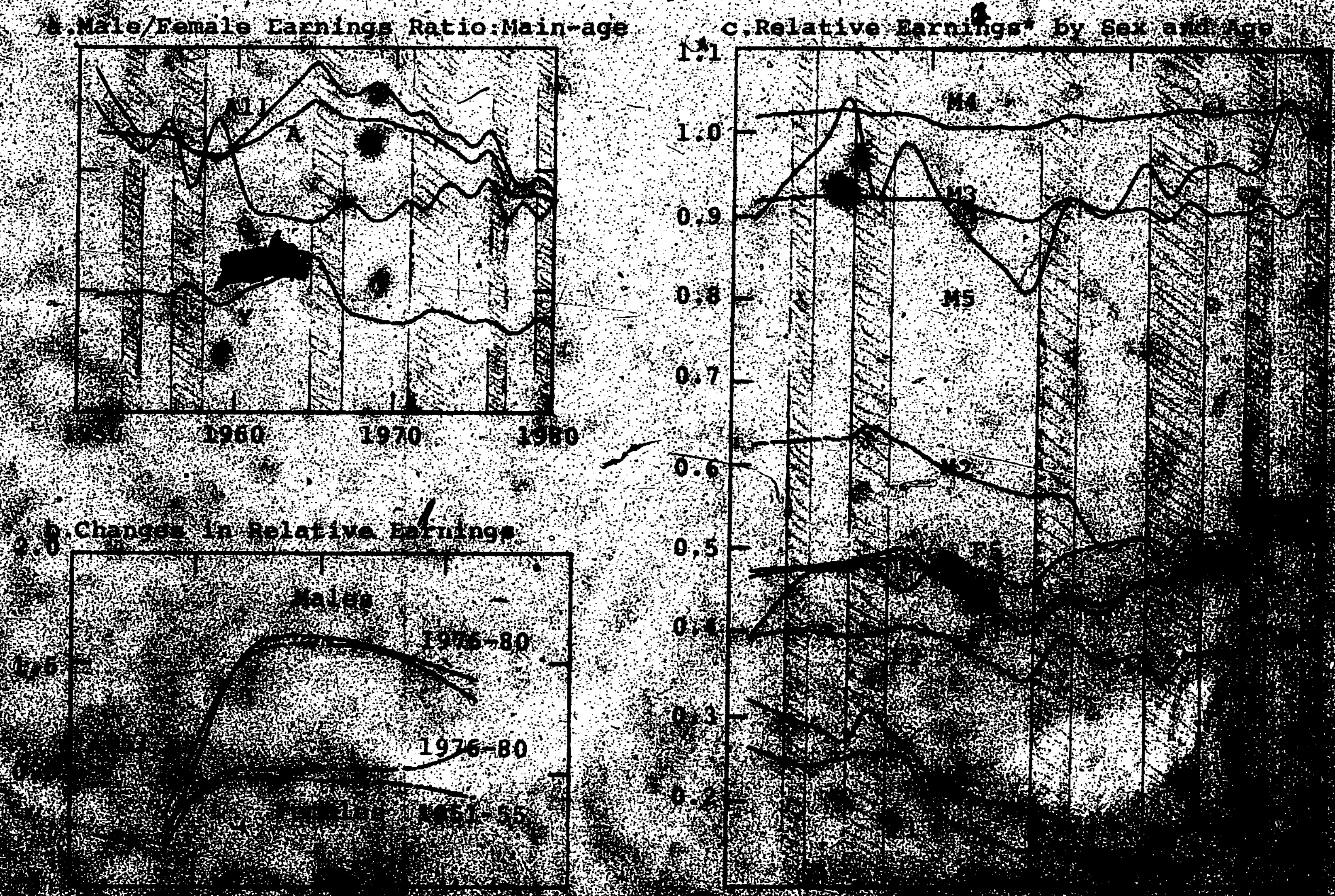
[11] Annual earnings of the composite group are computed as weighted average of the annual reported earnings of the subgroups aged 25-34 and 35-44, the weights given by their respective share in employment.

FIGURE III.7 Annual Changes in the Earnings Structure by Sex and Main Age Groups



These features accord well with the traditional role of *secondary workers* assumed for females in the labour market.

A more detailed analysis of the groups' earnings performance over time suggests that young workers have seen a continuous deterioration of their relative earnings. Among males, the relative earnings of the young have dropped from 49% in the early 1950's to only 40% in the late 1970's; over the same period, a deterioration of 10% for young females has occurred (relative earnings fell from 33% to 29%). These changes are mainly explained by the sharp fall of the youngest group's (aged less than 20 years old) relative earnings starting in the mid 1960's. Figure III.7.b illustrates the unfavourable shift against the youngest in the relative earnings structure when the 1951-55 and 1976-80 periods are compared.

Adult females have seen an improvement in their relative position over time. This trend is usually associated with changes in the industrial mix of the economy towards an increased importance of the tertiary sector, general improvements in working conditions -reduced hours of work, more part-time jobs available, increased automation among others- that have facilitated and expanded the employment opportunities open to women. Not less important has been the changed attitude towards women who work; indeed, social and cultural patterns have changed making it more readily accepted that women have a productive role to play in the market (see Peitchinis (1970) and Gunderson

(1980) [illegible]

Further insights [illegible] sex-age relative earnings [illegible] changes are considered [illegible] by year changes in [illegible] various groups.

In addition to the major [illegible] graph reveals that improvements in [illegible] women (except the youngest group [illegible] 1960's. This upward trend [illegible] fluctuations of their earnings. Both [illegible] with the increased share of women in the [illegible]

More important yet, it is seen that [illegible] variations in the relative earnings of [illegible] follow a definite procyclical pattern. [illegible] expansionary economic activity (Figure [illegible] areas) the relative earnings position of [illegible] to improve significantly, while in periods [illegible] growth a marked deterioration occurs. [illegible] greater gains with rapid economic growth; thus [illegible] differential tend to [illegible]

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* Detailed data on the [illegible] of [illegible] market can be found in the annual [illegible] Canada, *Women in the Labour Force: Fact[illegible]*

** Their increased [illegible] sex discrimination [illegible] capabilities. On the other [illegible] have helped to [illegible] given the more irregular [illegible] these, compared to [illegible] of this group.

In sum, the evidence reviewed in this section suggests that the relative earnings structure, by age and sex, has been flexible and sensitive to changes in the composition of the labour market and cyclical fluctuations in the economic activity. Young workers have seen their relative earnings position worsen, a fact that might well be attributed to their arrival in the market in unusually larger numbers. Adult women, on the other hand, have seen an improvement in their relative position, in spite of their increased number. This fact suggests that other forces have played a major offseting role, such as the changed industrial mix of the economy and advances in reducing sex discrimination. These improvements, nevertheless, have been rather modest in view of the still significant gap of earnings by sex. Finally, the high sensitivity of secondary workers'earnings to cyclical developments suggests that sex differentials could be reduced, and the relative position of young workers improved if a higher and permanent growth in employment [illegible] conditions of sustained

IV. Employment, Unemployment and Labour Force Participation: Empirical Approach

This chapter focusses on the simultaneous changes in employment, unemployment and labour force resulting from variations in cyclical and demographic variables and related changes in relative wages and other factors.

The chapter is divided into three parts. Part A examines the weaknesses of and interrelationships between alternative measures of employment performance. It specifically seeks to clarify the connections between alternative, frequently used, indices in order to select the most adequate combination of them for the subsequent empirical investigation.

Part B defines and tests competing specific functional forms for a model of employment and labour force participation and sets out the appropriate specifications and estimation techniques to be employed in the subsequent empirical analysis.

The final part of the Chapter is devoted to an analysis of the estimated results. It focusses on the direct impact that each independent variable has on a given age sex group's employment and labour force participation, and indirectly on its employment and unemployment rates. Based on these estimated effects, this part also discusses some implications of the pro cyclical labour force participation behaviour by providing estimates of *hidden* unemployment and economic losses due to its existence.

A. Alternative Measures of Employment Performance

The analysis of relative labour market performance over time necessitates the choice of an appropriate labour market indicator. Traditionally, the characterization of the relative hardship faced by different labour groups has relied on the examination of the paths followed by the employment (ER) and unemployment (UR) rates. Both aggregate rates give information on the ability of the economy to provide employment for a fraction of those actively engaged in the market while age-sex rates describe the distribution of employment among the various labour groups.

However, these rates have been criticized and their use has become controversial because the actual count of unemployed depends crucially on definitional questions and these rates are sensitive to changes in labour force participation over the business cycle.

Consider these problems in turn. Since the definition of labour force (L) is given by,

1) $L_t = E_t + U_t$

and the conventional employment rate defined as,

2) $(E/L)_t = 1 - (U/L)_t$ or, $ER_t = 1 - UR_t$

where E, U and L are the respective number of workers employed, unemployed and in the labour force at any time t.

Thus, errors in defining individuals as unemployed (and within or outside the labour force) arise when they are not actively seeking jobs and will therefore be reflected in U, L and their respective rates. A typical case occurs, for example, when there are so-called *discouraged* workers.[36]

If the magnitude of the measuring error in U is assumed to be ω, then the reported labour force and related rates would be affected as follows,[37]

1') $L^{o} = E + (U + \omega) = L + \omega$

and,

2') $(E/L)^{o} = 1 - (U + \omega)/L^{o}$ or, $ER^{o} = 1 - UR^{o}$

and, clearly, an omission error ($\omega > 0$) would imply that reported rates of unemployment (employment) underestimate (overestimate) the true levels, i.e. $ER > ER^{o}$ and $UR < UR^{o}$.

In a dynamic context, on the other hand, fluctuations of these rates can be the reflection of two very different phenomenon with distinct implications for the real hardship faced by the various labour groups and related policy purposes. Consider, for example, a falling ER (UR increasing) as result of declining economic activity and tighter labour demand; the same result might be obtained if

[36] Those who are not counted as unemployed because they are not seeking jobs, even though they would like to work and have usually done so but have given up in their search, or who are young people and would like to work part time but again, have given up their search.

[37] To simplify notation, the time subscript t will be included in what follows only if its presence is absolutely necessary, otherwise it will be dropped.

improved economic activity were to attract more participants to the market (*discouraged* workers) than the number of vacancies open. This situation can be easily understood by differentiating 2) with respect to time,

3) $\delta ER_t/\delta t = 1 - \delta UR_t/\delta t$

or,

3') $ER_t(e - 1) = - UR_t(u - 1)$

where e, u and l are the respective proportionate rates of change over time of E, U and L; i.e. in general, $x = (\delta X/\delta t)/X$

Thus, a definite fall in ER (increases in UR) is compatible with a decline in employment only ($e<0$), increases only in labour force ($l>0$) or combinations of both (i.e., $e,l>0$ but $e<l$; or, $e,l<0$ with $e<l$).

Furthermore, if the error of measurement (ω) varies with U over the business cycle, the conventional rates become weaker indicators of a labour group's performance over time.

1. The Employment to Population Ratio

In order to have a more meaningful measure of the relative hardship in the employment situation faced by labour groups and to avoid the problems mentioned above, the use of the employment to population ratio (EPR) has been suggested and enjoys increasing popularity in labour market research (see Brown (1979) and Moore (1976; 1977), among others). The EPR provides an indication of the fraction of the whole potential labour force (civilian population) in any group that is actually employed.

Advocates of the EPR argue that this ratio avoids the effects of cyclical variation in LF participation rates and definitional problems, since it doesn't depend on the degree to which a person must actively seek work to be considered unemployed, nor does it depend on whether his ideas are realistic (or unrealistic) as to employability, earning capacity, suitability of working conditions, etc. (Moore (1976, 174)).

Since there is less scope for ambiguity in counting the employed and population in each group this measure becomes a more objective and unambiguous indicator of performance than the conventional rates, hence its popularity.

Critics of the EPR argue that this ratio is not a practical measure of the unused labour supply given that the link between population of working age and labour force is by no means a predictable or constant one (Hughes and Perlman (1982, 14)).

Although some writers have focussed the discussion on an evaluation of the relative merits of each alternative indicator, the questions of real interest are clearly how the indicators are related and whether they can be used as complements. In fact, examination of these alternative sets of series in isolation may lead to different and contradictory conclusions or to an apparent *paradox* as Fellner (1978, 101) has noted: "..[an] increased proportion of employed population and (simultaneous) increase in unemployment rates [are observed].."[38] At present there is a considerable agreement that the various measures should be taken as complements in the analysis of the market. Even Moore (1976, 175) is cautious in his defense of the EPR in saying that "...evaluations of the labour market based upon employment data are not consistent with those based upon unemployment data..".[39]

In sum, the alternative indicators may not coincide in their direction of changes and should be considered simultaneously to improve the explanation of the changes in the market. It is possible that a constant EPR may coexist with a declining ER (rising UR) if E is just keeping pace with the growth in P and employment opportunities are not expanding at the same rate as the labour supply increases with rising LF participation. Thus, while the EPR would suggest that no changes have occurred in the state of the labour market, ER would indicate a deterioration of the system to provide jobs and that any burden may be disproportionally shared by some groups.

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[38]This paradox is based on the observation of the U.S. experience of the mid 1970s when the movements of the overall and groups EPRs and URs diverged.

[39] In addition, he emphasises the simultaneous use of both indicators in evaluating market performance by arguing that "..a high level of unemployment not accompanied by a low level of employment (relative to population) may not imply a deficiency in demand. It may, on the contrary, imply that large number of workers are seeking jobs, or seeking to change jobs, because employment opportunities are plentiful..", Moore (1976, 175).

2. Reconciliation of Alternative Measures

A close examination of the relationship between these indicators follows. First, the EPR is defined as:

4) $EPR_t = E_t/P_t = E_t/(NL_t + L_t)$

where P is population and NL are those not in the LF.

Second, changes over time in EPR are formulated as follows:

5) $\delta EPR_t/\delta t = EPR_t(e - p)$

where lower case letters denote proportionate rates of change over time of the respective variables.

Third, from 5) it is evident that a rise in EPR, $e > p$, is compatible with a fall in ER (which from 3) and 3') requires only that $e < 1$) as long as $p < 1$.

In words, employment must grow faster than the population for the given (age-sex) group but not faster than the growth in the LF if both EPR and LF participation are to rise and ER is to fall. Only in the special case when LF participation remains unchanged will EPR and ER necessarily move in the same direction and hence all indicators be regarded as genuine alternatives.

2.1 Employment Rates and Ratios of Employment and Labour Force to Population

Consider now the relationship between the employment to population ratio and the employment and labour force participation rates which is shown by the following identity,

6) $E^i_t/P^i_t = (E^i_t/L^i_t)\ (L^i_t/P^i_t)$

or,

6') $EPR^i_t = ER^i_t \times PR^i_t$

where PR^i_t is the participation rate of the ith group in period t, and similarly for the other variables already defined.

Now, fluctuations over time in the EPR can be decomposed into the rates of changes of ER (and UR) and PR if the logarithmic expression of 6') is differentiated with respect to time. Then, following our previous notation, equation 6) (or 6') becomes:

7) $epr^i_t = er^i_t + pr^i_t$,

It is clear from 7) that EPR may increase as a consequence of an increase in PR (with ER remaining constant); an increase in ER (with PR constant); both increasing; or a decline in one provided that the other increases more.

The connection with unemployment is straightforward, since at a moment of time any member of the LF is either employed or unemployed. Equation 7) may be written as a function of UR,

8) $epr^i_t = (1-ur^i_t) + pr^i_t$

Moreover, for small values of UR, 8) can be approximately reinterpreted as,[40]

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[40] Since for small values of UR, say less than 0.1, the log of ER is approximately equal to the negative value of UR, i.e. lnER = -UR

8') $epr' = pr' - \Delta UR'$

Therefore, percentage changes in the employment-population ratio over time are approximately equal to percentage changes in participation rates minus changes in unemployment rates.

This particular decomposition has the merit of showing explicitly the variables whose behaviour must be explained simultaneously if a complete description and meaning is to be attached to the changes occurring in the market. Variations of this basic decomposition might be examined, each depending upon the requirements imposed by the specific hypotheses to be tested in the empirical approach.

It is worthwhile to note that most of the studies in this area have either concentrated on explaining employment (or unemployment) of groups demographically defined as, for example, the works of Feldstein (1973), Feldstein and Wright (1976), OECD (1980) and Freeman and Medoff (1978) or on analyzing the behaviour of participation rates as in Wachter (1972; 1977), Perry (1977) for U.S. data and the recent work for Canada by Kuch and Sharir (1978). Others have attempted to deal with a complete demographic model of the labour market, a task which has proved to be a complex one (see for example Smith (1977) and Anderson (1977)). Only in the recent work by Clark and Summers (1981) a succesful attempt to link the alternative measures of employment and participation is reported. Schaafsma and Walsh (1983) follow a similar approach though their focus is on measuring the impact of minimum wages.

B. Empirical Approach

Given the discussion of the interrelationship between alternative measures of labour market performance and the need to separate the effects on employment and labour force that cyclical, demographic, and other factors have had over the period of study, an indirect approach to explaining the behaviour of employment and unemployment rates is adopted. These rates are chosen as the ultimate representation of a group's behaviour since they summarize the impact of the forces at work and are widely publicized and utilized by policy makers and private agents as a guide to their decisions.

1. Behavioural Equations and Expected Impacts

For empirical purposes, the rate of change over time of a group's employment rate ($ER^i = E^i/L^i$) is decomposed into the rate of change of each group's employment, $REP^i = E^i/P$, and labour force, $RLP^i = L^i/P$, *ratios* to population, by following a similar procedure as discussed in the preceding section. Thus,

9) $er^i_t = rep^i_t - rlp^i_t$

where variables er, rep and rlp are rate of change over time of ER, REP and RLP, respectively. The superscript i denotes the ith age-sex labour group and subscript t stands for time. E, L and P are (as usual) employment, labour force and population of working age (15 yrs and over).

This particular definition of the ratios can be justified on various grounds. First, their changes provide separate and unambiguously defined measures of movements in the actual supply and demand of each labour group. That is, the use of population instead of its labour force in the denominator avoids problems in interpreting changes in the traditional group rates. Second, biases arising from measurement and definitional errors are likely to be less important in this formulation since both variables in the ratios are drawn from independent sources and are therefore more objectively defined. Third, demographic impacts are allowed to enter as explanatory variables in a straightforward fashion since the size and changes over time of each group's labour force and employment are directly influenced by the variations occurring in its population size.

1.1 Behavioural Equations

For the above decomposition of changes in group's employment rates, the following general behavioural equations, common to all 14 age-sex groups,[11] are

[11] Note that no attempt is made to provide a complete explanation of the specific factors affecting each particular labour group's performance.

postulated.

Labour Force Ratios:

10) $RLP^i_t : (L^i/P)_t = f^i(BC_t,\ RP^i_t,\ RW^i_t,\ X_t)$

with $f^i_1 \geq 0;\ f^i_2 > 0;\ f^i_3 \geq 0;\ f^i_4 \geq 0$

Employment Ratios:

11) $REP^i_t : (E^i/P)_t = g^i(BC_t,\ RLP^i_t,\ RW^i_t,\ X_t)$

with $g^i_1 \geq 0;\ g^i_2 > 0;\ g^i_3 \geq 0;\ g^i_4 \geq 0$

where BC is a proxy for business cycle or fluctuations in the aggregate demand level; RP is the fraction of total population of the ith population group, i.e. P^i/P; RW^i is a measure of the group's relative wage; X is a vector of other variables, especially the slowly changing socio-economic and institutional factors; f^i and g^i are functions whose specific forms are to be defined, and the age-sex groups are denoted by i (i=1,...,14).

1.2 Expected Impacts

BC is expected to have a positive impact on the ratio of every group's employment to population ($g^i_1 > 0$); that is, expansionary phases of economic activity are likely to stimulate the overall demand for labour, hence the positive effect of BC on the employment of every group. The impact of BC on the labour force participation ratio will depend on whether the *discouraged* ($f^i_1 > 0$) or *added* ($f^i_1 < 0$) worker effect dominates.

Variations in the level and composition of the labour force are expected, *ceteris paribus*, to follow similar changes in the population; thus a direct impact of RP^i on RLP^i is expected to occur ($f_2^i > 0$). Similarly, although through less direct channels, employment ratios are likely to follow the relative availability of labour ($g_2^i > 0$). In fact, it is expected that a relative excess of the ith labour supply would exert upward pressure on unemployment and downward pressure on wages which might induce firms to employ more of the relatively abundant and cheaper factor. These "demographic" effects, as opposed to "cyclical" and "time trend" effects are likely to explain the intermediate run performance of the groups in the market in view of the observed swings in the population's composition.

Changes in relative wages are expected to have, in general, an indeterminate effect on labour supply ($f_3^i \gtrless 0$) depending on whether the income or substitution effect dominates the group's decision to participate. The direct wage effect on employment could be unambiguously predicted to be negative in a static model ($g_3^i < 0$). However, in a time series context, wages are not genuinely exogenous. Movements in wages can be viewed as being simultaneously determined with employment and labour force. Then the possibility that employment and wages move in the same direction can be ruled out *a priori*.[42]

The impact of other factors (z) on the employment and labour force participation ratios cannot be signed with certainty for each particular group, given the complexity of the changes involved in this variable. Thus, ($f^i_4 \gtrless 0$) and ($g^i_4 \gtrless 0$).

2. Data Sources and Definition of Variables

.1 Data Sources

Annual averages of population, labour force and employment for the fourteen age-sex labour groups are taken from the regular publication of Statistics Canada, *The Labour Force*.[43] The age-breakdown includes the following groups: 20 years and less, 20-24, 25-34, 35-44, 45-54, 55-64, and 65 years and over. The data cover the period 1950-1980.

The lack of official data on wages by age-sex categories (and on a continuous time series basis) necessitated a search for suitable proxies.

Besides Census data which is provided every ten years, income data for wage earners can be obtained from

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[42] Consider, for example, that as a consequence of a higher level of economic activity, employment and wages of some labour groups (particularly those more complementary with the fixed factor) might increase. In other words, upwards movements in wages could be just the outcome of employers' higher demand for labour.

[43] Special tabulations for the annual averages, 1950-1980, were provided directly. These data include the major revisions done in 1966 and 1975.

three sources on an annual basis:

- Statistics Canada, *Income Distribution by Size in Canada* covering the period 1951-1980 on irregular annual basis.
- Department of National Revenue, *Taxation Statistics*, annually, from 1963 up to 1980, and
- Canada Health and Welfare, *Canada Pension Plan Contributions*, annually from 1968.

Data from the first source were selected since it covered a longer period.[44] In addition, they seemed less affected by problems arising from definitional criteria, since limits for tax exemptions in the second source meant this sample excluded that important part of the population with declared low income, and "eligibility" for pension plan as in the third source similarly reduced sample size. The specific series chosen were the average annual incomes of those whose major source were wages and salaries. Thus relative wages (RW^i) were expressed as the ratios of the average income of the ith age sex group to the average income reported for all wage earners.

The use of annual data is undermined by the influence that variations over time and across groups in the proportion of those working part time or only part of the

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[44] It should be noted, however, that the data reported in this source correspond to the Surveys taken on the years 1951, 1954, 1957, 1959, 1961, 1965; biannually in the period 1967-1971, and annually from 1971 up to the present days. For the missing years, data for each age-sex group were interpolated based on the closest years for which information was available.

year can have on their measured earnings. It is also likely that fluctuations in the proportion of part time work could be inversely related to the level of economic activity and be more predominant among young and female workers. These observations suggest the need for a further disaggregation of workers and earnings by their full and part time status to isolate the effects of these changes.

Unfortunately, data on employment and earnings by the required age-sex division is very limited.[45] Therefore, in this study no corrections are made to the basic set of data. This decision implies an assumption that the distribution of full and part time employees, as well as their earnings, has not varied over time and across groups. There is no doubt that this is an "heroic" assumption, but it at least avoids the introduction of an arbitrary criterion in the correction process; moreover, its validity can be tested.

2. Variables

Business Cycle: Several measures have been suggested as a proxy for this variable, but since the concern is with labour market conditions the analysis is restricted to those measures directly related to the labour market. Traditional candidates are:

a. Employment(ER) and Unemployment(UR) Rates,

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[45] Data on part time employment from *The Labour Force Survey* by age-sex groups only starts in 1967, beginning only in 1971 on a regular annual basis. If only sex is considered, the series can be traced back to 1957. For full/part time earnings data by age-sex, series can only be constructed beginning in 1967 on irregular basis.

b. Adult Male Unemployment Rates (URAM),

c. Head of Household Unemployment Rate (URHH),

d. Long Term Unemployment Rate (URL),

e. Unemployment to population Ratio (UPR)

f. Employment to Population Ratio (EPR)

The ER and UR seem inadmissible because they reflect labour force responsiveness to market conditions, a phenomenon to be estimated. URAM and URHH avoids to a great extent the impact of variations in the labour force, but since members of these groups are likely to be the least affected by changed market conditions, movements in this rate would only provide a rather weak proxy for cyclical fluctuations. The selection of URL seems inadequate in this context, since by definition (and construction) is oriented to capture long-run effects in the market, while the concern here is on the effect of short run cyclical fluctuations of the economic activity.

The last two alternatives are more adequate, though EPR appears to be the best proxy. In fact, movements in EPR are directly related to changes in labour demand and the ratio components can be objectively measured at any time. This is not the case for UPR, since besides the definitional problems involved in classifying workers as unemployed (discussed earlier), UPR is a weaker proxy, since changes in U are more likely to be positively related to exogenous changes in L' and L (when unaccompanied by short-run variations in labour demand). Thus a probability of spurious positive correlation between the dependent variables (RLP' and REP') and UPR exists, which would not reflect the expected effect of the BC variable.[46]

In consequence, EPR is adopted as a proxy for labour market conditions in the empirical work, although it is recognized that it is not an ideal index. Among the weaknesses of this indicator, its joint determination with the individual's dependent variable (EPR') seems to be the main problem. However, since it cannot be expected that reporting and/or measurement errors of the EPR's across groups follow a definite *a priori* pattern, it is unlikely that movements in both group and aggregate EPR variables reflect only spurious correlation.
A minor problem is posed by its lack of definite meaning with regard to the actual population interested in labour market activity, as discussed earlier.[47]

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[46] For a more detailed discussion on this issue see Bowen and Finegan (1969, 502-4, 516-22), Mincer (1966, 78-80, 84-91, 109n), Proulx (1969, 272), Green (1977) and Grubel, Maki and Sax (1975).

[47] That is, the inclusion of all the population in working age, P, in the denominator of EPR treats all members of the population as equally interested in employment and participation in the market.

Demographic changes are expressed through the RP' s variables, which capture the changing composition of the population in working age and affect the size and composition of each group labour force (RLP').

Other gradually changing factors (X) are proxied by the use of a time trend (T) and the square of it (T^2). The latter enters the specifications to allow for non-linear changes in the dependent variables.

3. Testing Functional Forms

In the related empirical literature it is common to find that researchers usually select *a priori* a particular functional form for the employment and labour force participation equations (10) and 11) above). The most popular are the linear and double logarithmic forms. However, since neither theory nor the empirical evidence acummulated have dictated the appropriate functional form the model should assume, it is more convenient to leave the decision to the data and estimation procedures.

3.1 Box-Cox Transformations

This can be done by using the power transformation introduced by Box and Cox (1964):

12) $y(\lambda) = (y^{\lambda} - 1)/\lambda$

where y is a vector of observations on the dependent variable and λ is the power coefficient of y_i.[4]

Thus if the transformation given by 12) is extended to all variables in the specific equation of interest a general unrestricted model can be defined, and its parameters estimated, as follows:

13) $y(\lambda) = \Sigma_{i=1}^{k} a_i x_i(\lambda) + \epsilon$

where y is a vector of n observations for the dependent variable and x_i is the ith (i=1,..,k) explanatory variable. The coefficients a_i's and λ are the parameters to be estimated.

The alternative competing models are in this case, the linear specification,

14) $y = \Sigma_{i=1}^{k} a_i x_i + \epsilon$

and the log-linear specification given by,[5]

14') $\ln(y) = \Sigma_{i=1}^{k} a_i \ln(x_i) + \epsilon$

Formal statistical tests to compare the validity of the alternative models use the Likelihood Ratio Test (LR),

15) $LR = -2\ln(L(\hat{\theta})/L(\tilde{\theta})) \sim \chi^2_{(m)}$

where $L(\hat{\theta})$ and $L(\tilde{\theta})$ are the values of the likelihood function based on the restricted and unrestricted models (i.e. 14) or 14') and 13) respectively. LR follows a Chi-square (χ^2) distribution with m degrees of freedom, given by

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[4] There various cases of interest depending on the values of the power coefficient: if $\lambda \to 0$ then, $y(\lambda) = \ln(y)$; if $\lambda \to 1$ then, $y(\lambda) = y$; if $\lambda \to -1$ then $y(\lambda) = 1/y$, etc.

[5] A general discussion on Box-Cox transformations and use of tests to discriminate among competing models can be found in Zarembka (1968). For a more recent and general review see Spitzer (1982).

the number of restrictions imposed on the parameters.[50]

In order to test the specific functional form of the general models postulated by equations 10) and 11), the unrestricted model was defined by,

16) $y^i(\lambda) = a_0 + a_1 T + a_2 T^2 + \Sigma^5{}_{j=3} a_j x_j(\lambda) + \epsilon$

where y^i represents either the ith group labour force (RLP^i) or employment (REP^i) ratios. The x_j's are the respective explanatory variables (EPR, RW^i and RP^i or RLP^i) while T and T^2 are the time trends for other socio-economic factors.

The time trends were excluded from the general transformation, since the choice of model is invariant to any arbitrary scale of this variable. The alternative competing models to be tested against the general unrestricted given by 16) are,

The linear models,

17) $RLP^i = a_{10} + a_{11} + a_{12}T^2 + a_{13}EPR + a_{14}RP^i + a_{15}RW^i + \upsilon_1$

and,

18) $REP^i = \beta_{10} + \beta_{11}T + \beta_{12}T^2 + \beta_{13}EPR + \beta_{14}RLP^i + \beta_{15}RW^i + \phi_1$

versus the log-linear models,

17') $\ln RLP^i = a_{20} + a_{21}T + a_{22}T^2 + a_{23}\ln EPR + a_{24}\ln RP^i + a_{25}\ln RW^i + \upsilon_2$

[50] For a discussion on the connections between this test (LR); Lagrange Multipliers and Wald Tests see Buse (1982).

and,

$$18') \ \ln REP^i = \beta_{20} + \beta_{21}T + \beta_{22} + \beta_{23}\ln EPR + \beta_{24}\ln RLP^i + \beta_{25}\ln RW^i + \phi_2$$

Results for the tests on functional forms are summarized in Table IV.1, and complete results for the competing equations are shown in Appendices A1 and B1.[51] The model was also estimated so as to correct for autocorrelation of residuals and simultaneity bias and the results are reported in later sections.

3.2 Linear versus Log-linear Specifications

Table IV.1 presents the LR test values for the unrestricted and competing (restricted) specifications of the labour force and employment ratio equations.

For the labour force ratio equations (RLP^i) the results of the test show that in 50% of the cases both specifications -linear and log-linear- fit the data adequately and cannot be rejected. In four out of the remaining seven cases[52] the linear model (Li) is an inappropriate representation and is thus rejected. Both models (B) are rejected in two cases (see M(25-34) and F(<20)) and the log-linear is only rejected for F(55-64).

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[51] The unrestricted model (equation 16)) was estimated by the BOX option of the SHAZAM computer program, Version 2.7 (July/1979), while the restricted alternatives (equations 17) and 18)) were estimated by OLSQ technique. (OLS option in SHAZAM). For details on SHAZAM see White (1978).
[52] See RLPs results, reject column, for Males M(<20; 45-54) and Females, F(20-24; 25-34).

TABLE IV.1 Tests for Functional Forms: Linear versus Log-linear Models

Likelihood Ratio Test(LR)

LR(Θ):	Labour Force Ratio Equations(RLP[i]) Unrestr.[a]	Linear	Log-Li.	Reject[b]	Employment Ratio Equations(REP[i]) Unrestr.[a]	Linear	Log-Li.	Reject[b]
MALES								
- 20	32.68	5.22	2.85	Li	43.65	0.04	1.77	-
20-24	46.35	0.17	1.33	-	37.29	0.20	1.99	-
25-34	52.29	19.55	23.44	B	44.70[c]	9.36	7.70	B
35-44	43.12	1.09	0.28	-	62.62[c]	29.38	28.02	B
45-54	46.49	5.01	3.42	Li	69.33	5.41	1.66	Li
55-64	49.07[c]	4.40	4.15	-	60.98	0.01	0.02	-
65+	55.82	3.42	4.57	-	94.69	0.01	7.19	Lo
FEMALES								
- 20	46.42	20.43	9.94	B	62.92	6.03	0.17	Li
20-24	56.53	16.56	0.63	Li	77.14	34.47	15.33	B
25-34	31.43	24.91	0.07	Li	85.57	26.20	13.64	B
35-44	30.84	0.17	2.55	-	82.64	25.38	12.43	B
45-54	37.05	0.02	3.70	-	88.00	28.62	9.87	B
55-64	53.00	0.44	9.00	Lo	100.63	11.75	0.34	Li
65+	69.28	0.29	0.12	-	124.16	0.12	1.82	-

a Log. value of the Likelihood function from the general unrestricted model, equation 16).

b Rejection criteria: Chi-square distribution of LR. Table critical value for $\chi^2_{.025,1}$ is 5.02. Li: Linear, Lo: Log-linear and B: Both.

c *Local Maximum; iteration procedure failed to converge. Results are conditional to the the value of L(θ) reported in Table.*

If the employment ratio (REP') equations are examined the reported values for the LR test give less conclusive results. In fact, in six out of fourteen cases both specifications are rejected[53]. Among the remaining eight cases the linear specification is rejected in three cases (i.e. for M(45-54) and F(<20; 55-64)) and the log-linear only for the oldest male group, M(65+). For the rest (four cases) the low values of the LR statistics do not allow us to draw significant conclusions, thus we cannot discriminate among the competing models.

The overall evidence tend to favour the log-linear over the lineal model. These results, however, should be considered with caution since it should be clear that the LR test is clearcut only for large samples, i.e. LR is asymptotically distributed as the χ^2 distribution. In addition, the estimation procedure for the unrestricted model, though close to a maximum likelihood, doesn't guarantee a global maximum for the value of the likelihood function; thus reported LR statistics are conditional upon these estimates. More important yet is the fact that the general model, taken as benchmark, is only an approximation to the "true" unknown model.[54] In any event, subsequent discussion will be based on the

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[53]See M(25-34; 35-44) and F(20-24; 25-34; 35-44; 45-54) in REPs equations.

[54]In fact, there are other possible alternatives as the work by Spitzer (1982) illustrates. However, cost considerations prevented us from further pursuing this exercise.

log-linear specifications, unless otherwise stated. For completeness, however, and to facilitate eventual comparisons, results for the alternative linear model will be included in Appendices A1 and A2.

3.3 An Overview of Results

A summary overview of the results based on OLSQ results (see Appendices A1 and B1) reveal that both specifications are acceptable if the R^2's and significance of the estimated coefficients are taken as a criteria; only the employment and labour force behaviour of the oldest(65+) female group is not satisfactorily explained. The values of the Durbin-Watson statistic (DW) suggest the presence of autocorrelation in most equations.

The cyclical variable has a positive effect on the labour force participation of all groups, suggesting that net *discouraged* workers dominate the group's labour force behaviour. The most responsive are the *secondary* workers, as the values of the corresponding elasticities indicate (see Appendix C1). On the employment side, females are the least affected by cyclical developments, while among males the young and older adult groups (20-24; 45-64) experience the greatest impact.

Demographic changes, as expected, have a positive effect on the labour force. Employment follows closely the relative supply of labour, though in most cases its reaction is not enough to provide jobs to all available labour (elasticities are less than 1, see Appendix C1).

Changes in relative wages have in 50% of the cases a negligible impact on employment and labour force. When a significant impact is observed, they appear to serve as an incentive for participation among women and the youngest and older male groups. On employment its effects are positive for the adult male and female workers, a result that is not surprising if movements in wages are simply the outcome of competition in the hiring of the most skilled workers.

4. Estimation Procedures

Since the above results, derived from OLSQ estimates, show significant autocorrelation of residuals, both specifications for employment and labour force participation ratios were re-estimated using a correction for autocorrelation in order to improve the efficiency of the estimates.[55] Complete results for both models are reported in Appendices A2 and B2 for the linear and log-linear specifications, respectively.

Examination of the results for the estimated autocorrelation coefficient (ρ), its significance and the improved DW statistics confirm the validity of first order autocorrelation assumption and the need for the correction introduced.

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[55] The option AUTO of the SHAZAM program was utilized.

The inclusion of the RLP^i's and RW^i's as explanatory variables in both set of equations (RLP^i and REP^i) raises the question of the consistency of the estimated coefficients in these equations since these variables cannot be considered as truly exogenous. In fact they can be viewed as determined simultaneously in a larger system.[56] In this case consistent estimates can be obtained if Two Stages Least Squares or Instrumental Variables (IV) techniques are employed.

The additional presence of autocorrelation suggests that a combined technique that also corrects for the latter problem should give consistent and more efficient estimates. Recognition of both problems support the use of a combined technique, as provided by the AR1(INST) option from the TSP program, to ensure consistency of the estimates. The appropriate instruments chosen were the actual exogenous variables (T, T^2, EPR, RP^i plus a constant term), the same variables lagged once and lagged values of the dependent and endogenous variables (REP$^i_{-1}$, RLP$^i_{-1}$, and RW$^i_{-1}$) according to the discussion by Fair (1970).

It should be noted, however, that an examination of the series for relative wages (RW^i) showed that changes in the structure of earnings varied slowly over time.[57] In view of

[56] Alternatively, the problem arises from the nonstochastic character of the RLP^i's and RW^i's variables. On this issue see Kmenta (1971), Chapters 8, 9 and 13.

[57] This evidence suggests that a more complex simultaneous system characterizes the functioning of the market that requires further work in modelling. A more detailed analysis of the variations experienced by the relative earnings structure is postponed to the following Chapter.

this evidence little gains in efficiency can be expected by choosing their lagged values as instrument for the RW''s; thus, in these estimates only the current values of the groups' relative earnings were included to avoid further reductions in the already limited degrees of freedom. Complete results for the log-linear model are presented in Appendix B2.3.

Comparisons of the estimated coefficients derived from the OLSQ, AUTO and AR1(INST) techniques reveal that their values do not differ significantly. However, the estimates from the latter two procedures are more efficient, in general, as their improved t-statistics values indicate. To facilitate further comparisons among the different set of estimates, the partial impact of the main explanatory variables, in terms of partial elasticities, are presented in Appendix C2.1.

It is interesting to note that a consistent pattern and significance of effects are obtained across specifications. It is only in the linear specification (which was rejected by the LR test on functional forms, see Table IV.1) that the elasticity values do differ considerably.[4] If the comparisons of estimates are made across techniques but within specifications, it is seen that improvement in techniques result in theoretically more plausible and

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[4] For the LF participation ratio equations compare the linear and log-linear models for M(<20; 45-54) and F(20-24; 25-34); for employment ratio equations see M(45-54) and F(<20; 55-64) in Appendix C2.1 or detailed results in Appendices A2 and B2.

moderate values (see Appendices C1.1 and C2.1) for the coefficients.

In sum, the evidence reviewed on functional forms, autocorrelation and techniques allow us to conclude that reliable estimates for the labour force participation and employment ratio equations over the period are obtained if the log-linear models corrected for autocorrelation are considered in our subsequent analysis. Hereafter, comments will be based on them (complete results shown in Appendices B2.1 and B2.3).

C. Analysis of Results

An attempt to provide answers to the various questions raised in the theoretical discussion contained in Chapter 2 is made in this section. First an examination is made of the impact that cyclical fluctuations have on the employment and labour force participation of the various labour groups. The focus seeks to evaluate their relative and absolute responses and to provide evidence on the level and composition of the hidden unemployed, potential labour force and associated employment and unemployment rates.

Second an examination is made of the impact of demographic changes on the composition of employment and the labour force during the period and their estimated effects on the relative hardship of the various labour groups as measured by their unemployment and employment rates.

Finally, an examination of the role played by relative wages and other factors on the demand and supply of the age-sex labour groups is made.

1. Cyclical Fluctuations of Employment and Labour Force

Following the discussion of section B.1 above, consider the cyclical response of group's employment rates. This response, according to 9), can be decomposed into demand and labour supply cyclical reactions as follows,

Cyclical Employment Rates Elasticities:

19) $\xi_{BC}^{ER_i} = \xi_{BC}^{E_i} - \xi_{BC}^{L_i}$

where $\xi_{BC}^{E_i}$ and $\xi_{BC}^{L_i}$ are the cyclical employment and labour force elasticities of the ith group.

Since the group employment is directly increased by cyclical effects (EPR) and indirectly by the derived change in labour supply (effect of EPR on RLP^i which, in turn, affects REP^i according to 17') and 18')) the group employment elasticity can in turn be expressed as,

20) $\xi_{BC}^{E_i} = \beta_3 + \beta_4 a_3$

where a_3 is the cyclical impact on labour force and β_4 the induced employment effect of changed labour force, both measured as elasticities.[5]

The indirect effect reinforces or offsets the direct employment creation depending on whether the *discouraged* or

[5] For consistency we keep the notation employed in equations 17') and 18'), except that we have dropped the subscript 2, indicating the log-linear specification, which is now being used.

added worker effect dominate the groups labour force reaction (i.e. $a_3 > 0$ or < 0 respectively). In fact, an expansionary phase not only means that workers from each category are more in demand (scale effect) as measured by the direct employment effect but, also, an increase in the relative supply of a group (stemming from discouraged workers) may induce substitution and more employment of those in relative abundance. Thus, both effects act in the same direction. For groups in which the *added* worker effect dominates the opposite result can be expected.

1.1 Cyclical Response of Employment Rates: Elasticities

Combining 19) and 20) above, the employment rates elasticities can be re-written as,

21) $\xi^{\,i} = \beta_3 + (\beta_4 - 1)a_3$

which provides a straightforward decomposition of the total effect by source of variation. Estimates of these elasticities and the relative importance of the direct employment effect are included in the next Table.

