

An examination of the added- and the discouraged-worker effects  
in Canada at the end of the millennium

by

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## ABSTRACT

### **The added- and discouraged-worker effects**

The added- and discouraged-worker effects received a lot of attention in the 1960-70's as researchers attempted to understand the response of the labour force to cyclical changes in the demand for labour and in particular, the pattern of participation of those without a strong attachment to the labour force, i.e. youth, women and older men. Many empirical studies were conducted in Canada and in the United States using a variety of models. While the discouraged-worker effect was seen to prevail in the United States, the evidence in Canada was mixed. Interest in this subject seemed to wane in the following decades.

This paper takes a fresh look at the added- and discouraged-worker effects in the context of the changes in labour force participation of different age groups in Canada in the last three decades. After reviewing some of the seminal studies on the added- and discouraged-worker effects, some empirical tests are conducted to look at labour force participation during two distinct periods.

In addition to the unemployment rate (own rate and overall rate), a second cyclical variable is chosen that is not correlated with participation but is a good indicator of labour market conditions. Three regression models, involving eight different equations, are tested using seasonally adjusted quarterly statistics for five sex/age groups in 1962-1974 and 1985-2000. Since some of the labour force statistics are not stationary, differenced-equations are tested along with level equations.

The overall tests of significance indicate that the models have a strong explanatory power. However, the tests for autocorrelation show that the level equations are not sound due to autocorrelation. The signs of the significant coefficients are all positive for the capacity utilization variable and negative for the unemployment variables. The results show that the discouraged-worker effect dominates in both periods. No added-worker effect is observed.

Despite the limitations of a simple model like the one used in this paper, it appears that the focus of future research should be on the discouraged-worker effect, given the increased level of participation of women, the changes in the nature of employment, i.e., more casual, part-time and self-employed workers and the fact that many families are now two-earner families.

## Table of Contents

	<i>page</i>
<i>Abstract</i>	i
1. Introduction	1
2. Overview of trends in labour force participation over a century in Canada	6
2.1 Census analysis	6
2.2 Cohort analysis	9
2.3 Labour Force Survey	14
3. Review of the literature	19
3.1 U.S. studies	21
3.2 Canadian studies	30
3.3 Cross-sectional studies	40
3.4 Summary of findings from the literature review	42
4. Empirical study	43
4.1 Question	43
4.2 Methodology	43
4.2.1 Periods, variables, population and sources of data	43
4.2.2 Regression models	51
4.3 Regression results	53
5. Discussion	65
6. Conclusion	68
7. References	70
Appendix: Tables of values used in the study	73

**List of Tables**

Table 1	Labour force participation rates by age groups and sex, for 1901 and 1911 and census years 1921 to 2001.	8
Table 2	Labour force participation rates of male cohorts, 15-24 years, Canada 1921-2001.	12
Table 3	Labour force participation rates of female cohorts, 15-24 years, Canada 1921-2001.	13
Table 4	Econometric time-series studies conducted in the United States: comparing models and results.	28
Table 5	Explanatory variables in the study conducted by Officer and Andersen (1969).	33
Table 6	Econometric time-series studies conducted in Canada: comparing models and results.	38
Table 7	Correlation between the rates of capacity utilization and unemployment rates (quarterly data) for the periods 1962-1974 and 1985-2000.	51
Table 8	Significant regression results	56
Table 9	Equation 1: Regression results for males and females, by age group for 1962-1974 and 1985-2000.	57
Table 10	Equation 2: Regression results for males and females, by age group for 1962-1974 and 1985-2000.	58
Table 11	Equation 3: Regression results for males and females, by age group for 1962-1974 and 1985-2000.	59
Table 12	Equation 4: Regression results for males and females, by age group for 1962-1974 and 1985-2000.	60
Table 13	Equation 5: Regression results for males and females, by age group for 1962-1974 and 1985-2000.	61
Table 14	Equation 6: Regression results for males and females, by age group for 1962-1974 and 1985-2000.	62

Table 15	Equation 7: Regression results for males and females, by age group for 1962-1974 and 1985-2000.	63
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Table 16	Equation 8: Regression results for males and females, by age group for 1962-1974 and 1985-2000.	64
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### List of Figures

Figure 1	Labour force participation rates for males and females, 15 years and older, from 1901 to 2001.	7
----------	--	---

Figure 2	Male cohorts at different points in time.	12
----------	---	----

Figure 3	Female cohorts at different points in time.	13
----------	---	----

Figure 4	Annual participation rate (PR) by sex, age group in Canada, 1946-2002.	16
----------	--	----

Figure 5	Male participation rate (PR) by age group and unemployment rate (UR) for the total labour force, 1946-2002.	17
----------	---	----

Figure 6	Female participation rate (PR) by age group and unemployment rate (UR) for the total labour force, 1946-2002.	18
----------	---	----

Figure 7	Male detrended seasonally adjusted quarterly participation and unemployment rates, 1962-1974.	47
----------	---	----

Figure 8	Female detrended seasonally adjusted quarterly participation and unemployment rates, 1962-1974.	48
----------	---	----

Figure 9	Male detrended seasonally adjusted quarterly participation and unemployment rates, 1985-2000.	49
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Figure 10	Female detrended seasonally adjusted quarterly participation and unemployment rates, 1985-2000.	50
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## 1. Introduction

Wherever slavery does not exist, labour force participation is the result of a decision to take part in labour market activities as opposed to leisure or non-labour market activities, such as unpaid housework, full-time parenting, school attendance, voluntary work or retirement. Three sets of factors influence labour force activity, according to Fortin & Fortin (1999: 13): 1) the preferences and the characteristics of the workforce; 2) the prevailing economic conditions; and (3) the degree of availability of safety net measures to supplement income.

This paper will examine labour force participation during economic downturns and will attempt to find out if the business cycle has the same effect on participation today as it had in the past for different age groups. The evolution of different groups' preferences for labour force activity is captured by census data. While the participation rate of the core male workforce has remained more or less constant over time, some groups show interesting changes in levels of participation e.g., youth, older workers, women, new immigrants, etc. This is why those groups have attracted a lot of attention from researchers.<sup>1</sup>

Tracking the evolution of the labour force, in both the short and the long term, is important because changes in participation have an effect on the economy, influence social institutions and create particular challenges for planners and policy makers (Gunderson 1991: 23-5).<sup>2</sup> According to Denton and Ostry (1967: 6), the term "labour force" was coined in the United States in the 1930's and early techniques devised to measure fluctuations in

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<sup>1</sup> While recognizing that types of economic development, public policies, employment conditions, health, job characteristics, etc. influence labour force participation, these subjects are beyond the scope of this paper.

<sup>2</sup> The increased participation of women in the last decades for example, has brought to the forefront issues such as: problems facing two-earner families, the availability of child care, flexible work arrangements, equal pay and equality of opportunity, access to education and professional training and adjustments to policies like unemployment insurance, etc.

participation originated “within the framework of a national policy directed towards providing work-relief for the mass unemployment of the Great Depression.”

The size and the composition of the labour force also vary in the short-term, in response to cyclical changes in the demand for labour. Not surprisingly, early labour market researchers were preoccupied with finding the proper way of measuring unemployment and, above all, the correct interpretation of these data. Woytinsky (1940) challenged the validity of the unemployment figures released during the Depression in the U.S.. He argued that the true level of unemployment was significantly lower than the one reported in published data, due to the distortion created by additional job seekers (“forced-entrants”) who did not usually engage in gainful employment. He maintained that there was a difference between additional workers and supplementary workers. Supplementary workers are all the other normal breadwinners in a family, besides the main breadwinner. In contrast, an additional worker is “the person who is on the labour market because of the unemployment of the usual breadwinner in his family and who otherwise would not be seeking work.”<sup>3</sup> Woytinsky set out to demonstrate that the unemployment estimates that were reported at the time described the “visible” level of unemployment (including additional workers) and were not representative of the true (lower) “base point” level of unemployment. Following his theory, the labour force would expand in a period of recession and contract during a period of economic recovery, as additional workers would gradually withdraw from the labour force.<sup>4</sup>

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<sup>3</sup> W.S. Woytinsky (1940: 1), contended, in his book, *Additional Workers and the Volume of Unemployment in the Depression*, that the characteristics of the additional workers joining the workforce in times of boom and in times of depression were different.

<sup>4</sup> See Woytinsky (1940: 6) for a detailed description of his theory and methodology. He devised a complex method to estimate the number of additional workers based on the “visible” concentration of unemployment by family (see his Appendix A, pp. 27 ff.). He estimated that for each group of 1,000 workers laid-off during the Depression, 1,100-1250 job seekers were created.

Woytinsky's theory was challenged. Humphrey (1940) argued that, while some individuals joined the labour force in periods of high unemployment, others withdrew from it. He also rejected Woytinsky's assumption that the presence of multiple job seekers in the same family as the main earner who is unemployed was a proof of the additional worker theory. Humphrey pointed out that the unemployment rate was, not surprisingly, consistently higher among supplementary workers in a multi-worker household "because of their youth or old age and/or because their training and work history are inferior to that of the family head".<sup>5</sup> Using the same census data, Humphrey was unable to replicate Woytinsky's results for Philadelphia between 1929 and 1936: there were no significant changes in the number of one-, two-, three- or more worker families and no significant changes in the level of unemployment associated with different types of family structure over the period studied. Humphrey concluded that these data could not be used to demonstrate the presence of additional workers.<sup>6</sup>

Another development contributed to the debate about the means of measuring the level of unemployment. In the 1960's, empirical findings started to reveal that the labour force did not expand at the same rate during a period of recession as might be predicted, based on the long-run trend in the growth of the labour force (Mincer 1973: 27). The notion was that the economic downswing convinced some people who wanted to work to either delay their entry into the labour force, or stop looking for a job if they were currently unemployed, in the belief that opportunities were not available. The net outcome of delays in joining and voluntary withdrawals from the labour force came to be known as the "discouragement effect."

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<sup>5</sup> Humphrey (1940: 415). He added pointedly: "Unemployment was not distributed on a random basis in 1929, 1930, 1931, 1932, 1937, or in any other year."

<sup>6</sup> Ibid. pp. 417.

The debate over the relative importance of the added- and discouraged-worker effects generated a lot of interest from researchers in the 1960's and 1970's, in line with the theory on income and substitution effects. While all recognized that both added- and discouraged-worker effects coexisted, researchers focused on measuring the magnitude of this in-and-out non-seasonal responsiveness of the labour force and on determining which effect was dominant overall for each group of workers.

While some authors raised questions regarding the limitations of the analytical tools (Mincer 1966: 74) and the insufficiency of time-series data available to study this phenomenon (Bowen and Finegan 1969: 506), what captured the imagination of Canadian researchers was the fact that while the discouraged-worker effect appeared to dominate in the U.S., in Canada, the evidence was mixed (Gunderson 1980: 53). Swidinsky (1970: 150) wondered whether it was a case that the short-run behaviour of the Canadian labour force was "rather complex."

Several Canadian studies covering the period of the 1950's to 1970's (Kaliski 1962, Proulx 1969, Swidinsky 1969, Officer and Andersen 1969, Davis 1971, Donner and Lazar 1975, and Swan 1974) gave strong support to the dominance of the added-worker effect for women, at least for some age groups.<sup>7</sup> However, the last study on this subject dating from that period concluded that both the added- and the discouraged-worker effects were observed, but a small net discouraged-effect dominated for most age groups (Kuch and Sharir 1978). In the following decades, economists seem to have lost interest in the controversy. However, the discouraged-worker effect continues to be at the forefront of research and Statistics Canada's Labour Force Survey now directly monitors the number of discouraged workers through specific questions.

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<sup>7</sup> All those studies were based on Labour Force Survey data from the 1950's to the 1970's.

This paper takes a fresh look at the added- and discouraged-worker effects in the context of the changes in labour force participation in Canada in the last decades. Are the growing reliance on non-permanent, contract or part-time workers and the growing importance of service industry employment, which happens to be the most vulnerable in times of recession, creating a new environment for added and discouraged workers? After reviewing past econometric studies on the added- and discouraged worker effects, some empirical tests are conducted to look at labour force participation during two separate periods, i.e., 1962-1974 and 1985-2000. The results found when using a model similar to models used in previous studies, albeit correcting for some known problems, will be compared with the results obtained when using a different cyclical variable to account for labour market conditions.

The remainder of this paper has five parts. It starts with an overview of the trends in labour force participation over time in Canada and the observed annual changes in participation rate for different age/sex groups. This is followed by a survey of the literature, with a focus on studies conducted in Canada in the sixties and seventies and on several of the seminal studies conducted in the United States around the same time. All aspects of the methodology related to the empirical study, including data, models and tests performed, as well as results appear in the following section. The discussion puts the findings in the context of the previous studies reviewed earlier and the conclusion summarizes the main findings and highlights questions for further research.

## 2. Overview of trends in labour force participation over a century in Canada

Over time, researchers have used different types of data to examine the trends in labour force activity in Canada. The most important sources of data are censuses (conducted every ten years at first, then every five years) and the Labour Force Survey.<sup>8</sup> These sources provide information on different aspects of the labour market. They vary in terms of data collected, frequency of survey or collection, population and subgroups targeted, methodologies and definitions used. Comparable data are not always available for all periods and this makes longitudinal studies more difficult to conduct.

### 2.1 Census data

The earliest data relating to the workforce in Canada are those of censuses. Early raw census data are, however, of limited use to researchers because definitions and measurement procedures were known to change from one census to the next (Denton 1983: Section D in *Historical Statistics of Canada*). The current concepts employed to describe the labour force have only been in use since 1946: the censuses conducted between 1881 and 1941 employed the concept of “gainful occupation” as opposed to the currently used “labour force.” Despite the existence of corrected historical labour force estimates, tabulated by Denton and Ostry (1967) for the period from 1901 to 1941, early historical data on the labour force are not entirely comparable with later data (Crompton and Vickers (2000: 3).<sup>9</sup> With this caveat in mind, those historical estimates, based on census data, are presented in Table 1 to provide a

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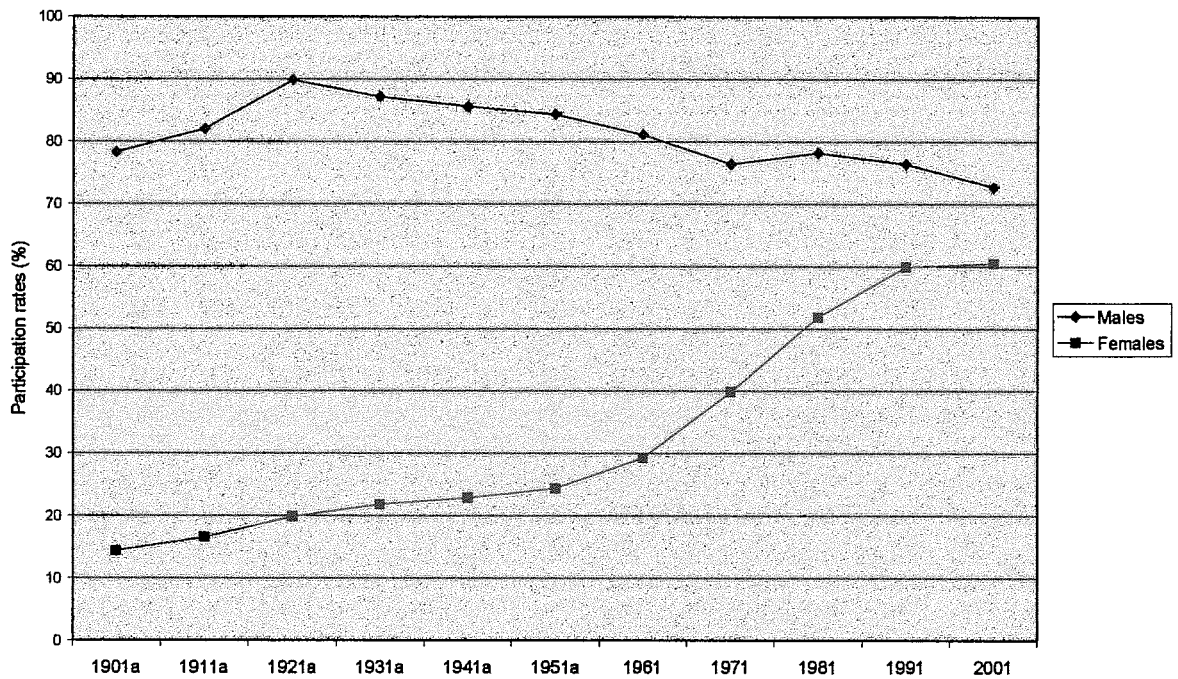
<sup>8</sup> Other useful sources but more limited in scope are the Employment Survey, the Help-Wanted Index and the Job Vacancy Survey.

<sup>9</sup> The first column in Table 1 demonstrates this break starting in 1951, where the labour force participation rate for the whole population appears to be receding. According to Denton (1983: Section D), that is the first year at which the labour force concept used in the census became in line with the one used in the Labour Force Survey.

long-range overview of the trends in labour force participation in Canada over the last one hundred years.

The overall participation rate of working age<sup>10</sup> Canadian males and females has increased over the course of the century, although it has experienced some fluctuations. It went from 53% in 1901 to 66.4% in 2001. This increase is due mostly to the remarkable growth in female participation, from a low of 16.1% in 1901 to a high of 60.5% in 2001. This is almost a fourfold increase. In contrast, male participation decreased overall, from a high of 90.6% in 1911 to 72.7% in 2001. Figure 1 clearly shows that male and female participation rates have been steadily converging, especially over the last fifty years.

Figure 1. Labour force participation rates for males and females 15 years and older, Canada, 1901-2001 (a indicates 14 years and older).



<sup>10</sup> Age 14 and over until 1951, and 15 and over thereafter.

**Table 1. Labour force participation rates by age group and sex, for 1901 and 1911 and decennial census years 1921 to 2001**

Year	15+		15-19		20-24		25-34		35-44		45-54		55-64		35-64		65+		
	Both	Males	Females	Males	Females	Males	Females	Males	Females	Males	Females	Males	Females	Males	Females	Males	Females	Males	Females
1901	53.0 <sup>a</sup>	87.8 <sup>a</sup>	16.1 <sup>a</sup>	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
1911	57.4 <sup>a</sup>	90.6 <sup>a</sup>	18.6 <sup>a</sup>	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
1921	56.2 <sup>a</sup>	89.8 <sup>a</sup>	19.9 <sup>a</sup>	68.4 <sup>a</sup>	29.6 <sup>a</sup>	94.3	39.8	19.5	12.2	n.a.	n.a.	n.a.	n.a.	n.a.	96.9	12.0	59.6	6.6	6.6
1931	55.9 <sup>a</sup>	87.2 <sup>a</sup>	21.8 <sup>a</sup>	57.4 <sup>a</sup>	26.5 <sup>a</sup>	93.9	47.4	24.4	14.3	n.a.	n.a.	n.a.	n.a.	n.a.	96.7	13.2	56.5	6.2	6.2
1941	55.2 <sup>a</sup>	85.6 <sup>a</sup>	22.9 <sup>a</sup>	54.6 <sup>a</sup>	26.8 <sup>a</sup>	92.6	46.9	27.9	18.1	n.a.	n.a.	n.a.	n.a.	n.a.	96.1	15.2	47.9	5.8	5.8
1951	54.3	84.0	24.1	58.6	37.8	92.4	46.9	24.2	21.8	94.5	20.4	14.5	11.1	14.5	93.2	19.6	38.6	5.1	5.1
1961	54.0	78.1	29.7	41.4	34.2	87.2	49.5	29.6	31.1	91.9	33.4	24.4	14.5	24.4	90.6	30.3	28.4	6.7	6.7
1971	58.0	76.4	39.9	46.6	37.0	86.5	62.8	44.5	43.9	90.3	44.4	34.4	34.4	34.4	88.6	41.5	23.6	8.3	8.3
1981	64.8	78.2	51.8	48.6	44.5	90.9	77.2	65.8	64.3	95.2	77.4	55.9	77.4	35.7	89.4	53.2	17.3	6.0	6.0
1991	67.9	76.4	59.9	49.1	47.5	88.2	81.1	78.5	79.6	94.5	91.5	71.9	66.5	39.2	86.8	67.2	14.4	5.6	5.6
2001	66.4	72.7	60.5	49.6	50.2	82.6	78.0	79.8	81.1	92.1	89.3	77.1	64.3	44.0	84.7	71.1	13.6	5.1	5.1

Sources:

Data for the period 1901-1941 were taken from: *Historical Estimates of the Canadian Labour Force*, by Frank T. Denton and Sylvia Ostry, Dominion Bureau of Statistics, Ottawa 1967 and Sylvia Ostry (1968) *The Female Worker in Canada*, Dominion Bureau of Statistics. These data include residents of the Yukon and Northwest Territories, Indians living on reserves and members of the Armed Forces, and exclude inmates of institutions. Data for the period 1951-2001 were taken from: Census data for those years, extracted from a document produced by Statistics Canada entitled *Labour Force and Individual Income - Historical Labour Force, for Canada and Provinces, 1911-1971*, Catalogue number 94-702, Vol. III, Part 1, *Labour Force Activity - The Nation, Catalogue number 93-324*, and the 2001 Census files available on Statistics Canada's internet site, Catalogue number 97F0012XCB01001 at <http://www.12statcan.ca/english/census01>.

<sup>a</sup> Includes 14 years old.

n.a. indicates data are not available for these age groups.

While male participation rates still exceed women's in all age groups, there has been a decrease in participation for all male age groups. All female age groups present variable but definite increases in participation, with the exception of the group 65 years and older, which has decreased slightly, from 6.6% in 1921 to 5.1% in 2001, but which had reached a high of 8.3% in 1971. By far the greatest increase in participation for women was evident in the middle age groups, 35-44 and 45-54. This means that a significant proportion of married women and women with children in 2001 continued in the labour force compared to the beginning of the century. For the first time in 2001, the participation rate of women increased in each age group from 15-19 through 35-44 and only declined by 4% once women reached the 45-54 age group. This seems to indicate that, as a group, women now have a strong attachment to the labour force compared to their counterparts in earlier times. In prior decades, women entered the labour force in their youth and early adulthood, withdrew from it during their childbearing years and sometimes returned when they were in their forties or fifties and their children were older. The participation rate of women aged 55-64 has been increasing steadily over the decades, which is the opposite of the trend observed with men. Once they have joined the labour force, men remain in it until retirement, which is arriving at an earlier age with each decade. The participation rate of young males 14-24 years was over twice that of young females in the early decades of the last century but both were nearly even in 2001.

## **2.2 Cohort analysis**

Another way of looking at labour force activity is to trace the participation profiles of different cohorts of males and females over their lifetime. A cohort is composed of

individuals born during a specific period, i.e., a ten-year period in the present case. Ostry (1968: 6) used a cohort analysis to examine female labour force activity from the beginning of the last century up to the census results of 1961. She explained: “In this way, one can examine changes in the labour market activity of these women as they age and as their circumstances, familial as well as social and economic, change.” Her model<sup>11</sup> is expanded here to include an examination of male cohorts and integrate census data that are now available for the period from 1971 to 2001.

Tables 2 and 3 show that a cohort of individuals born between 1877 and 1886 were between 15 and 24 years old in 1901, which means they had reached an age at which they could possibly be entering or taking part in the labour force. That same cohort would have been between 24-34 years old in 1911, etc.<sup>12</sup> Despite missing data, the tables show very different profiles for male and female cohorts. Figures 2 and 3 show these profiles graphically.

Figure 2 confirms that the cohort profiles of male participation have retained the same shape over the decades but they have incrementally shifted downwards. For each successive cohort, the profiles show a steep rise as the maximum number of males has joined the labour force by the time they are between 25 and 34 years of age. This trend is followed by a twenty-year period during which male labour force activity is relatively stable. Then the downward trend in participation becomes evident, especially after males reached the 45-54 age range.

The cohort profiles for females have changed dramatically over the decades. From cohort to cohort, a growing proportion of females entered the labour force once they had

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<sup>11</sup> Format of tables and size of cohorts are modeled on the study conducted by Ostry (1968) for female workers.

<sup>12</sup> All historical data that were obtainable were included in the tables; some manipulation of data was necessary to fit the required age groups (e.g., 35-64).

reached the working age. On the graph, each female profile lies above the preceding one and the shifts are impressive. Although some data are missing, the participation rates of females who joined the labour force in 1901 and 1911 remained relatively flat during their working life. The 1921 and 1931 cohorts reduced their labour force activity as they approached the 35-44 year bracket, but later returned to the labour force. That two-peak phenomenon became more apparent with the 1941 and 1951 cohorts but interestingly, the trough or lower participation rates occurred at a younger age. By the time the 1961 cohort joined the labour force, the participation profile of females was to change once again. Although the rate of growth in participation varied for that cohort, it never decreased until they reached the 45 to 54-year age range. The 1971 cohort showed a steady increase in participation, up to a maximum reached at 35-44 years, which more or less plateaued after that age. The 1981 and 1991 female cohorts show a pattern of participation similar to their male peers, albeit at a slightly lower level of participation. The female cohort data just examined illustrate what Ostry (1968: 47) has described as “essentially an evolutionary development, founded on long-run, fundamental social and economic trends”.

