



**Centre of Full Employment and Equity**

**Hidden unemployment in Australia and the United States –  
updated estimates**

**William F. Mitchell<sup>1</sup>**

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Centre of Full Employment and Equity  
The University of Newcastle, Callaghan NSW 2308, Australia  
Home Page: <http://e1.newcastle.edu.au/coffee>  
Email: [coffee@newcastle.edu.au](mailto:coffee@newcastle.edu.au)

## 1. Introduction

In this paper, a method developed by Mitchell *et. al.* (1995) is used to provide estimates of the net discouraged worker effect for Australia and the United States. The notion of cyclical upgrading was popularised by Arthur Okun and others in the 1960s and early 1970s. The upgrading hypothesis and the related high-pressure economy model provided a coherent rationale for Keynesian policy positions. Okun (1983: 171) believed that

unemployment was merely the tip of the iceberg that forms in a cold economy. The difference between unemployment rates of 5 percent and 4 percent extends far beyond the creation of jobs for 1 percent of the labor force. The submerged part of the iceberg includes (a) additional jobs for people who do not actively seek work in a slack labor market but nonetheless take jobs when they become available; (b) a longer workweek reflecting less part-time and more overtime employment; and (c) extra productivity - more output per man-hour - from fuller and more efficient use of labor and capital.

A vast body of literature describes the manner in which the labour market adjusts to the business cycle (see Reder, 1955; Wallich, 1956; Wachter, 1970; Okun, 1973; Thurow, 1975; Vroman, 1978). The literature also ties in with some versions of segmented labour market theory. Together they provide the basis of a theory of cyclical upgrading, whereby disadvantaged groups in the economy achieve upward mobility as a result of higher economic activity.

Two major questions are investigated in this paper:

- How does the labour force participation rates of different age and gender groups behave over the economic cycle?
- For a given arbitrary full employment level (in this paper we use a 4 per unemployment rate), what is the potential employment levels for groups and the economy in total, and how are the employment gaps (defined as the difference between potential and actual employment) distributed across demographic groups?<sup>2</sup>

A more complete analysis is contained in Mitchell (1999) and Mitchell *et al* (1995). From the viewpoint of upgrading, a cyclical rise in labour force participation (indicating that the discouraged worker effect is dominant) provides marginal workers with the chance to

share in the benefits of the higher output and employment. Workers who enter the labour force only when the probability of gaining work increases are often termed - *hidden unemployed*. The literature indicates that it is teenagers and to lesser extent women who exhibit the largest swings.

The paper finds that hidden unemployment is a significant problem in Australia and the United States. In Australia, the recorded unemployment rate in September 2000 was 8.1 per cent. Taking into account the estimated hidden unemployment in the same quarter, the adjusted unemployment rate (calculated by expressing the sum of hidden unemployment and recorded unemployment as a percentage of the potential labour force) would be 10.4 per cent. This gives a significantly different picture of the degree of slack in the macroeconomy and the extent to which jobs have to be created to absorb the real number of idle workers. In February 1999, for every 3.2 persons who were officially recorded as being unemployed there was another person who was hidden unemployed (at the 4 per cent unemployment rate benchmark). The increase in labour force participation resulting from moving to the benchmark would be equivalent to an increase in employment of around 2.75 per cent.

For the United States, the recorded unemployment rate in November 1998 was 4.5 per cent. Taking into account the estimated hidden unemployment in the same quarter, the adjusted unemployment would be 4.7 per cent. Compared to Australia, hidden unemployment thus makes a trivial impact on the measured degree of slack in the macroeconomy. This is clearly because the United States labour market is closer to the 4 per cent benchmark. In February 1999, for every 20.8 persons who were officially recorded as being unemployed there was another person who was hidden unemployed (at the 4 per cent unemployment rate benchmark). This compares to a ratio of 3.2 to 1 for Australia.

Section 2 outlines the method used to estimate cyclical participation effects and then compute estimates of hidden unemployment. Section 3 generates estimates for Australia and Section 4 repeats the exercise for the USA. Concluding remarks follow.