Column 1 of Table IV.2 shows that group employment rates have a relatively inelastic response to cyclical fluctuations. This is more evident for women, where a 1% change in BC (proxied by the EPR variable) would be followed by a change of only 0.16% in their employment rate. The male rate elasticity is more than double that of females. Young workers are the most cyclically sensitive group (0.57%), with the young males' reaction being the highest (0.79%).

TABLE IV.2 Cyclical Response of Employment Rates, Employment and Labour Force Elasticities

	Employment Rates	Employment	(% Direct)	Labour Force
	$\xi^{ER_i}_{BC}$:	$\xi^{E_i}_{BC}$:		$\xi^{L_i}_{BC}$:
	$(\beta_3+(\beta_4-1)\alpha_3)$	$(\beta_3+\beta_4\alpha_3)$	$(\beta_3/\xi^{E_i}_{BC})100$	(α_3)
MALES[a]	0.405	0.822		0.417
- 20	0.904	1.959	(29.7)	1.055
20-24	0.728	1.107	(69.4)	0.379
25-34	0.402	0.673	(69.5)	0.271
35-44	0.291	0.562	(51.8)	0.271
45-54	0.256	0.655	(76.3)	0.399
55-64	0.355	0.735	(46.8)	0.380
65+	0.016	1.253	(7.5)	1.237
FEMALES[a]	0.157	0.847		0.690
- 20	0.313	1.772	(11.0)	1.459
20-24	0.249	0.787	(31.0)	0.538
25-34	0.111	0.803	(31.4)	0.692
35-44	0.138	0.526	(20.3)	0.388
45-54	0.064	0.558	(11.5)	0.494
55-64	0.159	0.775	(19.0)	0.616
65+	-0.006	1.161	(2.4)	1.167
Both Sexes	0.329	0.829		0.500
Young (-24yrs)	0.570	1.344		0.774
males	0.790	1.444		0.654
females	0.267	1.209		0.942

Source: Appendix B2.3 for estimates of employment elasticities and Labour Force elasticities from Appendix B2.1.

a Employment and Labour Force Elasticities are weighted averages of the groups estimates, with weights given by the group's share of employment and labour force respectively. Employment Rates elasticities calculated as residuals.

If considered in isolation, these results could lead to the misleading conclusion that cyclical fluctuations have a negligible impact in the labour market. However, the disaggregated results for employment and labour force participation reveal that substantial variation occurs across groups in response to cyclical developments, as shown in the following sections.

1.2 Cyclical Impacts on Employment

On the demand side, the groups' employment elasticities with respect to total employment($\xi_{.}^{i}$, column 2, Table IV.2) exhibit a well-shaped saucer form, i.e. the youngest and oldest groups present the highest employment response, while the lowest elasticity values are recorded for the middle-aged workers.

The above evidence conforms well to the expectations that age is a good proxy for the experience and skill sought by employers up to the point at which technical obsolescence is likely to appear. Thus, employment of the middle-aged workers is the least cyclically affected; in response to a change of 1% in total employment, the employment of this group would only change by about half the change experienced by young workers.

If division by sex is considered, the elasticity estimates suggest that employment of both sexes react similarly over the cycle[48] thus, employment differentials by sex would remain unchanged in the aggregate. Comparisons by age-groups however, show that females have a lower elasticity for most groups, suggesting that their employment position is relatively less affected by cyclical fluctuations than for males.[49]

The above conclusion is strongly supported if attention is given to the relative importance of the direct cyclical effect on employment (i.e. as measured by the β_3 coefficient in column 2') of the Table IV.2) which is consistently much lower for females than for males, suggesting that, among permanent (rather than transient) members of the labour market, females are more protected.

1.3 Cyclical Impacts on Labour Supply

On the supply side of the market, labour force elasticities by age-sex groups present a shape similar to those of employment. The close association between employment and participation responsiveness to cyclical developments across labour groups suggests that the degree of discouragement is related to the degree of job

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[48] The estimated elasticity values are 0.82 for males and 0.85 for females.

[49] This finding agrees with reported evidence that female employment tends to be concentrated in relatively cyclically protected occupations and industries -white collar type occupations and service oriented industries; see Ostry and Zaidi (1972, 133)

security enjoyed by workers.[62]

As column 3) of the Table reveals, the estimated elasticities, a_3,[63] are all positive, giving strong support to the existence of a dominant *discouraged* worker effect for all groups. The overall positive response of of the labour force to employment opportunities (i.e. with an estimated value of 0.50) suggests that increased employment will not decrease the actual level of unemployment in equal magnitude, thus the creation of about 2k jobs would be necessary to reduce the number of unemployed by k.

Female participation behaviour is more cyclically responsive than male,[64] result that accords well with the traditional label assigned to these *secondary* workers. Participation of young and older workers (also often referred as *secondary*) is the most sensitive, while that of middle-aged male workers is the least cyclically sensitive.

The results presented confirm the great differences occurring in group participation in response to cyclical fluctuations. If considered in connection with the groups' employment reaction, a clear explanation of the overall cyclical impacts on employment rates is obtained. In the case of females, the increased

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[62] This observation was first done by Dernburg and Strand (1966, 81) in dealing with the U.S. market.
[63] See Appendix B2.1 for complete results.
[64] See column 3, Table IV.2. The values of elasticities are 0.69 and 0.42 for females and males, respectively.

employment is almost totally offset by the strong pro-cyclical female participation behaviour; thus, their employment rates provide little indication of real gains in group employment. On the other hand, the cyclical impact on male employment rates is less extreme, given the more inelastic male supply of labour; thus variations in their employment rates tend to follow closer the changes in the overall labour market conditions (as measured by the overall employment).

2. Some Implications of the Cyclical Estimates

Some implications, based on the results of the estimated employment and labour force participation equations are examined in this section. First, an evaluation is made of the absolute impact on the composition of employment an assumed job-creation program would have. Second, the composition and absolute levels of *hidden* unemployment throughout the period of analysis are examined. Finally, some estimates of the economic losses due to the existence of *hidden* unemployment are discussed.

1. Job Creation Programs: Absolute Impact on Employment

Consider now the proposal of a job-creation program that seeks to generate 100 thousand new employment opportunities in the market over a year. This objective is equivalent to an increase of about 1.4% in the average observed EPR variable over the 1950-80 period.[65]

From the policy makers point of view, various questions are relevant to an evaluation of the impact of the program. Among others, who would be the eventual beneficiaries of the program? How would total and groups unemployment be affected? The estimates presented in Table IV.3, attempt to provide some evidence useful for the evaluation of a program with such characteristics.

The bottom line of Table IV.3 provides estimates of the total impact of the assumed job-creation program. It is seen that an increase in total employment of 100 would be accompanied by an increase in the labour force of 53 new members, which implies that actual unemployment would be reduced by only 47. Therefore, the estimates suggest that, for each person meant to be rescued from the actual ranks of the unemployed, the proposed program should consider the creation of at least two new positions.

If the analysis is done by sex, the reported estimates imply that eighty per cent of the reduction in total unemployment would be due to decreased male unemployment. In other words, for every five unemployed workers rescued only one would be female. This result is the outcome of the relatively high female labour force

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[65] In other words, the program seeks to rise the average EPR level from 55.23 to 56.0 in one year. The implied absolute change of 0.77 percentage points is not unrealistic if compared to the annual average change of 0.61 points experienced by EPR over the 1958-80 period.

TABLE IV.3 Groups' Employment Response to Changes in Total Employment
Absolute Changes
(Total Employment Change=1000)

	Change in: Employment (ΔE^i)	Labour Force (ΔLF^i)	Reduction in: Unemployment[a] (ΔU^i)
MALES	686	309	377
- 20	126	65	61
20-24	109	34	75
25-34	141	49	92
35-44	105	44	61
45-54	101	53	48
55-64	73	33	40
65+	36	31	5
FEMALES	314	221	93
- 20	92	69	23
20-24	54	33	21
25-34	66	49	17
35-44	37	23	14
45-54	33	25	8
55-64	24	16	8
65+	8	6	2
Both Sexes	1000	530	470

Source: Employment from Appendix B2.3 and Labour Force from Appendix B2.1. Absolute impacts estimated from elasticities evaluated at the mean value of variables, i.e. $\Delta x/\Delta y : \xi^x_y \cdot (\bar{x}/\bar{y})$ where $\bar{x}$ and $\bar{y}$ are the sample means. To agree with the total change in employment of 1000, the groups variations were multiplied by a factor of 1.14.

a Calculated as a residual from: $\Delta E^i - \Delta LF^i = \Delta U^i$

resposiveness to job opportunities. Indeed, the program would tend to increase female employment by 31 persons of which, 22 would be new members -just attracted to the labour force- and only 9 rescued from the unemployed. For males, however, the increased employment of 69 would reduce the number of unemployed by 38, the difference (31) being absorption of new members.

In terms of age, the reduction of unemployment comes mainly from the younger groups, i.e. about 60% and 66% correspond to male and female workers aged 34 years and less. If employment is considered, the same groups would again benefit most from the program: about 57% of the jobs created for males would employ workers aged 34 and less, while the same age-groups would account for almost 67% of new female employment.

It is worthwhile mentioning that the above findings only provide an indication of the effects of the proposed program based on the average values of the variables in the sample. For any specific year, these estimates should be qualified by including the effect of changes in the other variables.

2. Hidden Unemployment and its Composition

The evidence of net *discouraged* worker behaviour for all the groups implies that in periods of economic slack, the measured labour force is lower than it would have been had the economy been at a *full* or *high* employment level of activity. In this situation, the recorded level of unemployment understates the additional number of jobs needed to restore a high level of employment.

In estimating *hidden* unemployment the traditional procedure involves the estimation of a "potential" labour force level associated with a measure of the *natural* rate of unemployment that is believed to have prevailed over the period, say 4% to 5%. These estimates become less reliable the longer the time period considered, since the *natural* rate may be shifting due to the changing demographic composition of the labour force (for example). Although, it is clear that any decision on this matter involves a certain degree of arbitrariness, the need for some standard to evaluate the performance of the market and the economy justifies the procedure.

To reduce the degree of arbitrariness in the estimates of the "potential" labour force (PLF^o) and to allow for the changing structural features of the economy, a flexible measure of *high employment*[66] is constructed(EPR^o). This measure is based on the highest observed values of the EPR variable over the period,[67] with the gap years estimated by linear interpolation.

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[66] Note that this is a measure of *high* employment rather than the usual *full* employment associated with a fixed *natural* rate of unemployment.

[67] These values follow closely the observed peaks in the economic activity over the period according to the timing of the Canadian growth cycle. For details see Kaish (1982) and Royal Bank "Trendicator" (1978).

In following the growth cycle chronology, the EPR variable compares well with other usual alternatives based on unemployment, (i.e. UR, URAM or UPR) over the major part of the period. They only diverge in the last decade when EPR tend to rise simultaneously with UR. This is not surprising if account is taken of the fact that an increasing participation of women and young workers has occurred. These groups have had a relatively high frictional unemployment rate, thus the overall UR has been rising as a reflection in part of this phenomenon. The EPR, on the other hand, is more likely to reflect directly the cyclical changes (through variations in its numerator, the number of employed) remaining less affected by changed participation.

The reported estimates of the PLF^o are based on the individual results of the regressions by sex-age groups (as reported in Appendix B2.1) after replacing the EPR variable by its *high* employment level EPR^o and an allowance made for auto[illegible]lation of [illegible]. That is,

22) $\hat{y}^i = \Sigma^5_{j=1} \hat{a}^i_j (x^i_j - \hat{\rho}^i x^i_{j-1}) + \hat{\rho}^i y^i_j$,

where $\hat{y}$ is the predicted value of $\ln PLF^i$ based on the group's explanatory variables x^i's: T, T^2, $\ln EPR^o$, $\ln P$[illegible] $\ln RU^i$ and on the estimated coefficients $\hat{a}^i_j$, and $\hat{\rho}^i$, the coefficient of autocorrelation [illegible] superscript i stands for the [illegible]

[illegible]

Estimates of PLF°'[8] by age-sex groups are presented in Appendix D1 (D1.1 for males and D1.2 for females). *Hidden* unemployment estimates, i.e. the difference between PLF'° and LF', by groups are shown in Appendix D2.1 and D2.2 for males and females respectively. A summary of the total estimates of *hidden* unemployment by sex and main age groups is presented in Appendix D2.3. Finally, estimates of the specific sex-age "potential" employme rates are included in Appendix D3.1 and D3.2 (males and females respectively). To keep the analysis and comments on these results manageable, a summary of results for the aggregate LF -potential and actual- and associated employment and unemployment rates are presented in Table IV.4.

Inspection of the *hidden* unemployed estimates (HID, column 3 in Table IV.4) reveals the presence of some suspicious negative values. These values should not be seen as conflicting, since these estimates can be considered very conservative, and rather than providing "potential" estimates of the LF associated with an arbitrary measure of *full* employment, they can only be interpreted as a "high employment LF" according to the real capacity shown by the economy. Furthermore, the two outlying observations, 1966 and 1975, can be well explained by the major definitional revisions of the LF Survey done in those years.[9]

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[8] The actual values of PLF° are obtained after antilogarithm is taken and reescaling by P (population in working age) is done for every year. The total PLF° in each year is based on the aggregation (sum) of the individual groups' PLF'°.

[9] In the discussion the 1966 and 1975 observations will be

TABLE IV.4 Hidden Unemployed, Actual and Potential Labour Force Employment and Unemployment Rates over the Cycle: 1952-80

	Labour Force PLF (000s)	Labour Force LF (000s)	Hidden HID (000s)	Business Cycle		Rates of: Employment PER %	Employment ER %	Unemployment PUR %	Unemployment UR %
1952	5348.7	5324	24.76	-	-	96.64	97.09	3.36	2.91
53*	5451.5	5397	54.53	q2	m03	96.03	97.00	3.97	3.00
54*	5550.3	5494	56.37	q3	m10	94.46	95.43	5.54	4.57
1955	5648.2	5610	37.24	-	-	94.97	95.61	5.03	4.39
56	5775.2	5783	-6.77	q4	m11	96.72	96.59	3.28	3.41
57*	6027.5	6008	19.54			95.08	95.39	4.92	4.61
58*	6210.2	6137	71.16	q3	m08	92.19	93.29	7.81	6.71
59*	6329.5	6241	87.46	q3	m10	92.74	94.06	7.26	5.94
1960*	6455.9	6411	44.97			92.40	93.04	7.60	6.96
61*	6611.0	6521	88.00	q1	m03	91.59	92.85	8.41	7.15
62*	6736.3	6616	121.31		m03	92.41	94.09	7.59	5.91
63*	6867.4	6749	118.46		m05	92.83	94.46	7.17	5.54
64	7040.7	6933	107.62	-	-	93.87	95.33	6.13	4.67
1965	7258.0	7141	115.98	-	-	94.54	96.09	5.46	3.91
66a	7213.7	7385	-170.31	q2	m03	98.70	96.41	1.30	3.59
67*	7648.0	7635	12.31			95.76	95.93	4.24	4.07
68*	7873.7	7837	36.66	q1	m02	94.76	95.20	5.24	4.80
69*	8140.1	8068	72.07	q1	m02	94.50	95.34	5.50	4.66
1970*	8293.8	8265	31.81	q4	m12	93.78	94.11	6.22	5.89
71	8552.3	8501	50.30	-	-	93.05	93.61	6.95	6.39
72	8801.0	8743	57.99	-	-	93.07	93.69	6.93	6.31
73	9167.3	9107	61.31	-	-	93.79	94.41	6.21	5.59
74	9546.1	9461	93.84	q1	m02	93.77	94.61	6.23	5.39
1975a	9788.6	9974	-177.42	q2	m10	94.84	93.08	5.15	6.92
76	10219.6	10206	14.57	-	m05	92.76	92.89	7.24	7.11
77	10481.9	10499	-18.09	-	m07	92.04	91.89	7.96	8.11
78	10812.1	10882	-72.94	-	-	92.23	91.64	7.77	8.36
79*	11284.0	11207	76.05		m09	91.89	92.52	8.11	7.48
80*	11618.4	11522	97.33		m06	91.71	92.48	8.29	7.52

* Years of 'Low-employment' according to recessionary cycles in column: Business Cycle

a Major revisions done to definitions and estimates of Labour Force Survey.

Variables:

PLF, Total Potential Labour Force, see text and Appendixes D1.1 and D1.2 for detailed estimates.

LF, Total Labour Force. Source; Statistics Canada, The Labour Force (unpublished annual estimates).

HID, Total hidden unemployed = $PLF_t - LF_t$

Business Cycle, Recessionary periods measured from peak to trough; q_i is the ith quarter. Source: Royal Bank (1978) m_i is the ith month. Source: Kaish (1982).

PER, Potential or 'High-employment' employment rate, i.e. E_t/PLF_t, where E_t is actual employment in period t.

ER, Actual employment rates, i.e. E_t/LF_t

PUR, Potential or 'High-employment' unemployment rate

UR, Actual unemployment rate

The HID estimates become meaningful if compared with the pattern followed by the economic cycles in the period.[70] It is evident from the Table that a strong positive association exists between the size of HID and the stage of the recessionary cycle, i.e. the number of HID increases as the economic slowdown tends to its trough. This comparison is somewhat obscured, however, by the fact that our estimates are annual averages. Thus, the exact correspondence of HID to the timing of the cycle cannot be clearly observed.

Actual employment rates during recesions[71] tend to overstate the real rates by about a 0.87 percentage points on the average, i.e. the average for the overall reported ER is 94.36 while the estimated potential ER is 93.49; these averages are calculated for the low employment years marked by an asterisk. The reported UR, on the other hand, is on the average proportionately 13% less than it would had been if the *hidden* unemployed had been counted in the labour force (the average UR reported for these years is 5.64 while corrected for hidden unemployment is 6.51).

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[69](cont'd)always excluded due to these major revisions.
[70] Recessionary periods are measured by the observed economic slowdown from peak to through according to two independent sources (Royal Bank(1978, 7) and Kaish(1982, 363-68)) and included in columns 4 and 5 of the Table as a reference.
[71]1956 is not considered since the slowdown in economic activity only began in November and some lags in labour force response is likely to occur. The 1976(5)-77(7) slowdown was short and mild, fact which precludes an appropriate measured reaction thus is also excluded from the commentary.

Further comments on this issue seem unnecessary given the self-explanatory nature of the data contained in the Table. Turn now to an evaluation of the economic losses associated with the unused labour force -the *hidden* unemployed.

3. Economic Losses due to Hidden Unemployment

Estimates of the *hidden* unemployed in each low-employment period provide limited insight into the marginal losses due to this component of the unused labour force since its composition has undoubtedly varied over time.

In fact, if wages reflect the marginal contribution of each type of workers to production, the observed wide distribution of wages clearly implies that workers have a different relative importance and should not be aggregated directly. An improved mesure of the manpower loss can be obtained by calculating the total foregone output due to *hidden* unemployed as follows,

23) $MLHU_t = \Sigma^{14}_{i=1} W^i_t HU^i_t$

where W^i is the wage of the ith type of workers; HU^i the hidden unemployed and $MLHU_t$ the Manpower Loss due to the hidden unemployment in period t.

There are various advantages to using this measure of the manpower losses (MLHU); it allows for the change in composition of the *hidden* unemployed and their specific (variable) contribution to production over time, as measured by their earnings, providing a measure based on 'homogeneous' units.

To judge the importance of MLHU six low-employment periods are selected and presented in Table IV.5. For each of these periods, the Table includes estimates of the HID, its composition by sex and main age groups, the MLHU and its relative importance (RMLHU) or fraction of the output produced by the actual employed labour.[72]

The results shown in the Table provide some interesting evidence of the effects on MLHU due to the changing composition of the *hidden* unemployed. Over the whole period, it is seen that in spite of the greater number of HID, the relative importance of the losses (as measured by RMLHU) has decreased over the later periods.

The above finding is compatible with the increased share of women among the *hidden* unemployed [73] which, in turn, can be associated with the strong upward trend in participation shown by this group since the mid 1960's and its higher cyclical sensitivity. Young workers have remained an important fraction, about 20%, of the *hidden* unemployed, while adult males have become steadily a smaller fraction.

These changes in the composition of the HID provide a clear answer to the observed diminished importance of the losses in the later periods. In fact, since young and female

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[72] The RMLHU is defined as follows,

$$RMLHU_t = MLHU_t / \Sigma^{14}_{i=1} W^i_t E^i_t$$

where E^i is employed labour of the ith type, and the other variables as defined in the text.

[73] This is particularly evident in the case of adult females whose relative importance in the total of *hidden* unemployment has raised sharply.

TABLE IV.5 Hidden Unemployed Composition and Economic Losses in Low Employment Periods 1952-1980

Period	HID (000s)	Relative Composition (%) MALES	Young	Adult	Older	FEMALES	Young	Adult	Older
1953-54	113.9	52.4	7.1	26.9	19.4	46.6	3.3	31.3	12.0
1957-58	104.6	59.1	15.0	34.0	10.1	40.9	28.1	12.0	1.0
1959-61	244.2	65.5	20.2	34.6	10.7	34.5	18.2	14.7	1.7
1962-63	243.1	61.8	15.6	31.7	14.4	38.2	21.2	14.2	2.8
1968-69	137.8	36.7	26.5	15.9	-	60.3	21.5	34.5	4.4
1979-80	204.4	24.6	21.1	8.1	-	75.4	18.1	55.5	1.7

Economic Loss

	MLHU (mill$)	Composition (%) Males	Females	Output (mill$)	Composition (%) Males	Females	RMLHU (%)
1953-54	255.3	69.6	30.4	25511	87.6	12.4	1.00
1957-58	237.0	74.6	25.4	34968	86.4	13.6	0.68
1959-61	592.0	75.0	25.0	59466	86.1	13.9	1.00
1962-63	779.1	80.3	19.7	47727	85.2	14.8	1.63
1968-69	477.0	55.4	44.6	82246	82.5	17.5	0.58
1979-80	2169.4	29.3	70.7	308774	74.6	25.4	0.70

Source: Appendixes D2.1 for Males and D2.2 for Females. Estimates based on individual age-sex labour groups. For Definitions see text: MLHU see 23); RMLHU see footnote 70. Note that negative estimates of hidden unemployed for some groups were excluded. Economic Loss, output and MLHU measured in current dollars.

workers have a lower marginal contribution to production (as measured by the level of their wages) the shift in composition towards them has decreased the total relative loss for the society. Thus, relatively less potential output is foregone due to the changed composition of the *hidden* unemployed than otherwise would have occurred.

3. Demographic Impact on Employment and the Labour Force

As opposed to cyclical changes, demographic changes occur only gradually, in a predictable fashion and with effects longer lasting and more difficult to remedy. Most notably, their eventual negative consequences for particular groups of the workforce would require major structural transformations in the industrial structure to provide productive employment for those in relative excess supply.

Based on the estimated models, quantification is possible for the impact of demographic changes over the labour market summary measures (the groups' employment and unemployment rates). These specific rates are likely to remain unchanged only if the structure of the demand for labour has altered synchronously with the changed labour supply structure.

The demographic sensitivity of the specific employment rates are examined first through the estimated elasticities. Next, some estimates are provided of the absolute demographic effects for selected periods in which the structure of the population has shown some important changes, i.e. turning points in the relative importance of some groups.

1. Demographic response of ER, E and LE

Following a derivation similar to taht of the preceding section, the employment rate elasticity with respect to demographic impacts can be written as follows.

Demographic Employment Rate Elasticities:

24) $\eta^{ER_i}_{RP^i} = \eta^{E_i}_{RP^i} - \eta^{L_i}_{RP^i}$

where the first right hand component corresponds to the induced employment effect stemming from the changes in relative supply of the ith type of workers and the second term is the direct demographic impact on the labour supply.

Since the first component can be reformulated in terms of the changes in employment induced by labour supply ($\xi^{E_i}_{RLP^i} = \beta_4$) and the demographic elasticity of supply ($\eta^{L_i}_{RP^i} = a_4$), estimates of the employment rates elasticities become,[74]

25) $\eta^{ER_i}_{RP^i} = (\beta_4 - 1)a_4$.

The above expression for the ER elasticities show explicitly that the total impact of demographic changes will depend on the elasticity of the employment reaction to the available labour force (β_4 >1 or <1). Thus, if

[74] For consistency with previous sections we maintain the notation defined in equations 17') and 18') from the preceding section B.2, in this Chapter. The coefficients a's and β's are the actual estimates from regression results.

the demand for certain groups of labour is inelastic, an increased supply due to demographic changes will imply a deterioration in their relative employment position with higher unemployment rates.

Table IV.6 below presents estimates of these elasticities.[75] It also includes estimates of the changes in groups' employment rates when a 1% point change is assumed in the groups' population shares.

The results indicate that changes in relative population size have adverse consequences for the employment opportunities of the groups. This is shown by the negative sign of the employment rate elasticity across labour groups (see Table IV.6, $\eta^{ER_i}_{RP_i}$). The only exception is given by the youngest male group for which the high employment elasticity (β_4) offsets the negative demographic effect of changed labour supply (a_4); the size of the total effect, however, is negligible since members of this group are usually not considered normal participants in the market.

The pattern of ER elasticities suggests that those affected most by the excess relative supply are workers at the beginning of their careers (i.e. M(20-24;25-34) and F(25-34)) and males rather than females. The latter is likely to be the consequence of the greater competition and easier substitution among the jobs performed by males, plus the obvious fact that they

[75] For complete results see Appendix B2.1 for LF and B2.2 for the Employment ratio equations.

TABLE IV.6 Demographic Impact on Employment Rates
Elasticities and Absolute Changes

	Empl. Rates $\eta^{ER}_{RP}(\beta_4-1)\alpha_4$	Induced-E ξ^E_L (β_4)	L-Supply η^L_{RP} (α_4)	Means[a] ER_i	RP^i	ER: Absolute Changes[b] $\Delta ER_i / \Delta RP^i$
MALES						
- 20	0.039	1.120	0.322	86.1	6.6	0.505
20-24	-0.203	0.780	0.921	90.6	5.3	-3.477
25-34	-0.231	0.752	0.932	94.9	10.1	-2.171
35-44	-0.070	0.926	0.943	95.9	8.9	-0.751
45-54	-0.350	0.352	0.541	95.7	7.5	-4.436
55-64	-0.150	0.883	1.274	95.1	5.5	-2.589
65+	-0.037	0.952	0.779	96.1	5.3	-0.672
FEMALES						
- 20	-0.038	0.866	0.282	89.5	6.6	-0.518
20-24	-0.055	0.956	1.250	93.6	5.6	-0.921
25-34	-0.310	0.742	1.200	94.9	10.3	-2.858
35-44	-0.105	0.894	0.987	96.3	9.0	-1.124
45-54	-0.020	0.957	0.459*	96.6	7.5	-0.258
55-64	-0.015	0.973	0.570*	96.8	5.6	-0.259
65+	0.000	0.997	-0.038*	98.2	6.0	0.00

Source: Appendix B2.2 and B2.1. ER elasticity estimated according to 25) in text.

a Sample mean values of employment rates and population shares for the labour groups.

b Change in ERs as a consequence of a change in 1% point in group share of population.

* Estimates are not significant.

constitute the most important section of the market.

The differences of impacts by sex is also evident from the employment induced elasticities (β_*), which are lower for males than for females, since male employment is less affected by shortages in their supply (a rather constant participation behaviour) and with a more stable demand. Excess relative supply has a greater effect on those with a greater degree of permanent attachment to the market (i.e. M(20-64) and F(25-44)). For the rest, changes in their relative population size do not affect their decision to participate, which suggests the existence of suitable non-market alternatives open to them (this is particularly true among older females and is confirmed by the insignificant demographic labour force elasticities, a_*).

The sizes of the absolute impacts of demographic changes on the specific ER's confirm these comments. However, they may lead to erroneous conclusions on the relative contribution of each group to the overall demographic effect on the market since it is neither the case that all groups have experienced similar changes, nor can all of them move in the same direction simultaneously (i.e. relative changes must add up to 1).

To asses the impact of the changed demographic composition on the overall ER (and UR) and the relative contribution of each group, the next section considers selected periods in which noticeable changes in the composition of the working age population have occurred.

2. Demographic Impacts in Selected Periods

The selection of subperiods of analysis in evaluating the effects of changed composition on the overall ER (and UR) is critical in view of the fluctuations experienced by the age structure of the population as a consequence of changes in previous fertility behaviour, e.g. the Post-War Baby Boom followed by the sharp decline in fertility in the late 1950's. Up to the late 1960's the age structure of the Canadian working age population became younger,[16] as a consequence of the arrival of the Baby Boom generation.

The fertility decline that occurred afterwards, resulted in a reversal of the age structure towards an aging population, with a decreasing proportion of the younger and an increasing participation of the older workers. In other words, the relatively short 1950-1980 period shows a unique experience of swings in the population structure. These swings are responsible, in part, for the observed LF composition and the performance of the overall and specific ER's in the period. The impact of these demographic shifts on the overall ER and the contribution of each group are compared in Table IV.7, below, for the 1950-65, 1965-80, 1970-80 and the complete period.

[16] Evidence of these changes is presented in Appendix E1.1; in particular, see the bottom line for the changed share of the Young.

TABLE IV.7 Employment Rates Variations due to Demographic Changes Selected Years

	Absolute Variations in ER[a]				Group's weighted contribution[b]			
	1950-80	1950-65	1965-80	1970-80	1950-80	1950-65	1965-80	1970-80
ER (overall)					-0.21	0.96	-1.71	-0.69
MALES					-0.09	0.67	-1.14	-0.42
- 20	0.36	0.87	1.22	0.21	0.02	0.05	0.07	0.01
20-24	-2.43	1.39	-3.82	-1.18	-0.20	0.11	-0.34	-0.10
25-34	-1.52	3.91	-5.43	-3.95	-0.24	0.75	-0.89	-0.65
35-44	0.90	0.0	0.90	0.44	0.15	0.0	-0.12	0.05
45-54	1.33	-1.33	2.66	2.71	0.18	-0.18	0.33	0.30
55-64	0.0	-0.52	-0.52	-0.05	0.0	-0.04	-0.04	-0.004
65+	-0.07	-0.20	-0.27	-0.27	-0.002	-0.01	0.0	-0.004
FEMALES					-0.12	0.29	-0.57	-0.27
- 20	-0.36	-0.78	1.14	0.33	-0.02	-0.03	0.05	0.02
20-24	-0.37	0.46	-0.83	0.16	-0.02	0.02	-0.05	0.01
25-34	0.0	6.29	-6.29	-4.17	0.0	0.33	-0.47	-0.38
35-44	-1.35	-0.45	-1.80	0.96	-0.08	-0.02	-0.11	0.06
45-54	0.0	-0.21	0.21	0.30	0.0	-0.008	0.1	0.02
55-64	-0.23	-0.03	-0.21	-0.07	-0.006	-0.001	-0.006	-0.002
65+	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Young (-24)					-0.22	0.15	-0.27	-0.06
Adult (25-54)					0.01	0.86	-1.40	-0.62
Older (55+)					-0.01	-0.05	-0.05	-0.01

a Calculated from the observed variations in population composition, as reported in Appendix El.1, and the estimated marginal effects from Table IV.6, i.e. Abs. Var= $(\delta ER/\delta RP^i)\cdot \Delta RP^i$

b Group's ER_i absolute variations are weighted by the fraction of the total LF the group represents in the middle years of each period, e.g. 1965, 1958, 1972 and 1975 respectively.

The first sub-period, 1950-1965, can be characterized by a relative tight labour market (from the demographic point of view) where low unemployment rates are the outcome of the decreasing importance of adult male workers, an increasing number of young workers just arriving in the market and low growth of older (55+) workers. Under these favourable circumstances a whole percentage point of the prevailing overall UR can be attributed to the particular change which occurred in the workforce structure (i.e. if no compositional change in the population had occurred, the unemployment rate would have been one percentage point higher).

Over the 1965-80 period, however, the larger cohort of young workers, having grown older and become active participants in the market, begins to exert its negative influence not only on the cohort's, but also on overall, employment. Their specific ER's (ER') tend to deteriorate and the overall UR tends to increase (ER decreases). These changes are mainly explained by the higher proportion of young adult workers (see groups aged 20-34 in App. E1.1), who in turn are more prone to unemployment (see elasticities in Table IV 6 and absolute variations in ER' in Table IV.7).

The results show that in the latter period, 1965-80 (and 1970-80) the total demographic impact over the overall UR can be estimated to be 1.7 (and 0.7) percentage points. This means that if no change in population composition had occurred, the observed UR's for the period would have been 1.7 (0.7) percentage points lower.

Alternatively, if it is assumed that the *natural* unemployment rate for the whole period is on the average 4.5%, as it is customary in the literature, this assumption would prove to be inconsistent with the changed demographic structure and the implied employment policies aimed at that target would have had inflationary consequences. In this situation a reasonable target should allow for the changed demographic composition by revising the *natural* rate upwards to 6.2% for the final years of the period.

Finally, it is interesting to note that any comparison between the extreme years of the period is likely to give meaningless results for the demographic impact, since the swing in the structure would remain hidden. In fact, estimates for the complete period only attribute one fifth of a percentage point to demographic factors in the explanation of the worsening in the unemployment rate. This is obviously the effect of the observed mild demographic change if measured at the extremes of the swing.

4. Relative Wage Effects on ER, E and LF

This section examines the evidence on the impact that relative wages have had on employment and labour force participation. For the sake of homogeneity, the analysis focuses on the employment rates effect of changed relative wages and, through it, the impacts on employment and labour force participation are discussed. Then, following the conventional disaggregation, the estimated wage elasticity of the employment rates can be written as follows:

Wage Elasticity of Employment Rate:

26) $\delta^{ER}_{RW} = \beta_5 + (\beta_4 - 1)a_5$

where the first right hand term measures the direct impact of wage changes on employment while the second is the indirect impact working through the supply side. Table IV.8 presents the estimated values for the main wage elasticities.

1. Changed Relative Wages and the Supply of Labour

On the supply side, the pattern of elasticity signs suggests that the *income effect* of a wage change dominates the male's decision to participate in the market. With the exception of the youngest group most of the impacts are negative or insignificant (see a_5 <0). Female participation behaviour, on the other hand, appears to be not only more wage responsive than that for males, but dominated by the *substitution* effect, i.e. a_5 >0.[77]

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[77] It should be noted, however, that these results are based

TABLE IV.8 Wage Elasticities of Employment and Labour Force

	Empl.Rates	Employment Direct Effect	Empl-induced by changes in LF	Labour Force Direct Effect
	$\delta^{ER_i}_{RW_i}$	$\delta^{E_i}_{RW_i}$ (β_5)	$(\beta_4-1)\cdot\alpha_5$	$\delta^{L_i}_{RW_i}$ (α_5)
MALES				
- 20	0.005	-0.009*	0.014	0.121
20-24	0.061	0.043*	0.018	-0.082**
25-34	-0.021	-0.055*	0.034	-0.139
35-44	0.092	0.091	0.001	-0.019*
45-54	0.215	0.223	-0.008	0.012*
55-64	-0.31	-0.025*	-0.006	0.049*
65+	-0.017	-0.021*	0.004	-0.077*
FEMALES				
- 20	-0.017	-0.008*	-0.009	0.068
20-24	-0.071	-0.063**	-0.008	0.184
25-34	0.134	0.169	-0.035	0.134*
35-44	-0.139	-0.111	-0.028	0.260*
45-54	-0.054	-0.038*	-0.016	0.373
55-64	0.043	0.051*	-0.008	0.284*
65+	-0.042	-0.042**	0.0	0.038*

Source: Appendix B2.1 and B2.2; elasticities were estimated according to 26) in text

* Denotes that basic estimated parameters are not significantly different from zero at the 95% level of confidence.

** Parameter estimates are significant only at the 90% level of confidence.

That is, improvements in relative wages make males better off and more leisure is demanded. Higher relative wages for females, on the other hand, raises the opportunity cost of their non-market activities and induce a higher participation in the labour market. This effect is particularly important among young, F(20-24), and older, F(35-54), adult females. This finding is interesting if related to the fact that both groups are likely to have weaker ties with household and childbearing responsibilities than other females. Indeed, young women are likely to be at the beginning of their careers and married life without children, while the latter group is relatively free from the intensive care required by small children. In both cases the opportunity cost of working is comparatively smaller than for the rest, thus their participation is more sensitive to changes in wages.

2. Wage Effect on Employment

On the demand side, the results for the employment equations reveal a mixed pattern of signs (see β_5), most of them insignificant. In nine out of fourteen cases the effects are negative, as expected from standard theory of demand. However, in only two cases are they significantly different from zero, at the 90% level of confidence, which is a weak evidence of support

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[7,7] (cont'd)on parameter estimates that are in part insignificant. See Appendixes B2.1 and B2.2 for detailed estimates.

for the theoretical expectations.

For the remaining five cases, a positive impact of wages on employment is registered[71] and some important regularities appear. These positive impacts are highly significant only for those groups with high degree of attachment to the market and with greater human capital, experience or appropriate skills, i.e. M(35-54) and F(25-34). These strong results can be taken as evidence of the high degree of fixity in production these groups enjoy and for the simultaneity involved in the determination of employment and wages, i.e. both variables moving in the same direction is a possible outcome of competition for hiring the most experienced/skilled workers.

3. Wage Elasticity of Employment Rates

The results for the total impact over ER show that changed wages appear to have a negligible effect on most groups' ER_i's (as the first column of the Table IV.8 indicates), a finding that is not unusual given the opposing forces at work.

In half of the cases the impact is negative, that is ER's (UR's) tend to deteriorate (increase) when relative wages are increased. In spite of the sign and size of the direct effects of wage on LF participation (which are sizeable among women), the total impact of

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[71] They correspond to the male groups M(20-24, 35-44, 45-54) and females F(25-34, 55-64) groups. See Table IV.8, column 2, values for the direct wage elasticity of employment, β_5.

wages on ER_i's reflects the greater importance of the direct wage employment effect (β_5) which dominates the indirect employment induced by changed supply. On the latter effect, it is interesting to note that when more workers join the market (females attracted by higher and/or some male groups drived by their lower wages) the indirect effect always acts so as to further deteriorate the ER's (increasing UR's).

On the whole the relatively low explanatory power of wages in determining employment and LF participation, shown by these results, suggests that in the aggregate the price mechanism is either not truly exogenous to these equations or only reacts slowly to disequilibrium in the market. [''] Both issues are explored in the next Chapter.

Another plausible explanation posits errors in measuring the particular wage variable employed. However, since the aim of this research is to extract information from the available set of data, rather than to introduce transformations to make them agree with our *a priori* expectations (usually introducing more arbitrariness and creating other type of errors), it was decided not to introduce further corrections.

''It is likely that the wage determination process is ruled by other institutional and historical, rather than 'pure market', considerations that introduce rigidities in the relative wage structure, hence, their weak estimated effect.

5. The Impact of Other Changing Factors

The influence of other changing factors (X) over the period are examined by the reaction of the employment and LF participation variables to the time trends (T and T^2) which are included as proxies for other changing factors. Since *per se* these trends do not "explain" the groups' behaviour, only a summary of the findings is provided.

Estimates of the time trend elasticities, for the usual variables and groups, are presented in Table IV.9. Since the estimated equations allowed for non-linearities in the variable's response to time trend, the typical partial elasticity is obtained as follows:

27) $\theta^{x}_{t,t} = (a_1 + 2a_2 T_t)\,\overline{T}$

where the superscript x denotes the dependent variables $\ln REP^i$ or $\ln RLP^i$; the a's are the estimated coefficients associated with the time trends T and T^2 in each set of equations respectively, and $\overline{T}$ is the sample mean value of T.

Thus, the estimated time trend elasticity of the employment rates $\theta^{ER}_{t,t}$ can be decomposed into the direct and indirect induced employment effects as usual with the trend elasticity of ER:

28) $\theta^{ER}_{t,t} = \theta^{E}_{t,t} + (\beta_4 - 1)\theta^{L}_{t,t}$

According to the results shown in the Table IV.9, it is seen that employment opportunities for the youngest group of workers (see direct employment elasticity, $\theta^{E}_{t,t}$ for M and

TABLE IV.9 Time Trend Elasticities of Employment and Labour Force

	Empl. Rates	Employment Direct Effect	Empl-induced by changes in LF	Labour Force Direct Effect
	$\theta^{ER_i}_{tt}$	$\theta^{E_i}_{tt}$	$(\beta_4+1)\cdot\theta^{L_i}_{tt}$	$\theta^{L_i}_{tt}$
MALES				
- 20	-0.102	-0.105	0.003	0.025
20-24	0.043	0.069*	0.112	-0.511
25-34	-0.038	-0.037	-0.001	0.004
35-44	-0.001	-0.002	0.001	-0.014
45-54	-0.042	-0.064	0.022	-0.034
55-64	-0.032	-0.039*	0.007	-0.039
65+	0.004	-0.016	0.020	-0.421
FEMALES				
- 20	-0.070	-0.058	-0.012	0.092**
20-24	-0.053	-0.047	-0.006	0.142
25-34	-0.051	0.032	-0.083	0.323
35-44	-0.025	0.011	-0.036	0.341
45-54	-0.020	-0.007	-0.013	0.295
55-64	-0.031	-0.023	-0.008	0.309
65+	0.002	0.002*	0.0	0.022

Source: Regression results reported in Appendix B2.1 and B2.2. The values of elasticities shown in this table have been multiplied by 10. Calculations based on 28) as discussed in the text.

* Basic parameter estimates are not significant at the 95% level of confidence

** Basic estimates are significant only at the 90% level of confidence.

F(<25)) have deteriorated relatively more than for the rest of labour groups. Female adults are the only groups enjoying increased direct employment opportunities over time.

On the supply side, the negative signs registered by older males reflect their well established declining trend in participation. The high elasticity value for those males aged 65+ show the increased willingness for early retirement, which, most likely, is the outcome of the extended facilities provided by the private and public pension plans and other closer substitutes developed over time, i.e. registered retirement savings plan, etc. The negative sign for young male workers, M(20-24), reflects the increased school enrollment in post-secondary institutions and hence their decreased participation.