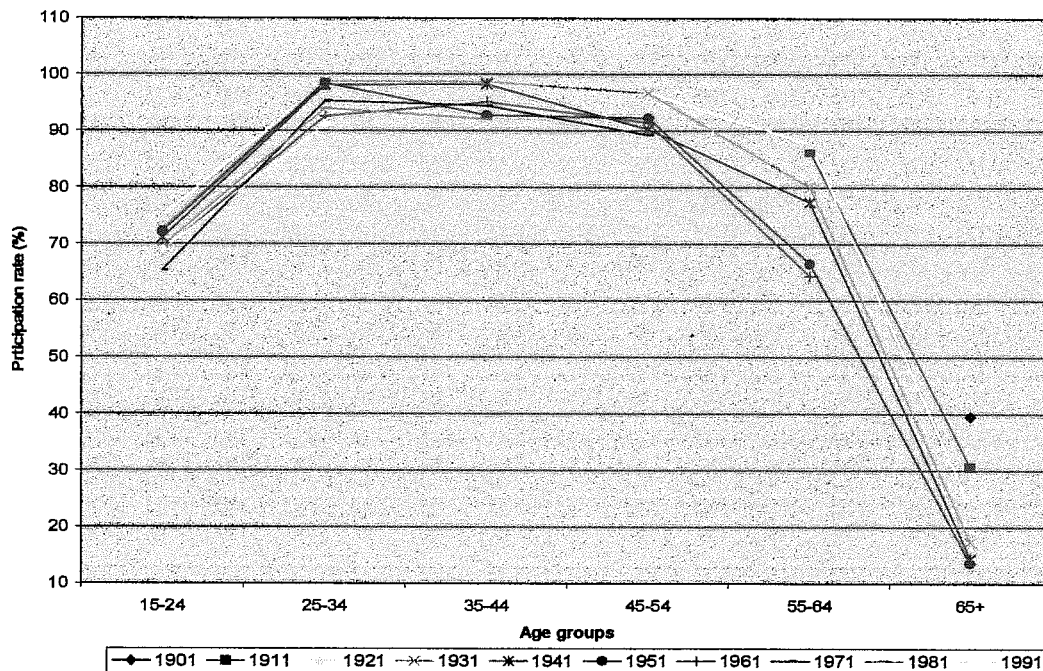
**Table 2. Labour force participation rates of male cohorts, Canada 1921-2001**

Date at which cohort was:		Age range and Participation rate of cohort in:										
Born	15-24 years old	1901	1911	1921	1931	1941	1951	1961	1971	1981	1991	2001
1877-1886	1901	(15-24) n.a.	(25-34) n.a.	(35-44)	(45-54)	(55-64)	(65+) 39.5 <sup>a</sup>					
1887-1896	1911		(15-24) n.a.	(25-34) 98.0 <sup>a</sup>	(35-44)	(45-54)	(55-64) 86.4 <sup>a</sup>	(65+) 30.6 <sup>a</sup>				
1897-1906	1921			(15-24) 74.9 <sup>a,b</sup>	(25-34) 98.6 <sup>a</sup>	(35-44)	(45-54) 96.7 <sup>a</sup>	(55-64) 87.8 <sup>a</sup>	(65+) 23.6			
1907-1916	1931				(15-24) 72.8 <sup>a,b</sup>	(25-34) 98.7 <sup>a</sup>	(35-44) 96.7 <sup>a</sup>	(45-54) 96.7 <sup>a</sup>	(55-64) 80.1	(65+) 17.3		
1917-1926	1941					(15-24) 71.1 <sup>a,b</sup>	(25-34) 98.2 <sup>a</sup>	(35-44) 98.3 <sup>a</sup>	(45-54) 90.3	(55-64) 77.4	(65+) 14.4	
1927-1936	1951						(15-24) 72.2 <sup>a,b</sup>	(25-34) 98.4 <sup>a</sup>	(35-44) 92.8	(45-54) 92.3	(55-64) 66.5	(65+) 13.6
1937-1946	1961							(15-24) 68.7 <sup>a</sup>	(25-34) 92.6	(35-44) 95.2	(45-54) 91.5	(55-64) 64.3
1947-1956	1971								(15-24) 65.3	(25-34) 95.3	(35-44) 94.5	(45-54) 89.3
1957-1966	1981									(15-24) 69.7	(25-34) 94	(35-44) 92.1
1967-1976	1991										(15-24) 68.9	(25-34) 91.2
1977-1986	2001											(15-24) 65.5

Sources: Data for 1921 to 1961 are taken from F.T. Denton & S. Ostry (1967) *Historical Estimates of the Canadian Labour Force*; data for 1971 are taken from *Labour Force and Individual Income*, 1971 Census of Canada, Catalogue Number 94-704 Vol. 3, Part 1; data for 1981 to 2001 are taken from 1981 to 2001 Censuses, Statistics Canada Catalogue number 97F0012XCB01001.

<sup>a</sup> includes residents of the Yukon and Northwest Territories, Indians living on reserves, and members of the Armed Services, and excludes Newfoundland and inmates of institutions; <sup>b</sup> 14-24; n.a. indicates data are not available for those age groups.

**Figure 2. Male cohorts at different points in time**



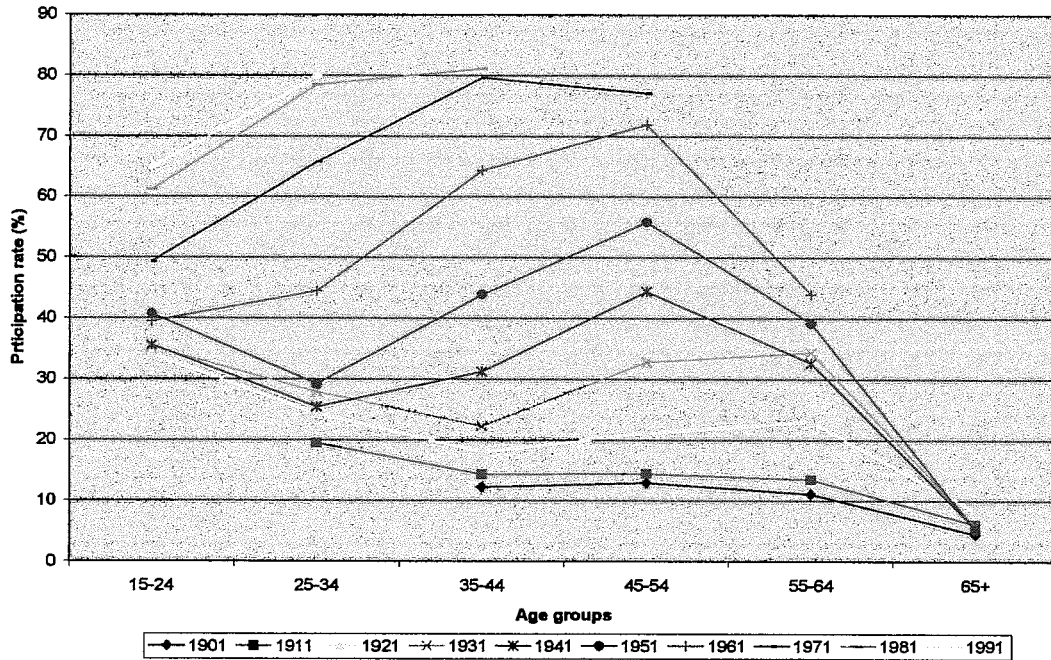
**Table 3. Labour force participation rates of female cohorts, Canada 1921-2001**

Date at which cohort was:		Age range and participation rate of each cohort in:										
Born	15-24 years old	1901	1911	1921	1931	1941	1951	1961	1971	1981	1991	2001
1877-1886	1901	(15-24) n.a.	(25-34) n.a.	(35-44) 12.2 <sup>c,d</sup>	(45-54) 12.9 <sup>c</sup>	(55-64) 11.1 <sup>c</sup>	(65+) 4.5 <sup>a</sup>					
1887-1896	1911		(15-24) n.a.	(25-34) 19.5 <sup>a</sup>	(35-44) 14.3 <sup>c</sup>	(45-54) 14.5 <sup>c</sup>	(55-64) 13.5 <sup>a</sup>	(65+) 6.1 <sup>a</sup>				
1897-1906	1921			(15-24) 34.1 <sup>a,b</sup>	(25-34) 24.4 <sup>a</sup>	(35-44) 18.1 <sup>c</sup>	(45-54) 21.1 <sup>a</sup>	(55-64) 23.1 <sup>a</sup>	(65+) 8.3			
1907-1916	1931				(15-24) 35.3 <sup>a,b</sup>	(25-34) 27.9	(35-44) 22.3 <sup>a</sup>	(45-54) 32.8 <sup>a</sup>	(55-64) 34.4	(65+) 6		
1917-1926	1941					(15-24) 35.6 <sup>a,b</sup>	(25-34) 25.4 <sup>a</sup>	(35-44) 31.2 <sup>a</sup>	(45-54) 44.4	(55-64) 32.7	(65+) 5.6	
1927-1936	1951						(15-24) 40.7 <sup>a,b</sup>	(25-34) 29.2 <sup>a</sup>	(35-44) 43.9	(45-54) 55.9	(55-64) 39.2	(65+) 5.1
1937-1946	1961							(15-24) 39.5 <sup>a</sup>	(25-34) 44.5	(35-44) 64.3	(45-54) 71.9	(55-64) 44
1947-1956	1971								(15-24) 49.3	(25-34) 65.8	(35-44) 79.6	(45-54) 77.1
1957-1966	1981									(15-24) 61.2	(25-34) 78.5	(35-44) 81.1
1967-1976	1991										(15-24) 64.9	(25-34) 79.8
1977-1986	2001											(15-24) 63.9

Sources: Data for 1921 to 1961 are taken from F.T. Denton & S. Ostry (1967) *Historical Estimates of the Canadian Labour Force*; data for 1971 are taken from *Labour Force and Individual Income*, 1971 Census of Canada, Catalogue Number 94-704 Vol. 3, Part 1; data for 1981 to 2001 are taken from 1981 to 2001 Censuses, Statistics Canada Catalogue number 97F0012XCB01001.

<sup>a</sup> includes residents of the Yukon and Northwest Territories, Indians living on reserves, and members of the Armed Services, and excludes Newfoundland and inmates of institutions; <sup>b</sup> 14-24; <sup>c</sup> Sylvia Ostry (1968) *The Female Worker in Canada*, Dominion Bureau of Statistics; <sup>d</sup> 35-49.

**Figure 3. Female cohorts at different points in time**



### 2.3 Labour Force Survey

The Canadian Labour Force Survey (LFS) started in 1945, in response to a need for reliable and timely data on the evolution of the labour market, at a time of major labour changes associated with the transition from a wartime to a peacetime economy.<sup>13</sup> National and regional data on employment by industry and occupation were collected on a quarterly basis from 1945 to 1952 and monthly thereafter. The LFS is the sole source of monthly estimates on all aspects of employment, unemployment (also those not in the labour force) and the characteristics of the workforce. The LFS estimates are compiled from the survey of a large number of households<sup>14</sup> representing the civilian, non-institutionalized population above 15 years of age on a specific week.<sup>15</sup> The full sample consists of six sub-samples of households that stay in the sample for a period of six months.

The first modifications to the LFS took place in 1960 when some categories were adjusted and renamed: “persons with jobs” were relabeled “employed” but the category excludes temporary layoffs; individuals on temporary layoff and “persons without jobs and seeking work” became the new “unemployed” category.<sup>16</sup> In 1976, the Survey underwent significant changes with the introduction of a new questionnaire and a new set of operational

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<sup>13</sup> Statistics Canada, *Guide to the Labour Force Survey*, Catalogue no. 71-543-GIE, p. 4.

<sup>14</sup> The number of households included in the survey went from 30,000 in 1953 (*Historical Labour Force Statistics, Actual Data, Seasonal Factors, Seasonally Adjusted Data*, Introduction) to approximately 54,000 starting in 1995 (idem footnote 15, p. 16).

<sup>15</sup> The starting age was 14 years and older before 1961. Excluded from the LFS are: residents of the Territories, persons living on Indian reserves, inmates of institutions and (full-time) members of the Canadian Armed Forces.

<sup>16</sup> Historical series of monthly estimates, based on the same methodology (e.g., summation or direct methods), have been published by Statistics Canada for selected periods (i.e., 1953-74, 1961-74, 1965-74 and 1966-74). However, monthly estimates that are consistent with the current methodology go back only as far as 1966, and those estimates are not seasonally adjusted.

definitions (Denton 1983: Section D). The LFS data are re-weighted after the results of each census are known to reflect better the true composition and location of the population.<sup>17</sup>

LFS annual average participation rates for males and females in different age groups are presented in Figure 4, for the period 1946-2002. Youth (14/15 to 19 years) and young adults are the two groups with a weaker attachment to the labour force over this period. Women and older males show reverse trends in participation. The effect on the aggregate participation of females of each successive cohort joining the labour force shows as an upward nearly smooth line in the lower right figure.

Figure 5 and Figure 6 show the male and female participation rates for the same age groups as shown in Figure 4, against the prevailing unemployment rate for the total labour force. By adjusting the separate axes, it becomes apparent that labour force activity (left axis) and the prevailing unemployment rate (right axis) rarely move in the same direction. Although the response is not uniform over the entire period, the participation of males and younger and older females seems to be more sensitive to the prevalent unemployment rate. Over the entire period, female participation seems not to be greatly affected by the rate of unemployment.<sup>18</sup>

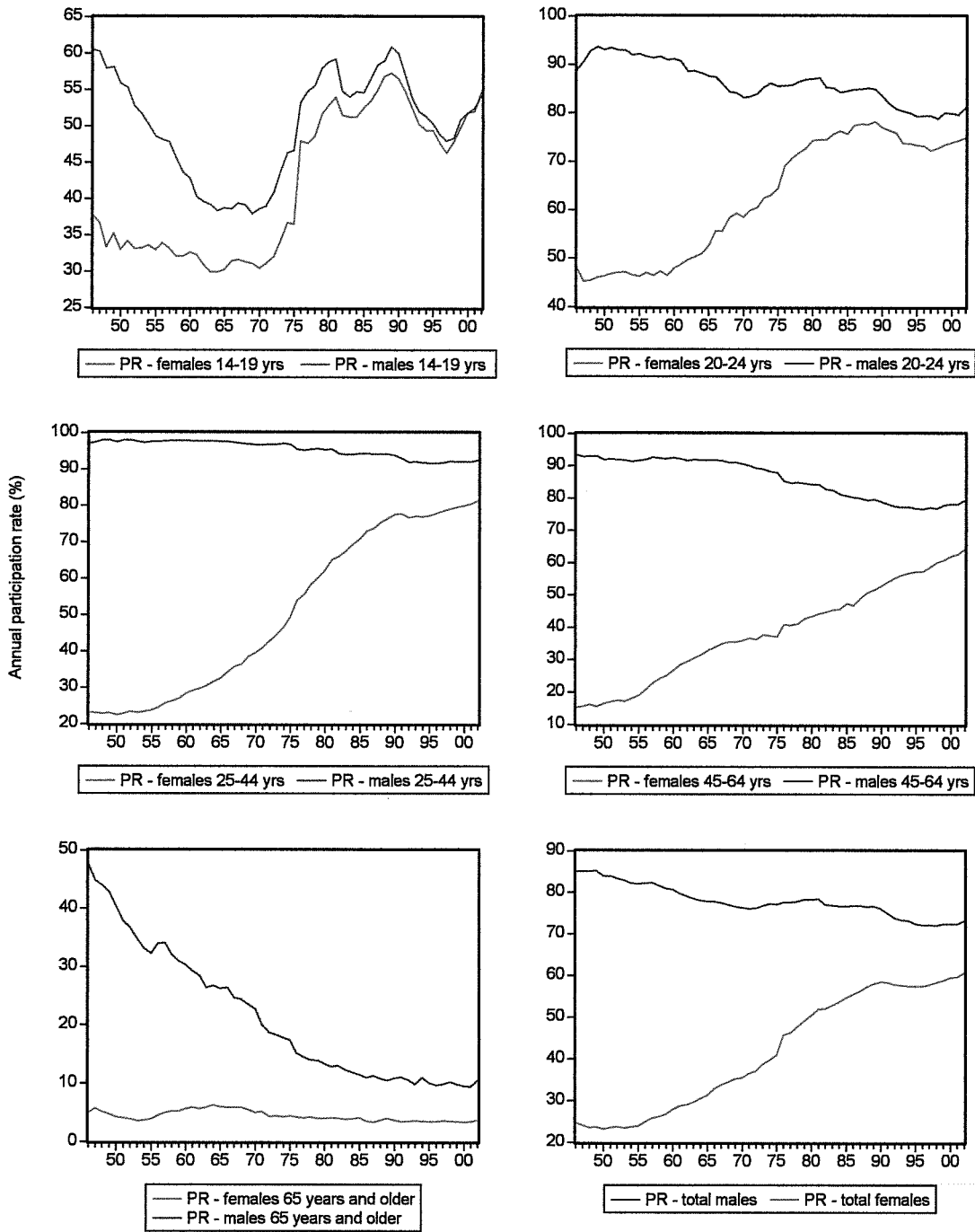
After reviewing a sample of important studies on the added- and discouraged-worker effects, the empirical section of this paper is devoted to a closer analysis of these cyclical fluctuations in participation in response to labour market conditions.

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<sup>17</sup> Population re-basing can have a different impact for each age group. Statistics Canada, *Labour Force Survey, Data Quality Statements*, Reference number 3701, p. 10.

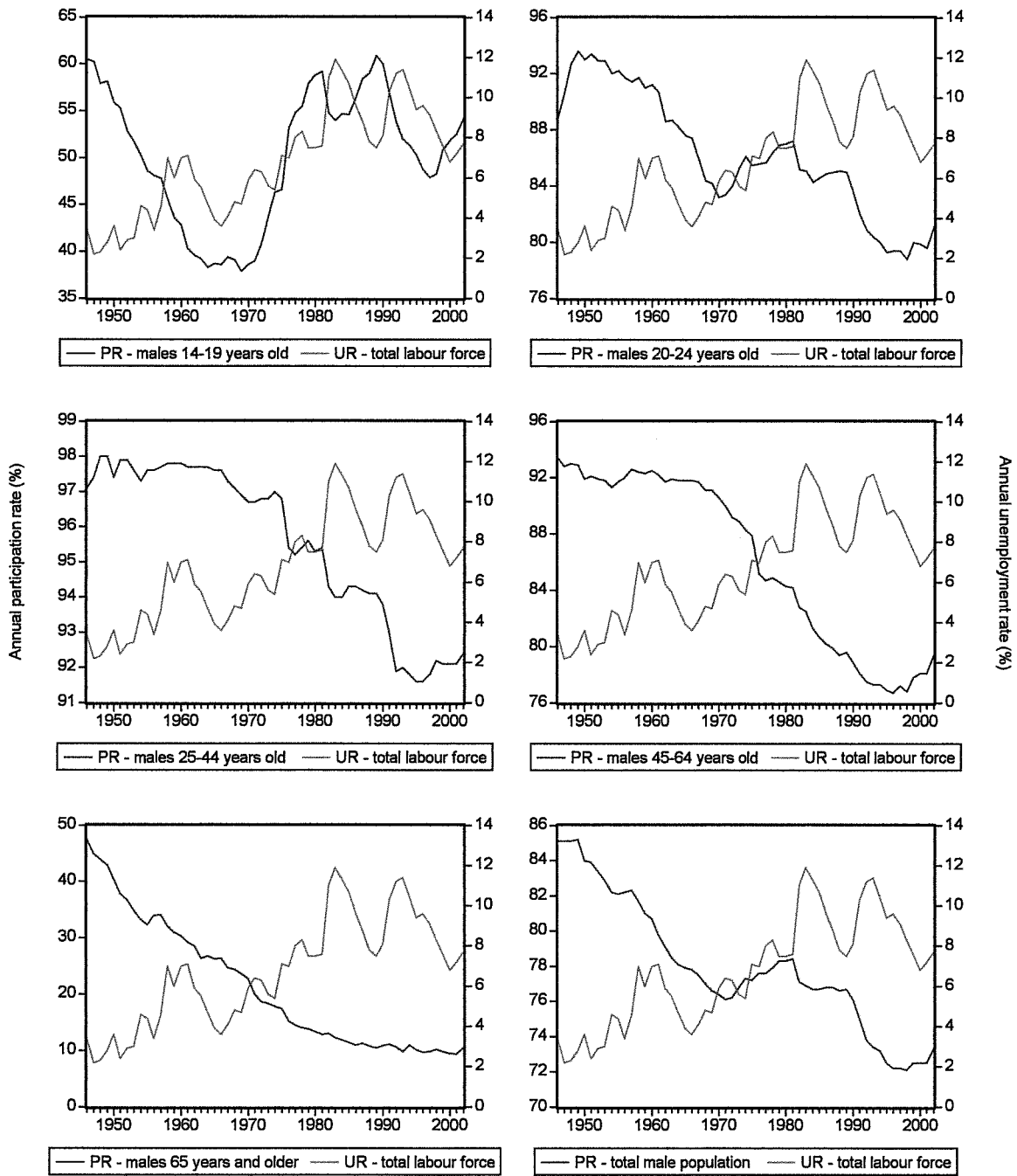
<sup>18</sup> Officer and Andersen (1970: 145) criticized Proulx (1969) for using annual data in his study, stating that such data may not be sensitive enough to capture short-term fluctuations.

Figure 4. Annual participation rate (PR) by sex, age group in Canada, 1946-2002.



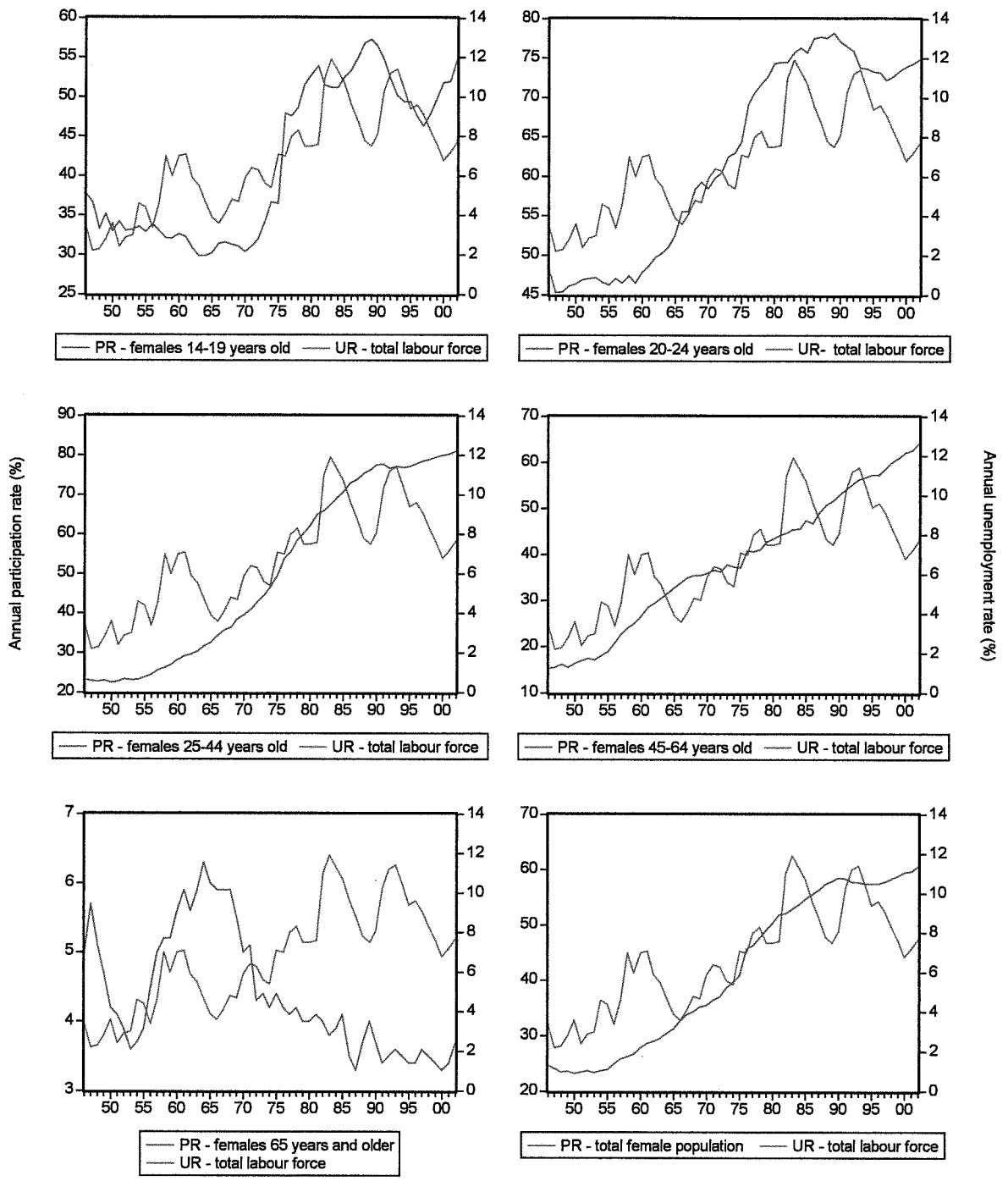
Sources: F. H. Leacy (Ed.) (1983), *Historical Statistics of Canada, Second Edition, Series D223-235*.  
 Data include Newfoundland beginning in 1950 but exclude the Yukon Territory, the Northwest Territories and Indians on reserves.  
 Data for 1976 to 2002 taken from Statistics Canada, Table 282-0002, *Labour Force Survey Estimates (LFS), by sex and detailed age group, annual*.

Figure 5. Male participation rate (PR) by age group and unemployment rate (UR) for the total labour force, 1946-2002.