## 2. Cyclical participation effects and hidden unemployment

In this section, we estimate the various demographic labour force participation responses over the business cycle and use these estimates to calculate hidden unemployment for each demographic group. The first issue concerns the derivation of a ‘full-employment’ labour force, which will serve as a benchmark upon which comparisons with the actual cyclically sensitive labour force are based.

Trend extrapolation is a popular method of deriving a benchmark labour force. An estimated trend is combined with an arbitrary full employment level of a variable designed to measure the cycle and the regression simulated to yield labour force estimates at full employment (for example, Simler and Tella, 1968; Gordon, 1971). Typically, linear trend functions are fitted and the simulated results are often unrealistic. Alternatively, some studies have chosen an arbitrary point in time as a full employment observation, and then simply projected a trend from that point to the end of the sample on the assumption that the long-term rate of GDP growth and its relationship to the labour market was stable over the sample period (for example, Stricker and Sheehan, 1981).

We use another approach first developed by Perry (1971). We begin with a set of age-gender regressions estimating labour force participation rates on cyclical and trend factors. The models seek adequate representations of the movements in terms of secular filters and cyclical filters rather than presenting structural explanations for the complex behaviour. The econometric model of labour force participation is:

$$\text{Eqn 1} \quad (LFPR)_i = \alpha + \beta NPOP_t + \phi T + \sum_{j=1}^3 \delta_j S_j + \varepsilon_t$$

where  $LFPR_i = (L_i / POP_i)$  and is the labour force participation rate of the  $i^{\text{th}}$  age-gender group defined as the labour force divided by the total civilian population for that particular group;  $NPOP$  is non-farm total employment divided by the civilian population between 15-64 years,  $T$  is a linear time trend,  $S$  are seasonal dummy variables and  $\varepsilon_t$  is a stochastic error term. The trend term was included to add precision to the cyclical coefficient on the  $NPOP$  variable.

The  $\beta$  coefficient measures the degree of cyclical sensitivity of the labour participation rate. The participation gap, being the extra labour force participation that would be forthcoming if the economy was at the “full employment” level of the *NPOP*, was calculated by multiplying the  $\beta$  coefficient by the deviation from this full employment *NPOP* in each period. The calculation of the participation gaps is:

$$\text{Eqn 2} \quad PRGAP_i = \beta(NPOP^{FN} - NPOP_i)$$

where  $PRGAP_i$  is the participation rate gap for the  $i^{\text{th}}$  age-gender group,  $NPOP^{FN}$  is the employment-population ratio at full employment, assuming some arbitrary benchmark unemployment rate as full employment, and  $NPOP_i$  is the current employment-population ratio.

*PRGAP* thus measures the incremental variation in the relevant participation rate, which would occur if the economy moved from its current level of activity to the defined full employment level of activity.

The process of deriving potential labour forces for each demographic group begins with the regression estimates reported in Tables 7.3 and 7.4. The participation gap for each group is derived by multiplying  $\beta$  times the difference between the full-employment employment population ratio and the actual value of the employment-population ratio. The full-employment population ratio was calculated using the formula:

$$\text{Eqn 3} \quad N^* = \frac{(1-x)(L - \beta N)}{1 - \beta(1-x)}$$

Where  $N^*$  is the full-employment level of employment at an unemployment rate equal to  $x$ ,  $L$  is the actual labour force,  $N$  is the actual level of employment, and  $\beta$  measures the cyclical sensitivity of the labour force, as before (see Appendix for full derivation). The full employment employment-population ratio is then calculated using  $N^*$  and the actual

civilian population. The estimation of  $\beta$  was based on a regression like Equation (1) except that the aggregate labour force was used as the dependent variable.

Once the employment gap is calculated, participation gaps for each age-gender group are calculated using Equation (2). The hidden unemployment for each age-gender group was then calculated as the participation gap times the appropriate civilian population.

This method is arguably superior to the trend simulation method, especially in times when participation rates exhibit trend increases quite unlike previous periods. In that case, trend simulation would seriously underestimate or overestimate the potential labour force. Using a method that is more sourced in terms of the actual data variations; the gap approach is better able to accommodate the strong trend variations in the labour force participation rates over time.