Since male participation has, in general, declined over time, this fact has facilitated the induced male employment effect[80] which shows a positive impact on E and ER. This effect, however, has not been strong enough to offset the negative trend in direct employment creation. The net result is a deterioration in the ER_i's for all groups, with an increasing differential in the rates of unemployment between the adult males and the youngest workers.

The situation for females is the opposite; their increased participation has not been accompanied by sufficient induced employment, thus the net negative impact

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[80]See third and last columns of Table IV.9 for the trend effects on LF (θ_{it}^{L}) and the employment induced by changed supply, respectively.

on the $ER_{\mu}s$ stems mainly from the supply side. This effect reinforces the negative direct employment trend or, when positive (F(25-44)) is strong enough to offset the direct employment gains.

The overall result is that employment rates have deteriorated over time, although the process has been slow and almost negligible for some groups, particularly for older workers.

V. Changes in Earnings Structure Due to Cyclical and Demographic Factors

The traditional approach to the study of labour earnings is to search for the main determinants that explain wage differentials among individuals or groups of workers. A growing body of literature has reported considerable evidence on the importance of these determinants. Earnings differentials have been attributed to sex, age, education, training and experience, the occupational and industrial distribution of workers, and even to the distinction between the public and private sector.

From a time series perspective, however, there are few systematic studies on the time pattern followed by the age-sex earnings structure and its sensitivity to fluctuations in the level of aggregate demand for labour and the changing composition of the labour force. For the Canadian experience no evidence has been yet published in this vein.

As discussed in Chapter II (on theoretical propositions and hypotheses), there are several questions that have remained unanswered since they are mainly empirical propositions. Among them are questions such as: Who are the groups most affected by cyclical fluctuations?; Do earnings differentials widen or narrow at the peak of business cycle?; Have these differentials changed significantly over time?; Have changes in a group's relative supply had any effect on its relative productive rewards?; To what extent are the different age-sex groups substitutes or complements in productive activities?; Or, is the relative age-sex earnings structure simply inflexible, reflecting socio-institutional rigidities in the wage determination process?.

In this chapter an attempt is made to provide some evidence on these questions by exploring different models applied to the Canadian experience of the last three decades, 1950-80.

An initial examination looks at the relative importance of demand, supply and other forces in shaping the change in the age-sex structure of earnings differential over time. Next, allowance is made for their short and long run impacts on the structure of earnings by including an adjustment mechanism for relative wages, a procedure justified by the allegedly sluggish wage response due to existing market rigidities. Finally the questions of labour sustitutability is examined by assuming an underlying production function of the constant elasticity of substitution (CES) type.

A. Age-Sex Earnings Differentials Over Time

This section focusses on the time pattern followed by the inter-group earnings differentials as a consequence of changes in demand conditions (the business cycle), variations in relative supply of workers, and other slowly changing socio-economic factors over the period. The expected impacts of these variables are examined first, followed by a discussion of the model and variables required for empirical purposes. Estimation procedures and results are then discussed.

1. Earnings Differentials: Model and Influential Variables

1.1 Anticipated Effects

Since a review of arguments, on the expected impacts that various factors have on wage and earnings differentials, has already been done in previous Chapters, i.e. Chs. II.C and IV.B.1.2, only a brief summary of the anticipated effects of these variables on wage differentials follows.

On the impact of cyclical fluctuations in economic activity, it has been argued that in expansionary phases the earnings differentials can be expected to narrow due to the pressure on wages exerted by the increased demand for all types of labour. This outcome, however, cannot be guaranteed for all age-sex groups in the labour force given their non-homogeneous character. Thus differentials might well decline for those more essential workers in production (skilled/experienced), remain unchanged, or even increase for those less qualified, i.e. young-inexperienced, for example[81] -for a review of arguments see Gunderson (1976, 61). Thus, the cyclical effects on every group's earnings differential cannot be signed with certainty, *a priori*.

The effect of variations in the cohort's supply on earnings differentials can be described by the *crowding* hypothesis. (Wachter (1977) and Welch (1979)). In its simplest form this hypothesis states that a relative abundance of a particular type of worker lowers his marginal productivity and hence his earnings; thereby, his earnings differential vis-a-vis others tends to increase.[82]

In a time series context, however, there may exist some other factors working against this result such as, minimum wage legislation, a reduced degree of discrimination due to improved information, higher levels of qualifications and skills reached through education, etc. All these factors have exerted a pressure to narrow the differentials which in part might offset the effect of relative excess supply of any type of worker.

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[81]For the latter effect to occur it suffices that increased labour demand improve the earnings of the most qualified relatively more than those of less skilled workers.
[82]This is the normal expected outcome in any simple demand and supply static analysis. It was early suggested by Fawcet (1918) and Edgeworth (1922) in discussing the male-female wage differential. Lately, it has been used as explanation in a demographic context by Easterlin (1980), Wachter (1979) and Welch (1979), among others.

1.2 Basic Model of Earnings Differentials

A general function that incorporates the variables of interest (considered above) is given by:

Earnings Differential Function:

1) $DW_t^{i0} = d^i(BC_t,\ S_t^{i0},\ O_t)$

where DW^{i0} and S^{i0} are some measures of the ith labour group earnings differential and relative supply with respect to a reference group 0. BC and O proxy variables for the state of labour demand and the influence of other factors, respectively. d^i symbolizes the functional form appropriate to the ith group.

Since the selection of a basic group of reference is required, a composite group based on adult male workers M(35-44; 45-54) was chosen. This decision is justified by the strong attachment to the market these workers show, with transitory changes in economic and demographic forces affecting their relative position only marginally.[83] Thus, the composite earnings of the basic group are defined as follows:

Basic Group's Earnings:

2) $W_t^0 = W_t^{m4}\omega_{1t} + W_t^{m5}(1 - \omega_{1t})$

a weighted average of the adult males' earnings, M(4=35-44; 5=45-54), with weights given by the proportion of employed

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[83]The findings reported in the preceding chapter provide evidence on the stability of their supply and demand to changed market conditions, i.e. their participation, employment and relative earnings ~~show the~~ least variability over the period if compared to the other labour groups.

workers over the total, i.e. $\omega_{1t} = E_t^{m4}/(E^{m4} + E^{m5})_t$ with E_t being the number of employed workers in period t.

The size of the LF for the composite reference group is derived in a similar fashion,

Basic Group's LF:

3) $L_t^o = L_t^{m4}\omega_{2t} + L_t^{m5}(1 - \omega_{2t})$

with weights given by the fraction of total earnings, which recognizes their differential contribution to production if earnings do in fact reflect their marginal productivities, i.e. $\omega_{2t} = W_t^{m4}/(W^{m4} + W_{m5})_t$, with W_t the average earnings of each group in period t.

1.3 Definition of Variables

The specific content and form of the general function 1) requires some comments since neither theory nor previous empirical work provide definitive guidance about it.

As a measure of the group's earnings differential the dependent variable is defined, as in Gunderson (1974), by the fraction of earnings represented by each age-sex differential,

4) $DW_t^{i\,o} = (W^o - W^i)/W_t^i$ with i=1,..,14

For the influence of other factors, O, and business cycle, BC, the time trend, T, and the employment to population ratio, EPR, are selected as proxies for reasons identical to those discussed in the previous chapter.

As a proxy for the group's relative supply variable, $S^{\prime o}$, the ratio of the respective groups LF is selected, i.e. $L_t^{\prime o} = L_t^{\prime}/L_t^{o}$, as a determinant of wage differentials. On this choice it can be argued that, though it is true by definition that earnings are only related to those actually employed, the relative earnings determination process and its change over time cannot be thought to be independent of the group's relative excess supply at any moment t. That is, for a given level of employment, the existence of a higher relative unemployment for the ith group would exert downward pressure on its earnings level, inducing a slower rate of change in their earnings than otherwise would have been the case.

Hence, the relevant determinant of the earnings determination process is the whole group's LF size rather than only the actual level of employment; thereby the choice of $L^{\prime o}$ seems to be well justified.

2. Earnings Differentials: Estimation

2.1 Functional Form

On the choice of the functional form adopted by equation 1), preliminary observation of the relationship among the variables over time leads to the conclusion that a curvilinear rather than a linear relationship exists. The search was then narrowed to two competing alternatives: semilog and log-linear forms. Both were estimated and the results compared.

The general function 1) can now be specified as follows:

5) $DW_t^{io} = \gamma_0 + \gamma_1 T_t + \gamma_2 \ln EPR_t + \gamma_3 \ln L_t^{io} + \omega_t$

with the dependent variable DW^{io} defined either as in 4) or by its logarithmic expression. The remaining variables are as defined in the text above.

In order to distinguish the "pure" demographic from changes in a group's "behaviour", a further modification to 5) was introduced by disaggregating the relative supply variable, L^{io} into the population ratio, P^{io} and participation rates ratio, PR^{io}. This distinction seems necessary in the chosen context, especially in view of the different pattern followed by the group's participation rates and respective population shares.[14] Therefore, the final equation to be estimated has the following form,

6) $DW_t^{io} = \gamma_0 + \gamma_1 T_t + \gamma_2 \ln EPR_t + \gamma_3 \ln P_t^{io} + \gamma_4 \ln PR_t^{io} + \omega_t$

2.2 Estimation Procedures

Estimation of both functional forms (semilog and log-linear) was done using the OLSQ technique. A comparison of estimated coefficients suggests that

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[14] In fact, participation rates have experienced great variability for some groups, particularly for young and females, while population shares have changed in a more smooth and predictable manner. Evidence of these changes are reported in Chapter III.

results are essentially the same in terms of size[55] and direction of impacts. However, judging from the estimated R^2 values and significance of the coefficients across groups, the evidence indicates that the log-linear specification can be considered a marginally better aproximation. Hence further comments are based on the log-linear model and complete results are reported in Appendix F1.1.

The results show that a satisfactory level of explanation is obtained for seven out of the twelve labour groups. The $\bar{R}^2$ values suggest that 60% or more of the total variation in earnings is explained by the estimated equations.[56] The low values of the DW statistic, in eight out of twelve cases, suggest the presence of significant positive autocorrelation of residuals.[57]

In view of the evidence on autocorrelation, the complete set of equations was re-estimated so as to correct for this problem and improve the efficiency of

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[55] The comparison was done in similar units, i.e. the DW[10] response to main explanatory variables expressed in terms of elasticities or absolute effects.

[56] A poor explanation is obtained for the older male groups, M(55-64; 65+), and female groups, F(20-24; 35-44; 55-64).

[57] Autocorrelation might be due to omitted variables, independent of the variables already included, whose influence is captured by residuals. This issue is explored in the next section. It should be noted that in presence of autocorrelation OLSQ estimates remain unbiased but not their standard errors. Thus, tests of significance based on the t-statistic are no longer valid. This is so because the OLSQ estimated variance of errors (in which these tests are based) is known to be greater.

the estimates.[2] The results are reported in Appendix F1.2. As expected, the estimates remain essentially unchanged and their significance is altered only in those cases in which the DW statistic detected significant autocorrelation. The values and significance of the estimated autocorrelation coefficient, ρ, confirm the validity of the correction procedure employed.

3. Earnings Differentials: Results

3.1 Cyclical Effects

In periods of economic expansion, the cyclical variable shows that a significant reduction in the differentials of M(20-24; 55-64) and F(35-44) occur. These groups are well attached to the market, with characteristics close to those of the basic group. Therefore, they can be considered close *complements* in production. The highest relative gain in earnings corresponds to the M(55-64) group, with about 8% reduction in the differential as a consequence of an increase of 1% in EPR.[3]

On the other extreme, the youngest group (<20) suffers a relative deterioration in its earnings (the differential increase by 4% for males and 5% for

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[2]It was assumed that residuals followed a first order autocorrelation pattern and the maximum likelihood technique AR1, TSP program, was employed.
[3]Note that estimated coefficients for the main explanatory variables can be directly interpreted as elasticities, given the log-linear model's form.

females). This means that in a tight labour market, earnings of the youngest workers grow less than those of the more experienced/skilled basic group, which is possibly a consequence of rigid minimum wage legislation. Indeed, young inexperienced workers are likely to be paid the minimum wage, a minimum that is not changed according to temporary market conditions; hence, in periods of expansion their earnings do not adjust upwards and a relative deterioration occurs, while in recessionary periods they are more protected and wages cannot be further lowered thereby its earnings differential is reduced. For the remaining groups a mixed pattern of signs is observed, but since they are insignificant no strong conclusions can be drawn.

If considered by sex, the results suggest that the relative earnings position of females improves less (greater deterioration) than that of males over the business cycle.

3.2 Changes in the Relative Supply of Workers

On the supply side, the "pure" demographic effect has, as expected, a direct and significant positive impact on the earnings differential of most groups, giving support to the *overcrowding* hypothesis. That is, an increased relative cohort size has a depressive effect on the cohort's earnings, thereby increasing the cohort's earnings differential.[20]

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[20] There are only two significant exceptions to this result,

The impact of a group's "behaviour" variable, the ratio of participation rates (PR'[o]), is insignificant in eight out of twelve cases. In the significant cases, increased participation tends to decrease the wage differential for the young groups (M(<20; 20-24) and F(<20)), and increases it for the older male group M(55-64). On the one hand these results are weakly inconsistent with the *overcrowding* hypothesis and seem unreliable. On the other hand, they might be considered as a support for Becker's (1971, 16) and Zellner's (1972, 158) arguments on the issue of discrimination. These authors have pointed out that the effect of greater participation generates a rightward shift in the demand curve for these groups since prejudice against minority groups tends to disappear with their increased presence and better knowledge of them in the market. Both effects are likely to coexist in reality, which in this case only means that in spite of the downward pressure exerted on wages by the increased number of workers (overcrowding effect), their presence in the market has helped to reduce the degree of ignorance

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'[o](cont'd)they are M(65+) and F(25-34). The result for the former group can be by-passed since the estimated equation provides a poor explanation, suggesting that other omitted factors are likely to play a major role in the determination of their earnings (pensions, savings funds or even return from investments rather than income from wages and salaries). The odd result for females is rather puzzling given that it cannot ~~be~~ attributed to problems of simultaneity in the determination of earnings and demographic composition of the population since the latter variable is clearly exogenously pre-determined.

regarding their productive capabilities, and a net upward adjustment of their wages has occurred as a consequence.[11]

The generally insignificant results for the participation variable, however, seems to suggest that the PR[10]'s are not truly exogenous to the earnings equations, but rather are simultaneously determined in a more general system, i.e. earnings affected negatively by participation and participation reacts positively to earnings changes, as the reported results for females in the previous chapter suggest. Thus, these estimated values should be considered with caution and no clear interpretation should be attached to them.

3.3 Other Determinants

For the sake of completeness, a word on the trend of each group's differential is in order. A relatively significant deterioration in the earnings position of young workers (<25) and older males M(55-64) is observed over time. Earnings differentials for older women, F(55-64; 65+), have been reduced. For the remaining groups the evidence is not strong enough to provide an indication of a clear trend, thus differentials can be regarded as remaining unchanged.

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[11]Regardless of the insignificance of the estimated effects, this is clearly the case for most female groups where earnings differentials decrease with increased participation.

Since, in general, the results are not completely satisfactory, the next section explores another alternative commonly mentioned in the literature, namely, that the earnings structure is relatively fixed and changes slowly over time in response to various market imperfections. A model of imperfect earnings adjustment is discussed and results compared to those obtained in this section.

B. Earnings Differentials and Market Rigidities

The existence of various institutional rigidities in the market,[72] as well as employers' recognition lags in adjusting their demand for labour to changed market conditions, may have different effects on the speed of earnings adjustment for the various labour groups.

This section formalizes a model of earnings differentials under imperfect conditions that allows groups' earnings levels and differentials to react in a less than instantaneous to actual market changes. Its results are then compared to the basic estimates of the previous section.

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[72] On this issue a growing body of literature and empirical work exist. Among other factors, these studies have focussed on the impact of minimum wage legislation, strength and development of unions, equal pay legislation, seniority rules, etc. A summary review of these factors and the impact on the labour market can be found in Gunderson (1980).

1. A Model of Imperfect Earnings Adjustment

A reformulation of the general model of earnings differentials, given by 1), can be accomplished by recognizing the existence of rigidities in the market that allow only partial adjustments in the earnings structure in response to changed market conditions.

In the presence of a positive excess supply of labour (unemployment) it is not unreasonable to assume that earnings are determined mainly by the demand side. Under this assumption, employers can be viewed as planning the variations of earnings, adjusting them to *desired* or target levels according to changes occurring in the market as they perceive it. Hence, the earnings differential equation in 1) can be stated as,

7) $^{*}DW_t^{io} = f^i\ (BC_t, S_t^{io}, O_t)$

the superscript * denoting the *desired* earnings differential sought by employers according to their perception of market conditions.

The actual observed changes in earnings differential, however, reflects only a fraction of the *desired* or target change since employers are impeded from adjusting earnings instantaneously given the rigidities they face. This behaviour can be represented by a partial adjustment mechanism of the form:

Actual Earnings Variations:

8) $\Delta DW_t^{io} = DW_t^{io} - DW_{t-1}^{io} = \delta^i\ (^{*}DW_t^{io} - DW_{t-1}^{io})$

where the coefficient $0 < \delta^i \leqslant 1$ is the speed of adjustment of the ith group's relative earnings to the target level.

Combining 7) and 8), the basic equation 6) can be re-written in terms of observable variables as follows:

Actual Earnings Differential Equation:

$$9)\ DW^{i0}_{t} = \mu_0 + \mu_1 T_t + \mu_2 \ln EPR_t + \mu_3 \ln P^{i0}_{t} + \mu_4 \ln PR^{i0}_{t} + \mu_5 DW^{i0}_{t-1} + \omega_t$$

estimates of the μ's coefficients measure the short run impact of the variables; $\mu_5 = 1-\delta^i$ provides a direct estimate for the ith group's speed of adjustment coefficient; the long run impact of independent variables on the target differential is given by ${}^*\mu_j=\mu_j/(1-\mu_5)$, $j=0,\ldots, 4$.

Compared to the basic specification in 6), the partial adjustment model 9) (when estimated) has the additional advantage of providing direct evidence on the extent to which earnings of the different groups are affected by the existing rigidities. This result has an interest *per se*, since it helps policy makers to identify segments of the labour market that require close examination if obstacles to a more flexible price system are to be removed.

2. Results: Imperfect Adjustment Model

Equation 9) was estimated by the OLSQ technique and results are reported in Appendix F1.3.[13] On the whole these results are more satisfactory than those discussed in the previous section, with higher levels of explanation attained for most groups and a pattern of effects which accords better with *a priori* expectations. The evidence of no autocorrelation of residuals gives further support to this specification.[14] Both results confirm that changes in the earnings structure occur slowly due to institutional and market imperfections.

2.1 Comparisons of Estimates: Elasticities

In order to allow comparisons of estimates from both models (i.e. equations 9) and 6) corrected for autocorrelation) and to facilitate comments on the results, earnings differential elasticities with respect to the main explanatory variables are summarized in Table V.1. Estimates of the short and long run elasticities together with the speed of adjustment coefficient for the partial adjustment model 9) are also included.

It is evident from the Table that estimates from equation 6) are similar in size to the long run

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[13] Again, only the log-linear specification was reported since it proved to be marginally superior to its competing alternative, the semi-log.

[14] The high significance of the lagged dependent variable, in ten out of twelve cases, suggest that detection of autocorrelation in previous model was due to the omission of this variable.

TABLE V.1 Earnings Differential Elasticities: Comparison of Estimates from Basic and Partial Adjustment Models

	Basic Model (equation 6))			Partial Adjustment Model (equation 9)).						
	Short-run Elasticities			Short-run Elasticities			Long-run Elasticities			Adjustment Coeff.
	EPR	PI^{10}	PR^{10}	EPR	PI^{10}	PR^{10}	EPR	PI^{10}	PR^{10}	
	(γ_2)	(γ_3)	(γ_4)	(μ_2)	(μ_3)	(μ_4)	(μ_2^{ℓ})	(μ_3^{ℓ})	(μ_4^{ℓ})	(δ^1)
Males										
- 20	3.6a	-0.6	-2.1	2.5b	-0.6b	-1.5	3.9	-0.9	-2.4	0.65
20-24	-1.5	1.2	-2.5	-1.4	1.3	-3.0	-1.4	1.3	-3.0	1.26c
25-34	0.7a	0.5b	-3.1a	0.6a	0.5	-2.9a	0.6a	0.5	-2.9a	1.01c
55-64	-7.9b	10.4	17.0	-6.6b	4.7a	11.4	-11.0	7.8	19.9	0.60
65 +	1.4a	-7.9	-1.0a	-0.8a	-5.7	-0.9a	1.2	-9.3	-1.5	0.61
Females										
- 20	5.0	0.1a	-2.5	3.7	0.1a	2.0	4.5	0.1	-2.6	0.76
20-24	-1.2b	0.6	-0.2	-1.7	0.4	0.4a	-2.8	0.7	0.6	0.60
25-34	0.4a	-1.4	0.4a	-0.5a	-1.0	0.9	-1.4	-2.8	2.5	0.36
35-44	-0.8b	0.1a	-0.2a	-0.8	0.3a	0.2a	-9.3	3.9	2.3	0.08
45-54	-0.2a	1.9	-0.1a	-0.0a	1.0	0.1a	-0.1	2.3	0.3	0.44
55-64	0.0a	0.6a	0.0a	-1.1	0.5a	0.1a	-6.5	2.9	0.4	0.17
65 +	-0.9a	2.3a	0.5a	-1.6a	1.8a	0.3a	-2.0	2.2	0.4	0.82

Source: Estimates from Appendices F1.2 and F1.3. Long-run effects are derived from short-run estimates and adjustment coefficient as explained in the text

a: Value of elasticity is based on estimate that is insignificant at the 95% level of confidence.

b: Basic estimates are significant only at the 90% level of confidence.

c: Estimates not different from unity at the 95% level of confidence. A value of 1 for the adjustment coefficient was assumed in estimating long-run effects.

estimates derived from the partial adjustment model. Hence, if used for prediction, they would tend to overstate the short run impact of the independent variables on the structure of earnings differentials. Indeed, short run estimates from the partial adjustment model are more moderate, indicating that earnings differentials are rather inflexible to current changes in market conditions. Detailed comments on the effect of each variable follow.

2.2 Determinants of Earnings Differentials

2.2.1 Business Cycles and Differentials

Earnings differentials behave, in general, in a countercyclical fashion; that is, during the business cycle peak the differential decreases for all groups, except the youngest whose relative earnings position deteriorates. This finding is consistent with the impact of minimum wage legislation, already discussed in the previous section.

The groups which benefit most from a tight labour market are the older, experienced, male workers (M(55-64)), followed by those at the beginning of their careers (young workers aged 20-24, and adult females F(35-44; 55-64)). Those groups well attached to the market and presumably at a mid-career stage are the most protected against economic fluctuations and their earnings differentials remain unchanged (see M(25-34) and F(25-34; 45-54)). The relative earnings position of the oldest segment of workers (65+) experience an insignificant improvement in the upswing of the business cycle.

2.2.2 The Supply of Labour and Earnings Differentials

Supply side effects on earnings differentials have, in general, the sign predicted by the *overcrowding* hypothesis. The "pure" demographic component (P'^{o}) provides evidence that increases in relative cohort size tend to result in a deterioration in the earnings position of the relevant cohort.[15]

The behavioural component given by the ratio of participation rates (PR'^{o}) shows a clear pattern of positive impacts, though some of them are insignificant, implying that the increased participation of certain groups tends to worsen their earnings position. The three significant exceptions to this pattern are again given by the youngest group of workers. What remains unclear is whether this odd result is the consequence of the observed higher educational levels attained by these groups compared to older cohorts of workers, which make them more trainable and adaptable to perform productive tasks, or simply the effect of minimum wages whose rigidity offsets the the downward pressure on earnings exerted by their increased participation.

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[15] The significant exceptions are given, again, by the oldest male group (65+) and women aged (25-34).

2.2.3 Flexibility of Earnings

The estimates for the speed of adjustment coefficient for earnings reveal that the wages of males are more flexible than those of females (see δ', last column Table V.1), a result that accords well with the usual "primary" role assigned to males in production.

For workers of the same sex, great variability by age is observed for the speed of adjustment coefficient. Among males, the adjustment of young adult workers' earnings, M(20-34), is rather instantaneous, i.e. δ''s are not significant different from unity, while for the older and youngest groups only about three fifths of the employers' desired adjustment can be accomplished in any period. These estimates reflect the degree of rigidities each group faces. Older workers are likely to enjoy seniority benefits and earnings which are based on historical performance and are difficult to be altered when firms foresee changes in the market. Earnings of the youngest workers are dictated mainly by institutional factors, i.e legislation on minimum wages. Young adult workers, on the other hand, are relatively unprotected since they are at the beginning of their career ladder, thus their wages become more flexible.

For females the pattern of earnings flexibility has the inverse shape of that for males, being more flexible at the extremes and almost completely rigid for the middle aged groups, F(35-44). This particular result is interesting if connected to the opportunity cost they face at different ages as a determinant of their labour supply. In fact, for younger and older women the opportunity cost of working is almost nonexistent since they have few household responsibilities, thus their supply of labour is relatively inelastic. Perceived changes in market conditions allow employers to adjust their earnings more easily to the desired levels.

The supply of labour from prime aged women, however, is elastic only at the reservation wage, its level being determined by the higher opportunity cost they face (given their household and chilbearing responsibilities). The existence of this floor, at which this group's supply of labour approaches perfect elasticity, imposes an additional constraint on employers which ~~impedes~~ variations in these women's earnings as a consequence of changed market conditions. The observed slow speed of adjustment of their earnings can then be rationalized as due to rigidities stemming mainly from the supply side.

C. Relative Earnings and Labour Substitution

The preceeding section provided evidence on the pattern followed by the groups' earnings differential in response to fluctuations in the demand and supply of labour. In this section the question is addressed as to how the relative earnings of a cohort of workers have been altered as a consequence of its changed size. Answering this question requires an examination of the degree of substitutability among different types of labour. The more imperfect substitutes that workers are for each other, the greater can be the expected effect of own cohort size on earnings.

First, a brief review of a theoretical framework for the empirical aim of this section is undertaken; next, models and results are discussed.

1. Labour Substitution and Production Functions

An appropriate concept to be used in quantifying this problem is the elasticity of complementarity (Hicks (1970)) rather than the Allen elasticity of substitution.[26] The Hicks' elasticity of complementarity provides a measure of how sensitive factor prices are to changes in relative factor quantities. This, in turn, means that factor quantities are exogenously determined and labour is demanded within the production function approach (Hammermesh and Grant (1979)).[27]

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[26] On the relationship between both elasticities see Sato and Koizumi (1973) and for a discussion of empirical estimates of the elasticity of substitution see Berndt and Christensen (1976).

[27] As Hammermesh and Grant (1979) have emphasized, only when prices can be considered exogenous and quantities endogenously determined is a cost function approach justified. Otherwise, a production function must clearly be made explicit.

In the case of this study it can be argued that the sizes of the age-sex cohorts of workers are exogenously predetermined by past demographic conditions. This being the case, the demand for labour becomes a wage determination schedule linking factor prices to factor quantities.[98]

A summary review of the concept of elasticity of complementarity is undertaken next, followed by a discussion on the underlying production function suitable for empirical purposes.

1.1 Elasticity of Complementarity

Consider a constant return to scale (CRS) production function given by,

10) $y = f(x_1, \ldots\ldots, x_n)$

where y denotes output and x input amounts.

The elasticity of complementarity between any pair of inputs, i and j, can be defined as,

11) $C_{ij} = (1/a_j)(\delta \ln f_i / \delta \ln x_j) = (1/a_i)(\delta \ln f_j / \delta \ln x_i) = C_{ji}$

where the a's are the input shares in total cost; $(\delta \ln f_i / \delta \ln x_j)$ is the proportional change in the marginal product of the ith input when the quantity of the jth factor is altered, with other input quantities held constant but output allowed to vary. C_{ij} stands for the elasticity

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[98] Similar arguments justifying this decision are common in the literature when the issue of labour substitution is the central question to be examined. A summary of earlier studies can be found in Hammermesh (1976) and Hammermesh and Grant (1979).

of complementarity between the ith and jth inputs.

Under the assumption that inputs are paid according to their marginal contribution to production, 11) becomes,

12) $C_{ij} = (1/a_j)(\delta lnW_i / \delta lnx_j)$

Furthermore, since for a CRS production function $\Sigma_j^n a_j C_{ij} = 0$ must be satisfied, the own elasticity of complementarity C_{ii} is negative for normal production functions and defined by,

13) $C_{ii} = -\Sigma_{j \neq i}^n (a_j/a_i)C_{ij}$

When all inputs are allowed to vary (over time) the impact on the ith input price can be written as:

14) $\delta lnW_i = \Sigma_{j \neq i}^n a_j C_{ij} \delta lnx_j + a_i C_{ii} \delta lnx_i$

or, after replacing 13) in 14),

14') $\delta lnW_i = \Sigma_{j \neq i}^n a_j C_{ij} (\delta lnx_j - \delta lnx_i)$

Moreover, changes in relative prices of any pair of factors, say i and k, can be readily expressed as follows:

15) $\delta(lnW_i/\delta lnW_k) = \Sigma_{j \neq i \neq k}^n a_j (C_{ij} - C_{kj}) \delta lnx_j +$
$a_i (C_{ii} - C_{ki}) \delta lnx_i + a_k (C_{ik} - C_{kk}) \delta lnx_k$.

If *separability* among inputs holds, i.e. changes in inputs other than i and k do not affect the ratio of their marginal productivities, then, the relative wage determination schedule collapses to the following simple expression,

16) $\delta(lnW_i/\delta lnW_k) = - (1/S_{ik}) \delta ln(x_i/x_k)$

where $S_{ik} > 0$ is the Allen elasticity of substitution between inputs i and k.

which can be shown to correspond to a production function of the CES type.''

1.2 Production Functions

On the choice of the underlying technology the popular alternatives include production functions of the Cobb-Douglas (CD) and CES type or other members of the flexible forms family, such as, the translog function.''' For the empirical purposes of this section, however, only functions of the last two types are suitable.

The CD is inadequate since it restricts all Allen partial elasticities of substitution to be equal to one. The CES is more general in the sense that allows for different elasticity values, though they are unnecessarily restricted to be constant and equal for any pair of inputs; both functions assume that strong separability holds. The translog, on the other hand,

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'' A typical CES production function is given by,
i) $y = A(ax_i^{-n}+(1-a)x_k^{-n})^{-1/n}$
with $A>0$ and $0<a<1$. It has a marginal rate of substitution (RTS) given by,
ii) $RTS=(\delta y/\delta x_i)/(\delta y/\delta x_k)=(a/(1-a))(x_k/x_i)^{1+n}= b_0(x_i/x_k)^{-(n+1)}$
and associated partial elasticity of substitution, $S_{ik}=1/(1+n)$. If inputs are paid according to their marginal productivity (RTS equals the input price ratio) the relative wage determination schedule 16) is obtained,
iii) $RTS=W_i/W_k= b_0(x_i/x_k)^{-1/S_{ik}}$
whose equivalent in log terms is
iv) $\ln(W_i/W_k)=b_0 + b_1\ln(x_i/x_k)$, with $b_0 = \ln(a/(1-a))$ and $b_1 = -1/S_{ik}$

'''This form is a more recent development due to Christensen, Jorgenson and Lau (1971). For an empirical application in testing aggregation of labour groups see Berndt and Christensen (1974).

neither restricts the elasticity values at any point of the input space nor assumes strong separability. Its flexibility has made the use of the translog very attractive for empirical purposes. This function, however, suffers from the practical limitation of being unable to handle large numbers of inputs because its estimation becomes cumbersome[*] and its use becomes feasible only at the expense of higher level of input aggregation.

In spite of its limitations, the CES has the advantage of simplicity, and more important yet, permits a detailed analysis for the various age-sex labour inputs of interest in this research plus the inclusion of additional variables in an straightforward fashion (when time is allowed to vary).

2. Relative Earnings: Model

2.1 Model and Variables

Following the discussion in the section above, the CES production function approach is adopted in defining the specific form of the relative earnings equation to be estimated. The earnings behaviour of the various groups is related to a basic group, adult-male workers aged 35-54 years, given that these workers, in addition

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[*] In fact for each n independent explanatory variables included in the equation, it is necessary to estimate n^2 parameters if no restrictions are placed *a priori*. If symmetry is imposed, the number of parameter estimates reduces to only $(n^2+n)/2$.

to being essential in the production process (they are highly complementary to capital), have demonstrated stable employment and strong and stable participation characteristics.

To control for the possibility that changes in relative earnings are due to cyclical or other long term influences rather than demographic, proxies for these variables were added to the specification. Thus, the equation to be estimated becomes,

$$17)\ \ln(W_i/W_0)_t = \gamma_0 + \gamma_1 \ln(L_i/L_0)_t + \gamma_2 T_t + \gamma_3 \ln EPR_t + \epsilon_t$$

where W's are earnings from wages and salaries; L is labour force; EPR the employment to population ratio and T is a time trend. The subscripts i and 0 refer to the 12 age-sex labour groups and the basic adult male group, respectively.[102]

Estimation of 17) employed the OLSQ technique and the results are presented in Appendix F2.1. The presence of autocorrelation (see low values for the DW's statistics) justified re-estimation[103] of 17). Appendix F2.2 presents the results for all groups. Since the presence of

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[102] All variables have been previously defined and justified in this and previous chapters

[103] It was assumed residuals followed a first order autocorrelation scheme and estimation was carried by the AR1 option from the TSP package.

autocorrelation can also be considered a proof of misspecification, equation 17) was redefined to take into account the relatively slow changes experienced by the earnings structure. The final form of the equation is given by,

$$18)\ \ln(W_1/W_0)_t = \gamma_0 + \gamma_1 \ln(L_1/L_0)_t + \gamma_2 T_t + \gamma_3 \ln EPR_t + \gamma_4 \ln(W_1/W_0)_{t-1} + e_t$$

The rationality of this final form can be justified either by the existence of rigidities, as defined by the partial adjustment model of the previous section, or by the fact that actual relative earnings not only reflect current changes in supply and demand, but also past changes in these variables. A distributed lag model can be applied, in consequence, and 18) is the result of applying a Koyck (1954) transformation.[104]

It should be noted that the interpretation of the coefficient of the lagged dependent variable in this formulation $\gamma_4=\lambda$ is not contradictory with the coefficient, $\mu_5=(1-\delta)$, from the partial adjustment model which measures the speed of adjustment for earnings, δ.[105]

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[104] If current relative earnings, y_t, depend on current and past values of the explanatory variables X, the model can be written as,
i) $y_t = \beta_0 X_t + \ldots\ldots + \beta_k X_{t-k} + e_t$
Thus, if impacts of past changes can be assumed to decline geometrically, i.e. $\beta_1=\lambda\beta_0$, $\beta_2=\lambda^2\beta_0$, ..., with $0<\lambda<1$, i) can be stated as,
ii) $y_t=\beta_0X_t+\lambda\beta_0X_{t-1}+\lambda^2\beta_0X_{t-2}+\ldots+\lambda^k\beta_0X_{t-k}+e_t$ and substracting λy_{t-1} from ii) yields the formulation above, i.e. iii) $y_t=\beta_0X_t+\lambda y_{t-1}+\phi_t$. This is the transformation suggested by Koyck (1954).

[105] In fact, small values of λ mean that relative earnings respond to changed market conditions with a short lag. This is only possible if δ is large enough, suggesting that no

The estimated results for equation 18) are presented in Appendix F2.3.

3. Relative Earnings: Estimated Results

The results obtained for the specification 18) are more satisfactory than those for the basic equation 17), with a higher level of explanation (R^2) reached, an absence of autocorrelation and significant parameter estimates for the included lagged endogenous variable.

To facilitate comparisons between the alternative models and be able to draw general conclusions on the effects of the main variables on the structure of relative earnings, the following Table summarizes the cyclical and demographic elasticities of relative earnings. These estimates are derived from the basic and lagged models. Comments on the effects of these variables on each group's relative earnings are considered next.

3.1 Cyclical Effects on Group Earnings

In expansionary stages of the business cycle, the relative earnings of the oldest male workers, M(55+), and young females, F(20-24), improve more than any other group; they are followed by adult females, F(35-44), and young males, M(20-24). These results suggest that in a tight labour market the demand for those more experienced (M(55+) and F(35-44)) is likely to be

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...(cont'd)rigidities exist to impede the earnings adjustment process to the desired levels.

TABLE V.2 Relative Earnings: Cyclical and Relative Cohort Size Elasticities
Comparison of Estimates from Basic and Lagged Models

	Cyclical (EPR) OLSQ s-run (γ_3)	Lagged Model s-run (γ_3)	Lagged Model l-run (γ_3)	Relative Cohort Size (RP10) OLSQ s-run (γ_1)	Lagged Model s-run (γ_1)	Lagged Model l-run (γ_1)	Lag Coeff (λ)
Males							
- 20	-1.68	-0.97	-1.92	1.43	0.93	1.84	0.50
20-24	0.54a	0.31a	0.50	-0.33b	-0.15a	-0.25	0.37
25-34	-0.12b	-0.13	-0.13	-0.07	-0.08	-0.08	0.08
55-64	-1.03	0.75	1.95	-0.90	-0.34b	-0.87	0.62
65 +	0.90	1.00	4.21	-0.06a	0.04a	0.15	0.76
Females							
- 20	-1.41b	-0.38a	-0.69	1.59	0.97	1.79	0.46
20-24	1.07	[illegible]	1.93	-0.26b	-0.22b	-0.41	0.45
25-34	0.87	0.29a	1.48	0.40	0.06a	0.29	0.80
35-44	0.91	0.48	7.43	0.48	-0.08a	-1.29	0.93
45-54	0.51	0.12a	0.64	-0.53	-0.14a	-0.80	0.82
55-64	0.55	0.40b	2.07	-0.14a	0.01a	0.04	0.81
65 +	0.34a	0.41a	0.58	-0.10a	-0.04a	-0.05	0.29

[illegible] from Appendices F2.1 and F2.3. Long-run effects are derived [illegible] estimates and the coefficient of the lagged dependent variable, [illegible] in the text.

[illegible] based on estimate that is insignificant at the 95% [illegible] significant only at the 80% level of confidence.

In sum, the evidence reviewed in this section suggests that the relative earnings structure, by age and sex, has been flexible and sensitive to changes in the composition of the labour market and cyclical fluctuations in the economic activity. Young workers have seen their relative earnings position worsen, a fact that might well be attributed to their arrival in the market in unusually larger numbers. Adult women, on the other hand, have seen an improvement in their relative position, in spite of their increased number. This fact suggests that other forces have played a major offseting role, such as the changed industrial mix of the economy and advances in reducing sex discrimination. These improvements, nevertheless, have been rather modest in view of the still significant gap of earnings by sex. Finally, the high sensitivity of secondary workers'earnings to cyclical developments suggests that sex differentials could be reduced, and the relative position of young workers improved if a high and permanent growth in employment [illegible] conditions of sustained.

IV. Employment, Unemployment and Labour Force Participation: Empirical Approach

This chapter focusses on the simultaneous changes in employment, unemployment and labour force resulting from variations in cyclical and demographic variables and related changes in relative wages and other factors.

The chapter is divided into three parts. Part A examines the weaknesses of and interrelationships between alternative measures of employment performance. It specifically seeks to clarify the connections between alternative, frequently used, indices in order to select the most adequate combination of them for the subsequent empirical investigation.

Part B defines and tests competing specific functional forms for a model of employment and labour force participation and sets out the appropriate specifications and estimation techniques to be employed in the subsequent empirical analysis.

The final part of the Chapter is devoted to an analysis of the estimated results. It focusses on the direct impact that each independent variable has on a given age sex group's employment and labour force participation, and indirectly on its employment and unemployment rates. Based on these estimated effects, this part also discusses some implications of the pro-cyclical labour force participation behaviour by providing estimates of *hidden* unemployment and economic losses due to its existence.

A. Alternative Measures of Employment Performance

The analysis of relative labour market performance over time necessitates the choice of an appropriate labour market indicator. Traditionally, the characterization of the relative hardship faced by different labour groups has relied on the examination of the paths followed by the employment (ER) and unemployment (UR) rates. Both aggregate rates give information on the ability of the economy to provide employment for a fraction of those actively engaged in the market while age-sex rates describe the distribution of employment among the various labour groups.

However, these rates have been criticized and their use has become controversial because the actual count of unemployed depends crucially on definitional questions and these rates are sensitive to changes in labour force participation over the business cycle.

Consider these problems in turn. Since the definition of labour force (L) is given by,

1) $L_t = E_t + U_t$

and the conventional employment rate defined as,

2) $(E/L)_t = 1 - (U/L)_t$ or, $ER_t = 1 - UR_t$

where E, U and L are the respective number of workers employed, unemployed and in the labour force at any time t.

Thus, errors in defining individuals as unemployed (and within or outside the labour force) arise when they are not actively seeking jobs and will therefore be reflected in U, L and their respective rates. A typical case occurs, for example, when there are so-called *discouraged* workers.[36]

If the magnitude of the measuring error in U is assumed to be ω, then the reported labour force and related rates would be affected as follows,[37]

1') $L^{o} = E + (U + \omega) = L + \omega$

and,

2') $(E/L)^{o} = 1 - (U + \omega)/L^{o}$ or, $ER^{o} = 1 - UR^{o}$

and, clearly, an omission error ($\omega > 0$) would imply that reported rates of unemployment (employment) underestimate (overestimate) the true levels, i.e. $ER > ER^{o}$ and $UR < UR^{o}$.

In a dynamic context, on the other hand, fluctuations of these rates can be the reflection of two very different phenomenon with distinct implications for the real hardship faced by the various labour groups and related policy purposes. Consider, for example, a falling ER (UR increasing) as result of declining economic activity and tighter labour demand; the same result might be obtained if

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[36] Those who are not counted as unemployed because they are not seeking jobs, even though they would like to work and have usually done so but have given up in their search, or who are young people and would like to work part time but again, have given up their search.