Sources: F. H. Leacy (Ed.) (1983), *Historical Statistics of Canada, Second Edition, Series D223-235*.  
 Data include Newfoundland beginning in 1950 but exclude the Yukon Territory, the Northwest Territories and Indians on reserves.  
 Data for 1976 to 2002 taken from Statistics Canada, Table 282-0002, *Labour Force Survey Estimates (LFS), by sex and detailed age group, annual*.

Figure 6. Female participation rate (PR) by age group and unemployment rate (UR) for total labour force, 1946-2002



Sources: F. H. Leacy (Ed.) (1983), *Historical Statistics of Canada, Second Edition, Series D223-235*.  
 Data include Newfoundland beginning in 1950 but exclude the Yukon Territory, the Northwest Territories and Indians on reserves.  
 Data for 1976 to 2002 taken from Statistics Canada, Table 282-0002, *Labour Force Survey Estimates (LFS), by sex and detailed age group, annual*.

### **3. Review of the literature**

Over the years, economists have used different approaches to study the labour force response to cyclical changes in demand for labour, however, time-series and cross-sectional studies have been most frequently used to examine for the presence of the added- and the discouraged-worker effects. In cross-sectional studies based on census data, researchers are able to bring into play a wide choice of explanatory variables that cannot be used in time-series studies, because the historical statistics are simply not available. However, two cyclical variables, both employment and unemployment, have consistently been used in both types of studies devoted to the added- and discouraged-worker effects. Mincer (1966:78) was of the opinion that time-series and cross-sectional parameters provided different types of information. He believed that labour force sensitivity to unemployment was overestimated in cross-sectional studies because the data captured both short-term and long-term labour force adjustments. This is why he felt that cross-sectional data were of limited use for the study of short-term fluctuations.

Having conducted both time-series and cross-sectional studies in the United States, Bowen and Finegan (1969:505) felt that the results of the cross-sectional studies differed in magnitude but not in direction from those found in cyclical sensitivity studies. Underlining the many problems with model specification, they acknowledged that the “dynamics of short-run changes in labour force participation are simply not well understood”.

Although it was not possible for Canadian researchers to replicate the methodologies of some of the studies conducted in the United States due to the unavailability of identical data (e.g., periods, population groups) there has always been a desire to see if the labour

force in the two countries tends to behave in a similar way.<sup>19</sup> In time-series studies, the added-worker effect appeared to be stronger in Canada, while the discouraged-worker effect has dominated nearly consistently in the United States.

Several explanations have been suggested to account for these differences. Those include: the presence of wealth and income differentials between the two countries; the lower labour force participation rate, in Canada, of some socio-demographic groups that may be more responsive to cyclical changes, i.e., married females; the lower rates of unemployment in the U.S. in periods of recession; and, the fact that periods of recession were longer in Canada than in the U.S. (Swidinsky 1969, Proulx 1969). Both authors predicted that the added-worker effect would tend to decrease in Canada as per capita income increased and the wage-effect became stronger. Swidinsky (1969: 75) thought that, as the participation rates in the two countries continued to converge, the discouraged-worker behaviour would become more apparent in Canada.

Earlier studies looking at the added- and discouraged-effects were plagued by theoretical and technical problems. One problem, described by several authors (Mincer 1966: 79; Fortin and Fortin 1999:12; Bowen and Finegan 1969: 612), relates to the fact that employment and unemployment are the constituent parts of the participation rate that they are attempting to explain. Labour force participation ( $L$ ) is by definition linked to the employment rate ( $E$ ) and the unemployment rate ( $U$ ), since  $L = E/(1-U)$ . In an attempt to prevent spurious correlations, many researchers have tried different model specifications such as: lagging the explanatory variable from one to three periods; using the statistics associated with a reference group (e.g., males 25-44); replacing the unemployment rate with

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<sup>19</sup> There was a similar surge in interest in the 1990's, when a lot of research was done to try to explain the widening gap in unemployment rates between Canada and the United States.

a proxy variable such as exhaustion of unemployment insurance benefits; replacing 'labour force' by the broader value for population; and including different trend variables. Two approaches have been used to capture the added- and discouraged-worker effects within the same equation: some studies made use of two discrete cyclical variables while others focused on the sign of the coefficient as an indication of which effect was dominant for each population subgroup.

The next sections will look at various models in detail. Table 4 and Table 6 list the seminal time-series studies conducted in Canada and the United States and summarize their findings in terms of added- and discouraged-worker effects. Since the focus of this paper is the labour force's response to cyclical changes in employment, only a few cross-sectional studies conducted in Canada are included in the literature review. Canadian cross-sectional studies are relevant because they provide a long-term trend perspective, validate (or not) the results obtained with time-series and enrich the debate over the question of which effect is present or dominant.

### **3.1 U.S. studies**

All the studies conducted in Canada on the added- and discouraged-worker effect referred to the groundbreaking American studies on the subject. This is the reason why these studies will be reviewed here.

Two seminal studies conducted by Tella (1964, 1965) in the United States in the 1960's looked at the added- and discouraged-worker effects in terms of which effect was dominant. In the first study, Tella used average annual data for the post-war period. His labour force and population data, for workers 14 years and over, were divided by sex, and

included the civilian population (L) and members of the armed forces (A).<sup>20</sup> His linear regression model comprised the following variables for each group: a dependent variable consisting of the ratio of the labour force to the population (L+A/ P); and two explanatory variables - the ratio of employed (E) plus armed forces to the population (E+A/ P) and a simple arithmetic linear trend. In both cases, the coefficients for employment rate were positive, indicating a pro-cyclical tendency. The relationship was more noteworthy for females than for males. The R<sup>2</sup> values obtained by Tella were very high (.99 and .97 respectively).

Tella (1965) repeated the study, this time using quarterly seasonally adjusted data covering the period 1947-64. The data were broken down into seven age groups (14-19, 20-24, 25-34, 35-44, 45-54, 55-64, 65+ years) for both males and females. Tella's second model was more refined: a log time trend replaced the simple arithmetic trend variable (log T, T<sub>1</sub>=100 for all groups) and the explanatory variable (E/P) was lagged one period. The partial regression coefficients for the employment-population ratios were statistically significant for all age/sex groups. The values of the coefficients for the cyclical variable followed a logically intuitive pattern:

“relatively high for very young workers who are generally the least experienced; high for very old workers of both sexes who are shown to be most cycle sensitive; relatively low for males in the central age groups who are comparatively experienced workers; and generally higher for females than males in most age groups, reflecting the more marginal labour force attachment of women” (Tella 1965: 73-4).

Tella (1965: 26) also noted that the employment rate coefficients for males formed a U: higher in younger and older age groups, with the lowest value for the 35-44 years group. The coefficients for females showed less variation and tended to rise with age.

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<sup>20</sup> Only data on the active civilian population were used in all other time-series studies.

Bowen and Finegan (1969: 609-614) were very critical of Tella's approach. First, they questioned the premise that  $(E/P)_i$  was indeed a valid measure of labour demand, since  $E_i$  constituted such a large part of  $L_i$ , there had to be some degree of spurious positive correlation. In addition, autonomous changes in  $L_i$  would necessarily be reflected in  $E_i$ , thus yielding an exaggerated measure of sensitivity and making it impossible to isolate the effect of cyclical changes in employment opportunities. They contended that these autonomous movements could not be discounted since they were seen to be particularly significant in certain periods, e.g., in response to changes in world events (wars), and policies or societal trends (e.g., changes in fertility rates). They doubted that the introduction of a trend variable would suffice to correct this problem. They proposed instead a basic model containing two interrelated cyclical variables. The basic equation was:

$$(L_i/P_i)_t = a + b(U/L)_{t-1} + c(E_m/E)_{t-1} + dT + eT^2 + fD$$

in which  $L_i/P_i$  is the participation rate for each age/sex group and  $E_m/E$  is the ratio of manufacturing employment to total employment.  $D$  is a dummy variable used to control for changes in the Census sampling methods used over the period under study. They chose  $E_m$  because manufacturing was the employment that males were most likely to be engaged in. A decrease in the  $E_m/E$  ratio was seen as an increase in employment opportunities for workers that are more marginal. Two time trends were included to account for a variety of determinants not specified in the regression:  $T$  and  $T^2$  allowed for the possibility that one or more of the influences could be curvilinear. Several regressions were tested for each group. The authors admitted that in selecting the best equation to be retained for each group, they relied "more on *a priori* considerations and on the results of experiments with various combinations of predictors than on any one rule of thumb" (Bowen and Finegan 1969: 509).

Strand and Dernburg (1964: 382) attempted to isolate the discouraged- from the added-worker effects on labour force participation (L/P) by using two cyclical explanatory variables in their model. As in previous studies, the measure of employment opportunities was given by the employment to population ratio (E/P) for the adult civilian non-institutionalized working age population. The added-worker effect was modeled as the ratio of exhaustion of unemployment insurance benefits to population (X/P). The ratio X/P with a two-month lead was found to best capture the mounting pressure on other family members to join the labour force. A trend variable was added to the model, defined as 1/population, to capture changes in labour force participation attributable to increase in population and time. Strand and Dernburg also regressed X/P on  $(X/P)_{t-1}$  and  $(E/P)_{t-1}$  to measure the net effect of changes in the employment ratio on labour force participation. The authors tested their model on monthly data for different periods: July 1947 to December 1962, July 1947 to December 1952 and January 1953 to December 1962. Their results showed that both the discouraged and the added-worker effects were present as both coefficients for E/P and X/P were positive, but the discouraged-worker effect was more important. From the two equations, they concluded that for each 100 fewer jobs available, 38 individuals withdrew from the labour market.

Dernburg and Strand (1966: 71, 77) repeated their study but modified their model slightly. They also divided their sample in groups, by age and sex. They ran two different equations. Their first model was defined as:

$$(L_i/P)_t = a_{mi} + a_{1i}(E/P)_t + a_{2i}(X/P)_{t+2} + a_{3i}(1/P)_t + a_{4i}(P_i/P) + r_{t3}.$$

They concurred with Tella's findings: the discouraged-worker effect was most apparent for the very young and the very old age groups, and was present for all female age

groups. They also reported the presence of an added worker effect among males under the age of 19 and over the age of 45, and females in all age groups. For all age groups where both effects were significant, the discouraged-worker effect dominated. Women responded more strongly to an improvement in employment conditions. The second equation only measured the discouraged-worker effect:  $(E_i/P)_t = c_{mi} + c_{1i}(E/P)_t + c_{2i}(1/P)_t + c_{3i}(P_i/P)_t + r_{t4i}$ . Dernburg and Strand concluded that a rise in total employment had a positive effect on the level of employment of all groups.

Mincer (1966: 83) expressed strong reservations about the model used by Strand and Dernburg for two reasons: the use of an employment-population ratio and the unrealistic coefficient obtained for the second cyclical variable  $X/P$ . According to their results, for each exhaustion of unemployment benefit, twelve additional workers joined the labour force. "If  $X/P$  does not mean what it says, it must be a proxy for some other variable which is at work." Mincer found that  $X/P_{t+1}$  was strongly correlated with  $U/P$  (.9) which he took as a proof that the model is more or less an identity.

Barth (1968) wanted to improve on the model devised by Strand and Dernburg (1966) by correcting what Mincer (1966) had identified as shortcomings. Barth replaced the variable  $E/P$  with  $U/L$ , the total national unemployment rate, which he lagged one period, and  $X/P$  with  $X/U$ , the ratio of new exhaustions of unemployment insurance benefits-average unemployed level, one period ahead. The full new equation read as:  $L_{it} = a + b(U/L)_{at-1} + c(X/U)_{at+1} + dT + eX_1 + fX_2 + gX_3 + hX_4$ . The reasons he gave for using statistics for the whole population instead of those corresponding to each particular group were twofold. First, he wanted to examine the impact of the overall labour conditions on the participation of individual groups and secondly, he believed that each group's own unemployment rate was

less important in determining participation than the rate affecting all other groups. His study spanned the period 1948-64. He used quarterly, rather than monthly, data in order to represent as much as possible the full effect of a change in the explanatory variables. His results showed that the rate of unemployment was inversely correlated with participation in the case of most male but only two of the female groups. Although significant, the coefficients were very small. The exhaustion variable was significant for only four of the 21 age/sex groups, all of which were male groups. This last result seemed to differ from the findings of Dernburg and Strand who had found the presence of an added-worker effect associated with all their females groups.

As a follow-up, a second equation was tested which was identical to the first one except for the omission of the exhaustion variable. Those new results showed that an increase in unemployment in the last quarter (i.e.,  $t-1$ ) had a significant, albeit very small, inverse effect on participation for all, except for three male groups (35-44, 55-64 and 65+ years). This seems to corroborate the belief that males belonged to the discouraged-worker category. Only in the cases of three female groups (16-17, 25-34 and 35-44 years) were the coefficients for the unemployment variable significant. He suggested some possible explanations: perhaps a longer lag would work better; maybe the movement of females in and out of the labour force cancelled each other out; or maybe females are not as responsive as males to labour market conditions. However, the coefficients of determination that he obtained were high (ten of them above .8). Barth speculated that these results had more to do with the importance of the trend variable in the equation than the unemployment variable. Although his results concurred with Dernburg and Strand regarding the presence of a discouraged-worker effect in males, his results showed no sign of an added-worker effect for females.

Barth tried a third equation containing a lagged dependent variable. He used seasonally adjusted data in order to omit the dummy variables, but included a trend variable as before. Only three of the groups were shown to have a significant coefficient for the variable  $U/L$ , and these results were not different from those obtained with the second equation. He concluded that the new specification did not improve the results.

**Table 4. Econometric time-series studies conducted in the United States: comparing models and results**

Study	Period	Data	Population	Dependent variable	Cyclical variables	Other variables	Trend	Added-worker effect observed for:		Discouraged-worker effect observed for:		Dominant effect for total population 14+
								Males	Females	Males	Females	
Tella (1964)	1948-1962	Annual data	Population 14+, civilian, non-institutional, by sex (including armed forces)	Labour force participation	Employment rate		$T = 1, 2, \dots$			14+	14+	
Tella (1965)	1947 (IV Q) - 1964 (II Q)	Quarterly seasonally adjusted	Population 14+, civilian, non-institutional, by age group, sex (including armed forces)	Labour force participation	Employment rate		$T = \log(T_1), T_1 = 100, \dots$			14-19 10-24 25-34 35-44 45-54 55-64 65+	14-19 10-24 25-34 35-44 45-54 55-64 65+	
Strand & Dernburg (1964)	July 1947- Dec. 1962	Monthly	Adult civilian non-institutional population	Labour force participation rate ( $L/P$ ) <sub>t</sub>	Employment rate ( $E/P$ ) <sub>t</sub> , new unemployment insurance exhaustion ratio ( $X/P$ ) <sub>t</sub>	Dummy variables for the months	$T = (1/P)_t$					Both effects are significant but discouraged-worker effect dominates
Dernburg & Strand (1966)	July 1947- Dec. 1962	Monthly	Adult civilian non-institutional population, by age group, sex	Labour force participation ratio ( $L_i/P_i$ )	Employment ratio ( $E_i/P_i$ ) <sub>t</sub> , new unemployment insurance exhaustion ratio ( $X/P$ ) <sub>yr2</sub>	Dummy variables for the months	$T_1 = (1/P)_t$ $T_2 = P/P$	14-19 20-24 25-34 35-44 45-54 55-64 65+	14-19 20-24 25-34 35-44 45-54 55-64 65+	14-19 20-24 25-34 35-44 45-54 55-64 65+	14-19 20-24 25-34 35-44 45-54 55-64 65+	
	Nov. 1952- Dec. 1962	Monthly	Adult civilian non-institutional population, by age group, sex	( $E_i/P_i$ ) <sub>t</sub>	Employment ratio ( $E/P$ ) <sub>t</sub>	Dummy variables for the months	$T_1 = (1/P)_t$ $T_2 = (P/P)_t$	14-19 20-24 25-34 35-44 45-54 55-64 65+	14-19 20-24 25-34 35-44 45-54 55-64 65+	14-19 20-24 25-34 35-44 45-54 55-64 65+	14-19 20-24 25-34 35-44 45-54 55-64 65+	A rise in total employment causes employment in all groups to rise.

**Table 4 (cont'd) Econometric time-series studies conducted in the United States: comparing models and results**

Study	Period	Data	Population	Dependant variable	Cyclical variables	Other variables	Trend	Added-worker effect observed for:		Discouraged-worker effect observed for:		Dominant effect for total population
								Males	Females	Males	Females	
Barth (1968)	1948-1964	Quarterly	Adult civilian population, by age groups (11), sex	Labour force in the each age/sex group over the population of that group in period t $(L/P)_t$	Total unemployment rate lagged one period $(U/L)_{t-1}$ and ratio of new unemployment insurance exhaustions $(\Delta U)_{t-1}$	Dummy variables for the four quarters	T= 1, 2, 3... in each quarter	20-24		14+		Discouraged
								25-34		16-17		
Bowen & Finegan (1969)	1949(II)-1965(III)	Quarterly seasonally adjusted	Adult civilian non-institutionalized population, by age group, sex	Labour force in the each age/sex group over the population of that group in period t $(L/P)_t$	$(U/L)_{t-1}$ and/or $(E_m/E)_t$ , which is the ratio of manufacturing employment to total employment in quarter t-1 (significant at 5% level)	To adjust sample: dummy variable equal to 0 for all quarters prior to 1962-II	T= 1, 2, 3... and T <sup>2</sup> =1, 4...	14-15		14-15		Discouraged
								16-17		16-17		
Bowen & Finegan (1969)	1954(IV)-1965(III)	Quarterly seasonally adjusted	Adult civilian non-institutionalized population, by age group, sex	Labour force in the each age/sex group over the population of that group in period t $(L/P)_t$	$(U/L)_{t-1}$ and/or $(E_m/E)_t$ , which is the ratio of manufacturing employment to total employment in quarter t-1 (significant at 5% level)	To adjust sample: dummy variable equal to 0 for all quarters prior to 1962-II	T= 1, 2, 3... and T <sup>2</sup> =1, 4...	14-15		14-15		Discouraged
								16-17		16-17		
								18-19		18-19		
								25-34		25-34		
								35-44		35-44		
								55-64		55-64		

### 3.2 Canadian studies

Whittingham (1971: 13) cited an early study conducted by Kaliski (1962) that focused on the net dominant effect.<sup>21</sup> That study used annual data on participation and unemployment for the whole population and a number of age/sex groups, for the period 1946-59. Kaliski was able to demonstrate that although labour force participation for the population as a whole was not influenced by the rate of unemployment, this was not the case for all age/sex groups taken individually. He found a significant positive relationship (added-worker effect) between participation and unemployment for females 25-64 years, and a significant negative relationship (discouraged-worker effect) for males and females under 20 and males 65+ years. Results obtained for males between the ages of 20-64 and women 65 years and older were not significant. The author is reported as writing that his findings could not be taken too seriously considering the nature of the study and the fact that his model had serious limitations (e.g., multicollinearity, absence of control for trends).

The proof that researchers were interested in the subject of the added- and discouraged-effects can be found in the number of studies that were conducted around the same time. While many studies tended to focus on the unemployed, Swidinsky (1969, 1973) chose to use the employment rate as the cyclical variable in his regression. His model had two explanatory variables: the ratio of all individuals employed over the total population (E/P), lagged one period, and an arithmetic trend. E/P served as a proxy variable for “transitory changes in the wage rate and other income” (Swidinsky 1969: 5). His data consisted of quarterly, seasonally adjusted participation and employment statistics for the

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<sup>21</sup> S.F. Kaliski (1962) presented a paper at the Canadian Political Science Association Conference on Statistics, at McMaster University, which was entitled: “The relation between labour force participation and unemployment in Canada: interim report on a pilot study”. Unfortunately, it was not possible to find a copy of this paper.

period 1953-69, disaggregated in ten sex/age groups. His results showed that the added-effect dominated for males aged 20-24, 25-44 and females 45-64 and 65+ years. The discouraged-worker effect was dominant for males 14-19 and 65+ years, and females 20-24 and 25-44 years. The values of the coefficients indicated that females were more sensitive to cyclical changes in employment. For the 45+ years, there was a close negative correlation between the participation rate of females and the employment rate of males. In short, fluctuations in the demand for labour affected the size and the composition of the female labour force but it only affected the composition, not the size, of the male labour force (Swidinsky 1973: 61-2).

Swidinsky (1973) republished his study, with a more detailed analysis of the results. He reported doubting the validity of his results in part because of a serious problem of autocorrelation, as revealed by the results of the Durbin-Watson test. In addition, he thought the signs of some of the coefficients were difficult to explain, e.g., the negative, albeit small, coefficient for males 25-44 years, which would point to an added-worker effect. When he modified his dependent variable to correct for autocorrelation (by re-specifying his variable as a percentage change), he found that the coefficients varied in sign but were “highly insignificant” and he was unable to confirm the presence of either the discouraged or the added-worker effect. He concluded that this type of cyclical sensitivity analysis might not be reliable.<sup>22</sup>

Officer and Andersen (1969) examined the short-run and long-run factors affecting labour force participation of fourteen age/sex groups in Canada. Their study made use of quarterly data covering the period 1950-67. The authors tested several equations for each group. The male unemployment rate ( $U_M/L_M$ ) constituted the main explanatory variable with

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<sup>22</sup> Swidinsky (1973: 63) wrote: “On the basis of these results one must regard evidence of the cyclical sensitivity of the Canadian labour force with considerable skepticism.”

additional variables used to characterize intensity of unemployment. The intensity variables were: the total number of males seeking employment ( $S_M$ ) (i.e., not on temporary lay-off) and the number seeking work for over one month ( $S_M^1$ ), over three months ( $S_M^3$ ), and over six months ( $S_M^6$ ). The variable  $S_M$  could take two different denominators: male labour force ( $L_M$ ) or total number of unemployed males ( $U_M$ ). The authors adopted an iterative approach to check nine alternative combinations of unemployment variables; variables that were found to be significant were kept in the final equation. A number of explicit variables were also selected to measure the influence of factors other than unemployment (i.e., per capita income and birth rate). Two other variables were also tested (real wage, consumer credit) but found not to be significant. Seasonal dummy variables were used to capture seasonal variations.

Table 5 summarizes the results of Officer and Andersen's study: only the variables that were found to be significant in the final equation for each group and the sign of the coefficients are reported. For males and females aged 14-19, the authors used each group's own unemployment rate. They deemed this modification necessary because teenagers were seen as not yet firmly attached to the workforce and as having a strong alternative to unemployment i.e., attending school. Overall, Officer and Andersen identified a discouraged-worker effect for all male groups and for females 14-19 years. They observed an added-worker effect for all other female groups.

Table 5. Explanatory variables in the study conducted by Officer and Andersen (1969). The authors reported only the significant results for the unemployment variables. The sign of the coefficient obtained for each explanatory variable is shown in parentheses.

Labour force participation for sex/age group:	Unemployment variable: short-run (A)	Intensity of unemployment variable: long-run (B)	Income per capita	Birth rate	Lagged dependent variable	Dominant effect (A and B)
M 14-19	$U_{M14-19}/L_{M14-19}$ (neg.)	$S^6_M/U_M$ (neg.)	(neg.)	-		Discouraged
M 20-24	$U_M/L_M$ (pos.)	$S^3_M/U_M$ (neg.)	(neg.)	-		Discouraged
M 25-34	$U_M/L_M$ (pos.)	$S^3_M/U_M$ (neg.)		-	(pos.)	Discouraged
M 35-44		$S_M/L_M$ (neg.)		-	(pos.)	Discouraged
M 45-54	$U_M/L_M$ (pos.)	$S^1_M/U_M$ (neg.)		-	(pos.)	Discouraged
M 55-64	$U_M/L_M$ (pos.)	$S^3_M/U_M$ (neg.)	(neg.)	-		Discouraged
M 65+		$S^3_M/L_M$ (neg.)	(neg.)	-		Discouraged
F 14-19	$U_{F14-19}/L_{F14-19}$ (neg.)		(neg.)			Discouraged
F 20-24		$S^6_M/L_M$ (pos.)	(pos.)	(neg.)		Added
F 25-34		$S_M/L_M$ (pos.)	(pos.)	(neg.)		Added
F 35-44	$U_M/L_M$ (pos.)	$S^6_M/U_M$ (pos.)	(pos.)	(neg.)		Added
F 45-54		$S^6_M/L_M$ (pos.)	(pos.)			Added
F 55-64		$S^6_M/L_M$ (pos.)	(pos.)			Added
F 65+		$S^3_M/L_M$ (pos.)	(pos.)			Added

Source: Table 1 in Officer & Andersen (1969), "Labour Force Participation in Canada", *CJE*, 2(2): 280.