### **3. Hidden Unemployment in Australia**

Table 1 shows the male regressions for Australia. The labour force participation rates of teenage males and males above 55 year of age are sensitive in varying degrees to the business cycle. For prime-age males (25-54 years of age) there is virtually no participation rate responsiveness detected. All male participation rates show a downward secular movement over the sample period used. The results are in accord with the prevailing wisdom.

Table 2 shows the female regressions, which are in contrast to the male results. The participation rates for every female age group demonstrate cyclical sensitivity, with females aged between 35 and 54 showing the most responsiveness. Further, while there are variations in the trend behaviour of the different age groups, all exhibit a rising secular trend. Women under 24 and over 60 exhibit modest upward trends over the sample, while the prime-age females show pronounced trends towards higher participation rates independent of the business cycle. The results support the net discouraged worker hypothesis.

Table 1 Australia, Male Participation Rate Regressions, 1980 (2) to 1999 (1)

	15-19	20-24	25-34	35-44	45-54	55-59	60-64	> 65
Constant	-5.19 (0.40)	77.25 (14.58)	93.74 (34.37)	93.24 (27.68)	84.07 (14.23)	31.39 (2.09)	7.73 (0.39)	-2.24 (0.32)
Trend	-0.133 (7.22)	-0.070 (13.09)	-0.045 (15.61)	-0.048 (13.50)	-0.053 (6.69)	-0.142 (7.12)	-0.082 (1.99)	-0.02 (1.85)
NPOP	1.24 (5.36)	0.26 (2.75)	0.04 (0.89)	0.05 (0.79)	0.13 (1.26)	0.88 (3.34)	0.76 (2.20)	0.23 (1.82)
R <sup>2</sup>	0.95	0.92	0.94	0.95	0.91	0.94	0.88	0.80
% s.e. *	1.34	0.58	0.28	0.28	0.45	1.13	1.98	4.14
DW	1.98	1.96	1.90	1.99	1.96	1.95	1.89	1.97

Note: All regressions used seasonal dummy variables. All regressions were estimated using an exact Maximum Likelihood Estimator with AR(2) disturbances (see Pesaran, 1972). The figures in parentheses are *t*-statistics.

\* the % s.e. is the standard error as a percentage of the mean of the dependent variable.

Table 2 Australia, Female Participation Rate Regressions, 1980 (2) to 1999 (1)

	15-19	20-24	25-34	35-44	45-54	55-59	60-64	> 65
Constant	29.07 (2.84)	44.74 (3.53)	16.05 (1.54)	20.67 (1.89)	-2.14 (0.17)	-5.86 (3.62)	-9.29 (0.89)	-2.59 (1.08)
Trend	0.03 (2.55)	0.094 (3.51)	0.217 (6.52)	0.155 (3.60)	0.307 (15.63)	0.202 (9.74)	0.083 (7.52)	0.004 (1.35)
NPOP	0.64 (3.55)	0.46 (2.05)	0.63 (3.46)	0.66 (3.54)	0.84 (3.74)	0.55 (1.95)	0.36 (1.96)	0.09 (2.04)
R <sup>2</sup>	0.89	0.95	0.99	0.99	0.99	0.97	0.92	0.73
% s.e. *	0.91	0.91	0.97	0.83	1.06	2.91	5.21	6.11
DW	1.98	1.98	1.98	1.98	1.89	1.98	1.96	1.92

Note: All regressions used seasonal dummy variables. All regressions were estimated using an exact Maximum Likelihood Estimator with AR(2) disturbances (see Pesaran, 1972). The figures in parentheses are *t*-statistics.

\* the % s.e. is the standard error as a percentage of the mean of the dependent variable.

Table 3 compares the actual and hidden unemployment for each age-gender group in 1993 (a recession year) and 2000 (full Australian results are available in Appendix Table A1). The comparison provides some indication of the changes that occur over a business cycle and the proportional impacts on demographic groups. In 1993, the aggregate unemployment rate was 10.9 per cent (seasonally adjusted) and then slowly declined over the next six years to reach 6.7 per cent in August 2000. The improved circumstances show up in lower total hidden unemployment (347.4 thousand in 1993 compared to 155.4 thousand in 2000). The outcomes for women overall has deteriorated in terms of both recorded and estimated hidden unemployment. They now account for a higher percentage of recorded unemployment (43.3 per cent from 38.9 per cent) and hidden unemployment (66.6 per cent from 66.2 per cent).