[37] To simplify notation, the time subscript t will be included in what follows only if its presence is absolutely necessary, otherwise it will be dropped.

improved economic activity were to attract more participants to the market (*discouraged* workers) than the number of vacancies open. This situation can be easily understood by differentiating 2) with respect to time,

3) $\delta ER_t/\delta t = 1 - \delta UR_t/\delta t$

or,

3') $ER_t(e - l) = - UR_t(u - l)$

where e, u and l are the respective proportionate rates of change over time of E, U and L; i.e. in general, $x = (\delta X/\delta t)/X$

Thus, a definite fall in ER (increases in UR) is compatible with a decline in employment only ($e<0$), increases only in labour force ($l>0$) or combinations of both (i.e., $e,l>0$ but $e<l$; or, $e,l<0$ with $e<l$).

Furthermore, if the error of measurement (ω) varies with U over the business cycle, the conventional rates become weaker indicators of a labour group's performance over time.

1. The Employment to Population Ratio

In order to have a more meaningful measure of the relative hardship in the employment situation faced by labour groups and to avoid the problems mentioned above, the use of the employment to population ratio (EPR) has been suggested and enjoys increasing popularity in labour market research (see Brown (1979) and Moore (1976; 1977), among others). The EPR provides an indication of the fraction of the whole potential labour force (civilian population) in any group that is actually employed.

Advocates of the EPR argue that this ratio avoids the effects of cyclical variation in LF participation rates and definitional problems, since it doesn't depend on the degree to which a person must actively seek work to be considered unemployed, nor does it depend on whether his ideas are realistic (or unrealistic) as to employability, earning capacity, suitability of working conditions, etc. (Moore (1976, 174)).

Since there is less scope for ambiguity in counting the employed and population in each group this measure becomes a more objective and unambiguous indicator of performance than the conventional rates, hence its popularity.

Critics of the EPR argue that this ratio is not a practical measure of the unused labour supply given that the link between population of working age and labour force is by no means a predictable or constant one (Hughes and Perlman (1982, 14)).

Although some writers have focussed the discussion on an evaluation of the relative merits of each alternative indicator, the questions of real interest are clearly how the indicators are related and whether they can be used as complements. In fact, examination of these alternative sets of series in isolation may lead to different and contradictory conclusions or to an apparent *paradox* as Fellner (1978, 101) has noted: "..[an] increased proportion of employed population and (simultaneous) increase in unemployment rates [are observed]..".[38] At present there is a considerable agreement that the various measures should be taken as complements in the analysis of the market. Even Moore (1976, 175) is cautious in his defense of the EPR in saying that "...evaluations of the labour market based upon employment data are not consistent with those based upon unemployment data..".[39]

In sum, the alternative indicators may not coincide in their direction of changes and should be considered simultaneously to improve the explanation of the changes in the market. It is possible that a constant EPR may coexist with a declining ER (rising UR) if E is just keeping pace with the growth in P and employment opportunities are not expanding at the same rate as the labour supply increases with rising LF participation. Thus, while the EPR would suggest that no changes have occurred in the state of the labour market, ER would indicate a deterioration of the system to provide jobs and that any burden may be disproportionally shared by some groups.

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[38] This paradox is based on the observation of the U.S. experience of the mid 1970s when the movements of the overall and groups EPRs and URs diverged.

[39] In addition, he emphasises the simultaneous use of both indicators in evaluating market performance by arguing that "..a high level of unemployment not accompanied by a low level of employment (relative to population) may not imply a deficiency in demand. It may, on the contrary, imply that large number of workers are seeking jobs, or seeking to change jobs, because employment opportunities are plentiful..", Moore (1976, 175).

2. Reconciliation of Alternative Measures

A close examination of the relationship between these indicators follows. First, the EPR is defined as:

4) $EPR_t = E_t/P_t = E_t/(NL_t + L_t)$

where P is population and NL are those not in the LF.

Second, changes over time in EPR are formulated as follows:

5) $\delta EPR_t/\delta t = EPR_t(e - p)$

where lower case letters denote proportionate rates of change over time of the respective variables.

Third, from 5) it is evident that a rise in EPR, $e > p$, is compatible with a fall in ER (which from 3) and 3') requires only that $e < 1$) as long as $p < 1$.

In words, employment must grow faster than the population for the given (age-sex) group but not faster than the growth in the LF if both EPR and LF participation are to rise and ER is to fall. Only in the special case when LF participation remains unchanged will EPR and ER necessarily move in the same direction and hence all indicators be regarded as genuine alternatives.

2.1 Employment Rates and Ratios of Employment and Labour Force to Population

Consider now the relationship between the employment to population ratio and the employment and labour force participation rates which is shown by the following identity,

6) $E_t^i/P_t^i = (E_t^i/L_t^i)\ (L_t^i/P_t^i)$

or,

6') $EPR_t^i = ER_t^i \times PR_t^i$

where PR_t^i is the participation rate of the ith group in period t, and similarly for the other variables already defined.

Now, fluctuations over time in the EPR can be decomposed into the rates of changes of ER (and UR) and PR if the logarithmic expression of 6') is differentiated with respect to time. Then, following our previous notation, equation 6) (or 6') becomes:

7) $epr_t^i = er_t^i + pr_t^i$,

It is clear from 7) that EPR may increase as a consequence of an increase in PR (with ER remaining constant); an increase in ER (with PR constant); both increasing; or a decline in one provided that the other increases more.

The connection with unemployment is straightforward, since at a moment of time any member of the LF is either employed or unemployed. Equation 7) may be written as a function of UR,

8) $epr_t^i = (1-ur_t^i) + pr_t^i$

Moreover, for small values of UR, 8) can be approximately reinterpreted as,[40]

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[40] Since for small values of UR, say less than 0.1, the log of ER is approximately equal to the negative value of UR, i.e. lnER = -UR

8') $epr_t^{\prime} = pr_t^{\prime} - \Delta UR_t^{\prime}$

Therefore, percentage changes in the employment-population ratio over time are approximately equal to percentage changes in participation rates minus changes in unemployment rates.

This particular decomposition has the merit of showing explicitly the variables whose behaviour must be explained simultaneously if a complete description and meaning is to be attached to the changes occurring in the market. Variations of this basic decomposition might be examined, each depending upon the requirements imposed by the specific hypotheses to be tested in the empirical approach.

It is worthwhile to note that most of the studies in this area have either concentrated on explaining employment (or unemployment) of groups demographically defined as, for example, the works of Feldstein (1973), Feldstein and Wright (1976), OECD (1980) and Freeman and Medoff (1978) or on analyzing the behaviour of participation rates as in Wachter (1972; 1977), Perry (1977) for U.S. data and the recent work for Canada by Kuch and Sharir (1978). Others have attempted to deal with a complete demographic model of the labour market, a task which has proved to be a complex one (see for example Smith (1977) and Anderson (1977)). Only in the recent work by Clark and Summers (1981) a succesful attempt to link the alternative measures of employment and participation is reported. Schaafsma and Walsh (1983) follow a similar approach though their focus is on measuring the impact of minimum wages.

B. Empirical Approach

Given the discussion of the interrelationship between alternative measures of labour market performance and the need to separate the effects on employment and labour force that cyclical, demographic, and other factors have had over the period of study, an indirect approach to explaining the behaviour of employment and unemployment rates is adopted. These rates are chosen as the ultimate representation of a group's behaviour since they summarize the impact of the forces at work and are widely publicized and utilized by policy makers and private agents as a guide to their decisions.

1. Behavioural Equations and Expected Impacts

For empirical purposes, the rate of change over time of a group's employment rate ($ER^i = E^i/L^i$) is decomposed into the rate of change of each group's employment, $REP^i = E^i/P$, and labour force, $RLP^i = L^i/P$, ratios to population, by following a similar procedure as discussed in the preceding section. Thus,

9) $er_t^i = rep_t^i - rlp_t^i$

where variables er, rep and rlp are rate of change over time of ER, REP and RLP, respectively. The superscript i denotes the ith age-sex labour group and subscript t stands for time. E, L and P are (as usual) employment, labour force and population of working age (15 yrs and over).

This particular definition of the ratios can be justified on various grounds. First, their changes provide separate and unambiguously defined measures of movements in the actual supply and demand of each labour group. That is, the use of population instead of its labour force in the denominator avoids problems in interpreting changes in the traditional group rates. Second, biases arising from measurement and definitional errors are likely to be less important in this formulation since both variables in the ratios are drawn from independent sources and are therefore more objectively defined. Third, demographic impacts are allowed to enter as explanatory variables in a straightforward fashion since the size and changes over time of each group's labour force and employment are directly influenced by the variations occurring in its population size.

1.1 Behavioural Equations

For the above decomposition of changes in group's employment rates, the following general behavioural equations, common to all 14 age-sex groups,'' are

'' Note that no attempt is made to provide a complete explanation of the specific factors affecting each particular labour group's performance.

postulated.

Labour Force Ratios:

10) $RLP^i_t : (L^i/P)_t = f^i(BC_t, RP^i_t, RW^i_t, X_t)$

with $f^i_1 \geq 0$; $f^i_2 > 0$; $f^i_3 \geq 0$; $f^i_4 \geq 0$

Employment Ratios:

11) $REP^i_t : (E^i/P)_t = g^i(BC_t, RLP^i_t, RW^i_t, X_t)$

with $g^i_1 \geq 0$; $g^i_2 > 0$; $g^i_3 \geq 0$; $g^i_4 \geq 0$

where BC is a proxy for business cycle or fluctuations in the aggregate demand level; RP is the fraction of total population of the ith population group, i.e. P^i/P; RW^i is a measure of the group's relative wage; X is a vector of other variables, especially the slowly changing socio-economic and institutional factors; f^i and g^i are functions whose specific forms are to be defined, and the age-sex groups are denoted by i (i=1,...,14).

1.2 Expected Impacts

BC is expected to have a positive impact on the ratio of every group's employment to population ($g^i_1 > 0$); that is, expansionary phases of economic activity are likely to stimulate the overall demand for labour, hence the positive effect of BC on the employment of every group. The impact of BC on the labour force participation ratio will depend on whether the *discouraged* ($f^i_1 > 0$ or *added* ($f^i_1 < 0$) worker effect dominates.

Variations in the level and composition of the labour force are expected, *ceteris paribus*, to follow similar changes in the population; thus a direct impact of RP^i on RLP^i is expected to occur ($f_2' > 0$). Similarly, although through less direct channels, employment ratios are likely to follow the relative availability of labour ($g_2' > 0$). In fact, it is expected that a relative excess of the ith labour supply would exert upward pressure on unemployment and downward pressure on wages which might induce firms to employ more of the relatively abundant and cheaper factor. These "demographic" effects, as opposed to "cyclical" and "time trend" effects are likely to explain the intermediate run performance of the groups in the market in view of the observed swings in the population's composition.

Changes in relative wages are expected to have, in general, an indeterminate effect on labour supply ($f_3' \gtrless 0$) depending on whether the income or substitution effect dominates the group's decision to participate. The direct wage effect on employment could be unambiguously predicted to be negative in a static model ($g_3' < 0$). However, in a time series context, wages are not genuinely exogenous. Movements in wages can be viewed as being simultaneously determined with employment and labour force. Then the possibility that employment and wages move in the same direction can [illegible] be ruled out *a priori*.[42]

The impact of other factors (g) on the employment and labour force participation ratios cannot be signed with certainty for each particular group, given the complexity of the changes involved in this variable. Thus, ($f^i_4 \gtrless 0$) and ($g^i_4 \gtrless 0$).

2. Data Sources and Definition of Variables

2.1 Data Sources

Annual averages of population, labour force and employment for the fourteen age-sex labour groups are taken from the regular publication of Statistics Canada, *The Labour Force*.[43] The age-breakdown includes the following groups: 20 years and less, 20-24, 25-34, 35-44, 45-54, 55-64, and 65 years and over. The data cover the period 1950-1980.

The lack of official data on wages by age-sex categories (and on a continuous time series basis) necessitated a search for suitable proxies.

Besides Census data which is provided every ten years, income data for wage earners can be obtained from

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[42] Consider, for example, that as a consequence of a higher level of economic activity, employment and wages of some labour groups (particularly those more complementary with the fixed factor) might increase. In other words, upwards movements in wages could be just the outcome of employers' higher demand for labour.

[43] Special tabulations for the annual averages, 1950-1980, were provided directly. These data include the major revisions done in 1966 and 1975.

three sources on an annual basis:

- Statistics Canada, *Income Distribution by Size in Canada* covering the period 1951-1980 on irregular annual basis.
- Department of National Revenue, *Taxation Statistics*, annually, from 1963 up to 1980, and
- Canada Health and Welfare, *Canada Pension Plan Contributions*, annually from 1968.

Data from the first source were selected since it covered a longer period.[44] In addition, they seemed less affected by problems arising from definitional criteria, since limits for tax exemptions in the second source meant this sample excluded that important part of the population with declared low income, and "eligibility" for pension plan as in the third source similarly reduced sample size. The specific series chosen were the average annual incomes of those whose major source were wages and salaries. Thus relative wages (RW^i) were expressed as the ratios of the average income of the ith age sex group to the average income reported for all wage earners.

The use of annual data is undermined by the influence that variations over time and across groups in the proportion of those working part time or only part of the

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[44] It should be noted, however, that the data reported in this source correspond to the Surveys taken on the years 1951, 1954, 1957, 1959, 1961, 1965; biannually in the period 1967-1971, and annually from 1971 up to the present days. For the missing years, data for each age-sex group were interpolated based on the closest years for which information was available.

year can have on their measured earnings. It is also likely that fluctuations in the proportion of part time work could be inversely related to the level of economic activity and be more predominant among young and female workers. These observations suggest the need for a further disaggregation of workers and earnings by their full and part time status to isolate the effects of these changes.

Unfortunately, data on employment and earnings by the required age-sex division is very limited.[45] Therefore, in this study no corrections are made to the basic set of data. This decision implies an assumption that the distribution of full and part time employees, as well as their earnings, has not varied over time and across groups. There is no doubt that this is an "heroic" assumption, but it at least avoids the introduction of an arbitrary criterion in the correction process; moreover, its validity can be tested.

2. Variables

Business Cycle: Several measures have been suggested as a proxy for this variable, but since the concern is with labour market conditions the analysis is restricted to those measures directly related to the labour market. Traditional candidates are:

a. Employment(ER) and Unemployment(UR) Rates,

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[45] Data on part time employment from *The Labour Force Survey* by age-sex groups only starts in 1967, beginning only in 1971 on a regular annual basis. If only sex is considered, the series can be traced back to 1957. For full/part time earnings data by age-sex, series can only be constructed beginning in 1967 on irregular basis.

b. Adult Male Unemployment Rates (URAM),

c. Head of Household Unemployment Rate (URHH),

d. Long Term Unemployment Rate (URL),

e. Unemployment to population Ratio (UPR)

f. Employment to Population Ratio (EPR)

The ER and UR seem inadmissible because they reflect labour force responsiveness to market conditions, a phenomenon to be estimated. URAM and URHH avoids to a great extent the impact of variations in the labour force, but since members of these groups are likely to be the least affected by changed market conditions, movements in this rate would only provide a rather weak proxy for cyclical fluctuations. The selection of URL seems inadequate in this context, since by definition (and construction) is oriented to capture long-run effects in the market, while the concern here is on the effect of short run cyclical fluctuations of the economic activity.

The last two alternatives are more adequate, though EPR appears to be the best proxy. In fact, movements in EPR are directly related to changes in labour demand and the ratio components can be objectively measured at any time. This is not the case for UPR, since besides the definitional problems involved in classifying workers as unemployed (discussed earlier), UPR is a weaker proxy, since changes in U are more likely to be positively related to exogenous changes in L^i and L (when unaccompanied by short-run variations in labour demand). Thus a probability of spurious positive correlation between the dependent variables (RLP^i and REP^i) and UPR exists, which would not reflect the expected effect of the BC variable.[46]

In consequence, EPR is adopted as a proxy for labour market conditions in the empirical work, although it is recognized that it is not an ideal index. Among the weaknesses of this indicator, its joint determination with the individual's dependent variable (EPR^i) seems to be the main problem. However, since it cannot be expected that reporting and/or measurement errors of the EPR^is across groups follow a definite *a priori* pattern, it is unlikely that movements in both group and aggregate EPR variables reflect only spurious correlation. A minor problem is posed by its lack of definite meaning with regard to the actual population interested in labour market activity, as discussed earlier.[47]

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[46] For a more detailed discussion on this issue see Bowen and Finegan (1969, 502-4, 516-22), Mincer (1966, 78-80, 84-91, 109n), Proulx (1969, 272), Green (1977) and Grubel, Maki and Sax (1975).

[47] That is, the inclusion of all the population in working age, P, in the denominator of EPR treats all members of the population as equally interested in employment and participation in the market.

Demographic changes are expressed through the RP'S variables, which capture the changing composition of the population in working age and affect the size and composition of each group labour force (RLP').

Other gradually changing factors (X) are proxied by the use of a time trend (T) and the square of it (T^2). The latter enters the specifications to allow for non-linear changes in the dependent variables.

3. Testing Functional Forms

In the related empirical literature it is common to find that researchers usually select *a priori* a particular functional form for the employment and labour force participation equations (10) and 11) above). The most popular are the linear and double logarithmic forms. However, since neither theory nor the empirical evidence acummulated have dictated the appropriate functional form the model should assume, it is more convenient to leave the decision to the data and estimation procedures.

3.1 Box-Cox Transformations

This can be done by using the power transformation introduced by Box and Cox (1964):

12) $y(\lambda) = (y^{\lambda} - 1)/\lambda$

where y is a vector of observations on the dependent variable and λ is the power coefficient of y.[4]

Thus if the transformation given by 12) is extended to all variables in the specific equation of interest a general unrestricted model can be defined, and its parameters estimated, as follows:

13) $y(\lambda) = \Sigma^k_{i=1} a_i x_i(\lambda) + \epsilon$

where y is a vector of n observations for the dependent variable and x_i is the ith (i=1,..,k) explanatory variable. The coefficients a_i's and λ are the parameters to be estimated.

The alternative competing models are in this case, the linear specification,

14) $y = \Sigma^k_{i=1} a_i x_i + \epsilon$

and the log-linear specification given by,[5]

14') $\ln(y) = \Sigma^k_{i=1} a_i \ln(x_i) + \epsilon$

Formal statistical tests to compare the validity of the alternative models use the Likelihood Ratio Test (LR),

15) $LR = -2\ln(L(\hat{\theta})/L(\tilde{\theta})) \sim \chi^2_{(m)}$

where $L(\hat{\theta})$ and $L(\tilde{\theta})$ are the values of the likelihood function based on the restricted and unrestricted models (i.e. 14) or 14') and 13) respectively). LR follows a Chi-square (χ^2) distribution with m degrees of freedom, given by

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[4] There various cases of interest depending on the values of the power coefficient: if $\lambda \to 0$, then, $y(\lambda) = \ln(y)$; if $\lambda \to 1$ then, $y(\lambda) = y$; if $\lambda \to -1$ then $y(\lambda) = 1/y$, etc.

[5] A general discussion on Box-Cox transformations and use of tests to discriminate among competing models can be found in Zarembka (1968). For a more recent and general review see Spitzer (1982).

the number of restrictions imposed on the parameters.[50]

In order to test the specific functional form of the general models postulated by equations 10) and 11), the unrestricted model was defined by,

16) $y^i(\lambda) = a_0 + a_1 T + a_2 T^2 + \Sigma^5{}_{j=3} a_j x_j(\lambda) + \epsilon$

where y^i represents either the ith group labour force (RLP^i) or employment (REP^i) ratios. The x_j's are the respective explanatory variables (EPR, RW^i and RP^i or RLP^i) while T and T^2 are the time trends for other socio-economic factors.

The time trends were excluded from the general transformation, since the choice of model is invariant to any arbitrary scale of this variable. The alternative competing models to be tested against the general unrestricted given by 16) are,

The linear models,

17) $RLP^i = a_{10} + a_{11} + a_{12}T^2 + a_{13}EPR + a_{14}RP^i + a_{15}RW^i + \upsilon_1$

and,

18) $REP^i = \beta_{10} + \beta_{11}T + \beta_{12}T^2 + \beta_{13}EPR + \beta_{14}RLP^i + \beta_{15}RW^i + \phi_1$

versus the log-linear models,

17') $\ln RLP^i = a_{20} + a_{21}T + a_{22}T^2 + a_{23}\ln EPR + a_{24}\ln RP^i + a_{25}\ln RW^i + \upsilon_2$

[50] For a discussion on the connections between this test (LR); Lagrange Multipliers and Wald Tests see Buse (1982).

and,

$$18') \ \ln REP^i = \beta_{20} + \beta_{21}T + \beta_{22} + \beta_{23}\ln EPR + \beta_{24}\ln RLP^i + \beta_{25}\ln RW^i + \phi_2$$

Results for the tests on functional forms are summarized in Table IV.1, and complete results for the competing equations are shown in Appendices A1 and B1.[51] The model was also estimated so as to correct for autocorrelation of residuals and simultaneity bias and the results are reported in later sections.

3.2 Linear versus Log-linear Specifications

Table IV.1 presents the LR test values for the unrestricted and competing (restricted) specifications of the labour force and employment ratio equations.

For the labour force ratio equations (RLP^i) the results of the test show that in 50% of the cases both specifications -linear and log-linear- fit the data adequately and cannot be rejected. In four out of the remaining seven cases[52] the linear model (Li) is an inappropriate representation and is thus rejected. Both models (B) are rejected in two cases (see M(25-34) and F(<20)) and the log-linear is only rejected for F(55-64).

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[51] The unrestricted model (equation 16)) was estimated by the BOX option of the SHAZAM computer program, Version 2.7 (July/1979), while the restricted alternatives (equations 17) and 18)) were estimated by OLSQ technique. (OLS option in SHAZAM). For details on SHAZAM see White (1978).

[52] See RLPs results, reject column, for Males M(<20; 45-54) and Females, F(20-24; 25-34).

TABLE IV.1 Tests for Functional Forms: Linear versus Log-linear Models

Likelihood Ratio Test (LR)

LR(Θ):	Labour Force Ratio Equations (RLP^i) Unrestr.[a]	Linear	Log-Li.	Reject[b]	Employment Ratio Equations (REP^i) Unrestr.[a]	Linear	Log-Li.	Reject[b]
MALES								
- 20	32.68	5.22	2.85	Li	43.65	0.04	1.77	-
20-24	46.35	0.17	1.33	-	37.29	0.20	1.99	-
25-34	52.29	19.55	23.44	B	44.70[c]	9.36	7.70	B
35-44	43.12	1.09	0.28	-	62.62[c]	29.38	28.02	B
45-54	46.49	5.01	3.42	Li	69.33	5.41	1.66	Li
55-64	49.07[c]	4.40	4.15	-	60.98	0.01	0.02	-
65+	55.82	3.42	4.57	-	94.69	0.01	7.19	Lo
FEMALES								
- 20	46.42	20.43	9.94	B	62.92	6.03	0.17	Li
20-24	56.53	16.56	0.63	Li	77.14	34.47	15.33	B
25-34	31.43	24.91	0.07	Li	85.57	26.20	13.64	B
35-44	30.84	0.17	2.55	-	82.64	25.38	12.43	B
45-54	37.05	0.02	3.70	-	88.00	28.62	9.87	B
55-64	53.00	0.44	9.00	Lo	100.63	11.75	0.34	Li
65+	69.28	0.29	0.12	-	124.16	0.12	1.82	-

a Log. value of the Likelihood function from the general unrestricted model, equation 16).

b Rejection criteria: Chi-square distribution of LR. Table critical value for $\chi^2_{.025,1}$ is 5.02, Li: Linear, Lo: Log-linear and B: Both.

c *Local Maximum; iteration procedure failed to converge. Results are conditional to the the value of L(θ) reported in Table.*

If the employment ratio (REP') equations are examined the reported values for the LR test give less conclusive results. In fact, in six out of fourteen cases both specifications are rejected[53]. Among the remaining eight cases the linear specification is rejected in three cases (i.e. for M(45-54) and F(<20; 55-64)) and the log-linear only for the oldest male group, M(65+). For the rest (four cases) the low values of the LR statistics do not allow us to draw significant conclusions, thus we cannot discriminate among the competing models.

The overall evidence tend to favour the log-linear over the lineal model. These results, however, should be considered with caution since it should be clear that the LR test is clearcut only for large samples, i.e. LR is asymptotically distributed as the χ^2 distribution. In addition, the estimation procedure for the unrestricted model, though close to a maximum likelihood, doesn't guarantee a global maximum for the value of the likelihood function; thus reported LR statistics are conditional upon these estimates. More important yet is the fact that the general model, taken as benchmark, is only an approximation to the "true" unknown model.[54] In any event, subsequent discussion will be based on the

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[53]See M(25-34; 35-44) and F(20-24; 25-34; 35-44; 45-54) in REPs equations.

[54]In fact, there are other possible alternatives as the work by Spitzer (1982) illustrates. However, cost considerations prevented us from further pursuing this exercise.

log-linear specifications, unless otherwise stated. For completeness, however, and to facilitate eventual comparisons, results for the alternative linear model will be included in Appendices A1 and A2.

3.3 An Overview of Results

A summary overview of the results based on OLSQ results (see Appendices A1 and B1) reveal that both specifications are acceptable if the R^2's and significance of the estimated coefficients are taken as a criteria; only the employment and labour force behaviour of the oldest(65+) female group is not satisfactorily explained. The values of the Durbin-Watson statistic (DW) suggest the presence of autocorrelation in most equations.

The cyclical variable has a positive effect on the labour force participation of all groups, suggesting that net *discouraged* workers dominate the group's labour force behaviour. The most responsive are the *secondary* workers, as the values of the corresponding elasticities indicate (see Appendix C1). On the employment side, females are the least affected by cyclical developments, while among males the young and older adult groups (20-24; 45-64) experience the greatest impact.

Demographic changes, as expected, have a positive effect on the labour force. Employment follows closely the relative supply of labour, though in most cases its reaction is not enough to provide jobs to all available labour (elasticities are less than 1, see Appendix C1).

Changes in relative wages have in 50% of the cases a negligible impact on employment and labour force. When a significant impact is observed, they appear to serve as an incentive for participation among women and the youngest and older male groups. On employment its effects are positive for the adult male and female workers, a result that is not surprising if movements in wages are simply the outcome of competition in the hiring of the most skilled workers.

4. Estimation Procedures

Since the above results, derived from OLSQ estimates, show significant autocorrelation of residuals, both specifications for employment and labour force participation ratios were re-estimated using a correction for autocorrelation in order to improve the efficiency of the estimates.[55] Complete results for both models are reported in Appendices A2 and B2 for the linear and log-linear specifications, respectively.

Examination of the results for the estimated autocorrelation coefficient (ρ), its significance and the improved DW statistics confirm the validity of first order autocorrelation assumption and the need for the correction introduced.

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[55] The option AUTO of the SHAZAM program was utilized.

The inclusion of the RLP^i's and RW^i's as explanatory variables in both set of equations (RLP^i and REP^i) raises the question of the consistency of the estimated coefficients in these equations since these variables cannot be considered as truly exogenous. In fact they can be viewed as determined simultaneously in a larger system.[56] In this case consistent estimates can be obtained if Two Stages Least Squares or Instrumental Variables (IV) techniques are employed.

The additional presence of autocorrelation suggests that a combined technique that also corrects for the latter problem should give consistent and more efficient estimates. Recognition of both problems support the use of a combined technique, as provided by the AR1(INST) option from the TSP program, to ensure consistency of the estimates. The appropriate instruments chosen were the actual exogenous variables (T, T^2, EPR, RP^i plus a constant term), the same variables lagged once and lagged values of the dependent and endogenous variables (REP^i_{-1}, RLP^i_{-1} and RW^i_{-1}) according to the discussion by Fair (1970).

It should be noted, however, that an examination of the series for relative wages (RW^i) showed that changes in the structure of earnings varied slowly over time.[57] In view of

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[56] Alternatively, the problem arises from the nonstochastic character of the RLP^i's and RW^i's variables. On this issue see Kmenta (1971), Chapters 8, 9 and 13.

[57] This evidence suggests that a more complex simultaneous system characterizes the functioning of the market that requires further work in modelling. A more detailed analysis of the variations experienced by the relative earnings structure is postponed to the following Chapter.

this evidence little gains in efficiency can be expected by choosing their lagged values as instrument for the RW''s; thus, in these estimates only the current values of the groups' relative earnings were included to avoid further reductions in the already limited degrees of freedom. Complete results for the log-linear model are presented in Appendix B2.3.

Comparisons of the estimated coefficients derived from the OLSQ, AUTO and AR1(INST) techniques reveal that their values do not differ significantly. However, the estimates from the latter two procedures are more efficient, in general, as their improved t-statistics values indicate. To facilitate further comparisons among the different set of estimates, the partial impact of the main explanatory variables, in terms of partial elasticities, are presented in Appendix C2.1.

It is interesting to note that a consistent pattern and significance of effects are obtained across specifications. It is only in the linear specification (which was rejected by the LR test on functional forms, see Table IV.1) that the elasticity values do differ considerably.** If the comparisons of estimates are made across techniques but within specifications, it is seen that improvement in techniques result in theoretically more plausible and

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** For the LF participation ratio equations compare the linear and log-linear models for M(<20; 45-54) and F(20-24; 25-34); for employment ratio equations see M(45-54) and F(<20; 55-64) in Appendix C2.1 or detailed results in Appendices A2 and B2.

moderate values (see Appendices C1.1 and C2.1) for the coefficients.

In sum, the evidence reviewed on functional forms, autocorrelation and techniques allow us to conclude that reliable estimates for the labour force participation and employment ratio equations over the period are obtained if the log-linear models corrected for autocorrelation are considered in our subsequent analysis. Hereafter, comments will be based on them (complete results shown in Appendices B2.1 and B2.3).

C. Analysis of Results

An attempt to provide answers to the various questions raised in the theoretical discussion contained in Chapter 2 is made in this section. First an examination is made of the impact that cyclical fluctuations have on the employment and labour force participation of the various labour groups. The focus seeks to evaluate their relative and absolute responses and to provide evidence on the level and composition of the hidden unemployed, potential labour force and associated employment and unemployment rates.

Second an examination is made of the impact of demographic changes on the composition of employment and the labour force during the period and their estimated effects on the relative hardship of the various labour groups as measured by their unemployment and employment rates.

Finally, an examination of the role played by relative wages and other factors on the demand and supply of the age-sex labour groups is made.

1. Cyclical Fluctuations of Employment and Labour Force

Following the discussion of section B.1 above, consider the cyclical response of group's employment rates. This response, according to 9), can be decomposed into demand and labour supply cyclical reactions as follows,

Cyclical Employment Rates Elasticities:

19) $\xi_{BC}^{ER_i} = \xi_{BC}^{E_i} - \xi_{BC}^{L_i}$

where $\xi_{BC}^{E_i}$ and $\xi_{BC}^{L_i}$ are the cyclical employment and labour force elasticities of the ith group.

Since the group employment is directly increased by cyclical effects (EPR) and indirectly by the derived change in labour supply (effect of EPR on RLP which, in turn, affects REP^i according to 17') and 18')) the group employment elasticity can in turn be expressed as,

20) $\xi_{BC}^{E_i} = \beta_3 + \beta_4 a_3$

where a_3 is the cyclical impact on labour force and β_4 the induced employment effect of changed labour force, both measured as elasticities.[5]

The indirect effect reinforces or offsets the direct employment creation depending on whether the *discouraged* or

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[5] For consistency we keep the notation employed in equations 17') and 18'), except that we have dropped the subscript 2, indicating the log-linear specification, which is now being used.

added worker effect dominate the groups labour force reaction (i.e. a_3 >0 or <0 respectively). In fact, an expansionary phase not only means that workers from each category are more in demand (scale effect)as measured by the direct employment effect but, also, an increase in the relative supply of a group (stemming from discouraged workers) may induce substitution and more employment of those in relative abundance. Thus, both effects act in the same direction. For groups in which the *added* worker effect dominates the opposite result can be expected.

1.1 Cyclical Response of Employment Rates: Elasticities

Combining 19) and 20) above, the employment rates elasticities can be re-written as,

21) $\xi^{i} = \beta_3 + (\beta_4 - 1)a_3$

which provides a straightforward decomposition of the total effect by source of variation. Estimates of these elasticities and the relative importance of the direct employment effect are included in the next Table.

Column 1 of Table IV.2 shows that group employment rates have a relatively inelastic response to cyclical fluctuations. This is more evident for women, where a 1% change in BC (proxied by the EPR variable) would be followed by a change of only 0.16% in their employment rate. The male rate elasticity is more than double that of females. Young workers are the most cyclically sensitive group (0.57%), with the young males' reaction being the highest (0.79%).

TABLE IV.2 Cyclical Response of Employment Rates, Employment and Labour Force Elasticities

	Employment Rates	Employment	(% Direct)	Labour Force
	$\xi_{BC}^{ER_i}$:	$\xi_{BC}^{E_i}$:		$\xi_{BC}^{L_i}$:
	$(\beta_3+(\beta_4-1)\alpha_3)$	$(\beta_3+\beta_4\alpha_3)$	$(\beta_3/\xi_{BC}^{E_i})100$	(α_3)
MALES[a]	0.405	0.822		0.417
- 20	0.904	1.959	(29.7)	1.055
20-24	0.728	1.107	(69.4)	0.379
25-34	0.402	0.673	(69.5)	0.271
35-44	0.291	0.562	(51.8)	0.271
45-54	0.256	0.655	(76.3)	0.399
55-64	0.355	0.735	(46.8)	0.380
65+	0.016	1.253	(7.5)	1.237
FEMALES[a]	0.157	0.847		0.690
- 20	0.313	1.772	(11.0)	1.459
20-24	0.249	0.787	(31.0)	0.538
25-34	0.111	0.803	(31.4)	0.692
35-44	0.138	0.526	(20.3)	0.388
45-54	0.064	0.558	(11.5)	0.494
55-64	0.159	0.775	(19.0)	0.616
65+	-0.006	1.161	(2.4)	1.167
Both Sexes	0.329	0.829		0.500
Young (-24yrs)	0.570	1.344		0.774
males	0.790	1.444		0.654
females	0.267	1.209		0.942

Source: Appendix B2.3 for estimates of employment elasticities and Labour Force elasticities from Appendix B2.1.

a Employment and Labour Force Elasticities are weighted averages of the groups estimates, with weights given by the group's share of employment and labour force respectively. Employment Rates elasticities calculated as residuals.

If considered in isolation, these results could lead to the misleading conclusion that cyclical fluctuations have a negligible impact in the labour market. However, the disaggregated results for employment and labour force participation reveal that substantial variation occurs across groups in response to cyclical developments, as shown in the following sections.

1.2 Cyclical Impacts on Employment

On the demand side, the groups' employment elasticities with respect to total employment(ξ^{i}, column 2, Table IV.2) exhibit a well-shaped saucer form, i.e. the youngest and oldest groups present the highest employment response, while the lowest elasticity values are recorded for the middle-aged workers.

The above evidence conforms well to the expectations that age is a good proxy for the experience and skill sought by employers up to the point at which technical obsolescence is likely to appear. Thus, employment of the middle-aged workers is the least cyclically affected; in response to a change of 1% in total employment, the employment of this group would only change by about half the change experienced by young workers.

If division by sex is considered, the elasticity estimates suggest that employment of both sexes react similarly over the cycle[60] thus, employment differentials by sex would remain unchanged in the aggregate. Comparisons by age-groups however, show that females have a lower elasticity for most groups, suggesting that their employment position is relatively less affected by cyclical fluctuations than for males.[61]

The above conclusion is strongly supported if attention is given to the relative importance of the direct cyclical effect on employment (i.e. as measured by the β_3 coefficient in column 2') of the Table IV.2) which is consistently much lower for females than for males, suggesting that, among permanent (rather than transient) members of the labour market, females are more protected.

1.3 Cyclical Impacts on Labour Supply

On the supply side of the market, labour force elasticities by age-sex groups present a shape similar to those of employment. The close association between employment and participation responsiveness to cyclical developments across labour groups suggests that the degree of discouragement is related to the degree of job

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[60] The estimated elasticity values are 0.82 for males and 0.85 for females.

[61] This finding agrees with reported evidence that female employment tends to be concentrated in relatively cyclically protected occupations and industries -white collar type occupations and service oriented industries; see Ostry and Zaidi (1972, 133)

security enjoyed by workers.[62]

As column 3) of the Table reveals, the estimated elasticities, a_3,[63] are all positive, giving strong support to the existence of a dominant *discouraged* worker effect for all groups. The overall positive response of of the labour force to employment opportunities (i.e. with an estimated value of 0.50) suggests that increased employment will not decrease the actual level of unemployment in equal magnitude, thus the creation of about 2k jobs would be necessary to reduce the number of unemployed by k.

Female participation behaviour is more cyclically responsive than male,[64] result that accords well with the traditional label assigned to these *secondary* workers. Participation of young and older workers (also often referred as *secondary*) is the most sensitive, while that of middle-aged male workers is the least cyclically sensitive.

The results presented confirm the great differences occurring in group participation in response to cyclical fluctuations. If considered in connection with the groups' employment reaction, a clear explanation of the overall cyclical impacts on employment rates is obtained. In the case of females, the increased

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[62] This observation was first done by Dernburg and Strand (1966, 81) in dealing with the U.S. market.
[63] See Appendix B2.1 for complete results.
[64] See column 3, Table IV.2. The values of elasticities are 0.69 and 0.42 for females and males, respectively.

employment is almost totally offset by the strong pro-cyclical female participation behaviour; thus, their employment rates provide little indication of real gains in group employment. On the other hand, the cyclical impact on male employment rates is less extreme, given the more inelastic male supply of labour; thus variations in their employment rates tend to follow closer the changes in the overall labour market conditions (as measured by the overall employment).

2. Some Implications of the Cyclical Estimates

Some implications, based on the results of the estimated employment and labour force participation equations are examined in this section. First, an evaluation is made of the absolute impact on the composition of employment an assumed job-creation program would have. Second, the composition and absolute levels of *hidden* unemployment throughout the period of analysis are examined. Finally, some estimates of the economic losses due to the existence of *hidden* unemployment are discussed.

1. Job Creation Programs: Absolute Impact on Employment

Consider now the proposal of a job-creation program that seeks to generate 100 thousand new employment opportunities in the market over a year. This objective is equivalent to an increase of about 1.4% in the average observed EPR variable over the 1950-80 period.[65]

From the policy makers point of view, various questions are relevant to an evaluation of the impact of the program. Among others, who would be the eventual beneficiaries of the program? How would total and groups unemployment be affected? The estimates presented in Table IV.3, attempt to provide some evidence useful for the evaluation of a program with such characteristics.

The bottom line of Table IV.3 provides estimates of the total impact of the assumed job-creation program. It is seen that an increase in total employment of 100 would be accompanied by an increase in the labour force of 53 new members, which implies that actual unemployment would be reduced by only 47. Therefore, the estimates suggest that, for each person meant to be rescued from the actual ranks of the unemployed, the proposed program should consider the creation of at least two new positions.

If the analysis is done by sex, the reported estimates imply that eighty per cent of the reduction in total unemployment would be due to decreased male unemployment. In other words, for every five unemployed workers rescued only one would be female. This result is the outcome of the relatively high female labour force

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[65] In other words, the program seeks to rise the average EPR level from 55.23 to 56.0 in one year. The implied absolute change of 0.77 percentage points is not unrealistic if compared to the annual average change of 0.61 points experienced by EPR over the 1958-80 period.

TABLE IV.3 Groups' Employment Response to Changes in Total Employment
Absolute Changes
(Total Employment Change=1000)

	Change in: Employment (ΔE^i)	Labour Force (ΔLF^i)	Reduction in: Unemployment (ΔU^i)[a]
MALES	686	309	377
- 20	126	65	61
20-24	109	34	75
25-34	141	49	92
35-44	105	44	61
45-54	101	53	48
55-64	73	33	40
65+	36	31	5
FEMALES	314	221	93
- 20	92	69	23
20-24	54	33	21
25-34	66	49	17
35-44	37	23	14
45-54	33	25	8
55-64	24	16	8
65+	8	6	2
Both Sexes	1000	530	470

Source: Employment from Appendix B2.3 and Labour Force from Appendix B2.1. Absolute impacts estimated from elasticities evaluated at the mean value of variables, i.e. $\Delta x/\Delta y : \xi_y^x \cdot (\bar{x}/\bar{y})$ where $\bar{x}$ and $\bar{y}$ are the sample means. To agree with the total change in employment of 1000, the groups variations were multiplied by a factor of 1.14.

a Calculated as a residual from: $\Delta E^i - \Delta LF^i = \Delta U^i$

resposiveness to job opportunities. Indeed, the program would tend to increase female employment by 31 persons of which, 22 would be new members -just attracted to the labour force- and only 9 rescued from the unemployed. For males, however, the increased employment of 69 would reduce the number of unemployed by 38, the difference (31) being absorption of new members.

In terms of age, the reduction of unemployment comes mainly from the younger groups, i.e. about 60% and 66% correspond to male and female workers aged 34 years and less. If employment is considered, the same groups would again benefit most from the program: about 57% of the jobs created for males would employ workers aged 34 and less, while the same age-groups would account for almost 67% of new female employment.

It is worthwhile mentioning that the above findings only provide an indication of the effects of the proposed program based on the average values of the variables in the sample. For any specific year, these estimates should be qualified by including the effect of changes in the other variables.

2. Hidden Unemployment and its Composition

The evidence of net *discouraged* worker behaviour for all the groups implies that in periods of economic slack, the measured labour force is lower than it would have been had the economy been at a *full* or *high* employment level of activity. In this situation, the recorded level of unemployment understates the additional number of jobs needed to restore a high level of employment.

In estimating *hidden* unemployment the traditional procedure involves the estimation of a "potential" labour force level associated with a measure of the *natural* rate of unemployment that is believed to have prevailed over the period, say 4% to 5%. These estimates become less reliable the longer the time period considered, since the *natural* rate may be shifting due to the changing demographic composition of the labour force (for example). Although, it is clear that any decision on this matter involves a certain degree of arbitrariness, the need for some standard to evaluate the performance of the market and the economy justifies the procedure.