Whittingham (1971: 95-111) examined closely the intensity variables used by Officer and Andersen (1969). As with Proulx's (1969) study, the proxy chosen for labour market conditions varied between age groups. Whittingham first focused on the results obtained for females aged 20-24, 45-54 and 55-64 years all of which had a positive coefficient for the variable  $S^6_M/L_M$ . Whittingham obtained previously unpublished annual data from Statistics Canada on the percentage of the male labour force seeking work for over 6 months for the period covered in the Officer and Andersen study. For many of those years, the percentage was very small (less than 1%) which meant that the estimated numerator would be very small, hence less reliable. He expected that the use of quarterly data would increase the chances of having small estimates. In addition, three of the unemployment variables<sup>23</sup> paralleled each other and showed an upward trend for three periods (1951-54, 1956-58 and 1959-61) covered by the study. Then, when he examined the participation rates of females in three age groups, he noticed a steady, nearly continuous increase over time, with "little

<sup>23</sup> Male unemployment rate, percentage of male labour force seeking work and percentage of male labour force seeking work over 3 months.

evidence of cyclical variability” for females 25-34, 35-44 years between 1950 and 1967 and females 65+ years after 1953. This led Whittingham to conclude that the regression results may have been coincidental rather than causal.<sup>24</sup>

Proulx (1969) reported the results of a two-part study in which he examined the labour force participation rate of ten age/sex groups during two separate periods (1948-1952 and 1953-1967). He annualized monthly and quarterly data for use in his regressions. His first equation comprised a detrended dependent variable  $L/P$  and two explanatory variables: the unemployment-population ratio ( $U/P$ ) for 25-44 year-old males and a linear trend. In the second model, he looked at labour force participation for the same ten groups in relation to an index of excess demand for labour. The concept of excess demand, as defined by Marion (1968: 521), is the difference between the desired employment level (demand) based on a production function and the observed number of employed and unemployed workers (supply). Unfortunately, Proulx only reported his significant results, at the 5 % level or better. He found an added-worker effect for the total male population, and the male subgroup 20-24 and female subgroups 45-64 and 65+. He identified a discouraged-worker effect for males 14-19 and females 20-24 years.

Officer and Andersen (1970: 145-6) pointed out that the results presented by Proulx (1969) were somewhat problematic because the author could not come to any conclusion for several age groups, including females who were most likely to represent the added-workers (25-44 years). They also raised issues regarding Proulx’s methodology: they thought that the use of yearly data was inappropriate to capture short-run cyclical effects. They also pointed out that the significance of the variable "excess demand" was overstated because that variable

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<sup>24</sup> Whittingham (1971: 102) concluded: “In light of these problems of interpretation, it is difficult to accept the conclusion reached through the use of time-series data that the additional worker hypothesis is satisfied for females.”

was already the result of estimation. Finally, Officer and Andersen contended that an annual linear trend was inadequate to represent variation in income, since periods of expansion and periods of recession were not necessarily of the same length.

The debate over the cyclical response of the labour force continued with Davis (1971) who proposed a different model for which he devised two new explanatory variables: "demand", defined as the period's imputed unfilled jobs, and "cumulative demand", which is the aggregation of the differences between the average level of demand over the period and the demand for the period. He based his approach on the theory of excess demand for labour. His results gave support to a cumulative discouraged-worker effect for males 14-19, 65+ years and females 14-19, 20-24 and 25-44 years, and a cumulative added-worker effect for males 20-24 and 25-44 years and females 45-64 and 65+ years. In order to determine the explained variation attributable to the presence of a trend variable in his equation, Davis (1971: 38) compared two models: one with a time trend only and one with a time trend plus the demand variables described above. He found that the time trend variable contributed the lion's share of the explained variation in the regressions for most age groups.

A large section of the study written by Davis (1971: 86-91) was devoted to a critical examination of the sampling methodology and the quality of the data contained in the Labour Force Survey, for the period 1953-68. He noted that except for Kaliski (1962), little attention had been given to these questions. Davis (1971: 89) was particularly concerned with the problem of serial correlation due to survey design, estimate variances being lower than sample variances and the concern that "significant cyclical response may be superimposed on an underlying autoregressive structure".

Swan (1974) compared the effect of unemployment on labour force participation in five different regions in Canada: Atlantic, Quebec, Ontario, Prairies and British Columbia. His study made use of different unemployment variables for males and females. He used the unemployment rate of males in the neighbouring region for males and the male unemployment rate in the same region for females. He used quarterly data for each region, which he detrended and adjusted for seasonal variation. Other variables also included in the model were wage rates, birth and marriage rates and a time trend. He found that the unemployment rate had different effects on participation in different regions. There was a strong added-worker effect in Ontario and Quebec for both males and females and for males in the Prairies and Atlantic provinces, but no effect in British Columbia. He did not observe a discouraged-worker effect in any of the regions. Results for the aggregate data (all regions) showed the evidence of an added-worker effect for males 20-24 and 25-44 years and females 15-19, 45-64 and 65+ years. Only one group presented with a discouraged-worker effect: males 15-19 years.

Only one Canadian study, that of Kuch and Sharir (1978), attempted to isolate the discouraged and added-worker effects by using two distinct explanatory variables: each group's own employment rate (lagged three months) and the employment rate of all others groups. They also included two time trends. They used Labour Force Survey data for ten age/sex groups for the period January 1953 to December 1974 that they seasonally adjusted using the census X-11 procedure. The results demonstrated the presence of a discouraged-worker effect for all ten groups (significant at the 10 % level for nine groups) and a negative coefficient for nine of the groups (significant at the 10 % level for seven groups).

Fortin and Fortin (1999) took a different approach. They proposed a model for the study of the changes in aggregate labour force participation rates, with a view to explaining the observed decrease in participation rates in the early nineties. Their model was based on perceived employment opportunities<sup>25</sup> (as measured by the ratio of the help-wanted index to the total working age population) and the effect of structural factors such as unemployment insurance, social assistance and the minimum wage. The authors rejected the use of either the unemployment or the employment rates as acceptable measures of labour market pressure. While recognizing that individual characteristics and labour market constraints (e.g., the availability of jobs by levels of skill) are important, their aggregate model did not allow them to consider those factors. They selected six explanatory variables: index of job availability, average real wage, average real minimum wage, index of unemployment insurance generosity, average real social assistance benefit and a quadratic annual time trend to capture the growth rate in participation and unspecified social and educational variables. The authors divided their sample in six large sex/age groups: 15-24, 25-54 and 55 + years. The period they studied extended from 1969 to 1996. They found that the younger and middle age groups had a positive response to cyclical changes in employment opportunities, but the older age groups were not significantly affected. Younger individuals were four time more responsive than the next age group. And in each respective age group, males were 50% more responsive than females. They concluded that the observed decline in labour force participation of recent years was the result of three factors of equal importance: unfavourable macroeconomic conditions, changes to the unemployment insurance program and minimum wage levels, and overall structural changes.

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<sup>25</sup> Donner and Lazar (1974) had also devised a model based on labour market expectations. Their model and results are described in Table 6.

**Table 6. Econometric time-series studies conducted in Canada: comparing models and results**

Study	Period	Data	Population	Dependant variable	Cyclical variables	Other variables	Trend	Added-worker effect observed for:		Discouraged-worker effect observed for:		Dominant effect for total population 14+
								Males	Females	Males	Females	
Kaliski (1962)	1946-1959	Annual	Population 14+, by age group, sex	Labour force participation rate	Unemployment rate				25-64	14-19 65+	14-19	No effect
Swidinsky (1969)	1953-1966	Quarterly, seasonally adjusted	Population 14+, by age group, sex	Labour force participation rate ( $L/P$ ) <sub>t</sub>	Aggregate employment rate, lagged one period ( $E/P$ ) <sub>t-1</sub>		T= 1, 2, 3 ...	20-24 25-44	45-64 65+	14-19 65+	14+ 20-24 25-44	n/a
Officer and Andersen (1969)	1950-1967	Quarterly, unadjusted data	Population 14+, by age group, sex	Labour force participation rate	Males unemployment rate, males seeking work over number of males unemployed; males seeking work over male labour force; intensity variables consisting of length of time looking for work (over 1, 3 or 6 months)	Real income per capita; birth rate; lagged dependant variable	Quarterly seasonal dummies	20-24 25-34 35-44 45-54 55-64 65+		14-19 20-24 25-34 35-44 45-54 55-64 65+	14-19	Added
Proulx (1969)	1948-1967	Unadjusted annualized data seasonally adjusted using the U.S. Census II, version X9 method.	Population 14+, by age group, sex	Labour force participation rate	Unemployed/Population for males 25-44		T= 0, 1, 2, 3...	14+ 20-24			20-24	n/a
	1953-1967	Unadjusted annualized data seasonally adjusted using the U.S. Census II, version X9 method.	Population 14+, by age group, sex	Labour force participation rate	Excess demand for labour		T= 0, 1, 2, 3...	20-24	45-64 65+	14-19	20-24	n/a

**Table 6 (cont'd) Econometric time-series studies conducted in Canada: comparing models and results**

Study	Period	Data	Population	Dependent variable	Cyclical variables	Other variables	Trend	Added-worker effect observed for:		Discouraged-worker effect observed for:		Dominant effect for total population 14
								Males	Females	Males	Females	
Davis (1971)	1953-1968	Monthly	Population 14+, by age group, sex	Labour force participation rate	Labour demand and cumulative labour demand		T= 1, 2, 3...	14+	14-19	14+	14-19	
	1953-1968	Annual	Population 14+, by age group, sex	Labour force participation rate	Labour demand and cumulative labour demand		T= 1, 2, 3...	14+	14-19	14+	14-19	
Donner and Lazar (1974)	1955-1970	Seasonally adjusted quarterly averages of monthly data	Population 14+, by age group, sex	Labour force participation rate	Current unemployment rate and labour market (unemployment) expectation, $U_{t+1}$		T=1, 2, 3...	20-24	45-64	14-19	14-19	
	1955-1970	Raw quarterly averages of monthly data	Population 14+, by age group, sex	Labour force participation rate	Current unemployment rate and labour market (unemployment) expectation, $U_{t+1}$	Dummy variables	T=1, 2, 3...	25-44	55-64	14-19	20-24	
Swan (1974)	1953-1971	Seasonally adjusted and de-trended quarterly data	Regional data: Qc, ON, Atlantic, BC, Prairies- Aggregate for Canada	Labour force participation rate	Unemployment rate in neighbouring region for males and male unemployment rate for females	Wage rate levels, birth rate, marriage rate,	Seasonality, time	20-24	15-19			added
	1953-1974	Monthly data seasonally adjusted using census X-11 procedure	Population 14+ by age group, sex	Labour force participation rate	Own employment rate at t-3; Employment rate of all others		T= 1, 2, 3...; $T^2= 1, 4, 9...$	14-19	20-24	14-19	20-24	discouraged
Fortin and Fortin (1999)	1969-1996	Annual	Three age/sex groups: 15-24, 25-54, 55+	Labour force participation rate	Index of job availability	Average real wage, average real minimum wage, index of unemployment insurance generosity, average real social assistance benefit	Quadratic annual time trend $T^2= 0, 1, 4, 9...$	15-24	25-54	15-24	25-54	n/a

### 3.3 Cross-sectional studies

The highlights of selected cross-sectional studies are included in this review of the literature because they add relevant information on the topic. Swidinsky (1970) conducted a study using 1961 Census data relating to the population of cities with 30,000 or more inhabitants to study labour force participation of different age/sex groups in different geographical areas. The equation he used had the following specification:  $(L/P)_{ij} = a + bU_i +$  (control variables, such as income, type of industrial employment, education, marital status, number of dependants, ethnic composition of the area population) where  $(L/P)_{ij}$  is the  $i^{\text{th}}$  area labour force participation rate for the  $j^{\text{th}}$  sex/age group and  $U_i$  is the  $i^{\text{th}}$  area aggregate unemployment rate. While there was no evidence of an added-worker effect, he found that both men and women were sensitive to the discouraged-worker effect, but males were more responsive than females. Sensitivity to unemployment was strongest in the younger and older age groups for males and females, forming a U shape pattern, however, the lowest coefficients were associated with different age groups in males (45-54) and females (25-34). For the male age groups, unemployment was the only variable for which more than two coefficients (there were 5 out of 7) were significant at the five percent level. For the female age groups, more explanatory variables were found to be significant for at least three age groups: unemployment, male earnings (proxy for other income), female earnings (proxy for female wage rate), marital status and population composition. Swidinsky reported that he did not get very different results when he used alternate measures of labour market conditions in his regression equation (i.e., male unemployment rate, female unemployment rate, male employment-population

ratio).<sup>26</sup> When his sample was disaggregated by sex and education level, Swidinsky (1970: 150) found that the added-worker effect dominated among females with a university degree.

Whittingham (1972) focused on variations in the labour force participation rate of married women, whom he saw as the most likely group to respond to changes in economic and labour market conditions. Grounded in the theory of consumer choice, his model also took into consideration some of the characteristics of the family unit such as the husband's wage level, the presence of children and the overall non-wage income of the family (excluding transfers)<sup>27</sup>. His sample consisted of family units that included both husband and wife and the husband was part of the labour force (either employed or unemployed). Data used in his analysis came from the 1961 Census conducted in thirty-seven metropolitan and urban areas. He included in his model a dummy variable to measure the additional worker effect: the dummy variable took the value zero if the husband was employed and one if he was unemployed. He used the variable "average rate of unemployment of husbands" in each of the 37 areas examined to measure the discouraged-worker effect. The author concluded that there was evidence that both the added- and the discouraged-worker effects were present, especially for married women whose husbands had the lowest earnings. Married women with children were more likely to become added workers and less likely to be discouraged workers when compared to their counterparts without children. Overall, the study concluded that the discouraged-worker effect was dominant.

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<sup>26</sup> Those results are not reported in Swidinsky's 1970 paper.

<sup>27</sup> This was due to data limitations. Whittingham (1972: 40) recognized that other income without the inclusion of transfer payments was unsatisfactory. Since transfer payments may represent an important counterbalance to the additional worker effect as they ensure a minimum income to the family, hence, he wrote that the significance of the variable in the empirical work was bound to be reduced as a result.

Lundberg (1985:12) looked at the employment and labour force participation of women in relation to the employment status of their husband. She found that women did look for work when their husbands were unemployed but they are less likely to be employed than women with employed husbands.

### **3.4 Summary of findings from the literature review**

Studies looking at the added- and discouraged-worker effects used a range of different methodologies and came to a range of conclusions. Bowen and Finegan (1969: 505) noted that the results were often very sensitive to the period included in the study. This may account for the contradictory results at least in some cases. The quality of the data may also be very important. The earlier models were not tested for stationarity and this was due to the level of knowledge of econometrics at the time.

Nevertheless, many researchers found that some groups appeared to be more responsive to labour market conditions than others because they were comprised of a larger proportion of secondary workers.

## **4. Empirical study**

### **4.1 Question**

The goal of the empirical component of this paper is to compare the labour force response to short-run fluctuations in the employment market during two distinct periods in Canada, in the context that many changes have taken place in the rate and pattern of participation of different age/sex groups in recent years. The question asked is whether a consistent or a different pattern of added- or discouraged-worker effects would be evident given these trends. Several studies have shown some evidence of added- and discouraged-worker effects affecting participation in the 1960's and 1970's and a discouraged-worker effect in more recent studies. Most studies followed the basic model, i.e.,  $L/P = a + b(\text{cyclical variable}) + \text{trend}(s)$ . Would similar results be found using that model for two distinct periods, given the changes in participation? Would these results still be valid if a different cyclical variable is used, which is highly correlated with one of the traditional cyclical variables (i.e., the unemployment rate) used in previous studies but is not a constituent part of the participation rate calculation? This section will explore these questions.

### **4.2 Methodology**

#### **4.2.1 Periods, variables, population and sources of data**

Three different considerations helped determine the choice of the two periods chosen for this study. First, since the goal was to compare the results of the present study to previous studies conducted in the 1950-70's, the first period selected had to overlap at least in part. Second, the availability of reliable data, including seasonally adjusted labour

force statistics as well as longitudinal data on an alternative cyclical variable in use during both periods was essential. Third, one searched for a meaningful break point between the two periods that would make the comparison interesting. One of the most significant changes in the last decades is the increased labour force activity of women; they had achieved a participation rate of 50% by the 1980's, and half of those women were married. Given that individuals with a weaker attachment to the labour force may be drawn towards service industries, it is interesting to note that, in Canada, the service sector has been the main source of employment since 1958 and employment in services increased by 24% in the 1980's (Crompton and Vickers 2000: 8). Proulx (1969: 276) also suggested that added-workers belong to families of the lowest paid workers who have little savings and accumulated wealth. Women working in the low-pay service sector often come from such families.

Based on the above considerations, the years 1962 to 1974 and 1985 to 2000 were chosen.<sup>28</sup> The first period, ended with a recession, in the aftermath of the oil crisis. The second period started in the wake of the recession of 1981-82, with a mild period of recession in 1990-92. There were ten years between the two periods, which appears as a reasonable time to notice changes in cyclical patterns of participation.

The labour force statistics for the period 1962-74 were taken from a compendium of historical statistics and the statistics for the period 1985-2000 were retrieved from the online CANSIM database.<sup>29</sup> Both sets of data consist of monthly seasonally adjusted statistics. For the purpose of this study, seasonally adjusted quarterly averages of the

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<sup>28</sup> The methodology of the Labour Force Survey also changed in 1976.

<sup>29</sup> Statistics Canada (1974), *Historical Labour Force Statistics, Actual Data, Seasonal Factors, Seasonally Adjusted Data*, 4-1101-524; Statistics Canada, *Labour Force Survey*, CANSIM 2820087, downloaded from the internet at <http://www.statcan.ca>.

monthly data were calculated. For meaningful comparison, it was desirable that the age/sex groups were identical in both periods. However, seasonally adjusted statistics were not available for as many age groups for the more recent period.<sup>30</sup> The following age/sex groups were available for both periods: 14+ years for 1962-74, and 15+ for 1985-2000; 15-19, 20-24, 25-54, and 55+ years.

Figures 7 to 10 illustrate the net cyclical variation in participation and unemployment over the two periods considered in this study. The figures are based on the detrended seasonally adjusted quarterly participation rate for each sex/age group and the detrended seasonally adjusted quarterly unemployment rate for the total labour force.<sup>31</sup>

Overall, it appears from the figures that labour force participation is independent to some extent from the prevailing level of unemployment, in terms of amplitude and the timing of the fluctuations on the figures. Sometimes participation nearly mirrors the unemployment curve, at other times, there seems to be a lag between the two. Figure 7e, 8e, 9e and 10e correspond to the total male and total female labour force for each of the two periods. In the first period (Figures 7e and 8e), the pattern is more jagged, with more frequent large peaks and troughs for females than males. However, the two patterns are more similar in the second period (Figures 9e and 10e). Not surprisingly, the pattern observed for the core age group composed of the 25-54 year-olds is close to the one observed for the whole population in each period. The 20-24 year-olds in the second period (9b and 10b) have the same narrow spikes as the 14-19 year-olds in the first period (7a and 7b). If there is an added- or discouraged-worker effect operating, the groups with the most uneven participation pattern may well be among the prime suspects. One

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<sup>30</sup> Personal communication. Statistics Canada does not release seasonally disaggregated adjusted statistics for ages between 25-54 years.

<sup>31</sup> The Hodrick-Prescott Filter in Eviews was used to create the trend.

interesting observation is that for several of the groups, participation and unemployment rate move in the same direction in the early 1970's; this is very obvious for males 55+ and females 25-54 years, and to a lesser degree for the other groups.

The series of quarterly statistics created from the monthly participation and unemployment statistics were tested for stationarity using the Dickey-Fuller Unit Root Test,<sup>32</sup> available on Eviews and were all found to have a unit root, with only four exceptions. For the period 1962-1974, the following series were stationary: participation rates for females aged 25-54 and 14+ years. For the period 1985-2000, the stationary series were: participation rates for females 25-54 and 15+ years, and males 55+ years. The series with a unit root became stationary when first-differenced, except for participation rates for males 14+ and 14-19 years for the period 1962-1974, which were stationary when second-differenced. All the unemployment rates series were found to be first-differenced stationary.

The search for a cyclical variable unrelated to participation but highly correlated with unemployment led to various economic indicators. Among the Canadian Industrial Capacity Utilization Rates, the one for goods-producing industries other than agriculture was selected. It is a quarterly indicator of cyclical activity. Statistics Canada devises it and it has been available since 1962. The capacity utilization rate represents an estimate of the ratio of actual output to potential output.<sup>33</sup> Actual output is determined using seasonally adjusted quarterly measures of real gross domestic product (GDP) at basic

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<sup>32</sup> The Augmented Dickey-Fuller test was also used in the case where error terms were suspected of being autocorrelated, as evidenced by the correlogram test and the Q statistic.

<sup>33</sup> Statistics Canada, *Canadian Industrial Capacity Utilization Rates: A Brief Summary of Methodology*,  
<http://www.statcan.ca/english/sdds/2821.htm>. Potential output is defined as "the maximum practical capacity" in accordance with a normal level of operation for plants, as opposed to a the engineering capacity or maximum yield.

Figure 7. Male detrended seasonally adjusted quarterly participation rate, 1962-1974.

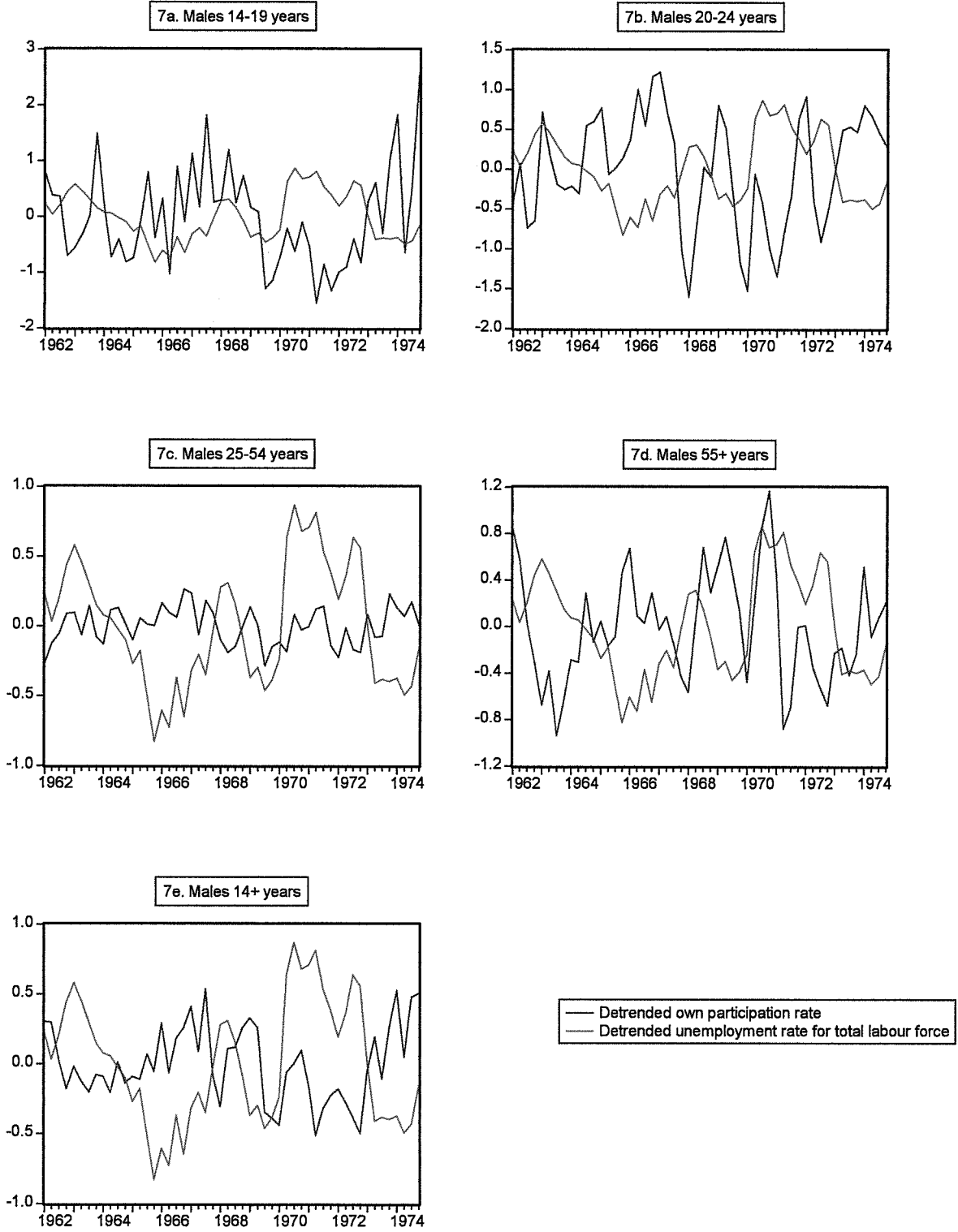
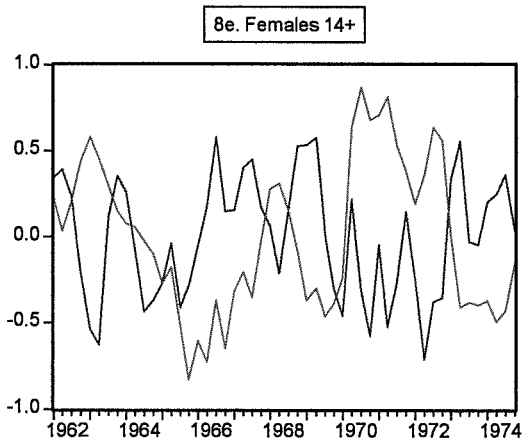
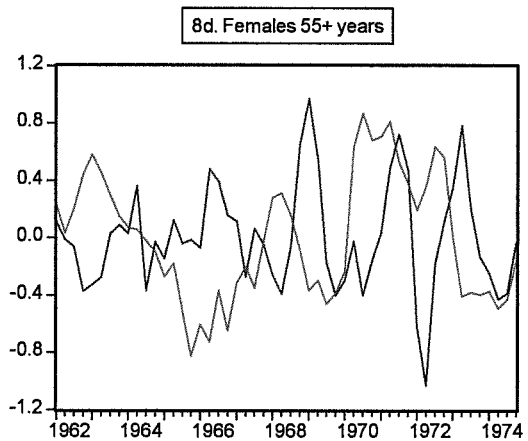
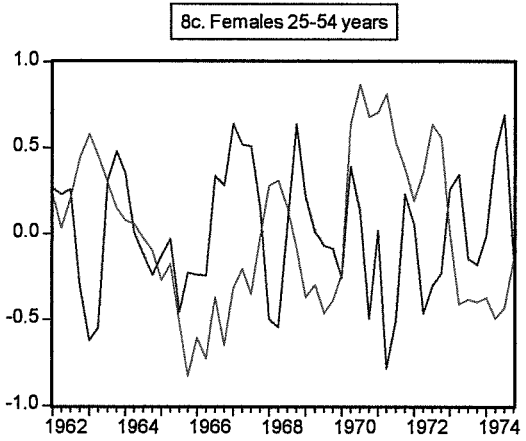
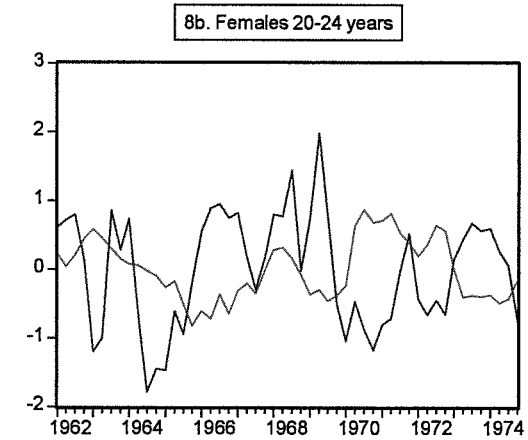
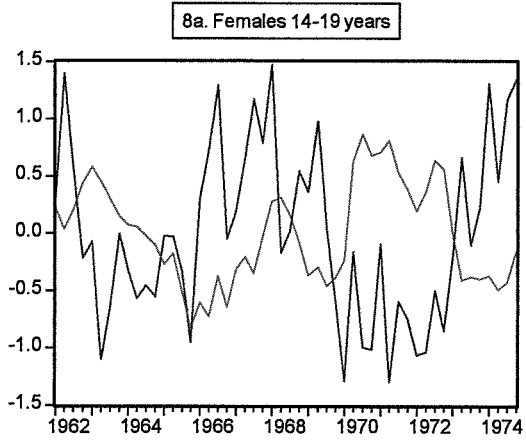


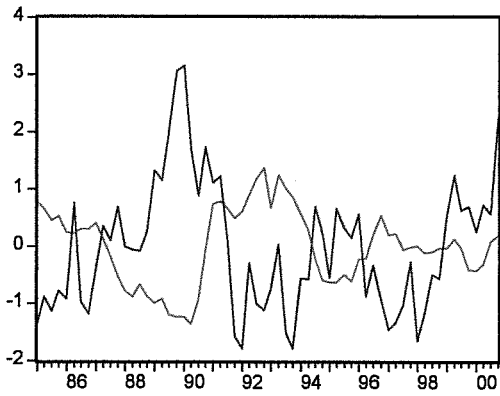
Figure 8. Female detrended seasonally adjusted quarterly participation rate, 1962-1974.