Table 3 Actual and Hidden Unemployment by Age-Gender, Australia, 1993 and 2000 (thousands and percentage shares)

	Males				Females				Total			
	UN	% of Total	HU	% of Total	UN	% of Total	HU	% of Total	UN	% of Total	HU	% of Total
<b>1993</b>												
15-19	89.3	9.5	51.3	14.8	78.8	8.4	25.3	7.3	168.1	17.9	76.7	22.1
20-24	107.4	11.5	11.6	3.3	75.1	8.0	20.3	5.8	182.5	19.5	31.9	9.2
25-34	143.7	15.3	3.7	1.1	85.6	9.1	55.3	15.9	229.3	24.5	59.0	17.0
35-44	104.1	11.1	3.7	1.1	72.4	7.7	55.2	15.9	176.5	18.8	58.9	17.0
45-54	68.7	7.3	8.7	2.5	43.4	4.6	53.0	15.3	112.1	12.0	61.7	17.8
55-59	32.5	3.5	21.2	6.1	8.1	0.9	13.0	3.8	40.6	4.3	34.3	9.9
60-64	27.0	2.9	17.0	4.9	1.5	0.2	8.0	2.3	28.5	3.0	25.0	7.2
Total	572.7	61.1	117.3	33.8	364.9	38.9	230.1	66.2	937.6	100.0	347.4	100.0
<b>2000</b>												
15-19	72.1	11.1	21.6	13.9	65.0	10.0	10.7	6.9	137.1	21.2	32.3	20.8
20-24	61.7	9.5	4.5	2.9	46.2	7.1	7.7	5.0	107.9	16.7	12.2	7.9
25-34	86.8	13.4	1.6	1.0	62.6	9.7	23.0	14.8	149.4	23.1	24.6	15.8
35-44	66.4	10.3	1.6	1.0	60.1	9.3	24.7	15.9	126.5	19.5	26.2	16.9
45-54	51.2	7.9	4.3	2.8	36.3	5.6	27.3	17.6	87.5	13.5	31.6	20.3
55-59	19.3	3.0	10.9	7.0	8.2	1.3	6.6	4.2	27.5	4.2	17.5	11.2
60-64	9.4	1.5	7.5	4.8	2.0	0.3	3.5	2.3	11.4	1.8	11.1	7.1
Total	366.9	56.7	52.0	33.4	280.4	43.3	103.5	66.6	647.3	100.0	155.4	100.0

(a) August 2000.

The estimates of hidden unemployment are based on a 4 per cent full employment unemployment rate.



It is also clear from Table 3 that women's underutilisation is manifested proportionately more in terms of hidden unemployment while men have a higher tendency to remain in the labour force as unemployed. Teenage males and females, as a group, have experienced a worsening in terms of their share of unemployment but this partially reflects their increased participation (and lower hidden unemployment). It is interesting to note that the position of 45-54 year old males has deteriorated over the period of growth from 1993. Their relative unemployment and hidden unemployment has risen since 1993. The 60-64 year old group has experienced no change in their hidden unemployment share but has improved significantly in terms of unemployment share. The other significant change is the deterioration in unemployment share for prime-age females (25-54 years age group). The results confirm that the benefits of expansion in terms of increased labour force participation and lower unemployment are not distributed evenly across all demographic groups.

To what extent do the estimates change our view of underutilisation? Mitchell and Carlson (2000) have computed a range of indicators for extending the measurement of underutilisation and underemployment. Table 5 is taken from their work. The relevant comparison is between U3, the official unemployment rate and CU4 (taken from the Centre of Full Employment and Equity's Labour Market Indicators – CLMI), which includes the estimates of hidden unemployment published in this paper in the numerator and denominator of the unemployment rate calculation.

The results show that even if we confine our broadening of underutilisation to include hidden unemployment, the measure of labour resource wastage is 1.5 per cent higher in 2000 than is represented by the official unemployment rate. Mitchell and Carlson (2000) show that once we include underemployment and marginal workers, the extent of labour resource wastage in 2000 was 11.1 per cent of total willing labour resources.