To reduce the degree of arbitrariness in the estimates of the "potential" labour force (PLF^{o}) and to allow for the changing structural features of the economy, a flexible measure of *high employment*[66] is constructed(EPR^{o}). This measure is based on the highest observed values of the EPR variable over the period,[67] with the gap years estimated by linear interpolation.

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[66] Note that this is a measure of *high* employment rather than the usual *full* employment associated with a fixed *natural* rate of unemployment.

[67] These values follow closely the observed peaks in the economic activity over the period according to the timing of the Canadian growth cycle. For details see Kaish (1982) and Royal Bank "Trendicator" (1978).

In following the growth cycle chronology, the EPR variable compares well with other usual alternatives based on unemployment, (i.e. UR, URAM or UPR) over the major part of the period. They only diverge in the last decade when EPR tend to rise simultaneously with UR. This is not surprising if account is taken of the fact that an increasing participation of women and young workers has occurred. These groups have had a relatively high frictional unemployment rate, thus the overall UR has been rising as a reflection in part of this phenomenon. The EPR, on the other hand, is more likely to reflect directly the cyclical changes (through variations in its numerator, the number of employed) remaining less affected by changed participation.

The reported estimates of the PLF° are based on the individual results of the regressions by sex-age groups (as reported in Appendix B2.1) after replacing the EPR variable by its *high* employment level EPR° and an allowance made for auto[illegible]lation of [illegible]. That is,

22) $\hat{y}^i = \Sigma_{j=1}^{5} \hat{a}^i_j (x^i_j \; [illegible] \; \hat{\rho}^i x^i_{j-1}) \; [illegible] \; \hat{\rho}^i y^i_j$,

where $\hat{y}$ is the predicted value of $\ln PLF^i$ base[illegible] on the group's explanatory variables x^i's: T, T^2, $\ln EPR^{\circ}$, $\ln P$[illegible] $\ln PU^i$ and on the estimated coefficients $\hat{a}^i_j$, and $\hat{\rho}^i$, the coefficient of autocorrelation [illegible]

[illegible]

Estimates of PLF°[18] by age-sex groups are presented in Appendix D1 (D1.1 for males and D1.2 for females). *Hidden* unemployment estimates, i.e. the difference between PLF'° and LF', by groups are shown in Appendix D2.1 and D2.2 for males and females respectively. A summary of the total estimates of *hidden* unemployment by sex and main age groups is presented in Appendix D2.3. Finally, estimates of the specific sex-age "potential" employme rates are included in Appendix D3.1 and D3.2 (males and females respectively). To keep the analysis and comments on these results manageable, a summary of results for the aggregate LF -potential and actual- and associated employment and unemployment rates are presented in Table IV.4.

Inspection of the *hidden* unemployed estimates (HID, column 3 in Table IV.4) reveals the presence of some suspicious negative values. These values should not be seen as conflicting, since these estimates can be considered very conservative, and rather than providing "potential" estimates of the LF associated with an arbitrary measure of *full* employment, they can only be interpreted as a "high employment LF" according to the real capacity shown by the economy. Furthermore, the two outlying observations, 1966 and 1975, can be well explained by the major definitional revisions of the LF Survey done in those years.[19]

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[18] The actual values of PLF° are obtained after antilogarithm is taken and reescaling by P (population in working age) is done for every year. The total PLF° in each year is based on the aggregation (sum) of the individual groups' PLF'°.

[19] In the discussion the 1966 and 1975 observations will be

TABLE IV.4 Hidden Unemployed, Actual and Potential Labour Force Employment and Unemployment Rates over the Cycle:1952-80

	Labour Force		Hidden	Business		Rates of : Employment		Unemployment	
	PLF	LF	HID	Cycle		PER	ER	PUR	UR
	(000s)		(000s)			%		%	
1952	5348.7	5324	24.76	-	-	96.64	97.09	3.36	2.91
53*	5451.5	5397	54.53	q2	m03	96.03	97.00	3.97	3.00
54*	5550.3	5494	56.37	q3	m10	94.46	95.43	5.54	4.57
1955	5648.2	5610	37.24	-	-	94.97	95.61	5.03	4.39
56	5775.2	5783	-6.77	q4	m11	96.72	96.59	3.28	3.41
57*	6027.5	6008	19.54			95.08	95.39	4.92	4.61
58*	6210.2	6137	71.16	q3	m08	92.19	93.29	7.81	6.71
59*	6329.5	6241	87.46	q3	m10	92.74	94.06	7.26	5.94
1960*	6455.9	6411	44.97			92.40	93.04	7.60	6.96
61*	6611.0	6521	88.00	q1	m03	91.59	92.85	8.41	7.15
62*	6736.3	6616	121.31		m03	92.41	94.09	7.59	5.91
63*	6867.4	6749	118.46		m05	92.83	94.46	7.17	5.54
64	7040.7	6933	107.62	-	-	93.87	95.33	6.13	4.67
1965	7258.0	7141	115.98	-	-	94.54	96.09	5.46	3.91
66a	7213.7	7385	-170.31	q2	m03	98.70	96.41	1.30	3.59
67*	7648.0	7635	12.31			95.76	95.93	4.24	4.07
68*	7873.7	7837	36.66	q1	m02	94.76	95.20	5.24	4.80
69*	8140.1	8068	72.07	q1	m02	94.50	95.34	5.50	4.66
1970*	8293.8	8265	31.81	q4	m12	93.78	94.11	6.22	5.89
71	8552.3	8501	50.30	-	-	93.05	93.61	6.95	6.39
72	8801.0	8743	57.99	-	-	93.07	93.69	6.93	6.31
73	9167.3	9107	61.31	-	-	93.79	94.41	6.21	5.59
74	9546.1	9461	93.84	q1	m02	93.77	94.61	6.23	5.39
1975a	9788.6	9974	-177.42	q2	m10	94.84	93.08	5.15	6.92
76	10219.6	10206	14.57	-	m05	92.76	92.89	7.24	7.11
77	10481.9	10499	-18.09	-	m07	92.04	91.89	7.96	8.11
78	10812.1	10882	-72.94	-	-	92.23	91.64	7.77	8.36
79*	11284.0	11207	76.05		m09	91.89	92.52	8.11	7.48
80*	11618.4	11522	97.33		m06	91.71	92.48	8.29	7.52

* Years of 'Low-employment' according to recessionary cycles in column: Business Cycle

a Major revisions done to definitions and estimates of Labour Force Survey

Variables:

PLF, Total Potential Labour Force, see text and Appendixes D1.1 and D1.2 for detailed estimates.

LF, Total Labour Force. Source; Statistics Canada, The Labour Force (unpublished annual estimates).

HID, Total hidden unemployed = $PLF_t - LF_t$

Business Cycle, Recessionary periods measured from peak to trough; q_i is the ith quarter. Source: Royal Bank (1978) m_i is the ith month. Source: Kaish (1982).

PER, Potential or 'High-employment' employment rate, i.e. E_t/PLF_t, where E_t is actual employment in period t.

ER, Actual employment rates, i.e. E_t/LF_t

PUR, Potential or 'High-employment' unemployment rate

UR, Actual unemployment rate

The HID estimates become meaningful if compared with the pattern followed by the economic cycles in the period.[70] It is evident from the Table that a strong positive association exists between the size of HID and the stage of the recessionary cycle, i.e. the number of HID increases as the economic slowdown tends to its trough. This comparison is somewhat obscured, however, by the fact that our estimates are annual averages. Thus, the exact correspondence of HID to the timing of the cycle cannot be clearly observed.

Actual employment rates during recesions[71] tend to overstate the real rates by about a 0.87 percentage points on the average, i.e. the average for the overall reported ER is 94.36 while the estimated potential ER is 93.49; these averages are calculated for the low employment years marked by an asterisk. The reported UR, on the other hand, is on the average proportionately 13% less than it would had been if the *hidden* unemployed had been counted in the labour force (the average UR reported for these years is 5.64 while corrected for hidden unemployment is 6.51).

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[69](cont'd)always excluded due to these major revisions.
[70] Recessionary periods are measured by the observed economic slowdown from peak to through according to two independent sources (Royal Bank(1978, 7) and Kaish(1982, 363-68)) and included in columns 4 and 5 of the Table as a reference.
[71]1956 is not considered since the slowdown in economic activity only began in November and some lags in labour force response is likely to occur. The 1976(5)-77(7) slowdown was short and mild, fact which precludes an appropriate measured reaction thus is also excluded from the commentary.

Further comments on this issue seem unnecessary given the self-explanatory nature of the data contained in the Table. Turn now to an evaluation of the economic losses associated with the unused labour force –the *hidden* unemployed.

3. Economic Losses due to Hidden Unemployment

Estimates of the *hidden* unemployed in each low-employment period provide limited insight into the marginal losses due to this component of the unused labour force since its composition has undoubtedly varied over time.

In fact, if wages reflect the marginal contribution of each type of workers to production, the observed wide distribution of wages clearly implies that workers have a different relative importance and should not be aggregated directly. An improved mesure of the manpower loss can be obtained by calculating the total foregone output due to *hidden* unemployed as follows,

23) $MLHU_t = \Sigma^{14}_{i=1} W^i_t HU^i_t$

where W^i is the wage of the ith type of workers; HU^i the hidden unemployed and $MLHU_t$ the Manpower Loss due to the hidden unemployment in period t.

There are various advantages to using this measure of the manpower losses (MLHU); it allows for the change in composition of the *hidden* unemployed and their specific (variable) contribution to production over time, as measured by their earnings, providing a measure based on 'homogeneous' units.

To judge the importance of MLHU six low-employment periods are selected and presented in Table IV.5. For each of these periods, the Table includes estimates of the HID, its composition by sex and main age groups, the MLHU and its relative importance (RMLHU) or fraction of the output produced by the actual employed labour.[72]

The results shown in the Table provide some interesting evidence of the effects on MLHU due to the changing composition of the *hidden* unemployed. Over the whole period, it is seen that in spite of the greater number of HID, the relative importance of the losses (as measured by RMLHU) has decreased over the later periods.

The above finding is compatible with the increased share of women among the *hidden* unemployed [73] which, in turn, can be associated with the strong upward trend in participation shown by this group since the mid 1960's and its higher cyclical sensitivity. Young workers have remained an important fraction, about 20%, of the *hidden* unemployed, while adult males have become steadily a smaller fraction.

These changes in the composition of the HID provide a clear answer to the observed diminished importance of the losses in the later periods. In fact, since young and female

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[72] The RMLHU is defined as follows,

$$RMLHU_t = MLHU_t / \Sigma^{14}_{i=1} W^i_t E^i_t$$

where E^i is employed labour of the ith type, and the other variables as defined in the text.

[73] This is particularly evident in the case of adult females whose relative importance in the total of *hidden* unemployment has raised sharply.

TABLE IV.5 Hidden Unemployed Composition and Economic Losses in Low Employment Periods 1952-1980

Period	HID (000s)	Relative Composition (%)							
		MALES	Young	Adult	Older	FEMALES	Young	Adult	Older
1953-54	113.9	52.4	7.1	26.9	19.4	46.6	3.3	31.3	12.0
1957-58	104.6	59.1	15.0	34.0	10.1	40.9	28.1	12.0	1.0
1959-61	244.2	65.5	20.2	34.6	10.7	34.5	18.2	14.7	1.7
1962-63	243.1	61.8	15.6	31.7	14.4	38.2	21.2	14.2	2.8
1968-69	137.8	36.7	26.5	15.9	-	60.3	21.5	34.5	4.4
1979-80	204.4	24.6	21.1	8.1	-	75.4	18.1	55.5	1.7

Economic Loss

	MLHU (mill$)	Composition (%) Males	Composition (%) Females	Output (mill$)	Composition (%) Males	Composition (%) Females	RMLHU (%)
1953-54	255.3	69.6	30.4	25511	87.6	12.4	1.00
1957-58	237.0	74.6	25.4	34968	86.4	13.6	0.68
1959-61	592.0	75.0	25.0	59466	86.1	13.9	1.00
1962-63	779.1	80.3	19.7	47727	85.2	14.8	1.63
1968-69	477.0	55.4	44.6	82246	82.5	17.5	0.58
1979-80	2169.4	29.3	70.7	308774	74.6	25.4	0.70

Source: Appendixes D2.1 for Males and D2.2 for Females. Estimates based on individual age-sex labour groups. For Definitions see text: MLHU see 23); RMLHU see footnote 70. Note that negative estimates of hidden unemployed for some groups were excluded. Economic Loss, output and MLHU measured in current dollars.

workers have a lower marginal contribution to production (as measured by the level of their wages) the shift in composition towards them has decreased the total relative loss for the society. Thus, relatively less potential output is foregone due to the changed composition of the *hidden* unemployed than otherwise would have occurred.

3. Demographic Impact on Employment and the Labour Force

As opposed to cyclical changes, demographic changes occur only gradually, in a predictable fashion and with effects longer lasting and more difficult to remedy. Most notably, their eventual negative consequences for particular groups of the workforce would require major structural transformations in the industrial structure to provide productive employment for those in relative excess supply.

Based on the estimated models, quantification is possible for the impact of demographic changes over the labour market summary measures (the groups' employment and unemployment rates). These specific rates are likely to remain unchanged only if the structure of the demand for labour has altered synchronously with the changed labour supply structure.

The demographic sensitivity of the specific employment rates are examined first through the estimated elasticities. Next, some estimates are provided of the absolute demographic effects for selected periods in which the structure of the population has shown some important changes, i.e. turning points in the relative importance of some groups.

1. Demographic response of ER, E and LE

Following a derivation similar to taht of the preceding section, the employment rate elasticity with respect to demographic impacts can be written as follows.

Demographic Employment Rate Elasticities:

24) $\eta^{ER_i}_{RP^i} = \eta^{E_i}_{RP^i} - \eta^{L_i}_{RP^i}$

where the first right hand component corresponds to the induced employment effect stemming from the changes in relative supply of the ith type of workers and the second term is the direct demographic impact on the labour supply.

Since the first component can be reformulated in terms of the changes in employment induced by labour supply ($\xi^{E_i}_{RL^i} = \beta_4$) and the demographic elasticity of supply ($\eta^{L_i}_{RP^i} = \alpha_4$), estimates of the employment rates elasticities become,[74]

25) $\eta^{ER_i}_{RP^i} = (\beta_4 - 1)\alpha_4$.

The above expression for the ER elasticities show explicitly that the total impact of demographic changes will depend on the elasticity of the employment reaction to the available labour force (β_4 >1 or <1). Thus, if

[74] For consistency with previous sections we maintain the notation defined in equations 17') and 18') from the preceding section B.2, in this Chapter. The coefficients α's and β's are the actual estimates from regression results.

the demand for certain groups of labour is inelastic, an increased supply due to demographic changes will imply a deterioration in their relative employment position with higher unemployment rates.

Table IV.6 below presents estimates of these elasticities.[75] It also includes estimates of the changes in groups' employment rates when a 1% point change is assumed in the groups' population shares.

The results indicate that changes in relative population size have adverse consequences for the employment opportunities of the groups. This is shown by the negative sign of the employment rate elasticity across labour groups (see Table IV.6, $\eta^{ER}_{RP^i}$). The only exception is given by the youngest male group for which the high employment elasticity (β_4) offsets the negative demographic effect of changed labour supply (a_4); the size of the total effect, however, is negligible since members of this group are usually not considered normal participants in the market.

The pattern of ER elasticities suggests that those affected most by the excess relative supply are workers at the beginning of their careers (i.e. M(20-24;25-34) and F(25-34)) and males rather than females. The latter is likely to be the consequence of the greater competition and easier substitution among the jobs performed by males, plus the obvious fact that they

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[75] For complete results see Appendix B2.1 for LF and B2.2 for the Employment ratio equations.

TABLE IV.6 Demographic Impact on Employment Rates Elasticities and Absolute Changes

	Empl. Rates $\eta^{ER}_{RP}(\beta_4-1)\alpha_4$	Induced-E ξ^{E}_{L} (β_4)	L-Supply η^{L}_{RP} (α_4)	Means[a] ER_i	RP^i	ER: Absolute Changes[b] $\Delta ER_i / \Delta RP^i$
MALES						
- 20	0.039	1.120	0.322	86.1	6.6	0.505
20-24	-0.203	0.780	0.921	90.6	5.3	-3.477
25-34	-0.231	0.752	0.932	94.9	10.1	-2.171
35-44	-0.070	0.926	0.943	95.9	8.9	-0.751
45-54	-0.350	0.352	0.541	95.7	7.5	-4.436
55-64	-0.150	0.883	1.274	95.1	5.5	-2.589
65+	-0.037	0.952	0.779	96.1	5.3	-0.672
FEMALES						
- 20	-0.038	0.866	0.282	89.5	6.6	-0.518
20-24	-0.055	0.956	1.250	93.6	5.6	-0.921
25-34	-0.310	0.742	1.200	94.9	10.3	-2.858
35-44	-0.105	0.894	0.987	96.3	9.0	-1.124
45-54	-0.020	0.957	0.459*	96.6	7.5	-0.258
55-64	-0.015	0.973	0.570*	96.8	5.6	-0.259
65+	0.000	0.997	-0.038*	98.2	6.0	0.00

Source: Appendix B2.2 and B2.1. ER elasticity estimated according to 25) in text.

a Sample mean values of employment rates and population shares for the labour groups.

b Change in ERs as a consequence of a change in 1% point in group share of population.

* Estimates are not significant.

constitute the most important section of the market.

The differences of impacts by sex is also evident from the employment induced elasticities (β_*), which are lower for males than for females, since male employment is less affected by shortages in their supply (a rather constant participation behaviour) and with a more stable demand. Excess relative supply has a greater effect on those with a greater degree of permanent attachment to the market (i.e. M(20-64) and F(25-44)). For the rest, changes in their relative population size do not affect their decision to participate, which suggests the existence of suitable non-market alternatives open to them (this is particularly true among older females and is confirmed by the insignificant demographic labour force elasticities, a_*).

The sizes of the absolute impacts of demographic changes on the specific ER's confirm these comments. However, they may lead to erroneous conclusions on the relative contribution of each group to the overall demographic effect on the market since it is neither the case that all groups have experienced similar changes, nor can all of them move in the same direction simultaneously (i.e. relative changes must add up to 1).

To asses the impact of the changed demographic composition on the overall ER (and UR) and the relative contribution of each group, the next section considers selected periods in which noticeable changes in the composition of the working age population have occurred.

2. Demographic Impacts in Selected Periods

The selection of subperiods of analysis in evaluating the effects of changed composition on the overall ER (and UR) is critical in view of the fluctuations experienced by the age structure of the population as a consequence of changes in previous fertility behaviour, e.g. the Post-War Baby Boom followed by the sharp decline in fertility in the late 1950's. Up to the late 1960's the age structure of the Canadian working age population became younger,[74] as a consequence of the arrival of the Baby Boom generation.

The fertility decline that occurred afterwards, resulted in a reversal of the age structure towards an aging population, with a decreasing proportion of the younger and an increasing participation of the older workers. In other words, the relatively short 1950-1980 period shows a unique experience of swings in the population structure. These swings are responsible, in part, for the observed LF composition and the performance of the overall and specific ER's in the period. The impact of these demographic shifts on the overall ER and the contribution of each group are compared in Table IV.7, below, for the 1950-65, 1965-80, 1970-80 and the complete period.

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[74] Evidence of these changes is presented in Appendix E1.1; in particular, see the bottom line for the changed share of the Young.

TABLE IV.7 Employment Rates Variations due to Demographic Changes Selected Years

	Absolute Variations in ER[a]				Group's weighted contribution[b]			
	1950-80	1950-65	1965-80	1970-80	1950-80	1950-65	1965-80	1970-80
ER (overall)					-0.21	0.96	-1.71	-0.69
MALES					-0.09	0.67	-1.14	-0.42
- 20	0.36	0.87	1.22	0.21	0.02	0.05	0.07	0.01
20-24	-2.43	1.39	-3.82	-1.18	-0.20	0.11	-0.34	-0.10
25-34	-1.52	3.91	-5.43	-3.95	-0.24	0.75	-0.89	-0.65
35-44	0.90	0.0	0.90	0.44	0.15	0.0	-0.12	0.05
45-54	1.33	-1.33	2.66	2.71	0.18	-0.18	0.33	0.30
55-64	0.0	-0.52	-0.52	-0.05	0.0	-0.04	-0.04	-0.004
65+	-0.07	-0.20	-0.27	-0.27	-0.002	-0.01	0.0	-0.004
FEMALES					-0.12	0.29	-0.57	-0.27
- 20	-0.36	-0.78	1.14	0.33	-0.02	-0.03	0.05	0.02
20-24	-0.37	0.46	-0.83	0.16	-0.02	0.02	-0.05	0.01
25-34	0.0	6.29	-6.29	-4.17	0.0	0.33	-0.47	-0.38
35-44	-1.35	-0.45	-1.80	0.96	-0.08	-0.02	-0.11	0.06
45-54	0.0	-0.21	0.21	0.30	0.0	-0.008	0.1	0.02
55-64	-0.23	-0.03	-0.21	-0.07	-0.006	-0.001	-0.006	-0.002
65+	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Young (-24)					-0.22	0.15	-0.27	-0.06
Adult (25-54)					0.01	0.86	-1.40	-0.62
Older (55+)					-0.01	-0.05	-0.05	-0.01

a. Calculated from the observed variations in population composition, as reported in Appendix El.1, and the estimated marginal effects from Table IV.6, i.e. Abs. Var= $(\delta ER/\delta RP^i)\cdot \Delta RP^i$

b Group's ER_i absolute variations are weighted by the fraction of the total LF the group represents in the middle years of each period, e.g. 1965, 1958, 1972 and 1975 respectively.

The first sub-period, 1950-1965, can be characterized by a relative tight labour market (from the demographic point of view) where low unemployment rates are the outcome of the decreasing importance of adult male workers, an increasing number of young workers just arriving in the market and low growth of older (55+) workers. Under these favourable circumstances a whole percentage point of the prevailing overall UR can be attributed to the particular change which occurred in the workforce structure (i.e. if no compositional change in the population had occurred, the unemployment rate would have been one percentage point higher).

Over the 1965-80 period, however, the larger cohort of young workers, having grown older and become active participants in the market, begins to exert its negative influence not only on the cohort's, but also on overall, employment. Their specific ER's (ER') tend to deteriorate and the overall UR tends to increase (ER decreases). These changes are mainly explained by the higher proportion of young adult workers (see groups aged 20-34 in App. E1.1), who in turn are more prone to unemployment (see elasticities in Table IV 6 and absolute variations in ER' in Table IV.7).

The results show that in the latter period, 1965-80 (and 1970-80) the total demographic impact over the overall UR can be estimated to be 1.7 (and 0.7) percentage points. This means that if no change in population composition had occurred, the observed UR's for the period would have been 1.7 (0.7) percentage points lower.

Alternatively, if it is assumed that the *natural* unemployment rate for the whole period is on the average 4.5%, as it is customary in the literature, this assumption would prove to be inconsistent with the changed demographic structure and the implied employment policies aimed at that target would have had inflationary consequences. In this situation a reasonable target should allow for the changed demographic composition by revising the *natural* rate upwards to 6.2% for the final years of the period.

Finally, it is interesting to note that any comparison between the extreme years of the period is likely to give meaningless results for the demographic impact, since the swing in the structure would remain hidden. In fact, estimates for the complete period only attribute one fifth of a percentage point to demographic factors in the explanation of the worsening in the unemployment rate. This is obviously the effect of the observed mild demographic change if measured at the extremes of the swing.

4. Relative Wage Effects on ER, E and LF

This section examines the evidence on the impact that relative wages have had on employment and labour force participation. For the sake of homogeneity, the analysis focuses on the employment rates effect of changed relative wages and, through it, the impacts on employment and labour force participation are discussed. Then, following the conventional disaggregation, the estimated wage elasticity of the employment rates can be written as follows:

Wage Elasticity of Employment Rate:

26) $\delta^{ER_i}_{RW^i} = \beta_5 + (\beta_4 - 1)\alpha_5$

where the first right hand term measures the direct impact of wage changes on employment while the second is the indirect impact working through the supply side. Table IV.8 presents the estimated values for the main wage elasticities.

1. Changed Relative Wages and the Supply of Labour

On the supply side, the pattern of elasticity signs suggests that the *income effect* of a wage change dominates the male's decision to participate in the market. With the exception of the youngest group most of the impacts are negative or insignificant (see $\alpha_5 < 0$). Female participation behaviour, on the other hand, appears to be not only more wage responsive than that for males, but dominated by the *substitution* effect, i.e. $\alpha_5 > 0$.[77]

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[77] It should be noted, however, that these results are based

TABLE IV.8 Wage Elasticities of Employment and Labour Force

	Empl.Rates	Employment Direct Effect	Empl-induced by changes in LF	Labour Force Direct Effect
	$\delta^{ER_i}_{RW_i}$	$\delta^{E_i}_{RW_i}$ (β_5)	$(\beta_4-1)\cdot\alpha_5$	$\delta^{L_i}_{RW_i}$ (α_5)
MALES				
- 20	0.005	-0.009*	0.014	0.121
20-24	0.061	0.043*	0.018	-0.082**
25-34	-0.021	-0.055*	0.034	-0.139
35-44	0.092	0.091	0.001	-0.019*
45-54	0.215	0.223	-0.008	0.012*
55-64	-0.31	-0.025*	-0.006	0.049*
65+	-0.017	-0.021*	0.004	-0.077*
FEMALES				
- 20	-0.017	-0.008*	-0.009	0.068
20-24	-0.071	-0.063**	-0.008	0.184
25-34	0.134	0.169	-0.035	0.134*
35-44	-0.139	-0.111	-0.028	0.260*
45-54	-0.054	-0.038*	-0.016	0.373
55-64	0.043	0.051*	-0.008	0.284*
65+	-0.042	-0.042**	0.0	0.038*

Source: Appendix B2.1 and B2.2; elasticities were estimated according to 26) in text
* Denotes that basic estimated parameters are not significantly different from zero at the 95% level of confidence.
** Parameter estimates are significant only at the 90% level of confidence.

That is, improvements in relative wages make males better off and more leisure is demanded. Higher relative wages for females, on the other hand, raises the opportunity cost of their non-market activities and induce a higher participation in the labour market. This effect is particularly important among young, F(20-24), and older, F(35-54), adult females. This finding is interesting if related to the fact that both groups are likely to have weaker ties with household and childbearing responsibilities than other females. Indeed, young women are likely to be at the beginning of their careers and married life without children, while the latter group is relatively free from the intensive care required by small children. In both cases the opportunity cost of working is comparatively smaller than for the rest, thus their participation is more sensitive to changes in wages.

2. Wage Effect on Employment

On the demand side, the results for the employment equations reveal a mixed pattern of signs (see β_5), most of them insignificant. In nine out of fourteen cases the effects are negative, as expected from standard theory of demand. However, in only two cases are they significantly different from zero, at the 90% level of confidence, which is a weak evidence of support

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[7,7](cont'd)on parameter estimates that are in part insignificant. See Appendixes B2.1 and B2.2 for detailed estimates.

for the theoretical expectations.

For the remaining five cases, a positive impact of wages on employment is registered[78] and some important regularities appear. These positive impacts are highly significant only for those groups with high degree of attachment to the market and with greater human capital, experience or appropriate skills, i.e. M(35-54) and F(25-34). These strong results can be taken as evidence of the high degree of fixity in production these groups enjoy and for the simultaneity involved in the determination of employment and wages, i.e. both variables moving in the same direction is a possible outcome of competition for hiring the most experienced/skilled workers.

3. Wage Elasticity of Employment Rates

The results for the total impact over ER show that changed wages appear to have a negligible effect on most groups' ER_i's (as the first column of the Table IV.8 indicates), a finding that is not unusual given the opposing forces at work.

In half of the cases the impact is negative, that is ER's (UR's) tend to deteriorate (increase) when relative wages are increased. In spite of the sign and size of the direct effects of wage on LF participation (which are sizeable among women), the total impact of

[78] They correspond to the male groups M(20-24, 35-44, 45-54) and females F(25-34, 55-64) groups. See Table IV.8, column 2, values for the direct wage elasticity of employment, β_5.

wages on ER_i's reflects the greater importance of the direct wage employment effect (β_5) which dominates the indirect employment induced by changed supply. On the latter effect, it is interesting to note that when more workers join the market (females attracted by higher and/or some male groups drived by their lower wages) the indirect effect always acts so as to further deteriorate the ER's (increasing UR's).

On the whole the relatively low explanatory power of wages in determining employment and LF participation, shown by these results, suggests that in the aggregate the price mechanism is either not truly exogenous to these equations or only reacts slowly to disequilibrium in the market. '' Both issues are explored in the next Chapter.

Another plausible explanation posits errors in measuring the particular wage variable employed. However, since the aim of this research is to extract information from the available set of data, rather than to introduce transformations to make them agree with our *a priori* expectations (usually introducing more arbitrariness and creating other type of errors), it was decided not to introduce further corrections.

''It is likely that the wage determination process is ruled by other institutional and historical, rather than 'pure market', considerations that introduce rigidities in the relative wage structure, hence, their weak estimated effect.

5. The Impact of Other Changing Factors

The influence of other changing factors (X) over the period are examined by the reaction of the employment and LF participation variables to the time trends (T and T^2) which are included as proxies for other changing factors. Since *per se* these trends do not "explain" the groups' behaviour, only a summary of the findings is provided.

Estimates of the time trend elasticities, for the usual variables and groups, are presented in Table IV.9. Since the estimated equations allowed for non-linearities in the variable's response to time trend, the typical partial elasticity is obtained as follows:

27) $\theta^{x}_{t\,t} = (a_1 + 2a_2T_t)\,\overline{T}$

where the superscript x denotes the dependent variables $\ln REP^i$ or $\ln RLP^i$; the a's are the estimated coefficients associated with the time trends T and T^2 in each set of equations respectively, and $\overline{T}$ is the sample mean value of T.

Thus, the estimated time trend elasticity of the employment rates $\theta^{ER_i}_{t\,t}$ can be decomposed into the direct and indirect induced employment effects as usual with the trend elasticity of ER:

28) $\theta^{ER_i}_{t\,t} = \theta^{E_i}_{t\,t} + (\beta_4 - 1)\theta^{L_i}_{t\,t}$

According to the results shown in the Table IV.9, it is seen that employment opportunities for the youngest group of workers (see direct employment elasticity, $\theta^{E_i}_{t\,t}$ for M and

TABLE IV.9 Time Trend Elasticities of Employment and Labour Force

	Empl. Rates	Employment Direct Effect	Empl-induced by changes in LF	Labour Force Direct Effect
	$\theta^{ER_i}_{tt}$	$\theta^{E_i}_{tt}$	$(\beta_4 - 1)\cdot\theta^{L_i}_{tt}$	$\theta^{L_i}_{tt}$
MALES				
- 20	-0.102	-0.105	0.003	0.025
20-24	0.043	0.069*	0.112	-0.511
25-34	-0.038	-0.037	-0.001	0.004
35-44	-0.001	-0.002	0.001	-0.014
45-54	-0.042	-0.064	0.022	-0.034
55-64	-0.032	-0.039*	0.007	-0.039
65+	0.004	-0.016	0.020	-0.421
FEMALES				
- 20	-0.070	-0.058	-0.012	0.092**
20-24	-0.053	-0.047	-0.006	0.142
25-34	-0.051	0.032	-0.083	0.323
35-44	-0.025	0.011	-0.036	0.341
45-54	-0.020	-0.007	-0.013	0.295
55-64	-0.031	-0.023	-0.008	0.309
65+	0.002	0.002*	0.0	0.022

Source: Regression results reported in Appendix B2.1 and B2.2. The values of elasticities shown in this table have been multiplied by 10. Calculations based on 28) as discussed in the text.

* Basic parameter estimates are not significant at the 95% level of confidence

** Basic estimates are significant only at the 90% level of confidence.

F(<25)) have deteriorated relatively more than for the rest of labour groups. Female adults are the only groups enjoying increased direct employment opportunities over time.

On the supply side, the negative signs registered by older males reflect their well established declining trend in participation. The high elasticity value for those males aged 65+ show the increased willingness for early retirement, which, most likely, is the outcome of the extended facilities provided by the private and public pension plans and other closer substitutes developed over time, i.e. registered retirement savings plan, etc. The negative sign for young male workers, M(20-24), reflects the increased school enrollment in post-secondary institutions and hence their decreased participation.

Since male participation has, in general, declined over time, this fact has facilitated the induced male employment effect[80] which shows a positive impact on E and ER. This effect, however, has not been strong enough to offset the negative trend in direct employment creation. The net result is a deterioration in the ER_i's for all groups, with an increasing differential in the rates of unemployment between the adult males and the youngest workers.

The situation for females is the opposite; their increased participation has not been accompanied by sufficient induced employment, thus the net negative impact

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[80]See third and last columns of Table IV.9 for the trend effects on LF (θ_{t}^{Li}) and the employment induced by changed supply, respectively.

on the ERs stems mainly from the supply side. This effect reinforces the negative direct employment trend or, when positive (F(25-44)) is strong enough to offset the direct employment gains.

The overall result is that employment rates have deteriorated over time, although the process has been slow and almost negligible for some groups, particularly for older workers.

V. Changes in Earnings Structure Due to Cyclical and Demographic Factors

The traditional approach to the study of labour earnings is to search for the main determinants that explain wage differentials among individuals or groups of workers. A growing body of literature has reported considerable evidence on the importance of these determinants. Earnings differentials have been attributed to sex, age, education, training and experience, the occupational and industrial distribution of workers, and even to the distinction between the public and private sector.

From a time series perspective, however, there are few systematic studies on the time pattern followed by the age-sex earnings structure and its sensitivity to fluctuations in the level of aggregate demand for labour and the changing composition of the labour force. For the Canadian experience no evidence has been yet published in this vein.

As discussed in Chapter II (on theoretical propositions and hypotheses), there are several questions that have remained unanswered since they are mainly empirical propositions. Among them are questions such as: Who are the groups most affected by cyclical fluctuations?; Do earnings differentials widen or narrow at the peak of business cycle?; Have these differentials changed significantly over time?; Have changes in a group's relative supply had any effect on its relative productive rewards?; To what extent are the different age-sex groups substitutes or complements in productive activities?; Or, is the relative age-sex earnings structure simply inflexible, reflecting socio-institutional rigidities in the wage determination process?.

In this chapter an attempt is made to provide some evidence on these questions by exploring different models applied to the Canadian experience of the last three decades, 1950-80.

An initial examination looks at the relative importance of demand, supply and other forces in shaping the change in the age-sex structure of earnings differential over time. Next, allowance is made for their short and long run impacts on the structure of earnings by including an adjustment mechanism for relative wages, a procedure justified by the allegedly sluggish wage response due to existing market rigidities. Finally the questions of labour sustitutability is examined by assuming an underlying production function of the constant elasticity of substitution (CES) type.

A. Age-Sex Earnings Differentials Over Time

This section focusses on the time pattern followed by the inter-group earnings differentials as a consequence of changes in demand conditions (the business cycle), variations in relative supply of workers, and other slowly changing socio-economic factors over the period. The expected impacts of these variables are examined first, followed by a discussion of the model and variables required for empirical purposes. Estimation procedures and results are then discussed.

1. Earnings Differentials: Model and Influential Variables

1.1 Anticipated Effects

Since a review of arguments, on the expected impacts that various factors have on wage and earnings differentials, has already been done in previous Chapters, i.e. Chs. II.C and IV.B.1.2, only a brief summary of the anticipated effects of these variables on wage differentials follows.

On the impact of cyclical fluctuations in economic activity, it has been argued that in expansionary phases the earnings differentials can be expected to narrow due to the pressure on wages exerted by the increased demand for all types of labour. This outcome, however, cannot be guaranteed for all age-sex groups in the labour force given their non-homogeneous character. Thus differentials might well decline for those more essential workers in production (skilled/experienced), remain unchanged, or even increase for those less qualified, i.e. young-inexperienced, for example[81] -for a review of arguments see Gunderson (1976, 61). Thus, the cyclical effects on every group's earnings differential cannot be signed with certainty, *a priori*.

The effect of variations in the cohort's supply on earnings differentials can be described by the *crowding* hypothesis. (Wachter (1977) and Welch (1979)). In its simplest form this hypothesis states that a relative abundance of a particular type of worker lowers his marginal productivity and hence his earnings; thereby, his earnings differential vis-a-vis others tends to increase.[82]

In a time series context, however, there may exist some other factors working against this result such as, minimum wage legislation, a reduced degree of discrimination due to improved information, higher levels of qualifications and skills reached through education, etc. All these factors have exerted a pressure to narrow the differentials which in part might offset the effect of relative excess supply of any type of worker.

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[81]For the latter effect to occur it suffices that increased labour demand improve the earnings of the most qualified relatively more than those of less skilled workers.
[82]This is the normal expected outcome in any simple demand and supply static analysis. It was early suggested by Fawcet (1918) and Edgeworth (1922) in discussing the male-female wage differential. Lately, it has been used as explanation in a demographic context by Easterlin (1980), Wachter (1979) and Welch (1979), among others.

1.2 Basic Model of Earnings Differentials

A general function that incorporates the variables of interest (considered above) is given by:

Earnings Differential Function:

1) $DW_t^{i0} = d^i(BC_t, S_t^{i0}, O_t)$

where DW^{i0} and S^{i0} are some measures of the ith labour group earnings differential and relative supply with respect to a reference group 0. BC and O proxy variables for the state of labour demand and the influence of other factors, respectively. d^i symbolizes the functional form appropriate to the ith group.

Since the selection of a basic group of reference is required, a composite group based on adult male ~~workers~~ M(35-44; 45-54) was chosen. This decision is justified by the strong attachment to the market these workers show, with transitory changes in economic and demographic forces affecting their relative position only marginally.[13] Thus, the composite earnings of the basic group are defined as follows:

Basic Group's Earnings:

2) $W_t^0 = W_t^{m4}\omega_{1t} + W_t^{m5}(1 - \omega_{1t})$

a weighted average of the adult males' earnings, M(4=35-44; 5=45-54), with weights given by the proportion of employed

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[13]The findings reported in the preceding chapter provide evidence on the stability of their supply and demand to changed market conditions, i.e. their participation, employment and relative earnings ~~show the~~ least variability over the period if compared to the other labour groups.

workers over the total, i.e. $\omega_{1t} = E^{m4}_t/(E^{m4} + E^{m5})_t$ with E_t being the number of employed workers in period t.

The size of the LF for the composite reference group is derived in a similar fashion,

Basic Group's LF:

3) $L^o_t = L^{m4}_t\omega_{2t} + L^{m5}_t(1 - \omega_{2t})$

with weights given by the fraction of total earnings, which recognizes their differential contribution to production if earnings do in fact reflect their marginal productivities, i.e. $\omega_{2t} = W_t^{m4}/(W^{m4} + W_{m5})_t$, with W_t the average earnings of each group in period t.

1.3 Definition of Variables

The specific content and form of the general function 1) requires some comments since neither theory nor previous empirical work provide definitive guidance about it.

As a measure of the group's earnings differential the dependent variable is defined, as in Gunderson (1974), by the fraction of earnings represented by each age-sex differential,

4) $DW^{io}_t = (W^o - W^i)/W^i_t$ with i=1,..,14

For the influence of other factors, O, and business cycle, BC, the time trend, T, and the employment to population ratio, EPR, are selected as proxies for reasons identical to those discussed in the previous chapter.

As a proxy for the group's relative supply variable, S^{io}, the ratio of the respective groups LF is selected, i.e. $L_t^{io} = L_t^i/L_t^o$, as a determinant of wage differentials. On this choice it can be argued that, though it is true by definition that earnings are only related to those actually employed, the relative earnings determination process and its change over time cannot be thought to be independent of the group's relative excess supply at any moment t. That is, for a given level of employment, the existence of a higher relative unemployment for the ith group would exert downward pressure on its earnings level, inducing a slower rate of change in their earnings than otherwise would have been the case.

Hence, the relevant determinant of the earnings determination process is the whole group's LF size rather than only the actual level of employment; thereby the choice of L^{io} seems to be well justified.

2. Earnings Differentials: Estimation

2.1 Functional Form

On the choice of the functional form adopted by equation 1), preliminary observation of the relationship among the variables over time leads to the conclusion that a curvilinear rather than a linear relationship exists. The search was then narrowed to two competing alternatives: semilog and log-linear forms. Both were estimated and the results compared.

The general function 1) can now be specified as follows:

5) $DW_t^{io} = \gamma_0 + \gamma_1 T_t + \gamma_2 \ln EPR_t + \gamma_3 \ln L_t^{io} + \omega_t$

with the dependent variable DW^{io} defined either as in 4) or by its logarithmic expression. The remaining variables are as defined in the text above.

In order to distinguish the "pure" demographic from changes in a group's "behaviour", a further modification to 5) was introduced by disaggregating the relative supply variable, L^{io} into the population ratio, P^{io} and participation rates ratio, PR^{io}. This distinction seems necessary in the chosen context, especially in view of the different pattern followed by the group's participation rates and respective population shares.[14] Therefore, the final equation to be estimated has the following form,

6) $DW_t^{io} = \gamma_0 + \gamma_1 T_t + \gamma_2 \ln EPR_t + \gamma_3 \ln P_t^{io} + \gamma_4 \ln PR_t^{io} + \omega_t$

2.2 Estimation Procedures

Estimation of both functional forms (semilog and log-linear) was done using the OLSQ technique. A comparison of estimated coefficients suggests that

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[14] In fact, participation rates have experienced great variability for some groups, particularly for young and females, while population shares have changed in a more smooth and predictable manner. Evidence of these changes are reported in Chapter III.

results are essentially the same in terms of size[85] and direction of impacts. However, judging from the estimated R^2 values and significance of the coefficients across groups, the evidence indicates that the log-linear specification can be considered a marginally better aproximation. Hence further comments are based on the log-linear model and complete results are reported in Appendix F1.1.