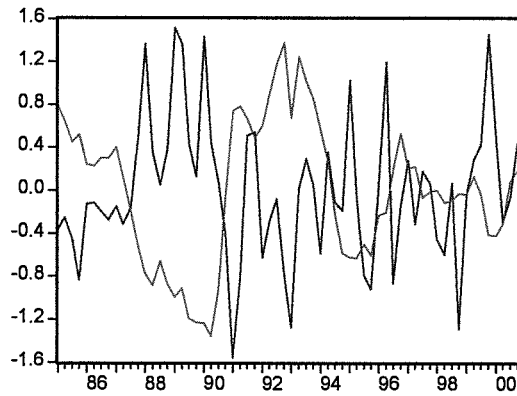
— Detrended own participation rate  
- - - Detrended unemployment rate for total labour force

Figure 9. Male detrended seasonally adjusted quarterly participation rate, 1985-2000.

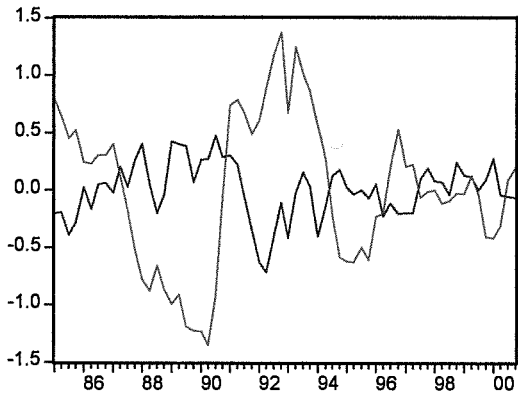
9a. Males 14-19 years



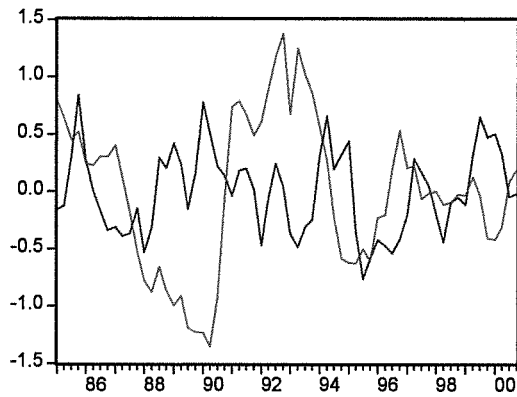
9b. Males 20-24 years



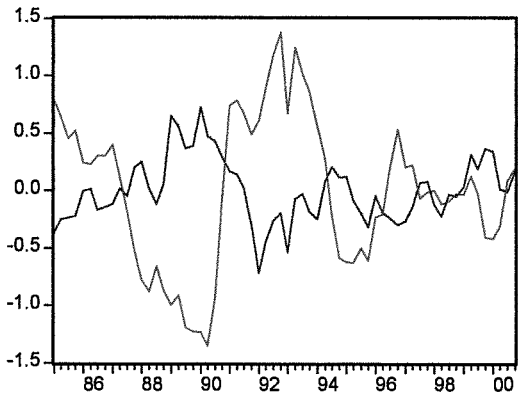
9c. Males 25-54 years



9d. Males 55+ years

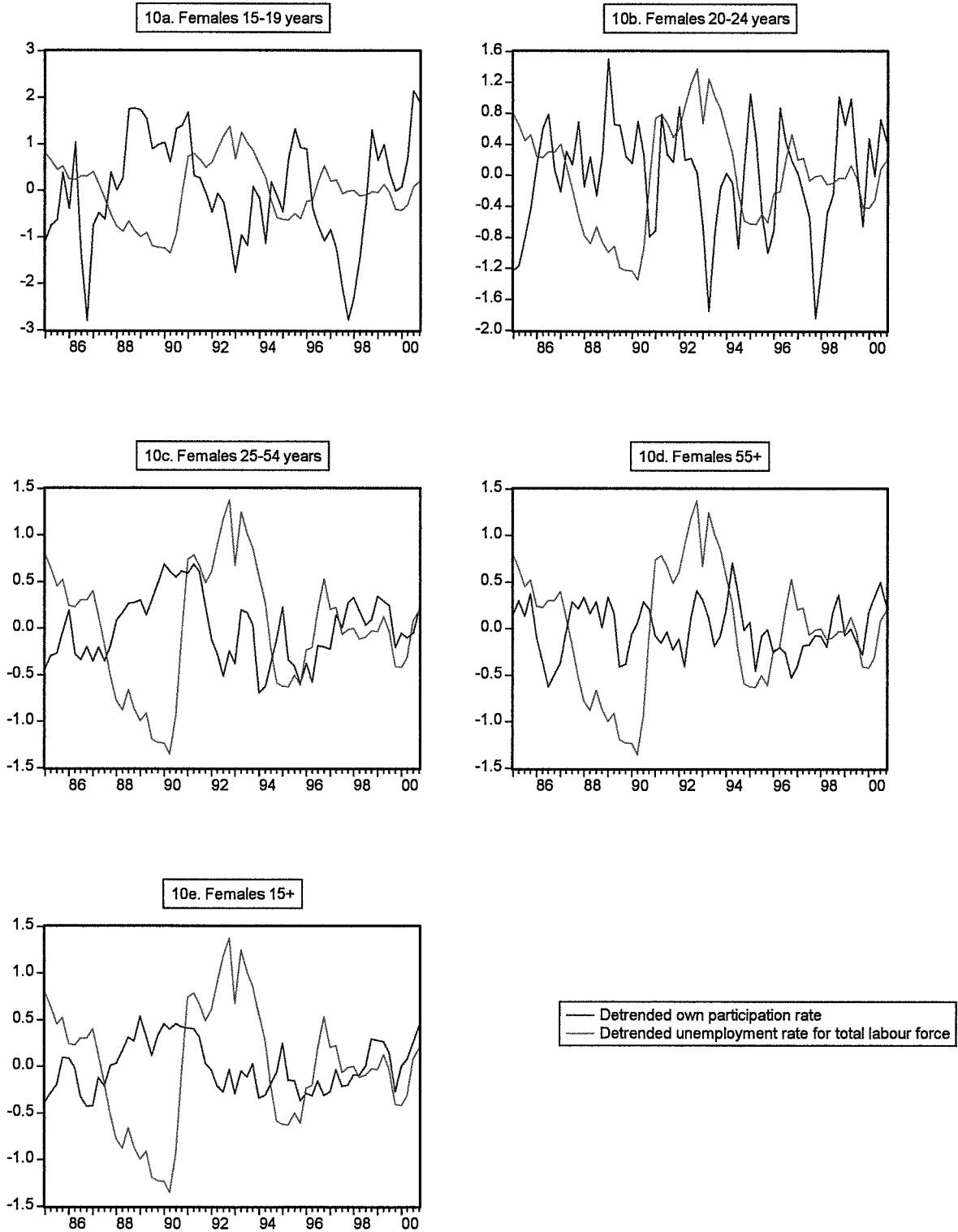


9e. Males 15+ years



— Detrended own participation rate  
- - - Detrended unemployment rate for total labour force

Figure 10. Female detrended seasonally adjusted quarterly participation rate, 1985-2000.



prices. Potential output is estimated by using two additional measures calculated by Statistics Canada: the Fixed Capital Flows and the Stock Survey. Capacity utilization rates figure among the range of economic indicators used by the Bank of Canada to track inflationary pressures in the economy.<sup>34</sup> Capacity utilization rates are highly correlated with unemployment rates of males and females in three of the four cases (Table 7). The series of quarterly statistics were stationary in both periods.

Table 7. Correlation between the rates of capacity utilization and unemployment rates (quarterly data) for the periods 1962-1974 and 1985-2000.		
Period	Males: all age groups	Females: all age groups
1962(I)-1974(IV)	-0.719956	-0.457276
1985(I)-2000(IV)	-0.677505	-0.675788

#### 4.2.2 Regression models

Three sets of equations (eight in total) were tested for each sex/age group in each of the two periods:

- 1)  $d(L_i/P_i)_t = a d(\text{Capacity}_{t-1}) + b d(T) + c d(T^2)$  (Results in Table 9)
- 2)  $d(L_i/P_i)_t = a d((U/L)_{t-1}) + b d(T) + c d(T^2)$  (Results in Table 10)
- 3)  $d(L_i/P_i)_t = a d((U_i/L_i)_{t-1}) + b d(T) + c d(T^2)$  (Results in Table 11)
- 4)  $(L_i/P_i)_t = a + b\text{Capacity}_{t-1} + cT + dT^2$  (Results in Table 12)
- 5)  $(L_i/P_i)_t = a + b(U/L)_{t-1} + cT + dT^2$  (Results in Table 13)
- 6)  $(L_i/P_i)_t = a + b(U_i/L_i)_{t-1} + cT + dT^2$  (Results in Table 14)
- 7)  $(L_i/P_i)_t = a + b\text{Capacity}_{t-1} + c(L_i/P_i)_{t-1} + dT + eT^2$  (Results in Table 15)
- 8)  $(L_i/P_i)_t = a + b(U_i/L_i)_{t-1} + c(L_i/P_i)_{t-1} + dT + eT^2$  (Results in Table 16)

<sup>34</sup> Bank of Canada, Indicators of Capacity and Inflation Pressures for Canada: Information Sheet, [http://www.bankofcanada.ca/en/indinf\\_sources.htm](http://www.bankofcanada.ca/en/indinf_sources.htm).

The dependent variable,  $L_i/P_i$ , is each age/sex group's own labour force-population ratio, or participation rate in each quarter;  $a$  is a constant;  $Capacity_{t-1}$  is the rate of capacity utilization lagged one quarter;  $U_i/L_{it-1}$  is each age/sex group's own unemployment-labour force ratio (unemployment rate), also lagged one quarter;  $L_i/P_{i t-1}$  is a lagged dependent variable;  $T$  is a linear trend and  $T^2$ , a quadratic trend. The  $d( )$  indicates the first difference of the variable.

In keeping with the approach used in many studies, trend variables were included in the equations, given that there is only one explanatory variable in the model. As suggested by Swidinsky (1969: 6), the trend variables can be regarded as a proxy for changes in attitudes, population changes and in the industrial composition of the job market. The cyclical variables were lagged one quarter because it could be reasonably expected that a decision to join or withdraw from the labour force would not be immediate in response to a deterioration or improvement in employment prospects. No constant was included in the differenced-equations since by taking the first difference of the linear trend, that becomes a constant.

The fact that the series of statistics used in this study were not stationary directed the form the regression equations should take, i.e., first-differenced equations. For the purpose of comparison with previous studies, two other types of equations were tested: level equations and equations with a lagged dependent variable.

### 4.3 Regression results

Table 8 A, 8 B and 8 C summarize the significant results at the 1%, 5% and 10% level for the coefficients of the cyclical variables in each set of equations. Tables 9-16 present the full results and test statistics. All the significant results in Table 8 support the theory of the pro-cyclical workforce: all the signs of the significant coefficients were positive for the capacity variable and negative for the two unemployment variables. The three groups of equations are discussed separately. Although many of the coefficients of the quadratic trend were significant in all the equations, they were so small that they rounded to zero, hence it could safely be said that this trend could probably have been omitted in this set of equations without affecting the overall results.

The first set of three equations (Equations 1, 2 and 3) were differenced-equations. These equations were devised with the knowledge that many of the series were not stationary. All the significant results for the cyclical variables were confined to two age groups (14-19 or 15-19 and 25-54) and the aggregate labour force. The coefficients were quite large for the 14-19 year-old females in the first period, and the 15-19 year-old males and females in the second period (-0.77, -0.86, and -0.93 respectively), using the unemployment rate for the total labour force variable. The coefficients were generally larger with the total unemployment variable than with the capacity or own unemployment rate variables. Since the 25-54 year-olds form the majority of the 14+ and 15+ work force, it is not surprising to see very similar results for both groups. This is the case for females in equation 1 and 2, for the first and second period respectively. The negative adjusted  $R^2$  statistics indicate that the model was poorly fitting for many of the groups. This is not surprising considering that very few of the coefficients in those equations

were significant (43/180). Only ten of those significant coefficients were associated with one of the cyclical variables in the differenced-equations; the others were associated with one of the trends. In addition, some of the coefficients were negative, many of them so small that they appear as negative zeros due to rounding. The F statistic confirmed that in many of the cases, it was not possible to reject the null hypothesis that all the coefficients were zero. However, the LM test showed that no autocorrelation was present.

Some groups were tested with the first-differenced dependent variable and the capacity variable at level, but the model did not offer a remarkable improvement on the differenced-equation in terms of the number of significant coefficients and the Akaike Criterion tended to be higher with those than with the fully differenced models. A partially differenced-equation would not have been appropriate with the unemployment variables because they had a unit root, hence that model was not retained.

The next set of equations (Equations 4, 5, and 6) all had extremely good explanatory power based on the test of overall significance, since all the F statistics were highly significant. However, they failed miserably the test for autocorrelation which indicates the possibility of spurious correlations. With this caveat in mind, one observes that all the coefficients that were significant were positive, and the younger age groups appeared more sensitive to changes in employment conditions than older age groups.

The final two equations (Equations 7 and 8) included a lagged dependent variable. Only equations with the variables "capacity" and "own unemployment" rates were tested. These last two equations gave the best results and they satisfied the test of overall significance in all cases, while also being sturdy to the test of autocorrelation. The coefficients of the lagged variable were all very significant. They were also very large

compared to the coefficients of the cyclical variables and this seems to indicate that, either the lagged variable was a proxy for some other omitted variable or it merely pointed to the strength of the underlying trend.

Table 8 A. Summary of significant results (at the 1%, 5% and 10% level) obtained for the three first-differenced equations described in the text (Equations 1, 2 and 3). The cyclical variables were unemployment rate ( $U_i/L_i$ , U/L) and capacity utilization rate (C), both lagged one quarter. All the significant coefficients below supported the discouraged-worker effect.

Significance level	Males						Females						
	1%		5%		10%		1%		5%		10%		
	U/L	C	U/L	C	U/L	C	U/L	C	U/L	C	U/L	C	
1962(I)-1974(IV)								14+ 20-24 25-54		14-19		14+	14-19
1985(I)-2000(IV)	15+ 15-19		15+			20-24	15+ 15-19	15+	25-54	15+			20-24

Variables: Unemployment rate (U/L) and Capacity utilization rate (C)  
Several of the trend coefficients were also significant.

Table 8 B. Summary of significant results (at the 1%, 5% and 10% level) obtained for the three level equations described in the text (Equations 4, 5 and 6). The cyclical variables were unemployment rate ( $U_i/L_i$ , U/L) and capacity utilization rate (C), both lagged one quarter. All the significant coefficients below supported the discouraged-worker effect.

Significance level	Males						Females						
	1%		5%		10%		1%		5%		10%		
	U/L	C	U/L	C	U/L	C	U/L	C	U/L	C	U/L	C	
1962(I)-1974(IV)	14+ 14-19 20-24 25-54	14+ 14-19 20-24 25-54					14+ 14-19 20-24 25-54	14+ 14-19 25-54	20-24	20-24			
1985(I)-2000(IV)	15+ 15-19 20-24 25-54 55+	15+ 15-19 20-24 25-54				55+	15+ 15-19 20-24 25-54	15-19	55+	15+ 20-24	55+	25-54 55+	

Variables: Unemployment rate (U/L) and Capacity utilization rate (C)  
Several of the trend coefficients were also significant.

Table 8 C. Summary of significant results (at the 1%, 5% and 10% level) obtained for the two equations with a lagged dependent variable described in the text (Equations 7 and 8). Two cyclical variables were tested: each group's own unemployment rate ( $U_i/L_i$ ) and the capacity utilization rate (C), both lagged one quarter. All the significant coefficients below supported the discouraged-worker effect.

Significance level	Males						Females						
	1%		5%		10%		1%		5%		10%		
	U/L	C	U/L	C	U/L	C	U/L	C	U/L	C	U/L	C	
1962(I)-1974(IV)	14+ 14-19 25-54	14+ 20-24 25-54				14-19	14+ 14-19 25-54	14+ 14-19		25-54			
1985(I)-2000(IV)	15-19 25-54		15+ 20-24	15-19 20-24		25-54	15+ 15-19 20-24 25-54			15+ 15-19 25-54			

Variables: Unemployment rate (U/L) and Capacity utilization rate (C)  
Several of the trend coefficients were also significant.

Period		Equation 1: Regression results for males (M) females (F), by age group for 1962(I)-1974(IV) and 1985(I)-2000(IV).												d(L <sub>t</sub> /P <sub>t</sub> ) = a d(Capacity <sub>t-1</sub> ) + b d(T) + c d(T <sup>2</sup> )					
		d(Capacity <sub>t-1</sub> )		d(T)		d(T <sup>2</sup> )		Adj. R <sup>2</sup>		LM Test		AIC		Adj. R <sup>2</sup>		LM Test		AIC	
Age group	Dependent variable	M	F	M	F	M	F	M	F	M	F	M	F	M	F	M	F	M	F
1962-1974	d(L <sub>t</sub> /P <sub>t</sub> )	-0.14	0.17	-0.37	-0.32	<b>0.01</b>	0.01	0.08	0.12	3.14	1.66	2.87	2.14						
	p-value	0.27	0.06	0.22	0.13	0.03	0.02			0.02	0.18								
	s.e.	0.12	0.09	0.30	0.20	0.00	0.00												
	d(L <sub>t</sub> /P <sub>t</sub> )	0.11	0.25	-0.32	0.31	0.01	-0.00					1.98	2.12						
	p-value	0.19	0.01	0.10	0.13	0.14	0.71												
	s.e.	0.08	0.08	0.19	0.20	0.00	0.00												
1962-1974	d(L <sub>t</sub> /P <sub>t</sub> )	-0.00	<b>0.13</b>	-0.02	<b>0.23</b>	-7.9E-5	0.00	-0.04	0.11	5.38	2.69	-0.76	0.95						
	p-value	0.96	0.01	0.76	0.05	0.92	0.50			0.00	0.06								
	s.e.	0.02	0.05	0.05	0.11	0.00	0.00												
	d(L <sub>t</sub> /P <sub>t</sub> )	0.02	0.07	0.00	0.19	-0.00	-0.00					1.32	0.94						
	p-value	0.77	0.15	0.99	0.11	0.27	0.17			0.05	0.16								
	s.e.	0.06	0.05	0.14	0.11	0.00	0.00												
1962-1974	d(L <sub>t</sub> /P <sub>t</sub> )	0.00	<b>0.14</b>	-0.19	0.16	<b>0.00</b>	0.00	0.05	0.16	1.34	2.07	0.26	0.61						
	p-value	0.90	0.00	0.02	0.11	0.03	0.52			0.27	0.10								
	s.e.	0.03	3.36	0.08	0.09	0.00	0.00												
	d(L <sub>t</sub> /P <sub>t</sub> )	0.18	0.17	-0.03	-0.04	1.2E-5	0.00	-0.00	-0.00	-0.00	0.44	1.15	2.71	2.68					
	p-value	0.18	0.18	0.90	0.87	0.99	0.84				0.78	0.34							
	s.e.	0.13	0.13	0.24	0.24	0.00	0.00												
1985-2000	d(L <sub>t</sub> /P <sub>t</sub> )	0.20	-0.03	-0.15	0.02	0.00	-0.00	0.02	-0.03	4.97	0.98	2.36	2.26						
	p-value	0.07	0.78	0.47	0.90	0.72	0.79			0.00	0.42								
	s.e.	0.11	0.10	0.21	0.19	0.00	0.00												
	d(L <sub>t</sub> /P <sub>t</sub> )	0.01	0.03	-0.06	<b>0.32</b>	0.00	<b>-0.00</b>												
	p-value	0.73	0.41	0.27	0.00	0.64	0.02				0.92	1.17	0.19						
	s.e.	0.03	0.03	0.06	0.07	0.00	0.00				0.46	0.34							
1985-2000	d(L <sub>t</sub> /P <sub>t</sub> )	-0.01	-0.00	-0.31	-0.11	<b>0.00</b>	<b>0.00</b>	0.06	0.04	3.15	2.16	0.65	0.25						
	p-value	0.90	0.91	0.09	0.12	0.02	0.03			0.02	0.09								
	s.e.	0.04	0.04	0.09	0.07	0.00	0.00												
	d(L <sub>t</sub> /P <sub>t</sub> )	0.04	0.03	-0.10	<b>0.14</b>	0.00	-0.00												
	p-value	0.16	0.30	0.07	0.01	0.51	0.27				3.50	1.48	-0.23	-0.34					
	s.e.	0.03	0.02	0.06	0.05	0.00	0.00			0.01	0.22								

		Regression results for males (M) females (F), by age group for 1962(I)-1974(IV) and 1985(I)-2000(IV).												$d(L_t/P_t) = a d(U/L_{t-1}) + b d(T) + c d(T^2)$ .					
Period	Age group	Dependent variable	$d(U/L_{t-1})$		$d(T)$		$d(T^2)$		Adj. R <sup>2</sup>		LM Test		AIC						
			M	F	M	F	M	F	M	F	M	F	M	F					
1962-1974	14-19 years	$d(L_t/P_t)$	-0.44	-0.77	-0.44	-0.36	0.01	0.01	0.07	0.13	3.09	2.18	2.88	2.13					
		p-value s.e.	0.42 0.53	0.04 0.36	0.16 0.30	0.08 0.21	0.03 0.00	0.01 0.00			0.03 0.07	0.09 0.38							
	20-24 years	$d(L_t/P_t)$	-0.02	-0.67	-0.30	0.30	0.00	-0.00	-0.00	0.03	2.29	1.07	2.02	2.22					
		p-value s.e.	0.95 0.35	0.09 0.38	0.13 0.19	0.18 0.22	0.18 0.00	0.79 0.00			0.07 0.00	0.38 0.00							
	25-54 years	$d(L_t/P_t)$	-0.01	-0.33	-0.02	0.22	-6.0E-5	0.00	-0.04	0.01	5.65	5.27	-0.76	1.05					
		p-value s.e.	0.89 0.09	0.12 0.21	0.74 0.05	0.07 0.12	0.94 0.00	0.49 0.00			0.00 0.00	0.00 0.00							
55+ years	$d(L_t/P_t)$	0.16	-0.02	0.01	0.20	-0.00	-0.00	-0.00	0.00	1.39	4.76	1.31	0.98						
	p-value s.e.	0.51 0.24	0.91 0.21	0.89 0.14	0.09 0.12	0.26 0.00	0.16 0.00			0.25 0.00	0.00 0.00								
14+ years	$d(L_t/P_t)$	-0.08	-0.33	-0.19	0.15	0.00	0.00	0.06	0.02	1.74	4.50	0.25	0.76						
	p-value s.e.	0.59 0.14	0.08 0.18	0.02 0.08	0.16 0.10	0.03 0.00	0.51 0.00			0.16 0.00	0.00 0.00								
1985-2000	15-19 years	$d(L_t/P_t)$	-0.86	-0.93	-0.08	-0.10	0.00	0.00	0.07	0.09	0.18	1.40	2.64	2.59					
		p-value s.e.	0.01 0.34	0.00 0.33	0.72 0.24	0.66 0.23	0.96 0.00	0.81 0.00			0.95 0.25	0.25 0.00							
20-24 years	$d(L_t/P_t)$	-0.25	0.02	-0.18	0.03	0.00	-0.00	-0.02	-0.03	5.94	1.06	2.40	2.25						
	p-value s.e.	0.42 0.30	0.94 0.28	0.40 0.21	0.88 0.19	0.63 0.00	0.78 0.00			0.00 0.00	0.39 0.00								
25-54 years	$d(L_t/P_t)$	-0.11	-0.22	-0.07	0.31	0.00	-0.00	0.00	0.13	1.48	1.23	-0.18	0.11						
	p-value s.e.	0.18 0.08	0.02 0.09	0.22 0.06	0.00 0.07	0.65 0.00	0.02 0.00			0.22 0.31	0.31 0.00								
55+ years	$d(L_t/P_t)$	-0.12	-0.14	-0.31	-0.12	0.00	0.00	0.07	0.07	3.59	2.26	0.63	0.21						
	p-value s.e.	0.35 0.12	0.16 0.10	0.00 0.09	0.10 0.07	0.02 0.00	0.04 0.00			0.01 0.00	0.07 0.00								
15+ years	$d(L_t/P_t)$	-0.20	-0.23	-0.11	0.12	0.00	-0.00	0.08	0.13	3.37	0.89	-0.30	-0.48						
	p-value s.e.	0.01 0.08	0.00 0.07	0.04 0.05	0.02 0.05	0.46 0.00	0.23 0.00			0.02 0.48	0.48 0.00								