In August 2000, for every 4.2 persons who were officially recorded as being unemployed there was another person who was hidden unemployed (at the 4 per cent unemployment rate benchmark).

Table 5 The unemployment rate - official and adjusted for hidden unemployment, 1980-2000

	<b>Official U3</b>	<b>UR + HU CU4</b>	<b>Difference</b>
1980	6.1	7.3	1.2
1981	5.8	6.8	1.0
1982	7.2	8.8	1.6
1983	10.0	13.1	3.1
1984	9.0	11.7	2.7
1985	8.3	10.6	2.3
1986	8.1	10.2	2.1
1987	8.1	10.3	2.2
1988	7.2	9.0	1.8
1989	6.2	7.4	1.2
1990	6.9	8.4	1.5
1991	9.6	12.4	2.8
1992	10.8	14.2	3.4
1993	10.9	14.3	3.4
1994	9.7	12.7	3.0
1995	8.5	10.8	2.3
1996	8.5	10.9	2.4
1997	8.5	10.9	2.4
1998	8.0	10.1	2.1
1999	7.2	9.0	1.8
2000 (a)	6.7	8.2	1.5

(a) average for the period from January to August. U3 is the official unemployment rate published by the ABS. CU4 is the total unemployment plus hidden unemployment as a percentage of labour force plus hidden unemployment - UR + HU

#### 4. Estimating Hidden Unemployment in the United States

Tables 6 and 7 show the male and female regressions, respectively for the USA. They are broadly similar in characteristics to those estimated for Australia. For the USA, the older males and females show strong cyclical sensitivity. For prime-age males (25-54 years of age) there is virtually no participation rate responsiveness. All male participation rates show a downward trend over the sample period used. The participation rates for every female age group demonstrate cyclical sensitivity, with females aged between 25 and 54 showing the most responsiveness. All the female groups, excepting the over 65-year olds exhibit a rising secular trend. The results again support the net discouraged worker hypothesis.

Table 6 United States, Male Participation Rate Regressions, 1952 (1) to 1998 (4)

	15-19	20-24	25-34	35-44	45-54	55-64	60-64
Constant	-15.64 (1.40)	57.81 (6.60)	92.16 (37.27)	96.24 (34.38)	90.67 (23.18)	92.28 (12.80)	13.13 (1.88)
Trend	-0.086 (4.01)	-0.050 (5.47)	-0.036 (12.84)	-0.033 (10.76)	-0.049 (11.66)	-0.112 (5.55)	-0.160 (7.44)
NPOP	1.37 (6.95)	0.55 (3.44)	0.11 (2.35)	0.05 (0.89)	0.12 (1.64)	0.74 (0.61)	0.48 (4.25)
R <sup>2</sup>	0.91	0.81	0.99	0.98	0.98	0.949	0.99
% s.e. *	1.54	0.92	0.22	0.26	0.37	0.66	1.97
DW	2.04	2.07	2.04	2.06	2.06	2.01	1.99

Note: All regressions used seasonal dummy variables. All regressions were estimated using an exact Maximum Likelihood Estimator with AR(2) disturbances (see Pesaran, 1972). The figures in parentheses are *t*-statistics.

\* the % s.e. is the standard error as a percentage of the mean of the dependent variable.

Table 7 United States, Female Participation Rate Regressions, 1952 (1) to 1998 (4)

	15-19	20-24	25-34	35-44	45-54	55-59	60-64
Constant	-24.79 (2.19)	31.09 (3.49)	9.79 (1.25)	17.46 (2.79)	13.64 (2.13)	8.89 (1.19)	0.44 (0.11)
Trend	0.022 (0.92)	0.147 (5.88)	0.209 (7.90)	0.188 (9.51)	0.171 (13.30)	0.107 (4.79)	-0.015 (2.76)
NPOP	1.17 (5.94)	0.25 (1.69)	0.43 (3.56)	0.39 (3.93)	0.48 (4.27)	0.36 (2.02)	0.17 (2.33)
R <sup>2</sup>	0.97	0.99	0.99	0.99	0.99	0.99	0.89
% s.e. *	1.97	1.07	0.89	0.74	0.84	1.31	3.82
DW	2.05	2.01	1.99	2.01	2.02	2.02	2.04

Note: All regressions used seasonal dummy variables. All regressions were estimated using an exact Maximum Likelihood Estimator with AR(2) disturbances (see Pesaran, 1972). The figures in parentheses are *t*-statistics.