The results show that a satisfactory level of explanation is obtained for seven out of the twelve labour groups. The R^2 values suggest that 60% or more of the total variation in earnings is explained by the estimated equations.[86] The low values of the DW statistic, in eight out of twelve cases, suggest the presence of significant positive autocorrelation of residuals.[87]

In view of the evidence on autocorrelation, the complete set of equations was re-estimated so as to correct for this problem and improve the efficiency of

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[85] The comparison was done in similar units, i.e. the DW[10] response to main explanatory variables expressed in terms of elasticities or absolute effects.

[86] A poor explanation is obtained for the older male groups, M(55-64; 65+), and female groups, F(20-24; 35-44; 55-64).

[87] Autocorrelation might be due to omitted variables, independent of the variables already included, whose influence is captured by residuals. This issue is explored in the next section. It should be noted that in presence of autocorrelation OLSQ estimates remain unbiased but not their standard errors. Thus, tests of significance based on the t-statistic are no longer valid. This is so because the OLSQ estimated variance of errors (in which these tests are based) is known to be greater.

the estimates.[24] The results are reported in Appendix F1.2. As expected, the estimates remain essentially unchanged and their significance is altered only in those cases in which the DW statistic detected significant autocorrelation. The values and significance of the estimated autocorrelation coefficient, ρ, confirm the validity of the correction procedure employed.

3. Earnings Differentials: Results

3.1 Cyclical Effects

In periods of economic expansion, the cyclical variable shows that a significant reduction in the differentials of M(20-24; 55-64) and F(35-44) occur. These groups are well attached to the market, with characteristics close to those of the basic group. Therefore, they can be considered close *complements* in production. The highest relative gain in earnings corresponds to the M(55-64) group, with about 8% reduction in the differential as a consequence of an increase of 1% in EPR.[25]

On the other extreme, the youngest group (<20) suffers a relative deterioration in its earnings (the differential increase by 4% for males and 5% for

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[24] It was assumed that residuals followed a first order autocorrelation pattern and the maximum likelihood technique AR1, TSP program, was employed.
[25] Note that estimated coefficients for the main explanatory variables can be directly interpreted as elasticities, given the log-linear model's form.

females). This means that in a tight labour market, earnings of the youngest workers grow less than those of the more experienced/skilled basic group, which is possibly a consequence of rigid minimum wage legislation. Indeed, young inexperienced workers are likely to be paid the minimum wage, a minimum that is not changed according to temporary market conditions; hence, in periods of expansion their earnings do not adjust upwards and a relative deterioration occurs, while in recessionary periods they are more protected and wages cannot be further lowered thereby its earnings differential is reduced. For the remaining groups a mixed pattern of signs is observed, but since they are insignificant no strong conclusions can be drawn.

If considered by sex, the results suggest that the relative earnings position of females improves less (greater deterioration) than that of males over the business cycle.

3.2 Changes in the Relative Supply of Workers

On the supply side, the "pure" demographic effect has, as expected, a direct and significant positive impact on the earnings differential of most groups, giving support to the *overcrowding* hypothesis. That is, an increased relative cohort size has a depressive effect on the cohort's earnings, thereby increasing the cohort's earnings differential.[9]

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[9] There are only two significant exceptions to this result,

The impact of a group's "behaviour" variable, the ratio of participation rates (PR'[9]), is insignificant in eight out of twelve cases. In the significant cases, increased participation tends to decrease the wage differential for the young groups (M(<20; 20-24) and F(<20)), and increases it for the older male group M(55-64). On the one hand these results are weakly inconsistent with the *overcrowding* hypothesis and seem unreliable. On the other hand, they might be considered as a support for Becker's (1971, 16) and Zellner's (1972, 158) arguments on the issue of discrimination. These authors have pointed out that the effect of greater participation generates a rightward shift in the demand curve for these groups since prejudice against minority groups tends to disappear with their increased presence and better knowledge of them in the market. Both effects are likely to coexist in reality, which in this case only means that in spite of the downward pressure exerted on wages by the increased number of workers (overcrowding effect), their presence in the market has helped to reduce the degree of ignorance

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[9] (cont'd) they are M(65+) and F(25-34). The result for the former group can be by-passed since the estimated equation provides a poor explanation, suggesting that other omitted factors are likely to play a major role in the determination of their earnings (pensions, savings funds or even return from investments rather than income from wages and salaries). The odd result for females is rather puzzling given that it cannot ~~be~~ attributed to problems of simultaneity in the determination of earnings and demographic composition of the population since the latter variable is clearly exogenously pre-determined.

regarding their productive capabilities, and a net upward adjustment of their wages has occurred as a consequence.[11]

The generally insignificant results for the participation variable, however, seems to suggest that the PR[10]'s are not truly exogenous to the earnings equations, but rather are simultaneously determined in a more general system, i.e. earnings affected negatively by participation and participation reacts positively to earnings changes, as the reported results for females in the previous chapter suggest. Thus, these estimated values should be considered with caution and no clear interpretation should be attached to them.

3.3 Other Determinants

For the sake of completeness, a word on the trend of each group's differential is in order. A relatively significant deterioration in the earnings position of young workers (<25) and older males M(55-64) is observed over time. Earnings differentials for older women, F(55-64; 65+), have been reduced. For the remaining groups the evidence is not strong enough to provide an indication of a clear trend, thus differentials can be regarded as remaining unchanged.

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[11] Regardless of the insignificance of the estimated effects, this is clearly the case for most female groups where earnings differentials decrease with increased participation.

Since, in general, the results are not completely satisfactory, the next section explores another alternative commonly mentioned in the literature, namely, that the earnings structure is relatively fixed and changes slowly over time in response to various market imperfections. A model of imperfect earnings adjustment is discussed and results compared to those obtained in this section.

B. Earnings Differentials and Market Rigidities

The existence of various institutional rigidities in the market,[92] as well as employers' recognition lags in adjusting their demand for labour to changed market conditions, may have different effects on the speed of earnings adjustment for the various labour groups.

This section formalizes a model of earnings differentials under imperfect conditions that allows groups' earnings levels and differentials to react in a less than instantaneous to actual market changes. Its results are then compared to the basic estimates of the previous section.

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[92] On this issue a growing body of literature and empirical work exist. Among other factors, these studies have focussed on the impact of minimum wage legislation, strength and development of unions, equal pay legislation, seniority rules, etc. A summary review of these factors and the impact on the labour market can be found in Gunderson (1980).

1. A Model of Imperfect Earnings Adjustment

A reformulation of the general model of earnings differentials, given by 1), can be accomplished by recognizing the existence of rigidities in the market that allow only partial adjustments in the earnings structure in response to changed market conditions.

In the presence of a positive excess supply of labour (unemployment) it is not unreasonable to assume that earnings are determined mainly by the demand side. Under this assumption, employers can be viewed as planning the variations of earnings, adjusting them to *desired* or target levels according to changes occurring in the market as they perceive it. Hence, the earnings differential equation in 1) can be stated as,

7) $^{+}DW_t^{io} = f^{i}\,(BC_t, S_t^{io}, O_t)$

the superscript $^{+}$ denoting the *desired* earnings differential sought by employers according to their perception of market conditions.

The actual observed changes in earnings differential, however, reflects only a fraction of the *desired* or target change since employers are impeded from adjusting earnings instantaneously given the rigidities they face. This behaviour can be represented by a partial adjustment mechanism of the form:

Actual Earnings Variations:

8) $\Delta DW_t^{io} = DW_t^{io} - DW_{t-1}^{io} = \delta^{i}\,(^{+}DW_t^{io} - DW_{t-1}^{io})$

where the coefficient $0 < \delta^{i} \leqslant 1$ is the speed of adjustment of the ith group's relative earnings to the target level.

Combining 7) and 8), the basic equation 6) can be re-written in terms of observable variables as follows:

Actual Earnings Differential Equation:

9) $DW^{i\circ}_t = \mu_0 + \mu_1 T_t + \mu_2 \ln EPR_t + \mu_3 \ln P^{i\circ}_t + \mu_4 \ln PR^{i\circ}_t + \mu_5 DW^{i\circ}_{t-1} + \omega_t$

estimates of the μ's coefficients measure the short run impact of the variables; $\mu_5 = 1- \delta^i$ provides a direct estimate for the ith group's speed of adjustment coefficient; the long run impact of independent variables on the target differential is given by ${}^*\mu_j=\mu_j/(1-\mu_5)$, $j=0,\ldots, 4$.

Compared to the basic specification in 6), the partial adjustment model 9) (when estimated) has the additional advantage of providing direct evidence on the extent to which earnings of the different groups are affected by the existing rigidities. This result has an interest *per se*, since it helps policy makers to identify segments of the labour market that require close examination if obstacles to a more flexible price system are to be removed.

2. Results: Imperfect Adjustment Model

Equation 9) was estimated by the OLSQ technique and results are reported in Appendix F1.3.[13] On the whole these results are more satisfactory than those discussed in the previous section, with higher levels of explanation attained for most groups and a pattern of effects which accords better with *a priori* expectations. The evidence of no autocorrelation of residuals gives further support to this specification.[14] Both results confirm that changes in the earnings structure occur slowly due to institutional and market imperfections.

2.1 Comparisons of Estimates: Elasticities

In order to allow comparisons of estimates from both models (i.e. equations 9) and 6) corrected for autocorrelation) and to facilitate comments on the results, earnings differential elasticities with respect to the main explanatory variables are summarized in Table V.1. Estimates of the short and long run elasticities together with the speed of adjustment coefficient for the partial adjustment model 9) are also included.

It is evident from the Table that estimates from equation 6) are similar in size to the long run

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[13] Again, only the log-linear specification was reported since it proved to be marginally superior to its competing alternative, the semi-log.

[14] The high significance of the lagged dependent variable, in ten out of twelve cases, suggest that detection of autocorrelation in previous model was due to the omission of this variable.

TABLE V-1 Earnings Differential Elasticities: Comparison of Estimates from Basic and Partial Adjustment Models

	Basic Model (equation 6))			Partial Adjustment Model (equation 9)).						
	Short-run Elasticities			Short-run Elasticities			Long-run Elasticities			Adjustment Coeff.
	EPR	P10	PR10	EPR	P10	PR10	EPR	P10	PR10	
	(γ_2)	(γ_3)	(γ_4)	(μ_2)	(μ_3)	(μ_4)	(μ_2^ℓ)	(μ_3^ℓ)	(μ_4^ℓ)	(δ^1)
Males										
- 20	3.6a	-0.6	-2.1	2.5b	-0.6b	-1.5	3.9	-0.9	-2.4	0.65
20-24	-1.5	1.2	-2.5	-1.4	1.3	-3.0	-1.4	1.3	-3.0	1.26c
25-34	0.7a	0.5b	-3.1a	0.6a	0.5	-2.9a	0.6a	0.5	-2.9a	1.01c
55-64	-7.9b	10.4	17.0	-6.6b	4.7a	11.4	-11.0	7.8	19.9	0.60
65 +	1.4a	-7.9	-1.0a	-0.8a	-5.7	-0.9a	1.2	-9.3	-1.5	0.61
Females										
- 20	5.0	0.1a	-2.5	3.7	0.1a	2.0	4.9	0.1	-2.6	0.76
20-24	-1.2b	0.6	-0.2	-1.7	0.4	0.4a	-2.8	0.7	0.6	0.60
25-34	0.4a	-1.4	0.4a	-0.5a	-1.0	0.9	-1.4	-2.8	2.5	0.36
35-44	-0.8b	0.1a	-0.2a	-0.8	0.3a	0.2a	-9.3	3.9	2.3	0.08
45-54	-0.2a	1.9	-0.1a	-0.0a	1.0	0.1a	-0.1	2.3	0.3	0.44
55-64	0.0a	0.6a	0.0a	1.1	0.5a	0.1a	-6.5	2.9	0.4	0.17
65 +	-0.9a	2.3a	0.5a	1.6a	1.8a	0.3a	-2.0	2.2	0.4	0.82

Source: Estimates from Appendices F1.2 and F1.3. Long-run effects are derived from short-run estimates and adjustment coefficient as explained in the text

a: Value of elasticity is based on estimate that is insignificant at the 95% level of confidence.

b: Basic estimates are significant only at the 90% level of confidence.

c: Estimates not different from unity at the 95% level of confidence. A value of 1 for the adjustment coefficient was assumed in estimating long-run effects.

estimates derived from the partial adjustment model. Hence, if used for prediction, they would tend to overstate the short run impact of the independent variables on the structure of earnings differentials. Indeed, short run estimates from the partial adjustment model are more moderate, indicating that earnings differentials are rather inflexible to current changes in market conditions. Detailed comments on the effect of each variable follow.

2.2 Determinants of Earnings Differentials

2.2.1 Business Cycles and Differentials

Earnings differentials behave, in general, in a countercyclical fashion; that is, during the business cycle peak the differential decreases for all groups, except the youngest whose relative earnings position deteriorates. This finding is consistent with the impact of minimum wage legislation, already discussed in the previous section.

The groups which benefit most from a tight labour market are the older, experienced, male workers (M(55-64)), followed by those at the beginning of their careers (young workers aged 20-24, and adult females F(35-44; 55-64)). Those groups well attached to the market and presumably at a mid-career stage are the most protected against economic fluctuations and their earnings differentials remain unchanged (see M(25-34) and F(25-34; 45-54)). The relative earnings position of the oldest segment of workers (65+) experience an insignificant improvement in the upswing of the business cycle.

2.2.2 The Supply of Labour and Earnings Differentials

Supply side effects on earnings differentials have, in general, the sign predicted by the *overcrowding* hypothesis. The "pure" demographic component (P'^{o}) provides evidence that increases in relative cohort size tend to result in a deterioration in the earnings position of the relevant cohort.[15]

The behavioural component given by the ratio of participation rates (PR'^{o}) shows a clear pattern of positive impacts, though some of them are insignificant, implying that the increased participation of certain groups tends to worsen their earnings position. The three significant exceptions to this pattern are again given by the youngest group of workers. What remains unclear is whether this odd result is the consequence of the observed higher educational levels attained by these groups compared to older cohorts of workers, which make them more trainable and adaptable to perform productive tasks, or simply the effect of minimum wages whose rigidity offsets the the downward pressure on earnings exerted by their increased participation.

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[15] The significant exceptions are given, again, by the oldest male group (65+) and women aged (25-34).

2.2.3 Flexibility of Earnings

The estimates for the speed of adjustment coefficient for earnings reveal that the wages of males are more flexible than those of females (see δ', last column Table V.1), a result that accords well with the usual "primary" role assigned to males in production.

For workers of the same sex, great variability by age is observed for the speed of adjustment coefficient. Among males, the adjustment of young adult workers' earnings, M(20-34), is rather instantaneous, i.e. δ''s are not significant different from unity, while for the older and youngest groups only about three fifths of the employers' desired adjustment can be accomplished in any period. These estimates reflect the degree of rigidities each group faces. Older workers are likely to enjoy seniority benefits and earnings which are based on historical performance and are difficult to be altered when firms foresee changes in the market. Earnings of the youngest workers are dictated mainly by institutional factors, i.e legislation on minimum wages. Young adult workers, on the other hand, are relatively unprotected since they are at the beginning of their career ladder, thus their wages become more flexible.

For females the pattern of earnings flexibility has the inverse shape of that for males, being more flexible at the extremes and almost completely rigid for the middle aged groups, F(35-44). This particular result is interesting if connected to the opportunity cost they face at different ages as a determinant of their labour supply. In fact, for younger and older women the opportunity cost of working is almost nonexistent since they have few household responsibilities, thus their supply of labour is relatively inelastic. Perceived changes in market conditions allow employers to adjust their earnings more easily to the desired levels.

The supply of labour from prime aged women, however, is elastic only at the reservation wage, its level being determined by the higher opportunity cost they face (given their household and chilbearing responsibilities). The existence of this floor, at which this group's supply of labour approaches perfect elasticity, imposes an additional constraint on employers which ~~impedes~~ variations in these women's earnings as a consequence of changed market conditions. The observed slow speed of adjustment of their earnings can then be rationalized as due to rigidities stemming mainly from the supply side.

C. Relative Earnings and Labour Substitution

The preceeding section provided evidence on the pattern followed by the groups' earnings differential in response to fluctuations in the demand and supply of labour. In this section the question is addressed as to how the relative earnings of a cohort of workers have been altered as a consequence of its changed size. Answering this question requires an examination of the degree of substitutability among different types of labour. The more imperfect substitutes that workers are for each other, the greater can be the expected effect of own cohort size on earnings.

First, a brief review of a theoretical framework for the empirical aim of this section is undertaken; next, models and results are discussed.

1. Labour Substitution and Production Functions

An appropriate concept to be used in quantifying this problem is the elasticity of complementarity (Hicks (1970)) rather than the Allen elasticity of substitution.[96] The Hicks' elasticity of complementarity provides a measure of how sensitive factor prices are to changes in relative factor quantities. This, in turn, means that factor quantities are exogenously determined and labour is demanded within the production function approach (Hammermesh and Grant (1979)).[97]

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[96] On the relationship between both elasticities see Sato and Koizumi (1973) and for a discussion of empirical estimates of the elasticity of substitution see Berndt and Christensen (1976).

[97] As Hammermesh and Grant (1979) have emphasized, only when prices can be considered exogenous and quantities endogenously determined is a cost function approach justified. Otherwise, a production function must clearly be made explicit.

In the case of this study it can be argued that the sizes of the age-sex cohorts of workers are exogenously predetermined by past demographic conditions. This being the case, the demand for labour becomes a wage determination schedule linking factor prices to factor quantities.[98]

A summary review of the concept of elasticity of complementarity is undertaken next, followed by a discussion on the underlying production function suitable for empirical purposes.

1.1 Elasticity of Complementarity

Consider a constant return to scale (CRS) production function given by,

10) $y = f(x_1, \ldots\ldots, x_n)$

where y denotes output and x input amounts.

The elasticity of complementarity between any pair of inputs, i and j, can be defined as,

11) $C_{ij} = (1/a_j)(\delta \ln f_i / \delta \ln x_j) = (1/a_i)(\delta \ln f_j / \delta \ln x_i) = C_{ji}$

where the a's are the input shares in total cost; $(\delta \ln f_i / \delta \ln x_j)$ is the proportional change in the marginal product of the ith input when the quantity of the jth factor is altered, with other input quantities held constant but output allowed to vary. C_{ij} stands for the elasticity

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[98] Similar arguments justifying this decision are common in the literature when the issue of labour substitution is the central question to be examined. A summary of earlier studies can be found in Hammermesh (1976) and Hammermesh and Grant (1979).

of complementarity between the ith and jth inputs.

Under the assumption that inputs are paid according to their marginal contribution to production, 11) becomes,

12) $C_{ij} = (1/a_j)(\delta \ln W_i / \delta \ln x_j)$

Furthermore, since for a CRS production function $\Sigma_j^n a_j C_{ij} = 0$ must be satisfied, the own elasticity of complementarity C_{ii} is negative for normal production functions and defined by,

13) $C_{ii} = -\Sigma_{j \neq i}^n (a_j/a_i)C_{ij}$

When all inputs are allowed to vary (over time) the impact on the ith input price can be written as:

14) $\delta \ln W_i = \Sigma_{j \neq i}^n a_j C_{ij} \delta \ln x_j + a_i C_{ii} \delta \ln x_i$

or, after replacing 13) in 14),

14') $\delta \ln W_i = \Sigma_{j \neq i}^n a_j C_{ij} (\delta \ln x_j - \delta \ln x_i)$

Moreover, changes in relative prices of any pair of factors, say i and k, can be readily expressed as follows:

15) $\delta(\ln W_i / \delta \ln W_k) = \Sigma_{j \neq i \neq k}^n a_j (C_{ij} - C_{kj}) \delta \ln x_j + a_i (C_{ii} - C_{ki}) \delta \ln x_i + a_k (C_{ik} - C_{kk}) \delta \ln x_k$

If *separability* among inputs holds, i.e. changes in inputs other than i and k do not affect the ratio of their marginal productivities, then, the relative wage determination schedule collapses to the following simple expression,

16) $\delta(\ln W_i / \delta \ln W_k) = -(1/S_{ik}) \delta \ln (x_i / x_k)$

where $S_{ik} > 0$ is the Allen elasticity of substitution between inputs i and k.

which can be shown to correspond to a production function of the CES type.''

1.2 Production Functions

On the choice of the underlying technology the popular alternatives include production functions of the Cobb-Douglas (CD) and CES type or other members of the flexible forms family, such as, the translog function.''' For the empirical purposes of this section, however, only functions of the last two types are suitable.

The CD is inadequate since it restricts all Allen partial elasticities of substitution to be equal to one. The CES is more general in the sense that allows for different elasticity values, though they are unnecessarily restricted to be constant and equal for any pair of inputs; both functions assume that strong separability holds. The translog, on the other hand,

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'' A typical CES production function is given by,
i) $y = A(ax_i^{-n}+(1-a)x_k^{-n})^{-1/n}$
with $A>0$ and $0<a<1$. It has a marginal rate of substitution (RTS) given by,
ii) $RTS=(\delta y/\delta x_i)/(\delta y/\delta x_k)=(a/(1-a))(x_k/x_i)^{1+n}= b_0(x_i/x_k)^{-(n+1)}$
and associated partial elasticity of substitution $S_{ik}=1/(1+n)$. If inputs are paid according to their marginal productivity (RTS equals the input price ratio) the relative wage determination schedule 16) is obtained,
iii) $RTS=W_i/W_k= b_0(x_i/x_k)^{-1/S_{ik}}$
whose equivalent in log terms is
iv) $\ln(W_i/W_k)=b_0 + b_1\ln(x_i/x_k)$, with $b_0 = \ln(a/(1-a))$ and $b_1 = -1/S_{ik}$

'''This form is a more recent development due to Christensen, Jorgenson and Lau (1971). For an empirical application in testing aggregation of labour groups see Berndt and Christensen (1974).

neither restricts the elasticity values at any point of the input space nor assumes strong separability. Its flexibility has made the use of the translog very attractive for empirical purposes. This function, however, suffers from the practical limitation of being unable to handle large numbers of inputs because its estimation becomes cumbersome[8] and its use becomes feasible only at the expense of higher level of input aggregation.

In spite of its limitations, the CES has the advantage of simplicity, and more important yet, permits a detailed analysis for the various age-sex labour inputs of interest in this research plus the inclusion of additional variables in an straightforward fashion (when time is allowed to vary).

2. Relative Earnings: Model

2.1 Model and Variables

Following the discussion in the section above, the CES production function approach is adopted in defining the specific form of the relative earnings equation to be estimated. The earnings behaviour of the various groups is related to a basic group, adult-male workers aged 35-54 years, given that these workers, in addition

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[8] In fact for each n independent explanatory variables included in the equation, it is necessary to estimate n^2 parameters if no restrictions are placed *a priori*. If symmetry is imposed, the number of parameter estimates reduces to only $(n^2+n)/2$.

to being essential in the production process (they are highly complementary to capital), have demonstrated stable employment and strong and stable participation characteristics.

To control for the possibility that changes in relative earnings are due to cyclical or other long term influences rather than demographic, proxies for these variables were added to the specification. Thus, the equation to be estimated becomes,

$$17)\ \ln(W_i/W_0)_t = \gamma_0 + \gamma_1 \ln(L_i/L_0)_t + \gamma_2 T_t + \gamma_3 \ln EPR_t + \epsilon_t$$

where W's are earnings from wages and salaries; L is labour force; EPR the employment to population ratio and T is a time trend. The subscripts i and 0 refer to the 12 age-sex labour groups and the basic adult male group, respectively.[102]

Estimation of 17) employed the OLSQ technique and the results are presented in Appendix F2.1. The presence of autocorrelation (see low values for the DW's statistics) justified re-estimation[103] of 17). Appendix F2.2 presents the results for all groups. Since the presence of

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[102] All variables have been previously defined and justified in this and previous chapters

[103] It was assumed residuals followed a first order autocorrelation scheme and estimation was carried by the AR1 option from the TSP package.

autocorrelation can also be considered a proof of misspecification, equation 17) was redefined to take into account the relatively slow changes experienced by the earnings structure. The final form of the equation is given by,

$$18)\ \ln(W_1/W_0)_t = \gamma_0 + \gamma_1 \ln(L_1/L_0)_t + \gamma_2 T_t + \gamma_3 \ln EPR_t + \gamma_4 \ln(W_1/W_0)_{t-1} + e_t$$

The rationality of this final form can be justified either by the existence of rigidities, as defined by the partial adjustment model of the previous section, or by the fact that actual relative earnings not only reflect current changes in supply and demand, but also past changes in these variables. A distributed lag model can be applied, in consequence, and 18) is the result of applying a Koyck (1954) transformation.[104]

It should be noted that the interpretation of the coefficient of the lagged dependent variable in this formulation $\gamma_4=\lambda$ is not contradictory with the coefficient, $\mu_5=(1-\delta)$, from the partial adjustment model which measures the speed of adjustment for earnings, δ.[105]

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[104] If current relative earnings, y_t, depend on current and past values of the explanatory variables X, the model can be written as,
i) $y_t = \beta_0 X_t + \ldots\ldots\ldots + \beta_k X_{t-k} + e_t$
Thus, if impacts of past changes can be assumed to decline geometrically, i.e. $\beta_1=\lambda\beta_0$, $\beta_2=\lambda^2\beta_0$, ..., with $0<\lambda<1$, i) can be stated as,
ii) $y_t=\beta_0 X_t+\lambda\beta_0 X_{t-1}+\lambda^2\beta_0 X_{t-2}+\ldots\ldots+\lambda^k\beta_0 X_{t-k}+e_t$ and substracting λy_{t-1} from ii) yields the formulation above, i.e. iii) $y_t=\beta_0 X_t+\lambda\, y_{t-1}+\phi_t$. This is the transformation suggested by Koyck (1954).

[105] In fact, small values of λ mean that relative earnings respond to changed market conditions with a short lag. This is only possible if δ is large enough, suggesting that no

The estimated results for equation 18) are presented in Appendix F2.3.

3. Relative Earnings: Estimated Results

The results obtained for the specification 18) are more satisfactory than those for the basic equation 17), with a higher level of explanation (R^2) reached, an absence of autocorrelation and significant parameter estimates for the included lagged endogenous variable.

To facilitate comparisons between the alternative models and be able to draw general conclusions on the effects of the main variables on the structure of relative earnings, the following Table summarizes the cyclical and demographic elasticities of relative earnings. These estimates are derived from the basic and lagged models. Comments on the effects of these variables on each group's relative earnings are considered next.

3.1 Cyclical Effects on Group Earnings

In expansionary stages of the business cycle, the relative earnings of the oldest male workers, M(55+), and young females, F(20-24), improve more than any other group; they are followed by adult females, F(35-44), and young males, M(20-24). These results suggest that in a tight labour market the demand for those more experienced (M(55+) and F(35-44)) is likely to be

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'''(cont'd)rigidities exist to impede the earnings adjustment process to the *desired* levels.

TABLE V.2 Relative Earnings: Cyclical and Relative Cohort Size Elasticities
Comparison of Estimates from Basic and Lagged Models

	Cyclical (EPR) OLSQ s-run (γ_3)	Cyclical (EPR) Lagged Model s-run (γ_3)	Cyclical (EPR) Lagged Model l-run (γ_3)	Relative Cohort Size (RP10) OLSQ s-run (γ_1)	Relative Cohort Size (RP10) Lagged Model s-run (γ_1)	Relative Cohort Size (RP10) Lagged Model l-run (γ_1)	Lag Coeff. (λ)
Males							
- 20	-1.68	-0.97	-1.92	1.43	0.93	1.84	0.50
20-24	0.54a	0.31a	0.50	-0.33b	-0.15a	-0.25	0.37
25-34	-0.12b	-0.13	-0.13	-0.07	-0.08	-0.08	0.0a
55-64	-1.03	0.75	1.95	-0.90	-0.34b	-0.87	0.62
65 +	0.90	1.00	4.21	-0.06a	0.04a	0.15	0.76
Females							
- 20	-1.41b	-0.38a	-0.69	1.59	0.97	1.79	0.46
20-24	1.07	1.[illegible]	1.93	-0.26b	-0.22b	-0.41	0.45
25-34	0.87	0.29a	1.48	0.40	0.06a	0.29	0.80
35-44	0.91	0.48	7.43	0.48	-0.08a	-1.29	0.93
45-54	0.51	0.12a	0.64	-0.53	-0.14a	-0.80	0.82
55-64	0.55	0.40b	2.07	-0.14a	0.01a	0.04	0.81
65 +	0.34a	0.41a	0.58	-0.10a	-0.04a	-0.05	0.29

[illegible] from Appendices F2.1 and F2.3. Long-run effects are derived [illegible] and the coefficient of the lagged dependent variable, [illegible] the text.
[illegible] based on estimate that is insignificant at the 95% [illegible] only at the 80% level of confidence.

increased first, exerting a higher upward pressure on their wages. Young inexperienced workers experience increased employment opportunities and hence greater rewards.

The greatest deterioration over the peak of the business cycle is registered for the youngest group (<20), followed by the young adult group (25-34). The result for the youngest group is not surprising if their strong procyclical participation behaviour and rigidities imposed by minimum wages are taken into account. The combined effects of these factors explain the relative deterioration of this group's earnings.

Some of the above estimates become insignificant, particularly those for women, when the lagged model is considered. This is consistent with the observed longer lags, or higher degree of rigidities, affecting the [illegible] of these groups.

Cohort Size Effects and Complementarity

As the results for most age sex groups show, increases in a cohort's relative size worsens relative earnings. The only significant exception is given by the youngest workers group, for whom increased size has no negative effect on their relative earnings position. On the contrary, according to the estimates, the larger their numbers the better their relative position becomes. Again, this result might well find an explanation in the existing minimum wage legislation protecting them, thus their earnings are not really determined as part of the market's demand and supply forces.

The estimates of cohort's size effects on wage differentials also provide evidence on how good as complements or substitutes are the various age-sex labour groups. Elasticities of complementarity and substitution, based on the three sets of estimates are presented in Table V.3.

Although the results are not totally conclusive, they provide consistent evidence across estimates that females F(25-34; 35-44) and the youngest group of workers (<20), in that order, are the best *complements* in production to the basic labour group of reference, the adult-male workers. The predominance of females among the complementary workers tends to confirm the existence of a segmented labour market, that is, males and females workers do not compete in the same market and their skills are utilized in different production processes.

The closest *substitutes* of the basic group are the adult male group, M(25-34) and young workers of both sexes (20-24). Adult females (F(45-54)) and older male workers (M(55-64)) follow with a lower degree of substitutability. It is interesting to note that the tasks of the (experienced) reference group can be best performed by workers in the adjacent age groups, mainly

TABLE V.3 Labour Elasticities of Complementarity and Substitution
Comparison of Estimates

	OLSQ s-run	Lagged Model short-run	AR1 estimates (corrected for autocorrelation)
Males			
- 20	0.70	08	0.87
20-24	-3.03b	-5.40a	-3.57a
25-34	-14.29	-12.82	-14.29
....			
55-64	-1.11	-2.99b	-1.27
65 +	-16.67a	-27.78a	-2.50a
Females			
- 20	0.63	.03	0.88
20-24	-3.85b	-4.46b	-5.56a
25-34	2.50	17.54a	4.00
35-44	2.08	-11.90a	7.59a
45-54	-1.89	-6.94a	9.09a
55-64	-7.14a	142.86a	-20.00a
65 +	-10.00	-27.03a	-33.33a

Source: Estimates from Appendices F2.1 (OLSQ), F2.3 (Lagged) and F2.2 (AR1).
Positive (negative) value indicates complementarity (substitutability) with relation to the basic group of reference; i.e., adult-males aged 35-54 yrs old.
a: Value of elasticity is based on estimate that is insignificant at the 95%.
b: Basic estimates are significant only at the 90% level of confidence.

of the same sex. In other words, workers with similar age-sex characteristics are closer substitutes. The fact that younger workers appear to be better substitutes can be attributed to their greater flexibility to receive the *on-the-job* specific training needed in order to meet the needs of firms.

3.3 Flexibility of the Relative Earnings Structure

The reported estimates on the degree of flexibility shown by the various groups earnings (see estimates for γ_i in Appendix F2.3) to current changes in market conditions provide additional evidence to support the above conclusions.

Earnings of young-adult males (25-34) and young workers (20-24)[10] show the highest flexibility; their earnings react almost instantaneously to current changes in the market, implying that the wage determination process of this group is the least affected by institutional rigidities. Furthermore, since these workers are likely to be at the beginning of their careers, they have little power to negotiate their wages and salaries and these can be adjusted more easily to current market conditions. This in turn increases the possibilities of their being closer substitutes for the adult male group in production.

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[10] Earnings flexibility of these groups are followed by that of oldest females (6[illegible]+). Since estimated equations for this group are in general poor no attempt is done to explain implications of this finding.

At the other extreme, females' earnings show the highest level of inflexibility; (in this order, see F(35-44; 25-34; 45-64)) actual changes in the market affect only marginally the relative earnings position of females since past changes still have great influence on their actual position. This inflexibility suggest that females' rewards for their productive contribution are still largely determined by non-market forces (i.e. prejudices, tradition, etc); and that they only change slowly, which explains the long and significant lags in response of females' earnings to changed conditions in the market.

VI. Summary and Conclusions

The objective of this study was to explore the relative importance of cyclical, demographic and other institutional factors in the determination of the employment, unemployment, labour force and earnings structure of the Canadian labour market in the last three decades.

As suggested by theoretical considerations on the heterogeneous characteristics of the workforce and empirically observed different patterns of behaviour for the various labour groups, a dissagregated analysis by age-sex for 14 labour groups was undertaken.

In view of the high level of disaggregation adopted, the likely simultaneity involved in the determination of the variables of interest (employment, labour force and earnings), plus the existence of specific determinants for each labour group, a parsimonious criterion had to be employed in modelling group behaviour to keep the project manageable.

Since the evidence on earnings suggested that changes in their structure occurred only gradually over time while real variables (employment, unemployment and labour force participation) showed greater variability, it was decided that a division of the analysis of the market into two parts was adequate

First, in explaining group employment and unemployment rates, an indirect approach was adopted by estimating jointly the employment and labour force equations for each group. This approach provides richer insights on the labour groups' reaction to the main determinants. In the second part a separate examination of changes in the age-sex structure of relative earnings, earnings differentials and the extent of labour-labour substitution as a consequence of changed cyclical and demographic factors was undertaken. In both approaches general specifications, common to all groups, were defined and then, their specific forms estimated and tested.

1. Summary of Results

The estimated results confirmed the significant short run impact of cyclical changes in the level of economic activity and intermediate run effects of demographic changes on the labour groups considered. The groups' reactions, however, are not homogeneous and substantial differences in employment, labour force participation and relative earnings are observed. Thereby, analysis of the labour market based on aggregate models and variables that also omit the effects of changed demographic composition of the workforce over the period are seen as producing unwarranted results, even becoming useless for intermediate run predictions of the market.

The estimates for the employment and labour force equations confirm the high sensitivity of these variables to cyclical fluctuations in the level of economic activity. In spite of these variations, the employment and unemployment rates of most groups remain rather inflexible, particularly for the middle-aged workers. The most cyclically responsive labour groups are the youngest and oldest. Women are relatively more protected than male workers, a result consistent with the observed concentration of female workers in cyclically safe sectors and occupations (service industries and secretarial and white collar occupations).

The findings of pro-cyclical labour force participation behaviour across groups, i.e. a dominant *discouraged*-worker effect, suggest that the officially reported unemployment rates underestimate by one-eighth, on the average, the rate of unemployment in periods of economic slack. Other estimates also suggest that a program oriented to create jobs to rescue 'n' unemployed workers will only attain its target if about twice number of new positions are opened. In these circumstances, most of the new ones attracted to the market would be females and young workers.

The impact of demographic variables is transmitted through the supply side of the market. The estimated results show that changes in the relative size of a group's population have had a negative impact on its employment rate. In other words, increased (decreased) population, hence labour force, of a group [illegible] (facilitate) its relative employment position. Most affected by relative excess supply are young workers, at the beginning of their careers, for whom the greatest negative demographic impact on their employment rates is recorded. As the age of a labour group rises, this demographic effect becomes negligible, and is likely to be offset by workers' being in a more advanced stage of their careers and more strongly linked to the market and their positions by accumulated on-the-job training.

The impact of changed demographic composition on the overall unemployment rate can be better appreciated if the second part of the period is considered. In this period the labour market received the arrival of the matured baby-boom generation. Estimates suggest that, on the average, 1.7 percentage points of the registered overall unemployment rate can be attributed to the changed workforce composition.

Changes in a group's relative wage have different effects on the supply of labour depending on workers' sex. Improvements in relative earnings of males induce them to demand more leisure, thus an *income* effect dominates their participation behaviour. Females participation behaviour, however, is dominated by the *substitution* effect, i.e. higher relative wages act as incentive to join the market. These results are in agreement with the *primary* and *secondary* role often assigned to the male and female labour force, respectively. Among women the size of the wage effect is directly related to the opportunity cost of not working faced by females of different ages.

The impact of relative wages on employment is, in general, insignificant. When significant, it is positive, suggesting that higher relative wages induce more employment for those groups. Though an odd result for the conventional static supply and demand analysis, it is interesting since it pertains to those groups with a high degree of attachment to the market and high accumulated human capital, suggesting that competition for hiring the most skilled workers raises their employment and wages simultaneously. The net effect of wages on employment rates is mixed, although these estimates provide an indication that the labour supply induced by wages always has a deteriorating impact on employment rates.

The estimates for the time trends, included as proxies for other institutional and slowly changing factors, show that the relative employment position of all groups has deteriorated over time, although at a very slow rate. The wider employment opportunities opened to females and the youngest workers have proved to be insufficient to match their increased participation in the labour force. For other groups, mainly males, the continuous deterioration has occurred in spite of their observed declining participation.

The results for earnings confirm that changes in its structure occur slowly due to the presence of institutional rigidities and lags in responding to the factors [illegible]
[illegible]

The evidence from the estimated models indicates that earnings of females are more inflexible than those of males. The youngest and oldest labour groups' earnings are the most rigid, a fact that can be attributed to the impact of minimum wage legislation for the former group and to seniority benefits and historical standards (difficult to modify) for the latter group. Only for young-adult males are earnings very flexible, probably as a result of their being at earlier stages of a career. The pattern of rigidities affecting earnings of females is found to be closely associated to the opportunity cost of working that they face at different ages.

Earnings differentials tend to decrease over the peak of the business cycle. Those benefited (harmed) most from economic upswing (downswing) are older and young males, and middle-aged female workers. Since these differentials are measured in relationship to the basic prime-age males group (who are essential in the production process), the above results indicate that these are the groups most closely related to the basic group. In fact, estimates of the degree of substitution among workers show that younger and older males can be considered close substitutes for prime-age male workers, while middle-aged females are their best complements. Thus it is clear that in expansionary stages, the earnings of these groups are first to increase (a consequence of their related demand) and hence earnings differentials decrease.

These results are also evidence of labour market segmentation; middle-aged females tend only to be obvious complements of male workers, and the youngest and oldest group of workers are a practically unrelated segment (they are the weakest complement or substitutes).

An increased cohort size of workers is found to worsen its relative earnings position and to increase its earnings differential vis-a-vis cohorts in relative excess supply. The greatest impact is recorded for those workers at the beginning of their careers. This evidence gives ample support to the *overcrowding* hypothesis.

2. Policy Implications

The major demographic developments which have occurred in the Canadian labour force, e.g. changed labour force composition toward young and female workers, have altered the nature of the problems posed by today's labour market. Indeed the increased shares of these groups have aggravated current unemployment problems in the economy by:

- enhancing the *structural* characteristics of unemployment; that is, the levels of skill and training of these groups of workers do not entirely match the technical requirements of existing productive process. Thus, a deterioration in their degree of employability has exerted upward pressure on overall unemployment.
- increasing the cyclical sensitivity of overall

labour force, employment and unemployment rates to changed market conditions given that these groups account for the highest labour force participation response to cyclical fluctuations in economic activity.

- raising the overall *natural* unemployment level, given the higher "frictional" unemployment that characterize these groups, i.e. longer periods of job search and higher employment turnover are associated with *secondary* and new workers.[107]

Since these demographic effects on the labour market will persist in the intermediate and long run, they are likely to have a profound impact on the traditional design of manpower policies and specific programs as well as the usual management practices of private and public institutions.

The challenge for policy-makers today is to design appropriate policies and programs, simultaneously aiming them at reducing short-run cyclical unemployment and longer run structural and frictional unemployment. In other words, what it is required is a set of consistent and complementary measures acting through the demand side, increasing the overall demand for labour (particularly, that of groups in most need) in recessionary periods, and more permanent

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[107] The empirical evidence shows that these results are the combined effects of their low level of skills and the longer period of search required by these workers to choose permanent positions that better suit their expectations and qualifications.

programs acting both through the supply side, aimed at removing some of the structural features of unemployment (i.e. by changing the composition and quality of the labour supply) and by facilitating the adjustment of supply and demand of labour through improved information on vacancies and job seekers.

Steps to upgrade manpower policies to the changed conditions in the market have been taken,[108] and greater emphasis is now being placed on programs aimed at enhancing the employability of the workforce. These experiences are rather new, however, which preclude an evaluation of their results. In any event, existing job creation initiatives, acting through the demand side, include not only direct assistance to actual unemployed members of the labour force (e.g. Canada Works Program), but also specific programs help young workers to gain work experience (e.g. Canada Summer Youth Employment Program) and indirect stimuli to private sector job creation through tax subsidies (i.e. Employment Tax Credit Program).

On the supply side, efforts are directed towards improving the employability of workers through training and mobility programs according to industrial manpower requirements. These programs subsidize on the job training within industry and have the desirable feature of letting firms register their specific needs rather than having

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[108]For a review of some of the Federal and Provincial joint programs in effect at the end of the period of this study see Smith (1979).

external public officials attempting to infer them.[109] Other initiatives include Mobility Grants to help the actual or potential unemployed to re-allocate to other areas, and wage subsidies to workers to improve their chances of obtaining new employment. In addition, informational and consultative services are provided through the offices of Canada Employment Centres, in order to improve communication and the matching of available workers and jobs.