Period		Regression results for males (M) females (F), by age group for 1962(I)-1974(IV) and 1985(I)-2000(IV).												$d(L_i/P_i) = a d(U_i/L_{i,t-1}) + b d(T) + c d(T^2)$					
		Age group	d(U <sub>i</sub> /L <sub>i,t-1</sub> )		d(T)		d(T <sup>2</sup> )		Adj. R <sup>2</sup>		LM Test		AIC						
	Dependent variable	M	F	M	F	M	F	M	F	M	F	M	F	M	F				
1962-1974	14-19 years																		
	d(L <sub>i</sub> /P <sub>i</sub> )	-0.10	0.14	-0.40	-0.29	0.01	0.01	0.06	0.07	3.44	0.87	2.89	2.20						
	p-value	0.55	0.32	0.19	0.16	0.03	0.03			0.02	0.49								
	s.e.	0.17	0.14	0.30	0.21	0.00	0.00												
	20-24 years																		
	d(L <sub>i</sub> /P <sub>i</sub> )	-0.01	-0.31	-0.30	0.35	0.00	-0.00	-0.00	-0.00	-0.00	2.13	0.19	2.02	2.25					
p-value	0.97	0.20	0.13	0.11	0.18	0.69	0.69			0.09	0.33								
s.e.	0.13	0.24	0.20	0.22	0.00	0.00													
25-54 years																			
d(L <sub>i</sub> /P <sub>i</sub> )	-0.04	-0.27	-0.02	0.24	-2.7E-5	0.00	0.00	-0.04	-0.02	5.79	2.23	-0.76	1.09						
p-value	0.64	0.40	0.69	0.05	0.97	0.55	0.55			0.00	0.01								
s.e.	0.08	0.31	0.05	0.12	0.00	0.00													
55+ years																			
d(L <sub>i</sub> /P <sub>i</sub> )	0.16	-0.12	0.01	0.21	-0.00	-0.00	0.00	0.00	0.02	1.36	4.05	1.31	0.96						
p-value	0.37	0.33	0.92	0.08	0.24	0.14	0.14			0.27	0.01								
s.e.	0.17	0.12	0.14	0.11	0.00	0.00													
14+ years																			
d(L <sub>i</sub> /P <sub>i</sub> )	-0.08	-0.46	-0.20	0.17	0.00	0.00	0.00	0.06	0.02	1.81	3.93	0.25	0.76						
p-value	0.46	0.09	0.02	0.09	0.03	0.54	0.54			0.14	0.01								
s.e.	0.11	0.26	0.08	0.10	0.00	0.00													
1985-2000	Age group	d(U <sub>i</sub> /L <sub>i,t-1</sub> )		d(T)		d(T <sup>2</sup> )		Adj. R <sup>2</sup>		LM Test		AIC							
		M	F	M	F	M	F	M	F	M	F	M	F	M	F				
	15-19 years																		
	d(L <sub>i</sub> /P <sub>i</sub> )	-0.15	-0.17	-0.06	-0.07	0.00	0.00	-0.01	0.00	0.27	1.00	2.72	2.68						
	p-value	0.21	0.17	0.79	0.76	0.86	0.69			0.90	0.41								
	s.e.	0.12	0.12	0.24	0.24	0.00	0.00												
	20-24 years																		
	d(L <sub>i</sub> /P <sub>i</sub> )	-0.02	-0.27	-0.17	0.01	0.00	-0.00	-0.03	0.03	4.77	1.90	2.41	2.20						
	p-value	0.85	0.06	0.43	0.94	0.61	0.73			0.00	0.12								
	s.e.	0.11	0.14	0.21	0.19	0.00	0.00												
	25-54 years																		
	d(L <sub>i</sub> /P <sub>i</sub> )	-0.13	-0.14	-0.07	0.31	0.00	-0.00	0.01	0.08	1.68	1.41	-0.19	0.17						
p-value	0.11	0.19	0.26	0.00	0.72	0.02			0.17	0.24									
s.e.	0.08	0.10	0.06	0.07	0.00	0.00													
55+ years																			
d(L <sub>i</sub> /P <sub>i</sub> )	-0.11	-0.08	-0.31	-0.11	0.00	0.00	0.09	0.07	3.53	2.53	0.62	0.22							
p-value	0.17	0.19	0.00	0.13	0.02	0.03			0.01	0.05									
s.e.	0.08	0.06	0.08	0.07	0.00	0.00													
15+ years																			
d(L <sub>i</sub> /P <sub>i</sub> )	-0.15	-0.24	-0.11	0.12	0.00	-0.00	0.05	0.14	3.20	1.19	-0.28	-0.49							
p-value	0.04	0.00	0.04	0.02	0.47	0.24			0.02	0.33									
s.e.	0.07	0.07	0.05	0.05	0.00	0.00													

Table 12. Equation 4: Regression results for males (M) females (F), by age group for 1962(I)-1974(IV) and 1985(I)-2000(IV).  $L_i/P_i = a + b\text{Capacity}_{i-1} + cT + dT^2$

Period	Age group	Dependent variable	Constant		Capacity <sub>i-1</sub>		T		T <sup>2</sup>		LM Test		F-stat		Adj. R <sup>2</sup> & AIC		
			M	F	M	F	M	F	M	F	M	F	M	F	M	F	
			M		F		M		F		M		F		M		F
1962-1974	14-19 years	$L_i/P_i$	22.58	12.09	0.22	0.23	-0.30	-0.12	0.01	0.00	1.84	6.66	96.19	77.30	Adj.R <sup>2</sup> 0.86	0.83	
		p-value s.e.	0.00 4.19	0.00 3.47	0.00 0.05	0.00 0.04	0.00 0.04	0.00 0.03	0.00 0.00	0.00 0.00	0.00 0.00	0.14	0.00	0.00	0.00	AIC 2.88	AIC 2.50
	20-24 years	$L_i/P_i$	69.82	39.27	0.25	0.10	-0.34	0.45	0.00	-0.00	8.12	10.34	122.23	369.29	Adj.R <sup>2</sup> 0.89	0.96	
		p-value s.e.	0.00 2.99	0.00 3.88	0.00 0.04	0.03 0.46	0.00 0.03	0.00 0.04	0.00 0.00	0.00 0.00	0.00 0.00	0.00	0.00	0.00	0.00	AIC 2.21	AIC 2.73
	25-54 years	$L_i/P_i$	94.58	25.26	0.03	0.06	-0.03	0.27	0.00	0.00	5.45	5.43	138.45	2454.76	Adj.R <sup>2</sup> 0.90	0.99	
		p-value s.e.	0.00 0.63	0.00 1.60	0.00 0.01	0.00 0.02	0.00 0.01	0.00 0.02	0.00 0.00	0.00 0.00	0.00	0.00	0.00	0.00	AIC -0.90	AIC 0.95	
	55+ years	$L_i/P_i$	54.55	11.58	0.02	0.02	0.14	0.24	-0.00	-0.00	5.78	11.13	265.12	119.07	Adj.R <sup>2</sup> 0.94	0.88	
		p-value s.e.	0.00 2.21	0.00 1.61	0.41 0.03	0.21 0.02	0.00 0.02	0.00 0.02	0.00 0.00	0.00 0.00	0.00	0.00	0.00	0.00	AIC 1.60	AIC 0.96	
	14+ years	$L_i/P_i$	72.94	22.19	0.08	0.07	-0.15	0.23	0.00	-0.00	3.55	6.07	146.98	1330.31	Adj.R <sup>2</sup> 0.90	0.99	
		p-value s.e.	0.00 1.19	0.00 1.55	0.00 0.01	0.00 0.02	0.00 0.01	0.00 0.01	0.00 0.00	0.00 0.00	0.00	0.00	0.00	0.00	AIC 0.36	AIC 0.89	
	1985-2000	15-19 years	$L_i/P_i$	14.72	18.53	0.52	0.44	-0.00	-0.01	-0.00	-0.00	82.67	78.28	38.17	24.35	Adj.R <sup>2</sup> 0.66	0.55
			p-value s.e.	0.32 14.82	0.19 13.88	0.00 0.17	0.01 0.16	0.98 0.09	0.86 0.09	0.05 0.00	0.17 0.00	0.00	0.00	0.00	0.00	AIC 4.8	AIC 4.67
20-24 years		$L_i/P_i$	60.84	62.24	0.30	0.19	-0.16	-0.05	0.00	-0.00	9.41	17.63	143.43	51.51	Adj.R <sup>2</sup> 0.88	0.72	
		p-value s.e.	0.00 5.01	0.00 6.57	0.00 0.08	0.02 0.08	0.00 0.03	0.18 0.04	0.30 0.00	0.32 0.00	0.00	0.00	0.00	0.00	AIC 2.63	AIC 0.17	
25-54 years		$L_i/P_i$	84.90	59.76	0.11	0.11	-0.08	0.31	0.00	-0.00	25.83	109.51	173.06	193.21	Adj.R <sup>2</sup> 0.90	0.91	
		p-value s.e.	0.00 2.18	0.00 4.75	0.00 0.03	0.06 0.05	0.00 0.01	0.00 0.03	0.09 0.00	0.00	0.00	0.00	0.00	0.00	AIC 0.97	AIC 2.52	
55+ years		$L_i/P_i$	37.13	14.34	0.06	0.04	-0.34	-0.08	0.00	0.00	26.97	13.83	575.66	55.65	Adj.R <sup>2</sup> 0.97	0.74	
		p-value s.e.	0.00 2.97	0.00 2.03	0.07 0.03	0.08 0.02	0.00 0.02	0.00 0.01	0.00	0.00	0.00	0.00	0.00	0.00	AIC 1.58	AIC 0.83	
15+ years		$L_i/P_i$	64.79	45.92	0.15	0.11	-0.12	0.14	0.00	-0.00	67.37	120.90	223.92	33.03	Adj.R <sup>2</sup> 0.92	0.63	
		p-value s.e.	0.00 3.22	0.00 4.03	0.00 0.04	0.02 0.05	0.00 0.02	0.00 0.02	0.00	0.00	0.00	0.00	0.00	0.00	AIC 1.75	AIC 2.19	

Table 13. Equation 5: Regression results for males (M) females (F), by age group for 1962(I)-1974(IV)  $L_t/P_t = a + bU/L_{t-1} + cT + dT^2$

Period	Age group	Dependent variable	Constant		U/L <sub>t-1</sub>		T		T <sup>2</sup>		LM Test		F-stat		Adj. R <sup>2</sup> & AIC	
			M	F	M	F	M	F	M	F	M	F	M	F	M	F
1962-1974	14-19 years	L <sub>t</sub> /P <sub>t</sub>	47.00	37.41	-1.05	-1.07	-0.43	-0.26	0.01	-0.01	1.19	2.59	130.30	122.30	0.89	0.88
		p-value s.e.	0.00 0.01	0.00 0.79	0.00 0.16	0.00 0.13	0.00 0.04	0.00 0.03	0.00 0.00	0.00 0.00	0.36	0.05	0.00	0.00	AIC	AIC
	20-24 years	L <sub>t</sub> /P <sub>t</sub>	96.18	50.12	-0.89	-0.43	-0.46	0.40	0.01	-0.00	8.53	9.29	104.96	379.97	0.86	0.96
		p-value s.e.	0.00 0.89	0.00 1.06	0.00 0.14	0.02 0.17	0.00 0.03	0.00 0.04	0.00 0.00	0.01 0.00	0.00	0.00	0.00	0.00	AIC	AIC
	25-54 years	L <sub>t</sub> /P <sub>t</sub>	98.29	31.46	-0.14	-0.25	-0.05	0.24	0.00	0.00	4.73	5.44	152.41	2632.5	0.90	0.99
		p-value s.e.	0.00 0.17	0.00 0.43	0.00 0.03	0.00 0.07	0.00 0.01	0.00 0.02	0.00 0.00	0.00 0.00	0.00	0.00	0.00	0.00	AIC	AIC
55+ years	L <sub>t</sub> /P <sub>t</sub>	57.09	13.71	-0.13	-0.02	0.12	0.23	-0.00	-0.00	5.54	11.66	271.48	114.74	0.94	0.87	
	p-value s.e.	0.00 0.60	0.00 0.45	0.19 0.09	0.81 0.07	0.00 0.02	0.00 0.02	0.00 0.00	0.00 0.00	0.00	0.00	0.00	0.00	AIC	AIC	
14+ years	L <sub>t</sub> /P <sub>t</sub>	81.59	30.00	-0.35	-0.30	-0.19	0.19	0.00	0.00	2.91	5.46	201.69	1418.3	0.92	0.98	
	p-value s.e.	0.00 0.29	0.00 0.42	0.00 0.04	0.00 0.07	0.00 0.01	0.00 0.02	0.00 0.00	0.07 0.00	0.03	0.00	0.00	0.00	AIC	AIC	
1985-2000	Age group	Dependent variable	Constant		U/L <sub>t-1</sub>		T		T <sup>2</sup>		LM Test		F-stat		Adj. R <sup>2</sup> & AIC	
		M	F	M	F	M	F	M	F	M	F	M	F	M	F	
15-19 years	L <sub>t</sub> /P <sub>t</sub>	74.89	69.64	-1.81	-1.55	0.02	0.01	-0.00	-0.00	33.93	44.38	127.36	69.49	0.86	0.76	
	p-value s.e.	0.00 1.58	0.00 1.66	0.00 0.17	0.00 0.18	0.65 0.05	0.90 0.05	0.00 0.00	0.00 0.00	0.00	0.00	0.00	0.00	AIC	AIC	
20-24 years	L <sub>t</sub> /P <sub>t</sub>	92.29	84.12	-0.17	-0.66	-0.17	-0.04	0.00	-0.00	2.93	8.00	231.71	100.43	0.92	0.83	
	p-value s.e.	0.00 0.69	0.00 0.86	0.00 0.02	0.00 0.09	0.00 0.02	0.11 0.03	0.04 0.00	0.02 0.00	0.03	0.00	0.00	0.00	AIC	AIC	
25-54 years	L <sub>t</sub> /P <sub>t</sub>	97.11	73.05	-0.30	-0.49	-0.08	0.33	0.00	-0.00	8.36	67.99	460.92	399.77	0.96	0.95	
	p-value s.e.	0.00 0.23	0.00 0.57	0.00 0.03	0.00 0.06	0.00 0.00	0.00 0.02	0.01 0.00	0.00 0.00	0.00	0.00	0.00	0.00	AIC	AIC	
55+ years	L <sub>t</sub> /P <sub>t</sub>	44.36	18.65	-0.22	-0.09	-0.34	-0.08	0.00	0.00	21.24	14.03	757.99	59.81	0.97	0.74	
	p-value s.e.	0.00 0.44	0.00 0.34	0.00 0.05	0.02 0.04	0.00 0.01	0.00 0.01	0.00 0.00	0.00 0.00	0.00	0.00	0.00	0.00	AIC	AIC	
15+ years	L <sub>t</sub> /P <sub>t</sub>	81.98	59.22	-0.44	-0.44	-0.12	0.14	0.00	-0.00	27.46	87.76	714.44	87.46	0.97	0.81	
	p-value s.e.	0.00 0.32	0.00 0.48	0.00 0.03	0.00 0.05	0.00 0.01	0.00 0.02	0.30 0.00	0.00 0.00	0.00	0.00	0.00	0.00	AIC	AIC	

Table 14. Equation 6: Regression results for males (M) females (F), by age group for 1962(I)-1974(IV)  
 $L_j/P_1 = a + bU_j/L_{j-1} + cT + dT^2$

Period	Age group	Dependent variable	Constant		U <sub>j</sub> /L <sub>j-1</sub>		T		T <sup>2</sup>		LM Test		F-stat		Adj. R <sup>2</sup> & AIC		
			M	F	M	F	M	F	M	F	M	F	M	F	M	F	
1962-1974	14-19 years	L <sub>j</sub> /P <sub>1</sub>	46.65	35.30	-0.40	-0.57	-0.38	-0.13	0.01	0.01	0.98	1.84	125.21	110.85	Adj.R <sup>2</sup>	0.89	0.88
		p-value s.e.	0.00 0.99	0.00 0.60	0.00 0.07	0.00 0.07	0.00 0.04	0.00 0.03	0.00 0.00	0.00 0.00	0.00 0.00	0.43 0.14	0.00 0.00	0.00	AIC	2.65	2.19
	20-24 years	L <sub>j</sub> /P <sub>1</sub>	94.82	49.75	-0.39	-0.53	-0.45	0.40	0.01	-0.00	7.96	9.80	97.90	382.23	Adj.R <sup>2</sup>	0.86	0.96
		p-value s.e.	0.00 0.73	0.00 0.91	0.00 0.07	0.01 0.21	0.00 0.03	0.00 0.34	0.00 0.00	0.00 0.00	0.00 0.00	0.00 0.00	0.00 0.00	0.00	AIC	2.40	2.70
	25-54 years	L <sub>j</sub> /P <sub>1</sub>	98.30	31.33	-0.15	-0.58	-0.05	0.24	0.00	0.00	4.25	3.82	161.86	2641.41	Adj.R <sup>2</sup>	0.91	0.99
		p-value s.e.	0.00 0.16	0.00 0.39	0.00 0.03	0.16 0.16	0.00 0.01	0.00 0.12	0.00 0.00	0.00 0.00	0.00 0.00	0.01 0.01	0.00 0.00	0.00	AIC	-1.04	0.87
55+ years	L <sub>j</sub> /P <sub>1</sub>	56.32	13.72	0.01	-0.05	0.13	0.23	-0.00	-0.00	6.17	12.11	261.11	115.11	Adj.R <sup>2</sup>	0.94	0.88	
	p-value s.e.	0.00 0.77	0.00 0.29	0.00 0.12	0.07 0.11	0.00 0.02	0.00 0.02	0.00 0.00	0.00 0.00	0.00 0.00	0.00 0.00	0.00 0.00	0.00	AIC	1.61	0.99	
14+ years	L <sub>j</sub> /P <sub>1</sub>	81.51	30.01	-0.29	-0.53	-0.19	0.21	0.00	0.00	2.76	5.10	198.31	1540.01	Adj.R <sup>2</sup>	0.93	0.99	
	p-value s.e.	0.00 0.28	0.00 0.37	0.00 0.34	0.11 0.11	0.00 0.01	0.00 0.01	0.00 0.00	0.00 0.00	0.00 0.00	0.04 0.00	0.00 0.00	0.00	AIC	0.00	0.75	
1985-2000	15-19 years	L <sub>j</sub> /P <sub>1</sub>	75.06	70.75	-0.94	-1.04	-0.1	-0.14	-0.00	0.00	11.32	7.00	151.29	122.86	Adj.R <sup>2</sup>	0.88	0.86
		p-value s.e.	0.00 1.43	0.00 1.26	0.00 0.08	0.00 0.08	0.03 0.04	0.00 0.04	0.00 0.00	0.00 0.00	0.00 0.00	0.00 0.00	0.00 0.00	0.00	AIC	3.72	3.49
	20-24 years	L <sub>j</sub> /P <sub>1</sub>	90.47	85.84	-0.27	-0.64	-0.18	-0.10	0.00	-0.00	5.22	5.02	168.76	133.59	Adj.R <sup>2</sup>	0.90	0.87
		p-value s.e.	0.00 0.65	0.00 0.87	0.00 0.04	0.00 0.07	0.00 0.03	0.00 0.02	0.00 0.00	0.00 0.00	0.00 0.00	0.00 0.00	0.00 0.00	0.00	AIC	2.48	2.41
	25-54 years	L <sub>j</sub> /P <sub>1</sub>	96.38	74.93	-0.29	-0.73	-0.06	0.32	6.95E-5	-0.00	8.29	39.36	500.69	437.66	Adj.R <sup>2</sup>	0.96	0.96
		p-value s.e.	0.00 0.17	0.00 0.73	0.00 0.02	0.00 0.08	0.00 0.01	0.00 0.02	0.00 0.00	0.00 0.00	0.00 0.00	0.00 0.00	0.00 0.00	0.00	AIC	-0.02	1.76
	55+ years	L <sub>j</sub> /P <sub>1</sub>	43.56	18.33	-0.2	-0.08	-0.33	-0.09	0.00	0.00	24.66	15.70	692.19	55.92	Adj.R <sup>2</sup>	0.97	0.74
		p-value s.e.	0.00 0.34	0.00 0.27	0.00 0.05	0.00 0.04	0.00 0.12	0.00 0.01	0.00 0.00	0.00 0.00	0.00 0.00	0.00 0.00	0.00 0.00	0.00	AIC	1.40	0.82
	15+ years	L <sub>j</sub> /P <sub>1</sub>	81.15	60.82	-0.37	-0.59	-0.11	0.13	0.00	-0.00	32.12	50.01	588.69	114.13	Adj.R <sup>2</sup>	0.97	0.85
		p-value s.e.	0.00 0.29	0.00 0.55	0.00 0.03	0.00 0.06	0.00 0.01	0.00 0.01	0.00 0.00	0.00 0.00	0.00 0.00	0.00 0.00	0.00 0.00	0.00	AIC	0.83	1.26