\* the % s.e. is the standard error as a percentage of the mean of the dependent variable.

The contrasting results are in the behaviour of the teenage (16-19) participation rates. While the male teenagers in Australia exhibit strong cyclical sensitivity in their participation rates, the US teenage males reveal stronger sensitivity. The teenage female participation rates in the US are considerably more cyclically sensitive than their Australian counterparts (1.17 compared to 0.64). As a result, teenagers will account for larger percentages of hidden unemployment in the USA than they do in Australia.

Table 8 compares the actual and hidden for each age-gender group for the same years as in Table 4 (full US results are available in Appendix Table A2). In 1993, the aggregate US unemployment rate was 6.5 per cent (seasonally adjusted), coming down from 7.5 per cent in 1992. In contrast to Australia, however, by August 2000, the aggregate unemployment rate in the United States was 4.0 per cent (compared to Australia 6.1 per cent). The substantial decline in total unemployment is matched by a dramatic decline in hidden unemployment, which is expected given the 4 per cent benchmark. The results are still useful in comparative terms. All age-gender groups benefited from the expansion although in proportionate terms unemployment males did better than their female counterparts. Prime-age males and females were not as advantaged. As in the Australian case, females increased their share of total hidden unemployment. The results show that males experience higher proportions of unemployment and lower proportions of hidden unemployment, indicating that when activity is low and job opportunities scarce, females are more prone to exit the labour force. In the upturn, males gain a higher proportion of the total jobs created than females.

The results for the USA are, in part, an artifact of the benchmark full employment rate of 4 per cent. It is obvious that hidden unemployment will be very low as a consequence. However, the results still provide comparisons between the state of the Australian labour market and the labour market in the USA. Over the 1993 to 2000 period, both economies have grown rapidly and unemployment has fallen. Australia has experienced a 31 per cent decline in unemployment while the USA has seen its unemployment level declining by 39 per cent. The accompanying percentage fall in hidden unemployment has been much larger in the USA over the same period than for Australia.

Table 8 United States, Actual and Hidden Unemployment by Age-Gender, 1992 and 2000 (thousands and percentage shares)

	Males				Females				Total			
	UN	% of Total	HU	% of Total	UN	% of Total	HU	% of Total	UN	% of Total	HU	% of Total
<b>1993</b>												
16-19	768.7	13.5	383.4	16.5	621.6	10.9	318.3	13.7	1390.3	14.9	701.7	30.3
20-24	861.5	15.1	199.4	8.6	697.9	12.2	93.3	4.0	1559.4	16.7	292.6	12.6
25-34	1530.6	26.8	85.5	3.7	1173.2	20.6	362.7	15.7	2703.8	28.9	448.2	19.3
35-44	1118.1	19.6	85.5	3.7	858.8	15.0	321.6	13.9	1976.8	21.1	407.0	17.6
45-54	674.8	11.8	64.5	2.8	464.0	8.1	278.4	12.0	1138.8	12.2	342.9	14.8
55-64	379.3	6.6	-28.6	-1.2	209.7	3.7	153.4	6.6	588.9	6.3	124.8	5.4
Total	5332.9	57.0	789.5	34.1	4025.1	43.0	1527.7	65.9	9358.0	100.0	2317.2	100.0
<b>2000</b>												
16-19	604.6	10.6	5.6	17.6	528.4	9.3	4.7	14.6	1133.0	19.9	10.3	32.2
20-24	545.5	9.6	2.5	7.8	480.8	8.4	1.2	3.6	1026.3	18.0	3.7	11.4
25-34	621.8	10.9	1.0	3.0	654.3	11.5	4.2	13.0	1276.2	22.4	5.2	16.1
35-44	570.8	10.0	1.0	3.3	583.1	10.2	4.5	14.0	1153.9	20.2	5.5	17.2
45-54	402.8	7.1	1.0	3.3	349.6	6.1	4.6	14.2	752.4	13.2	5.6	17.5
55-64	202.8	3.6	-0.4	-1.3	163.1	2.9	2.2	6.9	365.8	6.4	1.8	5.6
Total	2948.4	51.7	10.8	33.7	2759.3	48.3	21.3	66.3	5707.7	100.0	32.1	100.0

(a) August 2000.