Most of these programs, however, appear to be insufficient to solve the long lasting consequences of the changed age-sex workforce structure, given that the current management practices of private and public institutions are maintained. In fact, the advancement of the increased size cohorts of young workers to higher stages of their careers will exert continuous pressure on the existing hierarchical management structures of organizations and, if they are to remain unchanged, will constitute obstacles to promotion and become sources workers frustration in the future.

Efforts are needed today to innovate more flexible management structures so as to widen promotion opportunities at lower and middle management levels and so accommodate the increased number and competition of workers in similar stages of their careers. The specific problems faced by women re entering the workforce after long periods of

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[109] Among these programs are those maintained by Canada Employment and Immigration Commission: Canada Manpower Training Program and Canada Manpower Industrial Training Program and the Critical Skill Shortages Program which is financed by the Federal Government but administered by the provinces.

childbearing responsibilities also call for a re-assessment of actual work and management opportunities for women, on-the-job re-training programs of their likely out-dated skills, and greater emphasis on initiatives to increase part-time and flexible hours of work arrangements.

3. Limitations and Future Research

In this study the need for disaggregated analysis of the the labour market is met by the focus on the time behaviour of employment and earnings of age-sex labour groups. The adopted division of labour proved to be useful in understanding the main changes in the labour market since it provided greater homogeneity (heterogeneity) within (between) the specified labour groups.

Richer and more meaningful results could have been obtained, however, if the effects of changed education and part/full time status had been included. Indeed, the substantial variations observed in the educational background of workers have made the same labour groups inputs of a very different "quality" over time, which in turn is likely to have affected their employability and earnings capacity. This problem is particularly important among young workers, since they constitute the flow by which educational standards of the labour force stock are altered.

The increasing flexibility in hours of work observed over the period, especially as it affects the work performed [illegible] also calls for improved measures of earnings and employment that take into account the changed composition of workers by full and part time status.

Future research efforts should, therefore, attempt to control for the effects of these variables over time by standardizing the earnings and employment of each age-sex group for "quality" and then express them in terms of year-round full-time equivalent units.

The use of annual, rather than data based on shorter periods (quarterly or monthly data) tend to hide significant short-run fluctuations in employment and labour force participation behaviour due to seasonal factors. Although seasonality is a feature of the whole labour market, it is a rather marked phenomenon for the younger segment of workers during summer months; during this period the employment and earnings situation of these workers is an important matter of concern for policy makers and society in general. Thus, estimates derived from data based on shorter time units would better serve to guide specific policy recommendations and the design of programs.

Since most of the limitations mentioned above stem from the manner historical data have been collected and published by official agencies, a straightforward recommendation of this study is that centralized efforts to reconstruct historical series for employment, unemployment, labour force and earnings, along the lines already suggested, would be a valuable contribution to the economic research in the field.

In terms of modelling, the results reported in this study strongly suggest that problems of simultaneity in the determination of the labour market variables as well as the strong rigidities observed in the earnings structure, can be better approached and dealt with if explicit disequilibrium models and a simultaneous system of age-sex group equations are considered in future research. It should be noted, however, that the eventual gains associated with more complex approaches can only be obtained at the expense of less disaggregation in the analysis and their results would not necessarily assure more reliable results, given the heterogeneous behaviour of the labour groups participating in the market.

The relative weak employment and earnings position of the young and female groups of workers together with their increased presence in the market, suggest that the study of these groups' behaviour should have high priority in future labour market research. Focus on these groups is particularly important in view of the new phenomenon of "working students", as reflected by the recent increases in part time employment held by young as well as female workers.

Efforts in isolating and measuring the impact of specific factors affecting their position (i.e. minimum wage legislation for the younger segments and changes in determinants of the opportunity cost of working for females, among others) might well provide rewarding results.

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Appendices

Appendix A1.1 Labour Force Ratio Equations. Linear Model 1951-1980
(OLSQ estimates: SHAZAM)

	Const	T	T^2	EPR	RP[1]	RW[1]	R^2	DW	lnL
	α_{10}	α_{11}	α_{12}	α_{13}	α_{14}	α_{15}			
Males									
- 20	-2.24	-0.477	0.171	0.078	0.138	0.199	0.941	0.57	30.11
	(1.5)	(2.4)	(2.8)	(3.4)	(2.4)	(2.6)			
20-24	0.177	-0.399	0.111	0.024	0.840	-0.114	0.992	1.24	46.27
	(0.3)	(5.7)	(3.8)	(1.4)	(9.4)	(2.2)			
25-34	-1.09	0.240	-0.067	0.053	0.916	-0.097	0.992	0.935	42.52
	(0.8)	(1.9)	(1.4)	(4.4)	(15.9)	(1.3)			
35-44	-2.50	0.381	-0.193	0.062	0.885	0.005	0.987	0.784	42.58
	(2.5)	(3.9)	(5.0)	(5.5)	(12.7)	(0.2)			
45-54	0.84	0.832	-0.342	0.057	0.366	0.026	0.926	0.968	43.99
	(0.5)	(3.8)	(4.5)	(3.8)	(1.7)	(0.6)			
55-64	-5.05	0.559	-0.284	0.026	1.31	0.091	0.895	1.04	46.87
	(7.4)	(9.6)	(10.3)	(2.0)	(8.8)	(2.6)			
65+	-1.66	-0.212	-0.110	0.035	0.362	-0.007	0.989	1.11	55.82
	(2.0)	(2.5)	(3.4)	(4.2)	(4.2)	(0.7)			
Females									
- 20	-2.73	0.027	0.097	0.065	0.157	0.205	0.968	1.04	36.21
	(1.9)	(0.2)	(2.2)	(3.6)	(2.9)	(3.8)			
20-24	-2.90	-0.169	0.222	0.031	0.596	0.135	0.997	1.68	48.35
	(5.2)	(2.6)	(7.2)	(2.1)	(12.0)	(1.9)			
25-34	-0.12	-0.214	0.701	-0.036	0.602	-0.357	0.992	1.55	18.97
	(0.1)	(0.5)	(6.0)	(1.4)	(4.2)	(0.1)			
35-44	-4.41	0.257	0.324	0.012	0.545	0.094	0.988	0.78	30.76
	(2.9)	(1.7)	(4.2)	(0.7)	(7.6)	(0.7)			
45-54	-3.61	1.28	-0.201	0.045	0.170	0.187	0.992	0.75	37.03
	(3.1)	(4.8)	(2.1)	(2.4)	(1.3)	(1.9)			
55-64	-2.29	0.680	-0.111	0.019	0.227	0.103	0.992	1.28	52.77
	(4.8)	(10.5)	(4.8)	(1.6)	(2.4)	(2.3)			
65 +	0.004	0.213	-0.057	0.003	0.782	-0.006	0.715	0.90	69.13
	(0.01)	(6.0)	(4.3)	(0.5)	(0.1)	(0.6)			

Model and variables are defined in Chapter IV.B.2 and B.3, equation 17). ( ) denotes absolute value of the t-statistic; R^2 is adjusted R-square; DW is the Durbin-Watson statistic; lnL is the log value of the Likelihood function. Reported estimates for T and RW have been multiplied by 10, and estimates for T^2 are multiplied by 100.

Appendix A1.2 Employment Ratio Equations. Linear Model 1951-1980
(OLSQ estimates: SHAZAM)

	Const	T	T2	EPR	RLPi	RWi	R^2	DW	lnL
	β_{10}	β_{11}	β_{12}	β_{13}	β_{14}	β_{15}			
Males									
- 20	-2.02	-0.056	-0.010	0.036	1.08	-0.083	0.961	1.20	42.63
	(3.1)	(0.5)	(2.3)	(3.0)	(9.3)	(1.5)			
20-24	-4.32	0.049	0.015	0.083	0.826	0.075	0.979	1.00	57.19
	(4.9)	(0.6)	(4.1)	(3.5)	(6.5)	(1.0)			
25-34	-2.00	-0.537	0.045	0.076	0.770	0.028	0.990	1.15	40.02
	(1.5)	(4.1)	(0.9)	(5.4)	(11.8)	(0.3)			
35-44	-3.45	0.292	-0.021	0.047	0.965	0.090	0.991	1.32	47.93
	(5.0)	(3.2)	(0.5)	(4.7)	(15.7)	(3.7)			
45-54	-0.74	0.468	-0.287	0.067	0.338	0.125	0.981	1.98	66.62
	(1.8)	(4.1)	(6.5)	(7.5)	(3.7)	(5.9)			
55-64	-1.45	-0.085	-0.023	0.036	0.941	-0.022	0.963	1.23	60.97
	(4.2)	(1.6)	(0.9)	(4.1)	(15.1)	(1.0)			
65+	-0.099	-0.077	0.012	0.005	0.915	-0.002	0.999	2.31	94.69
	(0.8)	(3.1)	(2.1)	(2.4)	(21.5)	(0.7)			
Females									
- 20	-0.409	-0.003	-0.059	0.015	0.871	-0.047	0.990	1.49	61.39
	(1.2)	(0.05)	(2.9)	(2.3)	(11.4)	(1.8)			
20-24	-0.869	0.245	-0.143	0.025	0.962	-0.094	0.918	1.18	59.90
	(1.9)	(6.0)	(8.2)	(2.3)	(18.3)	(2.0)			
25-34	-0.762	-0.170	0.101	0.013	0.682	0.161	0.999	1.06	72.47
	(2.3)	(3.2)	(3.4)	(3.2)	(26.3)	(4.6)			
35-44	0.168	0.141	-0.038	0.009	0.883	-0.077	0.999	0.83	69.95
	(0.5)	(3.2)	(1.9)	(2.0)	(29.5)	(2.2)			
45-54	-0.361	0.221	-0.075	0.009	0.912	-0.016	0.999	1.32	73.69
	(0.9)	(2.3)	(3.2)	(1.7)	(15.7)	(0.5)			
55-64	-0.294	0.034	-0.028	0.005	0.987	0.008	0.999	1.62	94.75
	(1.8)	(1.0)	(3.5)	(1.7)	(21.8)	(0.7)			
65 +	0.005	0.002	-0.0005	0.002	0.966	-0.002	0.992	2.28	124.10
	(0.1)	(0.3)	(0.1)	(0.2)	(29.6)	(1.0)			

Model and variables are defined in Chapter IV.B.2 and B.3, equation 18). ( ) denotes absolute value of the t-statistic; R^2 is adjusted R-square; DW is the Durbin-Watson statistic; lnL is the log value of the Likelihood function. Reported estimates for T and RW have been multiplied by 10, and estimates for T^2 are multiplied by 100.

Appendix A2.1 Labour Force Ratio Equations. Linear Model 1951-1980
Corrected for Autocorrelation
(Auto estimates: SHAZAM)

	Const	T	T^2	EPR	RP^1	RW^1	R^2	ρ	lnL
	α_{10}	α_{11}	α_{12}	α_{13}	α_{14}	α_{15}			
Males									
- 20	-1.74	-0.540	0.187	0.070	0.157	0.160	0.949	0.77	41.06
	(1.4)	(3.1)	(3.3)	(3.6)	(3.3)	(3.4)		(6.6)	
20-24	-0.607	-0.290	0.088	0.031	0.826	-0.053	0.987	0.53	49.18
	(1.0)	(3.5)	(2.7)	(2.4)	(9.8)	(1.4)		(3.4)	
25-34	-0.057	0.210	-0.040	0.044	0.896	-0.569	0.996	0.58	47.79
	(0.05)	(1.5)	(0.8)	(3.8)	(15.9)	(2.2)		(3.9)	
35-44	-1.918	0.310	-0.134	0.047	0.933	-0.012	0.996	0.70	50.21
	(1.8)	(2.8)	(3.1)	(4.4)	(10.6)	(0.4)		(5.4)	
45-54	0.185	0.740	-0.306	0.056	0.492	0.012	0.984	0.53	48.68
	(0.1)	(3.2)	(3.6)	(4.0)	(2.1)	(0.3)		(3.4)	
55-64	-3.54	0.490	-0.244	0.033	1.12	0.020	0.962	0.71	53.40
	(3.8)	(5.2)	(7.2)	(3.1)	(6.3)	(0.8)		(5.5)	
65+	-0.948	-0.320	-0.077	0.033	0.256	-0.007	0.981	0.55	59.22
	(1.3)	(3.7)	(2.5)	(4.3)	(2.8)	(0.8)		(3.6)	
Females									
- 20	-2.86	-0.018	0.068	0.079	0.110	0.067	0.909	0.68	39.91
	(2.1)	(0.1)	(1.3)	(4.0)	(1.8)	(1.4)		(5.1)	
20-24	-2.91	-0.152	0.216	0.033	0.592	0.117	0.996	0.14	48.57
	(5.5)	(2.4)	(7.4)	(2.4)	(12.2)	(1.8)		(0.8)	
25-34	-1.90	-0.328	0.641	0.0001	0.497	0.155	0.981	0.40	20.21
	(0.9)	(0.8)	(5.0)	(0.0)	(3.3)	(0.6)		(2.4)	
35-44	-4.49	0.430	0.217	0.025	0.445	0.153	0.946	0.67	38.21
	(3.5)	(2.5)	(2.9)	(1.6)	(5.2)	(1.3)		(5.0)	
45-54	-2.76	1.01	-0.091	0.028	0.245	0.122	0.958	0.68	45.07
	(1.9)	(3.7)	(1.0)	(1.9)	(1.8)	(1.9)		(5.1)	
55-64	-2.15	-0.690	-0.107	0.016	0.282	0.058	0.982	0.43	45.07
	(4.2)	(9.3)	(4.2)	(1.4)	(2.7)	(1.3)		(2.6)	
65 +	-0.250	0.170	-0.055	0.007	0.007	0.005	0.295	0.69	75.53
	(0.9)	(3.6)	(3.5)	(1.5)	(0.2)	(0.7)		(5.2)	

Model and variables are defined in Chapter IV.B.2 and B.3, equation 17). ( ) denotes absolute value of the t-statistic; R^2 is adjusted R-square; DW is the Durbin-Watson statistic; lnL is the log value of the Likelihood function. ρ is the estimated value of the autocorrelation coefficient. Reported estimates for T and RW have been multiplied by 10 and estimates for T^2 are multiplied by 100.

Appendix A2.2 Employment Ratio Equations. Linear Model 1951-1980
Corrected for Autocorrelation
(Auto estimates: SHAZAM)

	Const β_{10}	T β_{11}	T^2 β_{12}	EPR β_{13}	RLP^1 β_{14}	RW^1 β_{15}	R^2	ρ	lnL	DW
Males										
- 20	-1.88	-0.052	-0.84	0.035	0.987	-0.026	0.967	0.49	46.77	
	(3.0)	(0.4)	(1.9)	(2.9)	(8.1)	(0.5)		(3.1)		
20-24	-2.59	-0.128	-0.057	0.067	0.724	0.030	0.976	0.69	42.91	
	(3.4)	(0.9)	(1.2)	(3.9)	(5.9)	(0.7)		(5.2)		
25-34	-1.41	-0.547	0.054	0.079	0.732	-0.025	0.993	0.45	42.94	
	(1.1)	(3.9)	(1.0)	(5.6)	(11.1)	(0.0)		(2.7)		
35-44	-2.77	-0.020	-0.059	0.053	0.897	0.063	0.995	0.44	50.16	
	(3.5)	(2.0)	(1.4)	(4.9)	(12.7)	(2.4)		(2.7)		
45-54	-0.750	0.469	-0.288	0.067	0.339	0.124	0.981	0.02	66.62	
	(2.1)	(4.5)	(7.2)	(8.4)	(4.1)	(6.5)		(0.1)		
55-64	-1.23	-0.072	-0.030	0.035	0.872	-0.001	0.992	0.50	63.87	
	(3.4)	(1.2)	(1.1)	(4.1)	(11.9)	(0.5)		(3.2)		
65+	-0.045	-0.086	0.014	0.004	0.902	-0.025	0.999	-0.20	95.19	
	(0.5)	(4.5)	(3.0)	(2.9)	(27.2)	(1.1)		(1.1)		
Females										
- 20	-0.467	0.024	-0.049	0.018	0.761	-0.015	0.980	0.44	62.98	1.67
	(1.3)	(0.4)	(2.3)	(2.5)	(9.9)	(0.6)		(2.6)		
20-24	-0.841	0.130	-0.070	0.025	0.811	-0.012	0.987	0.80	64.89	1.75
	(2.2)	(1.7)	(2.5)	(2.9)	(13.2)	(0.3)		(7.3)		
25-34	-0.558	-0.190	0.119	0.013	0.677	0.130	0.999	0.55	75.35	1.53
	(1.8)	(3.5)	(4.2)	(2.9)	(25.9)	(3.8)		(3.6)		
35-44	0.189	0.120	-0.016	0.010	0.839	-0.067	0.991	0.77	75.76	1.03
	(0.7)	(1.9)	(0.8)	(2.2)	(20.8)	(2.1)		(6.6)		
45-54	-0.060	0.200	-0.059	0.005	0.911	-0.030	0.998	0.41	75.59	1.82
	(0.2)	(2.0)	(2.8)	(1.0)	(15.4)	(1.2)		(2.5)		
55-64	-0.241	0.035	-0.026	0.004	0.985	0.057	0.999	0.21	95.27	1.94
	(1.6)	(1.0)	(3.4)	(1.5)	(23.6)	(0.5)		(1.2)		
65 +	0.005	0.002	-0.004	0.0002	0.970	-0.020	0.995	-0.15	124.44	2.08
	(0.1)	(0.3)	(0.2)	(0.4)	(36.3)	(1.4)		(0.9)		

Model and variables are defined in Chapter IV.B.2 and B.3, equation 18). ( ) denotes absolute value of the t-statistic; R^2 is adjusted R-square; DW is the Durbin-Watson statistic; lnL is the log value of the Likelihood function. ρ is the estimated value of the autocorrelation coefficient. Reported estimates for T and RW have been multiplied by 10 and estimates for T^2 are multiplied by 100.

Appendix B1.1 Labour Force Ratio Equations. Log-linear Model 1951-1980
(OLSQ estimates: SHAZAM)

	Const	T	T^2	lnEPR	lnRP[1]	lnRW[1]	R^2	DW	lnL
	α_{20}	α_{21}	α_{22}	α_{23}	α_{24}	α_{25}			
Males									
- 20	-5.25	-0.170	0.054	1.380	0.314	0.135	0.940	0.60	31.80
	(3.5)	(3.1)	(3.3)	(4.0)	(2.7)	(2.3)			
20-24	-0.389	-0.066	0.019	0.325	0.924	-0.189	0.991	1.27	45.69
	(0.6)	(5.6)	(3.5)	(1.7)	(9.3)	(2.3)			
25-34	-0.685	0.030	-0.010	0.324	0.948	-0.107	0.991	0.95	40.57
	(1.2)	(2.3)	(2.0)	(4.9)	(16.0)	(1.1)			
35-44	-1.24	-0.039	-0.019	0.357	0.903	0.003	0.988	0.78	42.98
	(3.4)	(3.6)	(4.8)	(5.5)	(13.5)	(0.1)			
45-54	-0.680	0.109	-0.044	0.421	0.422	0.021	0.931	0.97	44.78
	(1.3)	(3.8)	(4.5)	(3.9)	(2.0)	(0.2)			
55-64	-3.22	0.111	-0.057	0.295	1.46	0.226	0.893	0.97	47.00
	(6.4)	(9.4)	(10.7)	(2.0)	(8.2)	(2.3)			
65+	-6.62	-0.001	-0.125	1.33	1.51	-0.113	0.987	0.98	53.53
	(3.5)	(0.02)	(4.9)	(3.7)	(3.9)	(1.2)			
Females									
- 20	-5.89	0.030	0.028	1.36	0.396	0.152	0.979	1.41	41.45
	(4.2)	(0.7)	(2.0)	(4.5)	(3.1)	(3.9)			
20-24	-4.01	0.024	0.036	0.541	1.25	0.177	0.998	2.03	56.32
	(6.1)	(1.6)	(5.4)	(2.7)	(17.4)	(2.0)			
25-34	-5.26	0.134	0.058	0.660	1.23	0.154	0.994	1.51	31.40
	(3.7)	(1.9)	(3.0)	(2.9)	(4.8)	(0.5)			
35-44	-3.14	0.272	0.038	0.046	1.23	0.200	0.987	0.73	29.57
	(1.8)	(6.0)	(1.7)	(0.2)	(5.8)	(0.8)			
45-54	-6.86	0.800	-0.172	0.870	0.070	0.831	0.992	0.82	35.19
	(3.4)	(7.2)	(4.3)	(2.1)	(0.2)	(3.1)			
55-64	-6.38	0.778	-0.147	0.839	0.188	0.532	0.990	0.96	48.50
	(2.9)	(13.2)	(8.0)	(1.5)	(0.4)	(2.0)			
65 +	-1.23	0.801	-0.188	0.106	-0.056	-1.23	0.751	0.94	69.22
	(0.4)	(6.1)	(4.6)	(0.1)	(0.05)	(0.4)			

Model and variables are defined in Chapter IV.B.2 and B.3, equation 17'). ( ) denotes absolute value of the t-statistic; R^2 is adjusted R-square; DW is the Durbin-Watson statistic; lnL is the log value of the Likelihood function. Reported estimates for T have been multiplied by 10 and estimates for T^2 are multiplied by 100.

Appendix B1.2 Employment Ratio Equations, Log-linear Model 1951-1980
(OLSQ estimates: SHAZAM)

	Const β_{20}	T β_{21}	T^2 β_{22}	lnEPR β_{23}	lnRLP[1] β_{24}	lnRW[1] β_{25}	R^2	DW	lnL
Males									
- 20	2.84	-0.012	0.032	0.673	1.21	-0.039	0.957	1.05	42.77
	(3.0)	(0.3)	(2.2)	(2.9)	(8.6)	(0.8)			
20-24	-4.60	-0.004	-0.028	1.06	0.880	0.124	0.978	1.00	36.29
	(4.8)	(0.2)	(3.6)	(3.4)	(6.2)	(0.9)			
25-34	-1.16	-0.055	-0.006	0.458	0.784	-0.033	0.990	1.13	40.85
	(2.2)	(4.3)	(1.2)	(6.2)	(12.6)	(0.3)			
35-44	-1.78	-0.033	-0.022	0.283	0.995	0.135	0.992	1.24	48.60
	(6.6)	(3.3)	(0.4)	(4.8)	(16.6)	(3.4)			
45-54	-1.91	0.063	-0.039	0.502	0.351	0.237	0.984	1.88	68.50
	(12.5)	(4.1)	(6.6)	(7.7)	(3.9)	(5.6)			
55-64	-1.51	-0.019	-0.005	0.459	0.963	-0.056	0.962	1.21	60.87
	(3.6)	(1.7)	(0.9)	(4.3)	(13.9)	(0.8)			
65+	-0.380	-0.052	0.012	0.114	0.971	-0.014	0.999	2.56	91.10
	(1.0)	(3.5)	(2.4)	(1.2)	(20.5)	(0.5)			
Females									
- 20	-0.959	-0.019	-0.018	0.262	1.01	-0.032	0.990	1.34	62.83
	(1.6)	(0.8)	(2.4)	(1.8)	(10.8)	(1.3)			
20-24	-0.950	0.043	-0.030	0.356	0.996	-0.124	0.999	1.18	69.47
	(1.7)	(4.3)	(7.6)	(2.4)	(26.5)	(2.1)			
25-34	-2.01	-0.001	0.007	0.334	0.762	0.223	0.999	1.07	78.75
	(5.5)	(0.8)	(1.4)	(6.2)	(24.5)	(3.7)			
35-44	0.003	0.033	-0.010	0.129	0.935	-0.119	0.999	0.92	76.43
	(0.1)	(2.4)	(2.2)	(2.2)	(32.9)	(2.1)			
45-54	-0.526	0.064	-0.022	0.139	0.951	-0.009	0.999	1.56	83.06
	(1.0)	(1.8)	(2.6)	(1.8)	(22.4)	(0.1)			
55-64	-1.05	0.026	-0.016	0.201	0.977	0.058	0.999	1.75	100.46
	(2.6)	(0.8)	(2.5)	(2.8)	(26.4)	(1.2)			
65 +	0.076	0.003	0.000	0.014	0.994	-0.038	0.993	2.34	132.25
	(0.2)	(0.1)	(0.0)	(0.1)	(29.0)	(1.1)			

Model and variables are defined in Chapter IV.B.2 and B.3, equation 18'). ( ) denotes absolute value of the t-statistic; R^2 is adjusted R-square; DW is the Durbin-Watson statistic; lnL is the log value of the Likelihood function. Reported estimates for T have been multiplied by 10 and estimates for T^2 are multiplied by 100.

Appendix B2.1 Labour Force Ratio Equations. Log-linear Model 1951-1980
Corrected for Autocorrelation
(Auto estimates: SHAZAM)

	Const α_{20}	T α_{21}	T^2 α_{22}	lnEPR α_{23}	lnRP[1] α_{24}	lnRW[1] α_{25}	R^2	ρ	lnL	DW
Males										
- 20	-3.94	-0.180	0.062	1.060	0.322	0.121	0.964	0.77	78.48	1.89
	(3.1)	(3.6)	(4.0)	(3.5)	(3.3)	(3.3)		(6.7)		
20-24	-1.07	-0.560	0.015	0.379	0.921	-0.082	0.992	0.53	96.35	1.69
	(1.9)	(3.4)	(2.4)	(2.5)	(10.1)	(1.4)		(3.4)		
25-34	-0.281	0.027	-0.007	0.271	0.932	-0.139	0.999	0.57	114.89	1.90
	(0.6)	(1.9)	(1.4)	(4.2)	(16.0)	(1.8)		(3.8)		
35-44	-0.881	0.032	-0.014	0.271	0.943	-0.019	0.999	0.69	116.11	1.81
	(2.2)	(2.7)	(3.0)	(4.4)	(11.3)	(0.4)		(5.2)		
45-54	-0.787	0.095	-0.039	0.399	0.541	0.012	0.997	0.52	109.14	1.68
	(1.6)	(3.2)	(3.6)	(4.1)	(2.4)	(0.2)		(3.3)		
55-64	-2.38	0.099	-0.049	0.380	1.274	0.049	0.994	0.70	100.35	1.43
	(4.8)	(5.1)	(7.3)	(3.2)	(6.1)	(0.7)		(5.4)		
65+	-5.10	-0.140	-0.085	1.24	0.779	-0.077	0.947	0.70	66.80	1.49
	(3.3)	(1.8)	(3.4)	(3.8)	(2.0)	(0.9)		(5.4)		
Females										
- 20	-5.75	0.013	0.024	1.46	0.282	0.068	0.933	0.60	72.34	1.67
	(3.7)	(0.3)	(1.6)	(4.3)	(1.9)	(1.8)		(4.1)		
20-24	-4.03	0.023	0.036	0.538	1.25	0.184	0.988	-0.05	91.29	1.96
	(7.0)	(1.8)	(6.2)	(3.1)	(20.1)	(2.4)		(0.3)		
25-34	-5.23	0.128	0.059	0.692	1.20	0.134	0.992	0.20	70.89	1.74
	(3.8)	(1.9)	(3.0)	(3.0)	(4.8)	(0.5)		(1.1)		
35-44	-4.19	0.321	0.006	0.388	0.987	0.260	0.921	0.70	73.10	1.45
	(3.0)	(5.9)	(0.3)	(1.5)	(4.0)	(1.1)		(5.4)		
45-54	-4.17	0.625	-0.100	0.494	0.459	0.373	0.885	0.78	73.79	1.29
	(3.6)	(5.5)	(2.7)	(1.6)	(1.1)	(2.2)		(6.9)		
55-64	-5.11	0.761	-0.137	0.616	0.570	0.284	0.963	0.59	62.25	1.91
	(2.8)	(10.8)	(6.5)	(1.3)	(1.1)	(1.2)		(4.0)		
65 +	-6.37	0.606	-0.177	1.17	-0.038	0.038	0.777	0.71	38.74	1.96
	(2.0)	(3.5)	(3.3)	(1.4)	(0.05)	(0.2)		(5.5)		

Model and variables are defined in Chapter IV.B.2 and B.3, equation 17'). ( ) denotes absolute value of the t-statistic; R^2 is adjusted R-square; DW is the Durbin-Watson statistic; lnL is the log value of the Likelihood function. ρ is the estimated value of the autocorrelation coefficient. Reported estimates for T have been multiplied by 10 and estimates for T^2 are multiplied by 100.

Appendix B2.2 Employment Ratio Equations: Log-linear Model 1951-1980
Corrected for Autocorrelation
(Auto estimates: SHAZAM)

	Const β_{20}	T β_{21}	T^2 β_{22}	lnEPR β_{23}	lnRLP β_{24}	lnRW β_{25}	R^2	ρ	lnL	DW
Males										
- 20	-2.85	-0.019	-0.026	0.677	1.12	-0.009	0.969	0.50	78.83	1.76
	(3.3)	(0.5)	(1.7)	(3.1)	(7.7)	(0.2)		(3.2)		
20-24	-3.32	-0.036	-0.010	0.869	0.780	0.043	0.987	0.68	86.89	1.91
	(4.3)	(1.2)	(0.9)	(4.0)	(6.0)	(0.6)		(5.0)		
25-34	-1.03	-0.057	0.006	0.471	0.752	-0.055	0.998	0.46	111.57	1.81
	(2.1)	(4.0)	(1.3)	(6.3)	(11.9)	(0.6)		(2.8)		
35-44	-1.55	-0.022	0.006	0.318	0.926	0.091	0.999	0.48	115.56	1.84
	(4.9)	(2.0)	(1.3)	(5.0)	(13.3)	(2.1)		(3.0)		
45-54	-1.91	0.065	-0.039	0.517	0.352	0.223	0.992	0.10	127.02	1.92
	(12.9)	(4.5)	(7.1)	(8.5)	(4.2)	(5.6)		(0.6)		
55-64	-1.52	-0.016	-0.007	0.455	0.883	-0.025	0.996	0.52	108.98	1.80
	(3.9)	(1.2)	(1.2)	(4.4)	(10.9)	(0.5)		(3.3)		
65+	-0.219	-0.059	0.013	0.086	0.952	-0.021	0.999	-0.33	99.73	2.10
	(0.8)	(5.8)	(3.8)	(1.4)	(28.9)	(1.0)		(1.9)		
Females										
- 20	-1.39	-0.005	-0.016	0.371	0.866	-0.008	0.979	0.45	90.32	1.66
	(2.2)	(0.2)	(2.0)	(2.3)	(9.6)	(0.4)		(2.8)		
20-24	-1.10	0.032	-0.024	0.342	0.956	-0.063	0.996	0.58	105.92	1.85
	(2.2)	(2.4)	(4.7)	(2.7)	(22.6)	(1.3)		(3.9)		
25-34	-1.61	-0.014	0.014	0.296	0.742	0.169	0.999	0.62	121.25	1.87
	(5.0)	(1.5)	(2.8)	(5.1)	(26.0)	(3.3)		(4.3)		
35-44	-0.087	0.037	-0.008	0.152	0.894	-0.111	0.994	0.71	115.00	1.26
	(0.3)	(1.9)	(1.5)	(2.3)	(24.4)	(1.9)		(5.6)		
45-54	-0.275	0.056	-0.019	0.104	0.957	-0.038	0.999	0.24	111.96	1.85
	(0.6)	(1.6)	(2.4)	(1.5)	(22.8)	(0.7)		(1.4)		
55-64	-1.000	0.030	-0.016	0.194	0.973	0.051	0.999	0.13	109.08	1.95
	(2.6)	(1.0)	(2.7)	(2.8)	(28.2)	(1.1)		(0.7)		
65 +	0.032	0.003	-0.0002	0.030	0.997	-0.042	0.994	-0.17	86.51	2.08
	(0.1)	(0.1)	(0.03)	(0.3)	(36.0)	(1.4)		(1.0)		

Model and variables are defined in Chapter IV.B.2 and B.3, equation 18'). ( ) denotes absolute value of the t-statistic; R^2 is adjusted R-square; DW is the Durbin-Watson statistic; lnL is the log value of the Likelihood function; ρ is the estimated value of the autocorrelation coefficient. Reported estimates for T have been multiplied by 10 and estimates for T^2 are multiplied by 100.

Appendix B2.3 Employment Ratio Equations. Log-linear Model 1951-1980 Corrected for Autocorrelation and Instrumental Variables (AR1(INST) estimates: TSP)

	Const	T	T^2	lnEPR	lnRLP[1]	lnRW[1]	ρ	lnL	DW
	β_{20}	β_{21}	β_{22}	β_{23}	β_{24}	β_{25}			
Males									
- 20	-2.58	-0.002	-0.036	0.581	1.30	-0.038	0.46	78.15	1.82
	(2.5)	(0.04)	(1.8)	(2.1)	(5.2)	(0.7)	(2.6)		
20-24	-3.16	-0.024	-0.015	0.768	0.895	0.057	0.61	86.58	1.86
	(3.5)	(0.8)	(1.3)	(3.0)	(6.0)	(0.7)	(4.0)		
25-34	-1.08	-0.056	0.006	0.468	0.758	-0.050	0.44	111.56	1.80
	(1.9)	(3.6)	(1.1)	(5.6)	(10.4)	(0.5)	(2.5)		
35-44	-1.71	-0.029	-0.003	0.291	1.00	0.112	0.39	115.11	1.87
	(5.0)	(2.4)	(1.2)	(4.2)	(12.9)	(2.3)	(2.1)		
45-54	-1.91	0.059	-0.037	0.500	0.388	0.223	0.11	126.93	1.92
	(11.5)	(2.3)	(3.8)	(5.4)	(2.5)	(5.0)	(0.5)		
55-64	-1.23	-0.029	0.0[illegible]0	0.344	1.03	-0.039	0.39	107.71	1.79
	(2.6)	(1.9)	(0.0)	(2.6)	(9.9)	(0.6)	(2.1)		
65+	-0.227	-0.063	0.013	0.094	0.935	-0.023	-0.34	93.60	2.11
	(0.8)	(5.2)	(3.1)	(1.3)	(22.8)	(1.0)	(1.8)		
Females									
- 20	-0.769	-0.017	-0.021	0.195	1.08	-0.027	0.35	88.39	1.71
	(1.0)	(0.7)	(2.1)	(0.9)	(6.6)	(1.0)	(1.8)		
20-24	-0.688	0.320	-0.026	0.244	1.01	-0.081	0.46	105.33	1.78
	(1.2)	(2.4)	(5.0)	(1.6)	(21.3)	(1.4)	(2.6)		
25-34	-1.38	-0.006	-0.007	0.252	0.796	0.140	0.52	119.66	1.82
	(3.4)	(0.5)	(1.1)	(3.6)	(18.9)	(2.2)	(3.1)		
35-44	0.079	-0.002	-0.005	0.107	1.08	-0.127	0.56	111.31	1.45
	(0.2)	(0.1)	(0.9)	(1.3)	(18.3)	(1.8)	(3.3)		
45-54	0.010	0.019	-0.011	0.064	1.00	-0.070	0.27	111.38	1.80
	(0.01)	(0.4)	(1.1)	(0.8)	(17.3)	(1.0)	(1.4)		
55-64	-0.690	-0.009	-0.009	0.147	1.02	0.027	0.10	108.11	1.93
	(1.3)	(0.2)	(1.0)	(1.6)	(17.6)	(0.5)	(0.5)		
65 +	0.014	0.260	-0.006	0.028	0.968	-0.049	-0.14	85.99	2.05
	(0.03)	(0.7)	(0.6)	(0.2)	(0.2)	(1.4)	(0.7)		

Model and variables are defined in Chapter IV.B.2 and B.3, equation 18). ( ) denotes absolute value of the t-statistic; R^2 is adjusted R-square; DW is the Durbin-Watson statistic; lnL is the log value of the likelihood function. ρ is the estimated value of the autocorrelation coefficient. Reported estimates for T have been multiplied by 10 and estimates for T^2 are multiplied by 100.

Appendix C1.1 Employment and Labour Force Partial Elasticities.
Comparison of Linear and Log-linear Models.
OLSQ estimates)

Model:	Labour Force Ratio Equations						Employment Ratio Equations					
	Linear			og-linear			Linear			Log-linear		
	PR	RP^{1}	W^{1}	PR	RP^{1}	RW^{1}	EPR	RLP^{i}	RW^{i}	EPR	RLP^{i}	RW^{i}
Males												
:0	.28	0.27	0.17	.38	0.31	0.14	0.67	1.25	-0.08a	0.67	1.21	-0.04b
0-24	.27	0.90	-0.18	0.33	0.92	-0.19	.02	0.91	0.13b	1.06	0.88	0.12b
25-34	0.29	0.92	-0.12a	0.32	0.95	-0.11b	0.44	0.81	0.04b	0.46	0.78	-0.03b
35-44	.38	0.89	0.01b	0.36	0.90	0.00b	0.31	1.01	0.16	0.28	0.99	0.14
5-54	0.43	0.38a	0.05b	0.42	0.42	0.02b	0.53	0.35	0.26	0.50	0.35	0.24
5-64	0.30	53	0.25	0.30	1.46	0.23	0.45	0.99	-0.07b	0.46	0.96	-0.06b
65 +	40	40	-0.06b	.33	.51	-0.11a	0.20	0.95	0.02b	0.11b	0.97	-0.01b
Females												
:0	8	40	0.19	.36	0.40	0.15	0.34	0.97	-0.05	0.26	1.01	-0.03a
-24	51	0	0.2	0.54	.25	0.18	0.44	1.02	-0.16	0.36	0.99	-0.12
-34	.50a	.58	-0.57b	0.66	1.23	0.15b	0.20	0.72	0.27	0.33	0.76	0.22
-44	0.20b	.48	0.18b	0.05b	1.23	0.20b	0.16	0.91	-0.15	0.13	0.94	-0.12
-54	0.89	0.46a	0.44	0.87	0.07b	0.83	0.19a	0.94	0.04b	0.14	0.95	-0.01b
5-64	.72a	0.87	0.47	0.84a	0.19b	0.53	0.18	1.02	0.04b	0.20	0.98	0.06b
5 +	.45b	0.6b	-0.14b	0.11b	-0.06b	-1.23b	0.03b	0.98	0.04b	0.01b	0.99	-0.04b

Source: Elasticities based on estimates reported in Appendices A1.1 and B1.1 for the LF ratio equations and Appendices A1.2 and B1.2 for the Employment ratio equations, linear and log-linear models respectively. a indicates that basic estimates are significant at 90% level, significance of basic estimates denoted by b; otherwise, they are significant at the 95% level.

Appendix C2.1 Employment and Labour Force Partial Elasticities.
Comparison of Linear and Log-linear Models.
Estimates corrected for autocorrelation (AR1 and AR1(INST))

Model:	Labour Force Ratio Equations						Employment Ratio Equations								
	Linear			Log-linear			Linear			Log-linear					
	EPR	RP^i	RW^i	EPR	RP^i	RW^i	EPR	RLP^i	RW^i	EPR	RLP^i	RW^i	EPR	RLP^i	RW^i
Males															
- 20	1.14	0.31	0.13	1.06	0.32	0.12	0.66	1.14	-0.02b	0.68	1.12	-0.00b	0.58	1.30	-0.04b
20-24	0.3[illegible]	0.89	0.08a	0.38	0.92	-0.08a	0.82	0.80	0.05b	0.87	0.78	0.04b	0.77	0.90	0.06b
25-34	0.24	0.90	-0.16	0.27	0.93	-0.14	0.45	0.77	0.00b	0.47	0.75	-0.06b	0.47	0.76	-0.05b
35-44	0.2[illegible]	0.94	-0.02b	0.27	0.94	-0.02b	0.34	0.94	0.11	0.32	0.93	0.09	0.29	1.00	0.11
45-54	0.42	0.51	0.02b	0.40	0.54	0.01b	0.53	0.35	0.26	0.52	0.35	0.22	0.50	0.39	0.22
55-64	0.39	1.31	0.06b	0.38	1.27	0.05b	0.44	0.92	-0.03b	0.46	0.88	-0.03b	0.34	1.03	-0.04b
65 +	1.34	0.99	-0.06b	1.24	0.78	-0.08b	0.19	0.94	0.02b	0.09a	0.95	-0.02b	0.09a	0.94	-0.02b
Females															
- 20	1.68	0.28	0.06a	1.46	0.28	0.07	0.42	0.84	-0.02b	0.37	0.89	-0.00b	0.20b	1.08	-0.03b
20-24	0.54	1.00	0.18	0.54	1.25	0.18	0.44	0.86	-0.02b	0.34	0.96	-0.06a	0.24	1.01	-0.08a
25-34	0.00b	1.30	-0.25b	0.69	1.20	0.13b	0.20	0.71	0.22	0.30	0.74	0.17	0.25	0.80	0.14
35-44	0.41a	1.21	0.29a	0.39a	0.99	0.26b	0.16	0.87	-0.13	0.15	0.89	-0.11	0.11a	1.08	-0.13
45-54	0.56	0.66	0.29	0.49a	0.46b	0.37	0.11b	0.94	-0.73b	0.10a	0.96	-0.04b	0.06b	1.00	-0.07b
55-64	0.60a	1.08	0.26a	0.62a	0.57b	0.28b	0.15a	1.02	0.27b	0.19	0.97	0.05b	0.15a	1.02	0.03b
65 +	1.30a	0.15b	0.10b	1.17a	-0.04b	0.04b	0.05b	0.99	-0.05a	0.03b	1.00	-0.04a	0.03b	0.97b	-0.05a

Source: Elasticities based on estimates reported in Appendices A2.1 and B2.1 for the Labour Force ratio equations, linear and log-linear respectively; for the Employment ratio equations, linear model see Appendix A2.2 and Appendices B2.2 and B2.3 for the log-linear models. a indicates that basic estimates are significant at 90% level and the insignificance of basic estimates denoted by b; otherwise, they are significant at the 95% level of confidence.