Period	Age group	Dep. variable	Regression results for males (M) females (F), by age group for 1962(I)-1974(IV)												Regression results for males (M) females (F), by age group for 1962(I)-1974(IV)											
			Constant		Capacity <sub>t-1</sub>		L <sub>t</sub> /P <sub>t-1</sub>		T		T <sup>2</sup>		LM Test		F-stat		Adj. R <sup>2</sup> & AIC									
			M	F	M	F	M	F	M	F	M	F	M	F	M	F	M	F								
1962-1974	14-19 years	L <sub>t</sub> /P <sub>t</sub>	11.60	2.81	0.11	0.12	0.49	0.60	-0.16	-0.06	0.00	0.00	2.00	1.12	89.44	101.51	Adj.R <sup>2</sup> 0.88	Adj.R <sup>2</sup> 0.89								
		p-value	0.03	0.39	0.06	0.00	0.00	0.01	0.05	0.00	0.00	0.00	0.00	0.11	0.35	0.00	0.00	AIC 2.71	AIC 2.04							
	20-24 years	L <sub>t</sub> /P <sub>t</sub>	29.65	11.35	0.11	0.05	0.57	0.67	-0.16	0.16	0.00	-0.00	1.91	0.70	149.06	533.65	Adj.R <sup>2</sup> 0.92	Adj.R <sup>2</sup> 0.98								
		p-value	0.00	0.03	0.01	0.12	0.00	0.00	0.00	0.00	0.00	0.03	0.12	0.59	0.00	0.00	0.00	AIC 1.79	AIC 2.11							
	25-54 years	L <sub>t</sub> /P <sub>t</sub>	53.91	13.89	0.02	0.04	0.43	0.43	-0.02	0.16	0.00	0.00	4.38	2.57	133.21	2261.2	Adj.R <sup>2</sup> 0.91	Adj.R <sup>2</sup> 0.99								
		p-value	0.00	0.00	0.01	0.02	0.00	0.00	0.00	0.00	0.23	0.18	0.00	0.05	0.00	0.00	0.00	AIC -1.11	AIC 0.76							
	55+ years	L <sub>t</sub> /P <sub>t</sub>	19.43	6.12	0.03	0.01	0.61	0.48	0.06	0.12	-0.00	-0.00	2.90	4.78	349.14	117.39	Adj.R <sup>2</sup> 0.97	Adj.R <sup>2</sup> 0.90								
		p-value	0.00	0.00	0.16	0.46	0.00	0.00	0.01	0.00	0.00	0.00	0.03	0.00	0.00	0.00	0.00	AIC 1.08	AIC 0.74							
	14+ years	L <sub>t</sub> /P <sub>t</sub>	32.06	9.66	0.04	0.04	0.55	0.53	-0.07	0.11	0.00	-0.00	1.73	1.68	163.03	1453.3	Adj.R <sup>2</sup> 0.93	Adj.R <sup>2</sup> 0.99								
		p-value	0.00	0.00	0.01	0.01	0.00	0.00	0.00	0.00	0.00	0.52	0.16	0.17	0.00	0.00	0.00	AIC 0.02	AIC 0.54							
	1985-2000	15-19 years	L <sub>t</sub> /P <sub>t</sub>	5.16	-6.82	0.11	0.13	0.94	0.93	-0.06	-0.04	0.00	0.00	2.01	2.06	420.16	281.43	Adj.R <sup>2</sup> 0.96	Adj.R <sup>2</sup> 0.95							
			p-value	0.28	0.16	0.05	0.02	0.00	0.00	0.05	0.16	0.10	0.23	0.11	0.10	0.00	0.00	0.00	AIC 2.51	AIC 2.49						
20-24 years		L <sub>t</sub> /P <sub>t</sub>	25.00	13.44	0.12	0.04	0.60	0.79	-0.07	-0.04	0.00	0.00	1.41	3.14	174.73	143.07	Adj.R <sup>2</sup> 0.92	Adj.R <sup>2</sup> 0.90								
		p-value	0.00	0.03	0.04	0.41	0.00	0.00	0.01	0.07	0.24	0.34	0.24	0.02	0.00	0.00	0.00	AIC 2.21	AIC 2.11							
25-54 years		L <sub>t</sub> /P <sub>t</sub>	15.66	1.38	0.03	0.03	0.81	0.95	-0.02	0.00	0.00	4.7E-5	1.69	2.49	488.72	2008.4	Adj.R <sup>2</sup> 0.97	Adj.R <sup>2</sup> 0.99								
		p-value	0.01	0.60	0.10	0.05	0.00	0.00	0.02	0.98	0.14	0.78	0.17	0.054	0.00	0.00	0.00	AIC -0.27	AIC -0.00							
55+ years		L <sub>t</sub> /P <sub>t</sub>	8.14	4.66	0.00	-0.00	0.80	0.74	-0.07	-0.03	0.00	0.00	2.77	1.13	1246.0	96.43	Adj.R <sup>2</sup> 0.99	Adj.R <sup>2</sup> 0.86								
		p-value	0.02	0.02	0.86	0.97	0.00	0.00	0.01	0.03	0.01	0.01	0.04	0.35	0.00	0.00	0.00	AIC 0.56	AIC 0.17							
15+ years		L <sub>t</sub> /P <sub>t</sub>	5.94	0.50	0.02	0.03	0.90	0.96	-0.02	-0.01	0.00	0.00	3.03	2.06	1552.7	654.49	Adj.R <sup>2</sup> 0.99	Adj.R <sup>2</sup> 0.98								
		p-value	0.05	0.78	0.13	0.04	0.00	0.00	0.00	0.18	0.02	0.11	0.03	0.10	0.00	0.00	0.00	AIC -0.38	AIC -0.62							

Period	Age group	Dep. variable	Regression results for males (M) and females (F), by age group for 1962(I)-1974(IV)												Regression results for males (M) and females (F), by age group for 1962(I)-1974(IV)											
			Constant		U <sub>j</sub> /L <sub>j,t-1</sub>		L <sub>j</sub> /P <sub>j,t-1</sub>		T		T <sup>2</sup>		LM Test		F-stat		Adj. R <sup>2</sup> & AIC									
			M	F	M	F	M	F	M	F	M	F	M	F	M	F	M	F								
1962-1974	14-19 years	L <sub>j</sub> /P <sub>j</sub>	30.33	19.27	-0.28	-0.32	0.36	0.44	-0.26	-0.08	0.01	0.00	0.60	1.43	105.24	98.63	Adj.R <sup>2</sup>	0.89								
		p-value	0.00	0.00	0.00	0.01	0.02	0.01	0.00	0.01	0.00	0.00	0.67	0.24	0.00	0.00	AIC	2.06								
	s.e.	6.77	5.39	0.08	0.11	0.15	0.15	0.06	0.03	0.00	0.00					Adj.R <sup>2</sup>	0.91									
	20-24 years	L <sub>j</sub> /P <sub>j</sub>	27.61	16.45	-0.07	-0.13	0.70	0.67	-0.14	0.14	0.00	-0.00	2.60	0.76	128.16	511.74	AIC	0.98								
		p-value	0.03	0.01	0.38	0.44	0.00	0.00	0.03	0.01	0.03	0.26	0.07	0.55	0.00	0.00	AIC	2.15								
	s.e.	12.07	5.56	0.08	0.17	0.13	0.11	0.06	0.05	0.00	0.00					Adj.R <sup>2</sup>	0.92									
	25-54 years	L <sub>j</sub> /P <sub>j</sub>	64.53	19.81	-0.10	-0.39	0.34	0.37	-0.04	0.15	0.00	0.00	4.74	2.15	137.81	2280.6	AIC	0.99								
		p-value	0.00	0.00	0.01	0.01	0.01	0.01	0.00	0.00	0.01	0.01	0.00	0.09	0.00	0.00	AIC	0.75								
	s.e.	13.04	4.07	0.03	0.16	0.13	0.13	0.01	0.03	0.00	0.00					Adj.R <sup>2</sup>	0.96									
	55+ years	L <sub>j</sub> /P <sub>j</sub>	22.12	6.7	-0.06	0.04	0.61	0.51	0.05	0.11	-0.00	-0.00	2.27	4.20	337.63	116.31	AIC	0.90								
		p-value	0.00	0.00	0.50	0.69	0.00	0.00	0.03	0.00	0.00	0.00	0.07	0.01	0.00	0.00	AIC	0.75								
	s.e.	5.98	1.81	0.09	0.10	0.11	0.13	0.02	0.03	0.00	0.00					Adj.R <sup>2</sup>	0.93									
14+ years	L <sub>j</sub> /P <sub>j</sub>	48.48	16.59	-0.18	-0.30	0.41	0.45	-0.12	0.11	0.00	0.00	1.12	2.32	175.06	1429.1	AIC	0.56									
	p-value	0.00	0.00	0.00	0.01	0.01	0.00	0.00	0.00	0.00	0.16	0.35	0.07	0.00	0.00	AIC	0.56									
s.e.	11.24	3.88	0.05	0.12	0.14	0.13	0.03	0.03	0.00	0.00					Adj.R <sup>2</sup>	0.92										
1985-2000	15-19 years	L <sub>j</sub> /P <sub>j</sub>	15.00	17.78	-0.20	-0.28	0.82	0.77	-0.09	-0.09	0.00	0.00	0.49	1.41	444.70	306.47	Adj.R <sup>2</sup>	0.95								
		p-value	0.00	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.74	0.24	0.00	0.00	AIC	2.41								
	s.e.	4.91	4.93	0.07	0.08	0.07	0.07	0.02	0.02	0.00	0.00					Adj.R <sup>2</sup>	0.92									
	20-24 years	L <sub>j</sub> /P <sub>j</sub>	41.00	35.86	-0.11	-0.26	0.54	0.58	-0.10	-0.06	0.00	0.00	1.29	0.98	175.52	165.47	AIC	1.98								
		p-value	0.00	0.00	0.03	0.01	0.00	0.00	0.00	0.00	0.04	0.29	0.28	0.43	0.00	0.00	AIC	2.20								
	s.e.	10.69	8.53	0.05	0.09	0.12	0.10	0.03	0.02	0.00	0.00					Adj.R <sup>2</sup>	0.91									
	25-54 years	L <sub>j</sub> /P <sub>j</sub>	40.66	11.37	-0.12	-0.14	0.57	0.86	-0.03	0.03	0.00	-0.00	0.94	2.84	571.98	2160.9	Adj.R <sup>2</sup>	0.97								
		p-value	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.16	0.25	0.25	0.45	0.03	0.00	0.00	AIC	0.99								
	s.e.	9.18	3.63	0.03	0.05	0.01	0.05	0.01	0.02	0.02	9.5E-5	0.00				Adj.R <sup>2</sup>	0.99									
	55+ years	L <sub>j</sub> /P <sub>j</sub>	10.37	5.22	-0.04	-0.03	0.77	0.72	-0.08	-0.02	0.00	0.00	3.00	1.13	1272.3	98.30	AIC	0.86								
		p-value	0.01	0.00	0.30	0.33	0.00	0.00	0.01	0.03	0.00	0.01	0.03	0.35	0.00	0.00	AIC	0.15								
	s.e.	3.61	1.73	0.04	0.03	0.08	0.09	0.03	0.01	0.01	0.00	0.00				Adj.R <sup>2</sup>	0.54									
15+ years	L <sub>j</sub> /P <sub>j</sub>	16.15	8.78	-0.07	-0.11	0.80	0.87	-0.04	-0.00	0.00	5.6E-5	2.48	1.50	1640.3	721.97	Adj.R <sup>2</sup>	0.99									
	p-value	0.00	0.00	0.02	0.00	0.00	0.00	0.00	0.84	0.01	0.61	0.055	0.22	0.00	0.00	AIC	0.98									
s.e.	5.29	2.71	0.03	0.03	0.07	0.05	0.01	0.01	0.01	9.1E-5	0.00				Adj.R <sup>2</sup>	-0.44										

## 5. Discussion

While recognizing that the models used in this study were not without faults, general observations can nevertheless be made on the findings. In contrast to some other studies, the explanatory variables were not changed from one group to the next, although better results may have been observed if each equation was tailored to fit each group. The use of quarterly statistics, lagged one quarter, appears to have worked well overall in representing the change in the explanatory variables. There was no indication of an added-worker effect in the two periods for any of the age groups. However, a discouragement-effect was found for all groups with at least one of the models. Capacity utilization rates appeared to have been a valid proxy for labour market conditions since they were strongly correlated with the unemployment rate for males in the first period and with male and females unemployment rates in the second period. The sign of the coefficients for the capacity variable were very consistent overall and confirmed the discouraged-worker effect observed with the two unemployment variables. However, the first-differenced capacity variable only had a significant explanatory value for the aggregate female groups in the first period (25-54 and 14+ years), and none of the groups in the second period. Interestingly, some of the coefficients that were not significant had a negative value, albeit extremely small compared with their standard error, therefore this may be due to chance.

The largest coefficient values for the results obtained with the unemployment differenced-equations were associated with the 14-19 year-old females in the first period, and the 15-19 year-old males and females in the second period using the unemployment rate for the total labour force variable. They were two to three times the size of their

standard errors. Because the LM test confirmed that there was no autocorrelation, it could be concluded that these results hold true. This finding contrasts with those of Swidinsky (1973) who had also used differenced-equations but found the coefficients highly insignificant.

Another interesting finding is that the overall unemployment rate yielded more significant results than each group's own unemployment rate, in the differenced-equations. This is in agreement with Barth (1968) who believed the overall labour conditions and the rate of unemployment affecting all other groups were more important in determining participation than the group's own unemployment rate. This would indicate that individual groups are more affected by the prevailing labour market conditions than their particular range of employment opportunities.

In the case of the 14-19 year-olds in the first period and the 15-19 year-olds in the second period, they probably would be employed in low-skilled and precarious jobs due to their lack of experience, and may be very vulnerable to discouragement when there is a downturn in the economy. Archambault and Grignon (1999: 79) found that "the participation rates of students and young people aged 15-19 are more affected by the business cycle than those of other young people." However, deteriorating labour market conditions also tend to encourage a percentage of young people to stay in or return to school and students have a lower rate of labour force participation than non-students (Sunter 1994: 33). Officer and Andersen (1969: 282) had used the 14-19-year-olds's own unemployment rate in their model because they contended that the labour market for that age group was clearly segmented. Although their position appears reasonable, it was not supported in this study.

Significant results were also obtained for other groups with the second equation: females 25-54 years and females 15+ and males 15+ years. What is interesting here is that the aggregate groups had similar results when the cyclical variable was the unemployment rate of their own sex (equation 3), but this was not the case for women 25-54 years. This may be an indication that women are now much more solidly attached to the labour force throughout their lives. This was confirmed through the cohort analysis in the first part of this paper. Women are now better educated and have a wider range of employment opportunities, however, they still get discouraged more than their male counterparts do.

The trend variables did not seem to have extremely large explanatory value in the present regressions, compared to what Barth (1968: 26) and Davis (1971: 37) both reported in their own studies. Lastly, the coefficients for the lagged dependent variable nearly doubled between the first and the second period (equations 7 and 8) for 14 and 15-19, 25-54, 14+ and 15+ year-olds. It is difficult to know how to interpret these results, as this observation holds for both sexes (about 50% larger for 14-19 year-old females).

The overall results are in agreement with those of Kuch and Sharir (1978) for the first period, and those of Fortin and Fortin (1999) for the two periods (their study extended from 1969 to 1996). Both studies reported no evidence of an added-worker effect for any of the age/sex groups. Kuch and Sharir used monthly statistics for the exact same period as the first period in this study. They also selected employment-rate related explanatory variables. Fortin and Fortin used a broad range of variables and only three age groups.

One interesting thing to note is the different types of data used in the different Canadian studies, for those who reported their sources. This may account for some of the differences, as data manipulation is bound to introduce a certain amount of error. In addition, most of the other previous studies had used a larger number of age groups due to the availability of unadjusted data for these age groups. Seasonal fluctuations were corrected in other studies by using seasonal dummy variables (Officer and Andersen 1969, Donner and Lazar 1974), or versions of the Census X method (Proulx 1969, Kuch and Sharir 1978). Davis (1971: 35) reported the use of a seasonal adjustment procedure that has shortcoming of his own admission, but doesn't describe it in detail.

## **6. Conclusion**

This study looked at the changes in the pattern of labour force participation for different groups in Canada through census data, cohort analysis and short-run responses to changes in the labour market. The review of the literature showed that the phenomena of the added- and discouraged-worker effects are not easily demonstrated through studying the response to the demand conditions in the labour market, using time-series econometric models. Nowadays, in the course of the Labour Force Survey, people are asked directly the reason why they have left the labour force. This method may have limitations too because self-reporting has its own problems.

According to Akyeampong (1992: 1-2), the discouraged-worker effect is becoming less important: the economic downturn of 1992 saw about half the number of discouraged workers compared to the recession of 1983. He attributed this change to fewer young people in the labour force, the greater availability of education and youth

training programs, early retirement incentives and the fact that more laid-off people expected to return to their former employers in the 1990's once business picked up again.

It is not easy to find out why some people may join the labour force in times of recession. Some research findings indicate that pressure resulting from mortgage commitments may play an important role in attracting a second earner in the family (Fortin 1995, cited in Benjamin, Gunderson and Riddell 1998: 57). However, the added-worker effect may be less important today because of the current strong participation of women and because many families have come to depend on the income of two earners, hence the pool of secondary workers may have shrunk. The situation may be different in countries where the participation of women is still low and in developing countries.

Other types of models may be better to examine the added- and discouraged-worker effects but were not explored in this study. Studies that look at transition probabilities may be more suited to this type of investigation.

Additional variables representing some of the characteristics of the type of employment may have made the equations more useful and maybe the detrended series would have led to results that are more definite. In future, it would be interesting to look at many more age groups in different parts of the country, as there may well be varying and interesting patterns in rural and urban communities.

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# APPENDIX

Table 1. Values for male groups for period 1962(I)-1974(IV)

	PMG11	PMG12	PMG13	PMG14	PMG15	Capacity1	UMG11	UMG12	UMG13	UMG14	UMG15	trend1	trend2	Urall
1Q1962	40.233	88.933	96.967	58.058	79.400	80.8	13.783	10.571	5.845	6.363	7.054	1	1	6.063
2Q1962	39.767	89.267	97.100	57.786	79.300	81.8	14.064	9.408	5.479	6.269	6.657	2	4	5.743
3Q1962	39.667	88.333	97.167	57.233	78.933	82.8	15.216	9.515	5.324	6.968	6.770	3	9	5.781
4Q1962	38.533	88.300	97.300	56.877	78.633	81.6	14.974	9.619	5.522	6.472	6.817	4	16	5.887
1Q1963	38.600	89.533	97.300	56.500	78.700	81.3	15.070	9.936	5.431	6.153	6.771	5	25	5.892
2Q1963	38.767	88.867	97.133	56.783	78.500	81.8	14.327	9.755	5.184	5.962	6.476	6	36	5.636
3Q1963	39.033	88.367	97.333	56.226	78.333	82	14.033	9.480	4.731	5.664	6.121	7	49	5.353
4Q1963	40.433	88.167	97.100	56.541	78.367	84	13.002	8.931	4.644	5.217	5.881	8	64	5.081
1Q1964	39.133	88.067	97.033	56.879	78.267	85.1	12.855	8.554	4.374	5.030	5.602	9	81	4.887
2Q1964	38.100	87.833	97.267	56.868	78.067	85	12.532	7.839	4.140	4.979	5.349	10	100	4.752
3Q1964	38.367	88.533	97.267	57.465	78.200	84.6	12.030	6.745	3.992	5.103	5.110	11	121	4.568
4Q1964	37.900	88.433	97.133	57.054	77.967	86.2	11.628	7.671	3.794	4.697	4.994	12	144	4.394
1Q1965	37.933	88.433	97.000	57.233	77.933	86.9	10.630	6.147	3.621	4.601	4.642	13	169	4.139
2Q1965	38.567	87.433	97.133	57.026	77.833	86.5	10.986	5.940	3.634	4.783	4.711	14	196	4.157
3Q1965	39.400	87.333	97.067	57.100	77.933	87	9.903	5.553	3.256	4.205	4.229	15	225	3.758
4Q1965	38.200	87.267	97.033	57.648	77.733	88	9.271	4.642	2.843	4.099	3.786	16	256	3.403
1Q1966	38.867	87.300	97.167	57.837	78.000	87.9	9.565	4.926	3.060	4.586	4.074	17	289	3.596
2Q1966	37.500	87.733	97.067	57.235	77.567	86.9	9.467	5.348	2.866	3.813	3.880	18	324	3.464
3Q1966	39.400	87.067	97.000	57.143	77.733	84.8	10.582	6.025	3.005	4.150	4.197	19	361	3.822
4Q1966	38.400	87.467	97.167	57.366	77.733	84.5	8.917	5.085	2.928	4.523	3.933	20	400	3.562
1Q1967	39.600	87.300	97.100	57.000	77.800	83.2	10.088	5.660	3.328	4.525	4.406	21	441	3.929
2Q1967	38.633	86.567	96.767	57.056	77.400	82.8	10.768	6.039	3.484	4.369	4.558	22	484	4.087
3Q1967	40.267	85.967	96.967	56.758	77.767	83.1	10.577	5.960	3.377	4.297	4.464	23	529	4.003
4Q1967	38.700	84.400	96.833	56.400	77.067	82	12.802	6.914	3.847	4.378	5.048	24	576	4.403
1Q1968	38.733	83.600	96.600	56.176	76.767	81.5	12.771	7.704	4.245	4.826	5.517	25	625	4.787
2Q1968	39.633	84.267	96.467	56.701	77.100	83.3	12.850	7.786	4.142	4.983	5.536	26	676	4.907
3Q1968	38.700	84.833	96.467	57.209	77.033	83.4	12.711	7.590	3.933	5.170	5.327	27	729	4.848
4Q1968	39.200	84.533	96.567	56.700	77.100	83.4	12.359	7.638	3.966	5.124	5.337	28	784	4.713
1Q1969	38.667	85.267	96.667	56.789	77.100	83.9	12.290	7.384	3.632	4.903	5.053	29	841	4.530
2Q1969	38.633	84.833	96.500	56.881	76.967	83	12.596	7.360	3.788	4.976	5.204	30	900	4.708
3Q1969	37.333	83.900	96.167	56.424	76.300	82	11.632	7.349	3.865	4.935	5.111	31	961	4.653
4Q1969	37.567	82.900	96.267	55.899	76.200	81.4	12.617	7.917	3.899	4.933	5.328	32	1024	4.836
1Q1970	38.100	82.467	96.267	55.100	76.100	81.3	13.787	8.881	4.164	4.821	5.704	33	1089	5.095
2Q1970	38.767	83.867	96.167	55.550	76.433	78.3	15.747	11.039	5.056	5.724	6.879	34	1156	6.067
3Q1970	38.533	83.467	96.400	56.000	76.467	77.5	15.664	11.188	5.340	6.237	7.117	35	1225	6.394
4Q1970	39.267	82.867	96.267	56.093	76.533	77.9	15.324	11.561	5.147	5.311	6.929	36	1296	6.294
1Q1971	39.067	82.533	96.267	55.133	76.267	77.2	16.170	11.771	5.236	5.361	7.068	37	1369	6.396
2Q1971	38.333	83.100	96.367	53.567	75.900	77.7	16.969	11.657	5.289	5.425	7.227	38	1444	6.566
3Q1971	39.333	83.633	96.367	53.500	76.100	79.2	16.239	10.917	5.100	5.704	6.990	39	1521	6.338
4Q1971	39.200	84.667	96.067	53.933	76.200	79.1	15.366	10.962	4.911	5.448	6.759	40	1600	6.232
1Q1972	39.900	85.033	95.967	53.688	76.267	79.2	15.221	10.819	4.691	4.790	6.480	41	1681	6.075
2Q1972	40.400	83.833	96.167	53.067	76.200	80.6	14.766	11.359	4.966	5.216	6.797	42	1764	6.262
3Q1972	41.333	83.433	96.000	52.633	76.133	81.3	15.446	12.304	5.242	5.417	7.167	43	1849	6.548
4Q1972	41.367	83.967	95.967	52.220	76.067	83.5	15.874	12.181	4.967	4.862	6.965	44	1936	6.469
1Q1973	42.933	84.600	96.233	52.411	76.567	85.8	14.033	10.771	4.442	4.863	6.278	45	2025	5.912
2Q1973	43.767	85.267	96.067	52.193	76.867	86.5	12.577	9.498	4.002	4.465	5.709	46	2116	5.483
3Q1973	43.367	85.467	96.067	51.702	76.633	86	12.300	10.044	3.998	4.307	5.673	47	2209	5.492
4Q1973	45.233	85.567	96.367	51.636	77.067	86.3	12.908	9.493	3.878	4.758	5.698	48	2304	5.454
1Q1974	46.533	86.067	96.267	52.123	77.400	87.1	12.942	9.383	4.092	4.544	5.785	49	2401	5.455
2Q1974	44.600	86.100	96.200	51.267	77.000	85.5	12.078	9.497	3.980	4.088	5.613	50	2500	5.311
3Q1974	46.333	86.067	96.300	51.173	77.500	83.1	12.798	9.232	3.677	3.994	5.459	51	2601	5.349
4Q1974	48.900	86.067	96.133	51.052	77.600	80.5	13.009	9.757	4.054	4.405	5.880	52	2704	5.598

Legend:  
 PMG11 UMG11 Participation rate and unemployment rate for male group 14-19 years old  
 PMG12 UMG12 Participation rate and unemployment rate for male group 20-24 years old  
 PMG13 UMG13 Participation rate and unemployment rate for male group 25-54 years old  
 PMG14 UMG14 Participation rate and unemployment rate for male group 55+ years old  
 PMG15 UMG15 Participation rate and unemployment rate for male group 14+ years old  
 Capacity1 Rate of capacity utilisation  
 trend1 Linear trend  
 trend2 Quadratic trend

Table 2. Values for male groups for period 1985(I)-2000(IV)

	PMG21	PMG22	PMG23	PMG24	PMG25	Capacity2	UMG21	UMG22	UMG23	UMG24	UMG25	trend1	trend2	URALL
1Q1985	53.744	84.670	93.504	41.131	76.618	82.3	20.809	17.592	9.313	8.092	11.194	1	1	11.074
2Q1985	54.838	84.772	93.530	40.879	76.713	83.1	20.054	16.805	8.785	7.930	10.624	2	4	10.761
3Q1985	54.691	84.595	93.348	41.129	76.658	84	19.791	15.747	8.483	7.612	10.230	3	9	10.399
4Q1985	55.390	84.209	93.374	41.421	76.776	85	20.591	15.766	8.355	7.750	10.212	4	16	10.305
1Q1986	55.568	84.937	93.664	40.595	76.879	85.3	19.250	15.841	7.871	7.084	9.689	5	25	9.861
2Q1986	57.563	84.901	93.455	40.167	76.886	82.8	18.104	15.098	7.982	6.797	9.583	6	36	9.688
3Q1986	58.155	84.815	93.857	39.701	76.736	81.6	17.920	14.978	8.072	6.871	9.593	7	49	9.608
4Q1986	56.263	84.628	93.702	39.347	76.675	81.4	16.401	14.449	7.978	6.651	9.306	8	64	9.461
1Q1987	57.446	84.795	93.549	39.078	76.678	83.5	17.240	14.759	7.756	6.567	9.248	9	81	9.423
2Q1987	58.349	84.608	93.779	38.749	76.803	84.2	16.341	13.601	7.334	6.459	8.721	10	100	9.017
3Q1987	58.394	84.766	93.852	38.626	76.731	85.8	15.519	12.892	7.117	5.594	8.311	11	121	8.603
4Q1987	59.215	85.301	93.751	38.556	76.914	86.8	14.767	12.043	6.645	5.641	7.822	12	144	8.167
1Q1988	58.737	86.104	93.880	38.006	76.910	86.8	13.802	11.234	6.365	6.187	7.509	13	169	7.839
2Q1988	58.803	85.006	93.502	37.981	76.582	86.8	13.827	11.524	6.257	5.599	7.391	14	196	7.679
3Q1988	58.891	84.551	93.137	38.407	76.437	85.8	13.779	11.845	6.293	5.755	7.455	15	225	7.886
4Q1988	59.349	84.862	93.302	38.078	76.539	85.2	14.119	11.867	6.274	5.539	7.438	16	256	7.654
1Q1989	60.430	85.861	93.697	38.126	76.997	85.5	14.293	10.985	6.317	5.606	7.379	17	289	7.541
2Q1989	60.211	85.486	93.621	37.665	76.799	84.9	14.399	11.238	6.336	6.045	7.467	18	324	7.662
3Q1989	61.000	84.384	93.446	37.058	76.524	83.7	13.832	10.302	6.241	6.020	7.244	19	361	7.448
4Q1989	61.829	83.913	93.112	37.232	76.407	83.8	14.458	11.179	6.290	5.438	7.359	20	400	7.498
1Q1990	61.795	85.038	93.142	37.586	76.628	82.7	14.911	11.153	6.573	5.264	7.562	21	441	7.601
2Q1990	60.075	83.818	93.170	37.058	76.246	82.6	13.675	11.462	6.701	5.029	7.544	22	484	7.608
3Q1990	59.008	83.174	93.194	36.559	75.978	81.3	15.432	13.131	7.281	5.273	8.275	23	529	8.171
4Q1990	59.444	82.448	92.948	36.281	75.730	79.2	16.167	15.451	8.207	6.522	9.367	24	576	9.186
1Q1991	58.478	81.055	92.848	35.915	75.354	77.9	17.255	18.782	9.262	7.149	10.594	25	625	10.147
2Q1991	58.188	81.558	92.819	35.909	75.234	78.4	18.026	19.413	9.425	8.000	10.924	26	676	10.352
3Q1991	56.661	82.690	92.273	35.669	74.945	79.4	18.280	19.473	9.412	8.046	10.942	27	729	10.388
4Q1991	54.528	82.525	91.807	35.278	74.386	79.4	18.322	17.737	9.699	7.504	10.886	28	784	10.357
1Q1992	53.853	81.090	91.345	34.635	73.791	78.5	19.434	18.259	10.107	8.012	11.348	29	841	10.609
2Q1992	54.854	81.172	91.245	34.782	73.879	78.2	22.006	18.854	10.538	8.453	11.947	30	900	11.017
3Q1992	53.587	81.148	91.430	34.876	73.900	78.1	21.460	19.050	11.028	9.136	12.335	31	961	11.409
4Q1992	52.988	80.286	91.619	34.534	73.802	78.7	21.229	18.791	11.226	10.006	12.514	32	1024	11.689
1Q1993	52.926	79.625	91.152	33.892	73.319	79.8	21.451	17.646	10.317	9.079	11.852	33	1089	11.052
2Q1993	53.224	80.656	91.518	33.590	73.589	80	23.244	18.955	10.693	9.506	12.227	34	1156	11.664
3Q1993	51.218	80.760	91.642	33.603	73.481	80.2	20.822	18.316	10.891	9.528	12.125	35	1225	11.453
4Q1993	50.543	80.446	91.385	33.446	73.188	80.8	20.418	18.408	10.631	9.604	11.919	36	1296	11.299
1Q1994	51.261	79.598	90.922	33.886	72.998	81	20.801	18.381	10.182	9.804	11.633	37	1369	10.979
2Q1994	50.916	80.355	91.138	34.110	73.202	82.6	20.280	17.109	9.786	9.268	11.118	38	1444	10.650
3Q1994	51.850	79.795	91.354	33.469	73.197	83.2	20.743	15.053	9.378	8.336	10.551	39	1521	10.106
4Q1994	51.026	79.578	91.298	33.520	73.075	83.6	18.784	15.048	9.110	7.379	10.114	40	1600	9.669
1Q1995	49.879	80.651	91.091	33.514	72.942	83.8	18.129	13.964	8.827	7.947	9.813	41	1681	9.550
2Q1995	50.809	79.512	90.964	32.594	72.627	81.7	18.509	14.613	8.787	7.940	9.879	42	1764	9.456
3Q1995	50.220	78.689	90.978	32.137	72.388	80.8	19.518	15.621	8.597	7.470	9.838	43	1849	9.484
4Q1995	49.820	78.505	90.839	32.148	72.246	80.4	19.856	14.118	8.462	7.175	9.577	44	1936	9.270
1Q1996	50.010	79.440	90.974	32.316	72.451	80.8	20.828	14.601	8.832	7.048	9.944	45	2025	9.531
2Q1996	48.429	80.532	90.756	32.163	72.232	81.4	19.591	14.380	8.844	6.642	9.802	46	2116	9.435
3Q1996	48.804	78.410	90.842	32.089	72.091	82.3	20.417	13.742	8.852	7.236	9.850	47	2209	9.708
4Q1996	48.125	79.150	90.697	32.174	72.012	81.9	22.678	14.929	8.850	8.228	10.195	48	2304	9.907
1Q1997	47.508	79.455	90.693	32.412	72.028	82	21.833	14.512	8.554	7.423	9.791	49	2401	9.437
2Q1997	47.588	78.899	90.670	32.897	72.070	82.7	23.229	13.770	8.230	7.039	9.514	50	2500	9.307
3Q1997	47.917	79.454	91.019	32.805	72.301	83.8	22.504	13.661	7.665	6.846	9.028	51	2601	8.865
4Q1997	48.660	79.360	91.088	32.689	72.336	83.5	21.347	13.972	7.464	6.439	8.807	52	2704	8.757
1Q1998	47.409	78.837	91.008	32.481	72.054	83.1	21.717	13.798	7.428	6.121	8.728	53	2809	8.605
2Q1998	47.975	78.733	91.043	32.311	72.043	82.7	21.636	13.512	7.297	6.018	8.597	54	2916	8.322
3Q1998	48.732	79.392	90.955	32.735	72.176	81.9	21.061	13.933	7.154	6.162	8.526	55	3025	8.171
4Q1998	48.831	78.100	91.175	32.781	72.174	82.5	21.304	13.040	7.109	6.741	8.475	56	3136	8.060
1Q1999	50.174	79.347	91.069	32.786	72.309	82.6	20.684	12.645	6.809	6.455	8.175	57	3249	7.881
2Q1999	51.132	79.805	91.117	33.283	72.553	82.7	19.803	13.380	6.602	6.345	8.031	58	3364	7.863
3Q1999	50.676	79.990	91.048	33.706	72.552	84.1	19.920	12.301	6.582	5.676	7.847	59	3481	7.523
4Q1999	51.013	81.083	91.100	33.609	72.651	84.7	18.098	11.929	6.073	4.700	7.228	60	3600	6.967
1Q2000	50.829	80.130	91.310	33.748	72.678	85.7	17.346	11.632	5.697	4.868	6.887	61	3721	6.778
2Q2000	51.463	79.463	91.003	33.618	72.447	85.8	17.128	11.604	5.732	5.022	6.918	62	3844	6.707
3Q2000	51.629	79.846	91.011	33.289	72.382	85.7	17.960	11.807	5.780	5.120	7.039	63	3969	6.922
4Q2000	53.527	80.438	91.048	33.361	72.606	84.9	17.536	11.193	5.756	5.026	6.951	64	4096	6.856

Legend:		
PMG21	UMG21	Participation rate and unemployment rate for male group 14-19 years old
PMG22	UMG22	Participation rate and unemployment rate for male group 20-24 years old
PMG23	UMG23	Participation rate and unemployment rate for male group 25-54 years old
PMG24	UMG24	Participation rate and unemployment rate for male group 55+ years old
PMG25	UMG25	Participation rate and unemployment rate for male group 14+ years old
Capacity1		Rate of capacity utilisation
trend1		Linear trend
trend2		Quadratic trend

Table 3. Values for female groups for period 1962(I)-1974(IV)

	PFG11	PFG12	PFG13	PFG14	PFG15	Capacity1	UFG11	UFG12	UFG13	UFG14	UFG15	trend1	trend2	Ural1
1Q1962	30.700	49.267	30.433	14.280	28.867	80.8	7.856	3.607	2.340	1.582	3.337	1	1	6.063
2Q1962	31.767	49.700	30.686	14.320	29.133	81.8	7.227	3.340	2.348	1.905	3.243	2	4	5.743
3Q1962	30.933	50.100	30.999	14.426	29.200	82.8	7.102	3.301	2.417	2.229	3.219	3	9	5.781
4Q1962	30.133	49.767	30.725	14.273	28.967	81.6	8.373	4.389	2.170	1.722	3.468	4	16	5.887
1Q1963	30.267	48.767	30.696	14.478	28.867	81.3	8.010	4.094	2.333	2.195	3.482	5	25	5.892
2Q1963	29.233	49.300	31.058	14.687	29.000	81.8	7.917	4.025	2.238	1.981	3.336	6	36	5.636
3Q1963	29.700	51.500	32.209	15.150	29.967	82	8.148	4.453	1.965	2.073	3.350	7	49	5.353
4Q1963	30.333	51.267	32.665	15.365	30.433	84	6.862	4.004	1.967	2.493	3.116	8	64	5.081
1Q1964	30.033	52.067	32.828	15.462	30.567	85.1	7.319	3.504	1.920	2.312	3.048	9	81	4.887
2Q1964	29.800	51.067	32.777	15.946	30.467	85	7.951	3.333	2.038	2.226	3.172	10	100	4.752
3Q1964	29.933	50.267	32.946	15.368	30.333	84.6	7.593	3.266	1.992	2.296	3.134	11	121	4.568
4Q1964	29.867	50.967	33.116	15.854	30.633	86.2	6.650	3.273	1.977	2.651	2.956	12	144	4.394
1Q1965	30.433	51.333	33.519	15.881	30.967	86.9	6.990	3.211	1.976	1.758	2.933	13	169	4.139
2Q1965	30.467	52.567	33.914	16.288	31.433	86.5	7.195	3.485	1.604	1.694	2.798	14	196	4.157
3Q1965	30.200	52.633	33.789	16.260	31.300	87	6.467	2.511	1.605	1.405	2.579	15	225	3.758
4Q1965	29.633	53.767	34.313	16.417	31.667	88	6.500	2.691	1.631	1.384	2.506	16	256	3.403
1Q1966	30.933	54.900	34.598	16.484	32.133	87.9	5.996	2.504	1.751	1.096	2.450	17	289	3.596
2Q1966	31.400	55.633	34.896	17.155	32.600	86.9	5.920	2.275	1.755	1.948	2.456	18	324	3.464
3Q1966	32.000	56.067	35.771	17.177	33.233	84.8	6.907	3.053	1.810	1.033	2.822	19	361	3.822
4Q1966	30.700	56.233	36.013	17.045	33.033	84.5	7.048	2.666	1.850	1.287	2.702	20	400	3.562
1Q1967	30.967	56.667	36.688	17.104	33.267	83.2	7.870	2.991	1.853	1.789	2.910	21	441	3.929
2Q1967	31.467	56.367	36.839	16.808	33.733	82.8	7.781	3.427	1.812	1.935	2.996	22	484	4.087
3Q1967	32.000	56.233	37.121	17.225	34.000	83.1	6.618	2.924	2.015	1.746	2.890	23	529	4.003
4Q1967	31.633	57.000	37.059	17.190	33.933	82	7.179	3.730	2.082	1.120	3.024	24	576	4.403
1Q1968	32.333	57.933	36.694	17.051	34.033	81.5	7.281	4.335	1.942	1.617	3.150	25	625	4.787
2Q1968	30.700	58.200	36.936	16.975	33.967	83.3	7.960	4.391	2.342	1.607	3.490	26	676	4.907
3Q1968	30.900	59.133	37.813	17.354	34.533	83.4	8.892	4.196	2.307	2.161	3.689	27	729	4.848
4Q1968	31.433	57.933	38.689	18.121	35.100	83.4	8.597	3.816	2.175	2.160	3.385	28	784	4.713
1Q1969	31.267	58.933	38.557	18.477	35.300	83.9	8.525	3.691	2.406	1.883	3.486	29	841	4.530
2Q1969	31.900	60.400	38.642	18.075	35.533	83	8.987	3.564	2.647	1.463	3.622	30	900	4.708
3Q1969	31.000	59.433	38.853	17.385	35.167	82	8.680	3.444	2.596	1.739	3.609	31	961	4.653
4Q1969	30.400	58.333	39.125	17.167	35.033	81.4	9.452	4.508	2.519	2.331	3.815	32	1024	4.836
1Q1970	29.767	58.000	39.254	17.281	35.067	81.3	9.602	4.485	2.568	1.840	3.827	33	1089	5.095
2Q1970	30.967	58.767	40.198	17.556	35.933	78.3	10.406	5.187	2.781	2.812	4.303	34	1156	6.067
3Q1970	30.233	58.567	40.244	17.175	35.600	77.5	12.306	5.659	2.919	3.650	4.884	35	1225	6.394
4Q1970	30.333	58.467	39.921	17.407	35.533	77.9	13.061	5.311	3.259	3.465	4.978	36	1296	6.294
1Q1971	31.400	59.033	40.743	17.592	36.267	77.2	11.912	5.960	3.475	2.743	5.042	37	1369	6.396
2Q1971	30.367	59.333	40.261	18.023	36.000	77.7	13.319	6.308	3.387	2.442	5.179	38	1444	6.566
3Q1971	31.267	60.233	40.856	18.230	36.467	79.2	12.533	6.215	3.195	2.082	5.019	39	1521	6.338
4Q1971	31.333	61.000	41.924	17.950	37.100	79.1	12.474	5.915	3.716	2.314	5.192	40	1600	6.232
1Q1972	31.267	60.267	42.083	16.822	36.933	79.2	12.279	5.962	3.780	2.998	5.314	41	1681	6.075
2Q1972	31.567	60.267	41.905	16.378	36.700	80.6	11.383	6.487	3.717	3.061	5.165	42	1764	6.262
3Q1972	32.400	60.700	42.407	17.184	37.267	81.3	11.017	6.836	3.793	2.575	5.309	43	1849	6.548
4Q1972	32.367	60.733	42.831	17.435	37.533	83.5	10.985	7.030	4.013	3.168	5.507	44	1936	6.469
1Q1973	33.333	61.767	43.672	17.621	38.467	85.8	11.112	6.547	3.811	2.894	5.262	45	2025	5.912
2Q1973	34.567	62.300	44.115	18.009	38.933	86.5	10.693	6.291	3.696	2.913	5.036	46	2116	5.483
3Q1973	34.167	62.767	43.986	17.377	38.600	86	10.467	6.242	3.703	2.791	5.041	47	2209	5.492
4Q1973	34.867	62.900	44.312	16.987	38.833	86.3	11.074	6.727	3.244	2.315	4.969	48	2304	5.454
1Q1974	36.333	63.167	44.841	16.817	39.333	87.1	10.350	6.652	3.186	2.534	4.863	49	2401	5.455
2Q1974	35.867	63.067	45.693	16.579	39.633	85.5	9.293	6.460	3.423	2.968	4.725	50	2500	5.311
3Q1974	36.967	63.100	46.273	16.563	40.000	83.1	9.896	6.530	3.806	2.316	5.017	51	2601	5.349
4Q1974	37.533	62.533	45.807	16.862	39.933	80.5	10.932	6.786	3.382	2.360	5.089	52	2704	5.598

## Legend:

PFG11	UFG11	Participation rate and unemployment rate for female group 14-19 years old
PFG12	UFG12	Participation rate and unemployment rate for female group 20-24 years old
PFG13	UFG13	Participation rate and unemployment rate for female group 25-54 years old
PFG14	UFG14	Participation rate and unemployment rate for female group 55+ years old
PFG15	UFG15	Participation rate and unemployment rate for female group 14+ years old
Capacity1		Rate of capacity utilisation
trend1		Linear trend
trend2		Quadratic trend

Table 4. Values for female groups for period 1985(I)-2000(IV)

	PFG21	PFG22	PFG23	PFG24	PFG25	Capacity2	UFG21	UFG22	UFG23	UFG24	UFG25	trend1	trend2	URALL
1Q1985	51.573	75.183	67.665	17.577	54.178	82.3	17.024	13.359	9.921	6.991	10.911	1	1	11.074
2Q1985	52.191	75.381	68.179	17.697	54.546	83.1	16.934	13.632	9.911	7.168	10.947	2	4	10.761
3Q1985	52.611	75.867	68.659	17.492	54.818	84	16.578	12.957	9.670	7.011	10.627	3	9	10.399
4Q1985	53.862	76.442	69.222	17.689	55.329	85	15.950	12.388	9.600	7.002	10.428	4	16	10.305
1Q1986	53.402	77.091	69.774	17.146	55.493	85.3	15.921	13.273	8.926	6.723	10.092	5	25	9.861
2Q1986	55.104	77.685	69.677	16.890	55.579	82.8	14.668	12.491	8.891	6.610	9.830	6	36	9.688
3Q1986	53.063	78.048	70.041	16.612	55.515	81.6	14.226	11.634	8.873	6.772	9.628	7	49	9.608
4Q1986	51.811	77.353	70.511	16.727	55.566	81.4	14.511	12.225	8.769	7.001	9.669	8	64	9.461
1Q1987	54.106	77.196	70.723	16.749	55.845	83.5	14.766	11.592	8.869	6.862	9.656	9	81	9.423
2Q1987	54.606	77.807	71.201	17.043	56.261	84.2	13.292	11.740	8.610	7.465	9.408	10	100	9.017
3Q1987	54.688	77.880	71.404	17.351	56.416	85.8	12.505	10.702	8.356	7.335	9.886	11	121	8.603
4Q1987	55.908	78.288	71.913	17.246	56.815	86.8	12.179	10.739	7.899	6.899	8.617	12	144	8.167
1Q1988	55.657	77.504	72.473	17.372	57.023	86.8	11.429	9.925	7.748	6.356	8.268	13	169	7.839
2Q1988	56.059	77.951	72.948	17.228	57.309	86.8	10.981	9.939	7.580	5.581	8.051	14	196	7.679
3Q1988	57.711	77.412	73.276	17.282	57.578	85.8	11.522	10.254	7.916	5.361	8.394	15	225	7.866
4Q1988	57.821	77.939	73.601	17.002	57.732	85.2	11.763	8.753	7.594	5.140	7.928	16	256	7.654
1Q1989	57.801	79.144	73.892	17.329	58.088	85.5	11.138	8.444	7.463	5.352	7.748	17	289	7.541
2Q1989	57.612	78.193	74.030	17.152	58.002	84.9	10.833	8.920	7.657	5.261	7.910	18	324	7.662
3Q1989	56.893	78.144	74.386	16.489	57.949	83.7	11.039	8.288	7.440	5.469	7.708	19	361	7.448
4Q1989	56.943	77.538	74.866	16.524	58.160	83.6	10.715	8.855	7.290	5.904	7.676	20	400	7.498
1Q1990	56.770	77.414	75.155	16.779	58.361	82.7	11.217	9.221	7.242	4.996	7.653	21	441	7.601
2Q1990	56.225	77.770	75.267	16.882	58.435	82.6	12.396	9.134	7.197	4.882	7.689	22	484	7.608
3Q1990	56.638	77.234	75.382	17.067	58.526	81.3	12.469	10.194	7.512	4.824	8.041	23	529	8.171
4Q1990	56.494	75.988	75.647	16.993	58.515	79.2	13.944	11.380	8.333	5.799	8.962	24	576	9.186
1Q1991	56.487	75.874	75.727	16.693	58.462	77.9	14.506	11.387	8.938	7.758	9.593	25	625	10.147
2Q1991	54.841	77.229	75.889	16.623	58.515	78.4	14.988	11.727	8.939	7.565	9.644	26	676	10.352
3Q1991	54.430	76.486	75.894	16.659	58.416	79.4	14.954	11.297	9.112	7.534	9.707	27	729	10.388
4Q1991	53.766	76.208	75.612	16.527	58.144	79.4	13.888	12.052	9.100	7.629	9.705	28	784	10.357
1Q1992	52.935	76.726	75.312	16.572	57.975	78.5	15.590	12.332	8.850	7.932	9.704	29	841	10.609
2Q1992	52.895	75.786	75.208	16.290	57.759	78.2	16.357	12.637	8.988	7.624	9.872	30	900	11.017
3Q1992	52.275	75.608	75.042	16.731	57.716	78.1	17.929	13.101	9.249	8.238	10.267	31	961	11.409
4Q1992	51.220	75.246	75.336	17.161	57.877	78.7	17.507	12.568	9.908	8.723	10.675	32	1024	11.689
1Q1993	50.011	74.331	75.212	16.973	57.582	79.8	15.876	12.138	9.704	8.314	10.313	33	1089	11.552
2Q1993	50.451	73.042	75.809	16.822	57.802	80	16.724	13.245	10.248	9.350	10.973	34	1156	11.664
3Q1993	49.848	73.881	75.800	16.494	57.722	80.2	16.775	12.992	9.857	8.992	10.628	35	1225	11.453
4Q1993	50.681	74.131	75.700	16.621	57.775	80.8	18.397	11.946	9.742	8.890	10.542	36	1296	11.296
1Q1994	50.108	74.260	75.052	16.864	57.428	81	16.208	12.928	9.320	8.871	10.180	37	1369	10.979
2Q1994	48.803	73.911	75.117	17.428	57.468	82.6	15.860	12.585	9.246	9.267	10.076	38	1444	10.850
3Q1994	49.802	72.852	75.393	17.125	57.521	83.2	15.274	11.192	8.982	7.672	9.561	39	1521	10.106
4Q1994	49.237	73.797	75.740	16.705	57.624	83.6	16.580	11.003	8.430	6.489	9.127	40	1600	9.669
1Q1995	48.638	74.569	76.156	16.803	57.891	83.8	15.602	11.235	8.536	7.468	9.231	41	1681	9.550
2Q1995	49.485	73.874	75.621	16.331	57.462	81.7	16.038	10.749	8.151	7.557	8.941	42	1764	9.456
3Q1995	49.884	72.827	75.604	16.757	57.494	80.8	16.130	11.117	8.206	7.965	9.055	43	1849	9.484
4Q1995	49.294	72.210	75.498	16.736	57.312	80.4	15.712	11.314	8.067	7.464	8.898	44	1936	9.270
1Q1996	49.129	72.375	75.822	16.607	57.447	80.8	15.641	11.381	8.328	6.665	9.028	45	2025	9.531
2Q1996	47.647	73.863	75.717	16.728	57.408	81.4	16.374	10.610	8.276	7.197	8.990	46	2116	9.435
3Q1996	47.154	73.399	76.170	16.684	57.551	82.3	19.147	11.147	8.685	7.330	9.538	47	2209	9.708
4Q1996	46.791	73.133	76.353	16.504	57.536	81.9	18.649	11.790	8.656	7.544	9.560	48	2304	9.907
1Q1997	47.026	72.880	76.405	16.727	57.610	82	19.598	11.524	7.895	7.357	9.010	49	2401	9.437
2Q1997	46.600	72.605	76.860	17.043	57.877	82.7	20.302	12.417	7.813	7.258	9.059	50	2500	9.307
3Q1997	45.856	72.304	76.938	17.089	57.818	83.8	20.257	12.452	7.347	6.924	8.668	51	2601	8.865
4Q1997	45.260	70.947	77.301	17.306	57.890	83.5	19.468	12.017	7.561	6.727	8.696	52	2704	8.757
1Q1998	45.781	71.608	77.458	17.373	58.060	83.1	18.991	11.962	7.271	6.843	8.458	53	2809	8.605
2Q1998	46.754	72.355	77.518	17.369	58.201	82.7	18.747	11.031	6.850	6.160	7.993	54	2916	8.322
3Q1998	48.212	72.658	77.534	17.898	58.455	81.9	17.119	9.996	6.805	5.959	7.747	55	3025	8.171
4Q1998	49.980	74.013	77.719	18.215	58.856	82.5	17.479	9.652	6.536	6.070	7.568	56	3136	8.060
1Q1999	49.613	73.684	78.038	17.959	58.875	82.6	16.776	9.560	6.618	5.674	7.531	57	3249	7.881
2Q1999	50.229	74.119	78.180	18.066	59.039	82.7	17.897	10.450	6.669	4.738	7.666	58	3364	7.863
3Q1999	49.868	73.343	78.336	18.100	59.003	84.1	15.941	9.790	6.215	5.011	7.139	59	3481	7.523
4Q1999	49.762	72.571	78.043	18.093	58.729	84.7	16.199	9.068	5.710	4.463	6.657	60	3600	6.967
1Q2000	50.233	73.747	78.270	18.705	59.127	85.7	15.126	9.093	5.768	4.687	6.650	61	3721	6.778
2Q2000	51.071	73.457	78.401	19.014	59.303	85.8	14.605	8.822	5.503	5.430	6.459	62	3844	6.707
3Q2000	52.888	74.135	78.595	19.269	59.643	85.7	15.559	8.272	5.853	5.852	6.786	63	3969	6.922
4Q2000	52.991	73.999	79.036	19.240	59.842	84.9	15.077	8.368	5.940	4.989	6.744	64	4096	6.856

Legend:  
PFG21 UFG21 Participation rate and unemployment rate for female group 14-19 years old  
PFG22 UFG22 Participation rate and unemployment rate for female group 20-24 years old  
PFG23 UFG23 Participation rate and unemployment rate for female group 25-54 years old  
PFG24 UFG24 Participation rate and unemployment rate for female group 55+ years old  
PFG25 UFG25 Participation rate and unemployment rate for female group 14+ years old  
Capacity1 Rate of capacity utilisation  
trend1 Linear trend  
trend2 Quadratic trend