Appendix C2.2 Direct Cyclical Impact: Absolute Variations in Labour Force and Employment. Comparison of Models and Techniques (Average impact period 1951-1980)

	Labour Force Ratio Equations				Employment Ratio Equations				
Model:	Linear		Log-linear		Linear		Log-linear		
Method:	OLSQ	Auto	OLSQ	Auto	OLSQ	Auto	OLSQ	Auto	AR1(INST)
Both Sexes	54.58	50.34	55.85	53.02	42.61	41.51	42.27	39.67	36.57
Males	33.53	31.54	34.49	30.86	34.99	34.03	34.90	34.24	31.32
<20	7.85	7.04	3.49	6.52	3.56	3.49	3.58	3.60	3.09
20-24	2.44	3.14	2.91	3.40	8.31	6.67	8.63	7.08	6.25
25-34	5.28	4.41	5.91	4.94	7.58	7.88	7.93	8.16	8.10
35-44	5.20	4.65	5.75	4.36	4.73	5.28	4.37	4.91	4.50
45-54	5.72	5.61	5.59	5.30	6.68	6.71	6.38	6.57	6.36
55-64	2.55	3.35	2.53	3.25	3.64	3.55	3.74	3.71	2.80
65 +	3.48	3.34	2.31	3.09	0.49	0.45	0.27	0.21	0.22
Females	21.05	18.80	21.36	22.16	7.62	7.48	7.37	5.43	5.25
<20	5.52	7.33	6.43	5.90	1.46	1.81	1.12	1.58	0.83
20-24	3.06	3.28	3.27	3.25	2.51	2.48	2.02	1.94	1.39
25-34	-3.59	0.01	4.71	4.93	1.33	1.29	2.27	2.01	1.71
35-44	1.23	2.47	0.28	2.33	0.90	0.95	0.75	0.88	0.62
45-54	4.49	2.82	4.39	2.39	0.94	0.54	0.68	0.51	0.31
55-64	1.91	1.59	2.22	1.63	0.46	0.39	0.52	0.50	0.38
65 +	0.25	0.70	0.06	0.63	0.02	0.02	0.01	0.02	0.01
Young	19.87	21.39	21.10	20.07	15.84	14.45	14.91	14.20	11.56
males	10.29	10.18	11.40	9.92	11.87	10.16	12.21	10.68	9.34
females	9.58	11.21	9.7	10.15	3.97	4.29	2.70	3.52	2.22
Older	8.19	8.98	8.12	8.60	4.61	4.41	4.54	4.44	3.41
males	6.03	6.69	5.84	6.34	4.13	4.00	4.01	3.92	3.02
females	2.16	2.29	2.28	2.26	0.48	0.41	0.53	0.52	0.39

Source: Absolute variations estimated from partial elasticities reported in Appendix C2.1; a change in total employment of 100 was assumed.

Appendix D1.1 Potential or High-Employment Male Labour Force by Age groups 1952-1980
(thousands)

Year	TOTAL	Age Groups - 20	20-24	25-34	35-44	45-54	55-64	65 +
1952	4160.73	340.31	471.55	1024.76	935.92	708.69	476.75	202.74
1953*	4228.00	33.061	472.16	1051.25	958.14	728.51	482.89	[illegible]
1954*	4301.02	333.87	475.15	1075.71	982.51	748.58	487.80	197.4[illegible]
1955	4365.05	332.02	473.82	1098.19	1000.41	768.45	488.95	194.21
1956	4434.51	331.05	477.23	1123.08	1022.84	790.79	497.74	191.78
1957	4586.11	352.67	489.48	1156.76	1052.34	820.88	508.72	205.26
1958	4684.65	359.29	496.26	1176.15	1074.68	846.71	526.56	205.21
1959*	4739.37	360.82	500.63	1183.54	1091.67	868.47	536.54	197.70
1960*	4790.74	363.63	500.25	1180.94	1112.22	891.22	547.74	194.74
1961*	4853.70	373.14	504.83	1177.44	1129.43	913.54	562.20	193.13
1962*	4894.80	374.55	515.20	1163.30	1143.48	929.58	578.48	190.22
1963*	4952.34	390.65	528.46	1149.83	1162.23	945.72	588.29	187.15
1964	5037.75	410.05	559.61	1142.54	1179.94	964.95	603.06	177.61
1965	5145.38	423.61	593.60	1146.16	1198.37	981.88	622.10	179.67
1966a	5031.28	382.07	593.01	1145.09	1175.83	954.05	612.71	168.52
1967*	5278.38	413.57	651.42	1190.76	1206.78	995.81	646.53	173.51
1968*	5375.57	423.01	688.40	1221.02	1204.76	1011.23	658.33	168.83
1969*	5525.01	435.58	723.53	1273.34	1214.69	1029.58	681.26	167.03
1970*	5563.96	437.90	729.30	1302.48	1199.38	1035.99	692.52	166.39
1971	5700.27	461.81	755.08	1362.78	1204.55	1051.00	704.90	160.15
1972	5824.43	489.72	773.93	1430.86	1202.66	1073.64	703.40	150.22
1973	6008.24	536.14	805.22	1503.40	1213.24	1096.38	709.29	144.56
1974	6180.61	573.35	843.45	1580.21	1223.08	1113.62	708.35	138.56
1975a	6308.13	598.52	863.70	1645.94	1226.35	1115.81	719.96	137.86
1976	6433.21	636.08	884.43	1697.71	1228.35	1120.64	723.30	142.71
1977	6492.34	647.42	895.37	1746.28	1242.50	1114.34	712.80	133.55
1978	6623.87	649.49	939.27	1794.64	1268.05	1118.22	722.21	131.97
1979*	6830.66	700.57	974.01	1845.10	1310.19	1130.07	737.96	132.76
1980*	6914.88	681.68	999.86	1894.77	1337.83	1122.04	746.80	131.91

Source: Estimates of Potential or High-Employment Labour Force are based on equation 22), Chapter IV.C.2.2. in the text. Periods of slowdown in economic activity are marked by asterisks. Years in which major revisions of the Labour Force Survey were were done are marked by an 'a'.

Appendix D1.2 Potential or High-Employment Female Labour Force by Age groups 1952-1980
(thousands)

Year	TOTAL	Age Groups - 20	20-24	25-34	35-44	45-54	55-64	65 +
1952	1188.03	216.66	256.36	269.65	206.04	146.43	70.41	22.49
1953*	1223.52	214.94	256.15	277.52	222.64	153.41	76.02	22.85
1954*	1249.34	219.66	256.81	285.29	228.08	158.75	78.26	22.49
1955	1292.19	226.97	257.30	294.02	237.43	268.35	84.61	23.51
1956	1340.71	229.53	258.69	300.93	254.52	181.22	90.42	25.41
1957	1441.42	247.22	267.41	316.20	273.36	207.67	100.10	29.46
1958	1525.50	252.79	275.93	328.11	294.10	228.96	112.92	32.70
1959*	1590.08	257.93	281.51	334.70	313.21	247.21	121.05	34.48
1960*	1665.23	268.34	289.45	342.07	331.37	265.43	132.53	36.04
1961*	1757.30	282.50	297.69	349.93	355.80	289.24	143.45	38.69
1962*	1841.51	295.04	309.64	355.41	374.48	310.10	155.61	41.23
1963*	1915.12	301.61	325.22	360.49	392.21	329.56	165.02	41.00
1964	2002.86	310.96	344.84	370.56	406.62	350.18	176.02	43.68
1965	2112.59	326.98	368.54	383.91	426.27	371.19	188.66	47.05
1966a	2182.41	307.19	406.84	408.15	438.38	379.90	198.11	43.85
1967*	2369.59	343.30	450.44	435.78	464.64	410.56	218.08	46.79
1968*	2498.08	351.22	484.63	467.49	479.81	436.65	230.54	47.75
1969*	2615.05	358.92	520.48	501.17	485.75	453.77	244.48	50.48
1970*	2729.85	366.36	548.21	548.19	501.53	460.17	257.59	47.78
1971	2852.02	375.88	574.12	591.11	515.79	481.63	267.56	45.94
1972	2976.55	400.20	577.07	647.47	530.44	494.22	278.99	48.17
1973	3159.07	426.79	611.30	721.21	553.91	523.13	278.25	44.49
1974	3365.46	460.21	650.68	799.73	574.56	538.21	296.95	45.12
1975a	3480.45	480.48	676.81	836.68	604.92	546.23	291.28	44.05
1976	3786.35	534.55	708.92	936.51	671.38	575.23	309.75	50.01
1977	3989.57	549.11	733.86	1013.66	706.77	611.12	329.50	45.54
1978	4188.19	547.44	762.63	1090.83	765.13	633.07	342.06	47.04
1979*	4453.38	583.47	813.96	1198.00	818.48	635.73	353.56	50.18
1980*	4703.60	596.60	837.93	1322.85	870.97	657.54	369.37	48.18

Source: Estimates of Potential or High-Employment Labour Force are based on equation 22), Chapter IV.C.2.2, in the text. Periods of slowdown in economic activity are marked by asterisks. Years in which major revisions of the Labour Force Survey were were done are marked by an 'a'.

Appendix D2.1 Male Hidden Unemployed by Age groups 1952-1980
(thousands)

Year	TOTAL	Age Groups - 20	20-24	25-34	35-44	45-54	55-64	65 +
1952	16.73	7.31	1.55	-0.24	2.92	2.69	0.75	1.74
1953*	22.01	1.06	-0.84	6.25	2.14	4.51	1.89	7.00
1954*	38.03	3.87	3.15	5.71	7.51	4.58	7.80	5.41
1955	14.05	5.02	-1.18	2.19	1.41	2.45	-0.05	4.21
1956	-2.49	-1.95	1.23	4.08	2.84	2.79	0.74	-12.22
1957	13.12	4.67	0.48	3.77	5.34	4.88	-3.28	-2.74
1958	42.66	10.29	0.26	7.15	6.68	7.71	4.36	6.21
1959*	52.38	10.82	5.63	11.54	6.67	8.48	5.54	3.70
1960*	36.74	4.63	2.25	6.94	9.22	6.22	4.74	2.74
1961*	70.70	20.14	5.83	11.44	9.43	14.54	5.20	4.13
1962*	76.80	7.55	16.20	13.30	7.48	17.58	10.48	4.22
1963*	73.35	4.65	9.46	13.83	10.23	14.72	7.29	13.15
1964	75.76	12.05	12.61	15.54	9.94	20.95	5.06	-0.39
1965	79.39	3.61	15.60	18.16	12.37	22.88	4.10	2.67
1966a	-127.72	-18.93	-15.99	-18.91	-25.17	-21.95	-16.29	-10.48
1967*	1.38	-1.43	3.42	-1.24	-1.22	-0.19	-0.47	2.51
1968*	-1.42	3.01	8.40	-2.98	-7.24	4.23	-4.67	-2.17
1969*	39.02	14.58	10.53	8.34	4.70	4.58	-1.74	-1.97
1970*	-34.04	-4.10	-5.70	-10.52	-7.62	-4.00	-2.48	0.39
1971	-1.73	0.19	-4.92	-4.22	-0.45	-6.00	3.90	10.15
1972	-2.56	-10.28	-3.07	-0.14	-1.33	4.64	-0.60	8.22
1973	11.24	-10.86	0.22	2.41	5.24	3.38	6.29	4.56
1974	-5.38	-16.65	0.45	0.21	5.08	2.62	4.35	-1.44
1975a	23.13	-26.48	3.70	15.94	13.35	9.81	8.96	-2.14
1976	64.22	22.08	0.43	1.71	2.35	7.64	20.30	9.71
1977	-13.66	9.42	-14.63	-1.72	-0.50	-1.66	-5.10	0.54
1978	-27.13	-1.51	-1.73	-1.36	-3.94	-8.77	-8.79	-1.03
1979*	31.67	22.57	6.01	3.10	2.19	7.07	-4.04	-5.24
1980*	31.67	1.68	12.86	3.77	-3.17	0.04	-4.20	-5.09

Source: See text, Chapter IV.C.2.2. Hidden unemployed are defined as the difference between Potential (Appendix D1.1) and Actual Labour Force. Periods of economic slowdown are marked by asterisks. Years in which major revisions of the Labour Force Survey were done are marked by an 'a'.

Appendix D2.2 Female Hidden Unemployed by Age groups 1952-1980
(thousands)

Year	TOTAL	Age Groups - 20	20-24	25-34	35-44	45-54	55-64	65 +
1952	8.03	7.66	0.36	-0.35	-5.96	4.43	0.41	1.49
1953*	32.52	1.94	-0.85	4.52	8.64	8.41	7.02	2.85
1954*	18.34	-1.34	1.81	2.29	7.08	4.75	2.26	1.49
1955	23.19	4.97	3.30	9.02	-0.57	2.35	3.61	0.51
1956	-4.29	-5.47	-1.31	2.93	4.52	-5.78	2.42	-1.59
1957	6.42	8.22	5.41	-0.80	0.36	-1.33	-3.90	-1.54
1958	28.50	10.79	4.93	8.11	2.10	1.96	0.92	-0.30
1959*	35.08	4.93	13.51	12.70	-0.79	3.21	1.05	0.48
1960*	9.23	0.34	10.45	10.07	-10.63	-2.57	2.53	-0.96
1961*	17.30	4.50	10.69	9.93	-2.20	-2.76	-1.55	-1.31
1962*	44.51	15.04	9.64	15.41	0.48	-0.90	2.61	2.23
1963*	45.12	15.61	11.22	12.49	6.21	-1.44	2.02	-1.00
1964	31.86	9.96	13.84	9.56	0.62	-0.82	1.02	-2.32
1965	36.59	8.98	11.54	15.91	1.27	-0.81	-2.34	2.05
1966a	-42.59	-22.81	-0.16	7.15	-7.63	-8.10	-8.89	-2.15
1967*	10.59	6.30	4.44	6.78	0.64	-9.45	2.08	-0.21
1968*	38.08	13.22	-2.37	10.49	14.81	1.65	2.54	-2.25
1969*	33.05	13.91	2.48	-4.83	2.75	17.77	-2.52	3.48
1970*	65.85	18.36	16.21	14.19	6.53	1.17	5.59	3.78
1971	52.03	6.88	12.12	12.11	12.79	10.63	-1.44	1.06
1972	60.55	6.20	6.07	1.47	13.44	11.22	14.99	7.17
1973	50.07	-3.21	10.30	13.21	18.91	11.13	-2.75	2.49
1974	88.46	-5.79	22.68	37.73	-3.44	12.21	21.95	3.12
1975a	-200.55	-47.52	-12.19	-70.32	-41.08	-19.77	-3.72	-5.95
1976	-49.65	3.55	-3.08	-23.49	-6.62	-19.77	-6.25	6.01
1977	-4.43	17.11	-11.14	-3.34	-12.23	5.12	1.50	-1.46
1978	-45.81	-2.57	-12.37	-27.17	-4.87	6.07	-0.94	-3.96
1979*	44.38	2.47	15.96	24.00	12.48	-2.27	-9.44	1.18
1980*	91.45	7.60	10.93	65.85	10.97	-2.46	2.37	-3.82

Source: See text, Chapter IV.C.2.2. Hidden unemployed are defined as the difference between Potential (Appendix D1.2) and Actual Labour Force. Periods of economic slowdown are marked by asterisks. Years in which major revisions of the Labour Force Survey were done are marked by an 'a'.

Appendix D2.3 Composition of Hidden Unemployed by Sex and Main Age groups 1952-1980
(thousands)

Year	TOTAL (HID)	MALES (HIDM)	Young (HIDYM)	Adult (HIDAM)	FEMALES (HIDF)	Young (HIDYF)	Adult (HIDAF)
1952	24.76	16.73	8.86	5.38	8.03	8.02	-1.88
1953*	54.53	22.01	0.22	12.89	32.52	1.09	21.56
1954*	56.37	38.03	7.02	17.80	18.34	0.47	14.12
1955	37.24	14.05	3.85	6.05	23.19	8.27	10.81
1956	-6.77	-2.49	-0.72	9.71	-4.29	-6.78	1.67
1957	19.54	13.12	5.15	13.98	6.42	13.63	-1.77
1958	71.16	42.66	10.55	21.54	28.50	15.72	12.17
1959*	87.46	52.38	16.46	26.69	35.08	18.44	15.11
1960*	44.97	36.74	6.88	22.38	9.23	10.79	-3.13
1961*	88.00	70.70	25.97	35.41	17.30	15.19	4.97
1962*	121.31	76.80	23.75	38.36	44.51	24.68	15.00
1963*	118.46	73.35	14.12	38.79	45.12	26.84	17.26
1964	107.62	75.76	24.66	46.43	31.86	23.80	9.35
1965	115.98	79.39	19.21	53.42	36.59	20.52	16.36
1966a	-170.31	-127.72	-34.92	-66.02	-42.59	-22.97	-8.58
1967*	12.13	1.38	1.99	-2.65	10.59	10.75	-2.02
1968*	36.66	-1.42	11.41	-5.99	38.08	10.85	26.95
1969*	72.07	39.02	25.11	17.62	33.05	16.40	15.68
1970*	31.81	-34.04	-9.80	-22.14	65.85	34.57	21.90
1971	50.30	-1.73	-5.11	-10.67	52.03	18.99	35.53
1972	57.99	-2.56	-13.35	3.17	60.55	12.27	26.13
1973	61.31	11.24	-10.64	11.03	50.07	7.09	43.24
1974	93.84	-5.38	-16.20	7.92	88.46	16.90	46.50
1975a	-177.42	23.13	-22.78	39.09	-200.55	-59.71	-131.17
1976	14.57	64.22	22.51	11.70	-49.65	0.47	-49.88
1977	18.09	-13.66	-5.22	-3.88	-4.43	5.97	-10.44
1978	-72.94	-27.13	-3.23	-14.08	-45.81	-14.93	-25.97
1979*	76.05	31.67	28.58	12.37	44.38	18.43	34.21
1980*	97.33	31.67	14.53	0.64	91.45	18.54	74.36

Source: Estimates based on Appendices D2.1 and D2.2. Periods of economic slowdown are marked by asterisks. Years in which major revisions of the Labour Force Survey were done are marked with an 'a'.

Appendix D3.1 Male Potential Employment Rates by Age groups 1952-1980
(%)

Year	TOTAL	Age Groups - 20	20-24	25-34	35-44	45-54	55-64	65 +
1952	96.49	91.68	95.22	97.29	97.34	97.08	96.91	96.67
1953*	96.10	92.78	95.31	96.27	97.27	96.64	96.92	93.07
1954*	94.02	88.96	91.76	94.64	95.47	95.11	94.10	93.21
1955	94.77	88.55	93.07	95.52	96.06	95.52	95.72	93.71
1956	96.20	92.43	94.08	96.16	96.79	96.49	96.44	100.00
1957	94.39	87.62	91.73	94.75	95.60	95.14	96.32	96.95
1958	91.43	80.71	87.25	91.74	93.42	92.36	92.33	91.62
1959*	92.06	83.14	88.49	92.60	94.35	93.27	93.38	93.07
1960*	91.18	82.50	87.36	91.88	93.06	92.57	92.01	93.97
1961*	90.26	78.79	86.96	91.04	92.79	91.73	91.07	92.17
1962*	91.69	83.83	87.34	92.84	94.19	92.62	91.45	92.53
1963*	92.22	84.99	88.75	93.23	94.47	93.58	92.64	88.70
1964	93.26	85.11	90.06	94.18	95.43	93.79	94.02	96.28
1965	94.10	89.00	91.98	95.01	95.71	94.21	94.84	93.51
1966a	98.42	94.49	97.47	98.59	99.25	98.95	98.42	100.00
1967*	95.39	88.98	93.49	96.33	96.79	96.61	95.74	93.37
1968*	94.60	86.05	91.37	95.82	96.45	95.72	95.70	96.55
1969*	94.19	84.03	91.22	95.42	95.91	95.86	95.41	95.79
1970*	94.05	84.95	90.22	95.43	96.05	95.85	94.73	95.56
1971	93.01	82.72	89.26	94.73	95.31	95.34	94.06	88.67
1972	93.25	85.76	88.77	94.49	95.62	94.91	94.68	90.54
1973	93.99	88.22	90.04	95.18	95.69	95.86	94.46	94.08
1974	94.42	89.47	90.58	95.30	96.23	95.99	95.15	95.99
1975a	93.58	88.38	89.15	94.05	95.32	95.36	94.73	100.00
1976	92.72	80.65	88.87	94.77	95.90	95.75	93.32	91.09
1977	92.89	80.63	88.79	94.20	95.69	95.84	95.67	97.35
1978	92.82	81.60	87.41	93.89	95.74	96.13	95.68	99.27
1979*	92.92	80.93	88.40	94.30	95.94	95.39	95.94	100.00
1980*	92.99	82.59	87.41	93.89	95.98	95.90	96.41	100.00

Source: Estimates of Potential Employment rates are based on actual employment and Potential or High-Employment Labour Force, see Appendix D1.1. Periods of economic slowdown are marked by asterisks. Years in which major revisions of the Labour Force Survey were done are marked by an 'a'.

Appendix D3.2 Female Potential Employment Rates by Age groups 1952-1980
(%)

Year	TOTAL	- 20	20-24	25-34	35-44	45-54	55-64	65 +
		Age Groups						
1952	97.14	92.31	97.52	98.28	100.00	95.61	98.00	93.39
1953*	95.79	96.31	98.38	96.93	95.22	93.87	90.76	83.15
1954*	95.97	95.60	96.57	96.74	95.14	95.75	95.84	93.38
1955	95.65	92.52	96.39	94.89	98.55	96.82	93.37	97.84
1956	98.46	98.03	98.57	97.03	97.44	100.00	96.22	100.00
1957	97.27	92.23	94.99	98.04	98.41	99.20	100.00	100.00
1958	94.53	88.61	94.23	94.18	96.91	96.96	96.53	100.00
1959*	94.78	91.50	91.65	93.82	98.34	97.49	96.66	98.61
1960*	95.90	91.30	92.59	94.43	100.00	99.08	95.83	100.00
1961*	95.26	89.56	92.38	94.30	98.37	98.88	98.29	100.00
1962*	94.33	87.79	93.33	93.13	97.47	98.03	96.40	92.16
1963*	94.41	87.53	92.24	94.32	96.38	98.31	96.35	99.99
1964	95.41	89.72	92.80	95.26	97.88	98.52	97.15	100.00
1965	95.62	90.52	93.89	94.03	97.83	98.87	99.65	93.51
1966a	99.34	100.00	97.58	96.29	99.91	100.00	100.00	100.00
1967*	96.60	90.59	95.68	96.38	97.93	100.00	97.21	100.00
1968*	95.11	87.98	96.16	95.40	[illegible]	97.56	97.16	100.00
1969*	95.14	87.21	95.87	98.17	[illegible]	93.66	99.39	89.14
1970*	93.23	83.80	92.12	94.31	95.91	97.36	94.72	92.08
1971	93.13	85.40	91.97	94.23	94.22	94.68	97.92	97.96
1972	92.73	86.96	92.54	95.14	94.26	94.49	91.76	83.05
1973	93.41	89.51	91.93	93.73	93.70	95.20	98.11	94.40
1974	92.56	90.83	90.06	91.28	97.29	95.32	90.25	90.87
1975a	97.14	94.07	92.49	99.68	100.00	97.76	96.13	100.00
1976	92.83	84.37	90.56	93.97	94.43	97.87	97.18	85.98
1977	90.66	80.68	89.66	91.45	94.37	92.78	94.08	100.00
1978	91.30	83.30	89.82	92.87	92.93	92.56	94.72	100.00
1979*	90.31	83.81	87.84	89.65	91.88	94.22	97.58	95.65
1980*	89.83	83.64	88.07	87.77	92.70	94.14	94.48	100.00

Source: Estimates of Potential Employment rates are based on actual employment and Potential or High-Employment Labour Force, see Appendix D1.2. Periods of economic slowdown are marked by asterisks. Years in which major revisions of the Labour Force Survey were done are marked by an 'a'.

Appendix E1.1 Population Composition and Variations, Selected Years

	Population Shares (%)				Absolute Variations in Pop. Shares			
	1950	1965	1970	1980	1950-65	1965-80	1970-80	1950-80
Males	50.15	49.55	48.77	49.43				
- 20	6.55	8.27	6.26	5.85	1.72	-2.42	-0.41	-0.70
20-24	5.37	5.03	5.76	6.10	-0.34	1.07	0.34	0.73
25-34	10.63	8.81	9.41	11.23	-1.82	2.42	1.82	0.60
35-44	9.32	9.25	8.64	8.15	-0.07	-1.10	-0.49	-1.17
45-54	7.25	7.62	7.60	6.99	0.37	-0.63	-0.61	-0.26
55-64	5.66	5.45	5.67	5.69	-0.21	0.24	0.02	0.03
65 +	5.38	5.12	5.13	5.53	-0.26	0.41	0.40	0.15
Females	49.85	50.45	51.23	50.57				
- 20	6.53	8.02	6.39	5.75	1.49	-2.27	-0.64	-0.78
20-24	5.71	5.17	6.26	6.09	-0.54	0.92	-0.17	0.38
25-34	11.16	9.02	9.69	11.15	-2.14	2.13	1.46	-0.01
35-44	9.14	9.50	8.75	7.90	0.36	-1.60	-0.85	-1.24
45-54	6.86	7.66	8.04	6.89	0.80	-0.77	-1.15	0.03
55-64	5.26	5.39	5.97	6.24	0.13	0.85	0.27	0.98
65 +	5.18	5.69	6.41	7.14	0.51	1.45	0.73	1.96
Young	24.16	26.49	24.67	23.79	2.33	-2.70	-0.88	-0.37
Adult	54.36	51.86	52.15	51.61	-2.50	-0.25	-0.54	-2.75
Older	21.48	21.65	23.18	24.60	0.17	2.95	1.42	3.12

Source: Based on data from Statistics Canada, The Labour Force (unpublished annual estimates).
Young: aged 24 yrs. and less; Adults: aged 25-54 yrs. and Older: aged 55 +.

Appendix F1.1 Earnings Differential Equations. 1951-1980
(OLSQ estimates)

	Const	lnEPR	$\ln P^{i}_{0}$	$\ln PR^{i}_{0}$	T	R^2	DW	lnL
	γ_0	γ_2	γ_3	γ_4	γ_1			
Males								
- 20	-5.142	4.397	-0.601	-2.294	0.054	0.898	1.20	25.0
	(0.9)	(2.9)	(1.4)	(6.5)	(0.4)			
20-24	11.725	-1.025	1.023	-2.523	0.081	0.922	2.87	45.7
	(4.8)	(1.4)	(3.1)	(4.4)	(2.0)			
25-34	7.759	0.653	0.487	-3.058	0.030	0.667	2.01	36.8
	(0.2)	(1.0)	(1.6)	(0.4)	(0.6)			
.....								
55-64	-83.610	-8.850	10.815	17.407	0.707	0.255	1.21	-19.8
	(2.1)	(1.8)	(2.3)	(2.7)	(2.6)			
65+	23.570	1.746	-7.965	1.085	-0.426	0.377	1.37	-11.4
	(1.6)	(0.7)	(3.3)	(0.5)	(0.6)			
Females								
- 20	-11.009	5.260	0.168	-2.625	0.325	0.860	1.78	19.5
	(1.7)	(3.5)	(0.3)	(5.1)	(3.0)			
20-24	4.220	-1.284	0.662	-0.246	0.119	0.406	1.41	44.9
	(2.6)	(1.3)	(2.5)	(0.3)	(1.6)			
25-34	1.798	0.912	-1.740	0.699	-0.292	0.800	1.32	52.8
	(1.4)	(2.1)	(6.7)	(1.8)	(2.5)			
35-44	1.600	-0.518	1.054	-1.214	0.550	0.275	0.31	29.8
	(0.3)	(0.7)	(1.2)	(2.1)	(2.7)			
45-54	-9.457	0.401	2.040	0.210	-0.278	0.605	1.06	44.9
	(3.6)	(0.9)	(6.6)	(0.8)	(2.3)			
55-64	-2.132	0.208	0.474	0.029	-0.156	0.343	0.63	36.0
	(1.0)	(0.3)	(0.7)	(0.2)	(1.6)			
65 +	-5.172	0.955	2.611	0.536	-0.656	0.795	1.73	16.5
	(0.8)	(0.7)	(1.4)	(1.4)	(2.7)			

Variables are defined in Chapter V.A.1, equation 6). Males aged (35-54) are excluded since they are the basic group of reference. ( ) denotes absolute value of the t-statistic; R^2 is adjusted R-square; DW is the Durbin-Watson statistic; lnL is the log value of the Likelihood function. Reported estimates for T have been multiplied by 10.

Appendix F1.2 Earnings Differential Equations Corrected for Autocorrelation 1951-1980
(AR1 estimates: TSP)

	Const	lnEPR	$\ln P^{i0}$	$\ln PR^{i0}$	T	R^2	DW	lnL	ρ
	γ_0	γ_2	γ_3	γ_4	γ_1				
Males									
- 20	-2.770	3.620	-0.595	-2.133	0.115	0.726	2.00	27.5	0.41
	(0.4)	(2.0)	(1.2)	(4.6)	(0.8)				(2.3)
20-24	12.816	-1.465	1.199	-2.514	0.091	0.974	1.97	50.5	-0.55
	(8.9)	(3.0)	(5.7)	(7.5)	(3.6)				(3.2)
25-34	7.846	0.654	0.488	-3.078	0.030	0.669	2.00	36.8	-0.005
	(0.2)	(1.0)	(1.6)	(0.4)	(0.6)				(0.0)
.....									
55-64	-84.223	-7.858	10.410	17.015	0.586	0.102	1.86	17.8	0.38
	(1.6)	(1.5)	(1.9)	(2.0)	(1.7)				(2.0)
65+	24.570	1.346	-7.895	-0.993	-0.393	0.270	1.64	-10.6	0.26
	(1.5)	(0.4)	(2.8)	(0.5)	(0.5)				(1.2)
Females									
- 20	-10.089	4.997	0.118	-2.543	0.337	0.825	1.95	19.7	0.11
	(1.5)	(3.1)	(0.2)	(4.6)	(2.9)				(0.5)
20-24	3.703	-1.155	0.562	-0.152	0.104	0.285	1.90	46.3	0.30
	(2.0)	(1.2)	(1.8)	(0.2)	(1.3)				(1.6)
25-34	3.409	0.355	-1.362	0.369	-0.144	0.574	2.07	55.6	0.58
	(2.1)	(0.7)	(4.9)	(1.1)	(1.4)				(3.7)
35-44	3.602	-0.760	0.075	-0.216	0.103	0.078	1.02	52.2	0.91
	(0.8)	(1.5)	(0.1)	(0.5)	(0.7)				(13.8)
45-54	-5.943	-0.145	1.869	-0.046	-0.130	0.418	1.71	49.2	0.53
	(1.9)	(0.3)	(4.1)	(0.1)	(0.9)				(3.3)
55-64	-1.825	0.001	0.626	0.039	-0.186	0.365	1.38	44.7	0.70
	(0.7)	(0.0)	(0.9)	(0.4)	(2.0)				(5.1)
65 +	-4.396	-0.865	2.312	0.460	-0.621	0.763	1.89	16.6	0.11
	(0.7)	(0.6)	(1.2)	(1.2)	(2.5)				(0.5)

Variables and Model are defined in the text, Chapter V.A.1, equation 6).
Males aged (35-54) are excluded since they are the basic group of reference.
( ) denotes absolute value of the t-statistic; R^2 is adjusted R-square;
DW is the Durbin-Watson statistic; lnL is the log value of the Likelihood function. Reported estimates for T have been multiplied by 10.

Appendix F1.3 Earnings Differential Equations. Partial Adjustment Model 1951-1980
(OLSQ estimates: TSP)

	Const	lnEPR	$\ln P^{i}_{0}$	$\ln PR^{i}_{0}$	T	$\ln DW^{i}_{-1}{}^{0}$	R^2	lnL	DW
	μ_0	μ_2	μ_3	μ_4	μ_1	μ_5			
Males									
- 20	-1.189	2.524	-0.572	-1.541	0.067	0.354	0.889	26.8	2.18
	(0.2)	(1.5)	(1.3)	(3.4)	(0.5)	(2.3)			
20-24	14.30	-1.379	1.326	-3.028	0.108	-0.261	0.992	45.0	2.41
	(4.7)	(1.8)	(3.3)	(4.5)	(2.3)	(1.4)			
25-34	7.215	0.643	0.491	-2.940	0.033	-0.013	0.650	35.1	1.98
	(0.2)	(0.8)	(1.5)	(0.4)	(0.6)	(0.1)			
.....									
55-64	-45.504	-6.600	4.686	11.404	0.726	0.397	0.396	-15.7	2.11
	(1.1)	(1.4)	(1.0)	(1.8)	(2.4)	(2.2)			
65+	25.128	-0.752	-5.691	-0.901	-0.169	0.390	0.436	-9.1	1.86
	(1.7)	(0.3)	(2.1)	(0.5)	(0.3)	(1.6)			
Females									
- 20	-7.358	3.726	0.109	-1.961	0.262	0.244	0.851	19.3	2.25
	(0.9)	(1.7)	(0.1)	(2.6)	(1.8)	(1.2)			
20-24	4.010	-1.656	0.419	0.350	0.057	0.404	0.483	45.9	2.23
	(2.5)	(1.8)	(1.6)	(0.4)	(0.7)	(2.2)			
25-34	3.574	-0.522	-1.003	0.890	-0.262	0.637	0.884	59.1	2.50
	(3.2)	(1.1)	(3.7)	(2.8)	(2.6)	(4.3)			
35-44	1.109	-0.747	0.315	0.182	-0.004	0.925	0.899	57.7	1.79
	(0.5)	(2.5)	(0.9)	(0.7)	(0.1)	(12.1)			
45-54	-3.828	-0.044	1.002	0.139	-0.135	0.561	0.699	47.6	2.00
	(1.1)	(0.1)	(2.2)	(0.6)	(1.0)	(2.9)			
55-64	2.541	-1.117	0.491	0.066	0.007	0.829	0.622	46.7	1.83
	(1.5)	(1.9)	(1.1)	(0.6)	(0.1)	(5.2)			
65 +	0.238	-1.600	1.783	0.327	-0.391	0.180	0.782	18.1	2.21
	(0.04)	(1.1)	(0.9)	(0.9)	(1.5)	(1.0)			

Model and variables are defined in Chapter V.B.1, equation 9). Males aged (35-54) excluded since they are the basic group of reference. ( ) denotes absolute value of the t-statistic; R^2 is adjusted R-square; DW is the Durbin-Watson statistic; lnL is the log value of the Likelihood function. Reported estimates for T have been multiplied by 10.

Appendix F2.1 Relative Earnings Equations, 1951-1980
(OLSQ estimates)

	Const γ_0	$\ln(L^i/L^0)$ γ_1	lnEPR γ_3	T γ_2	R^2	DW	lnL
Males							
- 20	5.824 (2.0)	1.432 (4.9	-1.679 (1.9)	-0.295 (4.9)	0.822	0.90	25.1
20-24	3.059 (1.9	-0.330 (1.6)	0.544 (1.0)	-0.095 (3.8)	0.800	1.25	53.1
25-34	5.178 (18.5)	-0.066 (2.1)	-0.117 (1.3)	-0.004 (0.6)	0.680	2.25	90.9
55-64	3.471 (3.9)	-0.896 (2.9)	1.034 (3.8)	-0.060 (3.0)	0.299	0.81	57.3
65+	0.974 (0.4)	-0.056 (0.1)	0.898 (1.7)	-0.071 (0.4)	0.034	0.55	29.5
Females							
- 20	4.912 (1.4)	1.590 (3.5)	-1.410 (1.3)	-0.549 (6.6)	0.790	1.12	18.3
20-24	0.107 (0.1)	-0.258 (1.6)	1.070 (1.9)	-0.037 (1.6)	0.345	1.24	55.7
25-34	6.118 (6.3)	0.398 (7.2)	-0.866 (3.1)	-0.083 (4.6)	0.674	1.00	61.4
35-44	-0.912 (0.7)	0.483 (2.0)	0.905 (2.9)	-0.242 (2.7)	0.241	0.26	45.4
45-54	6.839 (4.5)	-0.528 (3.1)	0.507 (1.5)	0.279 (3.0)	0.222	0.73	52.2
55-64	6.052 (5.1)	-0.135 (1.0)	-0.552 (2.0)	0.150 (1.9)	0.384	0.71	54.1
65+	4.857 (2.0)	-0.102 (0.6)	-0.341 (0.5)	0.231 (3.0)	0.772	1.29	32.6

Variables and Model are defined in the text, Chapter V.B.2, equation [illegible]).
Males aged (35-54) are excluded since they are the basic group of reference.
( ) denotes absolute value of the t-statistic; R^2 is adjusted R-square;
DW is the Durbin-Watson statistic; lnL is the log value of the Likelihood function. Reported estimates for T have been multiplied by 10.

Appendix F2.2 Relative Earnings Equations. Corrected for Autocorrelation 1951-1980
(AR1 estimates: TSP)

	Const	ln(L/L0)	lnEPR	T	R^2	DW	lnL	ρ
	γ_0	γ_1	γ_3	γ_2				
Males								
- 20	2.893	1.152	-0.723	-0.329	0.910	2.13	30.6	0.59
	(0.8)	(3.1)	(0.7)	(4.1)				(3.8)
20-24	3.563	-0.278	0.370	-0.088	0.972	2.31	55.3	0.37
	(2.2)	(1.2)	(0.7)	(3.0)				(2:1)
25-34	5.201	-0.065	-0.124	-0.004	0.986	1.98	91.1	-0.12
	(20.4)	(2.3)	(1.6)	(0.6)				(0.6)
55-64	4.274	-0.790	0.732	-0.030	0.991	1.78	63.7	0.64
	(1.6)	(1.5)	(1.9)	(2.0)				(4.3)
65+	1.574	-0.397	0.954	-0.134	0.956	1.60	40.3	0.77
	(0.6)	(0.9)	(1.3)	(0.8)				(6.6)
Females								
- 20	3.018	1.141	-0.649	-0.500	0.836	2.17	21.6	0.47
	(0.7)	(1.8)	(0.5)	(4.3)				(2.8)
20-24	1.044	-0.179	0.777	-0.039	0.968	1.95	58.1	0.39
	(0.6)	(1.0)	(1.3)	(1.3)				(2.2)
25-34	3.633	0.247	-0.132	-0.072	0.991	1.66	66.7	0.71
	(3.0)	(2.5)	(0.4)	(2.0)				(5.4)
35-44	1.654	0.131	0.457	-0.061	0.988	1.03	69.4	0.90
	(1.5)	(0.7)	(1.6)	(0.8)				(13.9)
45-54	2.847	-0.107	0.292	0.049	0.987	1.94	62.6	0.80
	(1.9)	(0.5)	(0.9)	(0.5)				(7.5)
55-64	4.704	-0.051	-0.239	0.098	0.985	1.50	61.9	0.70
	(3.5)	(0.3)	(0.7)	(1.1)				(5.2)
65 +	4.842	-0.033	-0.346	0.227	0.735	1.80	34.1	0.34
	(1.8)	(0.2)	(0.5)	(2.7)				(1.8)

Variables and Model are defined in the text, Chapter V.B.2, equation 17).
Males aged (35-54) are excluded since they are the basic group of reference.
( ) denotes absolute value of the t-statistic; R^2 is adjusted R-square;
DW is the Durbin-Watson statistic; lnL is the log value of the Likelihood function. Reported estimates for T have been multiplied by 10.

Appendix F2.3 Relative Earnings Equations. Distributed Lag Model 1951-1980 (PDL estimates: TSP)

	Const	$\ln(L^i/L^0)$	lnEPR	T	$\ln(W^i/W^0)_{-1}$	R^2	DW	lnL
	γ_0	γ_1	γ_3	γ_2	γ_4			
Males								
- 20	2.819	0.925	-0.966	-0.168	0.496	0.877	2.36	31.3
	(1.1)	(3.3)	(1.3)	(2.3)	(3.7)			
20-24	1.867	-0.154	0.311	-0.068	0.373	0.813	2.27	53.0
	(1.1)	(0.7)	(0.6)	(2.1)	(1.9)			
25-34	6.049	-0.078	-0.134	-0.005	-0.169	0.673	1.89	87.8
	(5.0)	(2.2)	(1.3)	(0.6)	(0.8)			
.....								
55-64	-0.054	-0.355	0.748	-0.054	0.616	0.631	2.23	65.0
	(0.1)	(1.3)	(3.4)	(3.0)	(4.5)			
65+	-2.942	0.036	1.002	-0.067	0.762	0.592	2.03	41.4
	(1.7)	(1.0)	(2.5)	(0.6)	(5.7)			
Females								
- 20	0.904	0.971	-0.375	-0.363	0.458	0.831	2.41	22.2
	(0.3)	(2.0)	(0.4)	(2.9)	(2.8)			
20-24	-1.555	-0.224	1.057	-0.035	0.451	0.476	2.23	57.5
	(0.9)	(1.6)	(2.1)	(1.4)	(2.7)			
25-34	-0.534	0.057	0.294	-0.043	0.801	0.845	2.00	68.1
	(0.3)	(0.6)	(0.9)	(2.2)	(4.4)			
35-44	-1.409	-0.084	0.477	-0.005	0.935	0.904	1.78	74.2
	(2.6)	(0.8)	(3.6)	(0.1)	(13.1)			
45-54	0.530	-0.144	0.116	0.059	0.820	0.659	2.34	62.6
	(0.3)	(1.0)	(0.4)	(0.7)	(5.7)			
55-64	-0.820	0.007	0.402	-0.036	0.806	0.615	1.75	63.3
	(0.5)	(0.1)	(1.5)	(0.5)	(5.0)			
65 +	0.939	-0.037	0.410	0.835	0.295	0.790	2.02	36.5
	(0.4)	(0.3)	(0.7)	(1.1)	(1.8)			

Variables and Model are defined in the text, Chapter V.B.2, equation 18). Males aged (35-54) are excluded since they are the basic group of reference. ( ) denotes absolute value of the t-statistic; R^2 is adjusted R-square; DW is the Durbin-Watson statistic; lnL is the log value of the Likelihood function. Reported estimates for γ have been multiplied by 10.