The estimates of hidden unemployment are based on a 4 per cent full employment unemployment rate

## Conclusion

The estimates of hidden unemployment in Australia and the United States are comparable. The differences in the results are due in a large part to the benchmark that we chose. The actual unemployment rate in the United States is much closer to the benchmark and as such is by construction a tighter labour market. The cyclical behaviour of the labour force participation rates for demographic groups is comparable across countries.

The estimates indicate that many more jobs have to be created to reduce the true slack in the labour market than is indicated by the unemployment rate. Unemployment is the tip of the iceberg.

## Appendix

The estimates of the employment gap requires an assumption to be made about the full employment unemployment rate, which then defines the potential employment-population ratio,  $NPOP^{FN}$  and implicitly the potential labour force,  $L^*$ .

Expressions can be derived for these unknown aggregates. We define the potential labour force as:

$$\text{Eqn A.1} \quad L^* = L + H$$

where  $L$  is the actual labour force and  $H$  is the estimated hidden unemployment.

$$\text{Eqn A.2} \quad H = \beta(NPOP^{FN} - NPOP)$$

Hidden unemployment is defined as the cyclical sensitivity of the labour force participation rate,  $\beta$  times the employment gap.

Substituting and re-arranging Eqn A.1 gives:

$$\text{Eqn A.3} \quad L^* = L + \beta N^* - \beta N$$

Where  $N^*$  is the level of employment at full employment and  $N$  is the actual level of employment in any period.

Define the target full employment unemployment rate,  $x$  as:

$$\text{Eqn A.4} \quad x = \frac{H}{L^*} = \frac{N^* - N}{L^*}$$

Re-arranging Eqn A.4 and substituting for the potential labour force generates an expression for the potential employment level:

$$\text{Eqn A.5} \quad N^* = \frac{(1-x)(L - \beta N)}{1 - \beta(1-x)}$$

Substituting back into Eqn A.3 provides a straightforward expression for the potential labour force.

Table A1 Hidden Unemployment Estimates by Age and Gender, Australia, 1979-2000, at a 4 per cent unemployment rate benchmark

Gender	Age	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
Males	<b>15-19</b>	14.8	15.1	12.7	20.2	41.6	35.7	31.0	30.3	32.2	26.2	18.1	22.0	42.0	51.1	51.3	43.2	33.6	33.3	34.2	30.7	25.2	21.6
Females		7.5	7.6	6.4	10.2	20.9	17.9	15.5	15.1	16.1	13.1	9.1	11.0	20.9	25.3	25.3	21.3	16.6	16.5	16.9	15.1	12.4	10.7
Total		22.3	22.8	19.1	30.4	62.6	53.5	46.4	45.4	48.3	39.3	27.2	33.0	62.9	76.3	76.7	64.5	50.3	49.8	51.1	45.8	37.6	32.3
Males	<b>20-24</b>	2.9	3.0	2.6	4.2	8.8	7.6	6.5	6.1	6.3	5.0	3.5	4.4	8.7	11.1	11.6	9.9	7.7	7.4	7.4	6.5	5.2	4.5
Females		5.1	5.3	4.6	7.5	15.7	13.4	11.4	10.7	11.0	8.8	6.1	7.7	15.4	19.6	20.3	17.3	13.4	12.9	12.9	11.2	9.1	7.7
Total		7.9	8.3	7.2	11.8	24.5	21.0	17.9	16.8	17.3	13.8	9.6	12.0	24.1	30.7	31.9	27.2	21.0	20.3	20.2	17.7	14.3	12.2
Males	<b>25-34</b>	0.9	0.9	0.8	1.3	2.8	2.4	2.1	2.0	2.1	1.7	1.2	1.5	2.9	3.7	3.7	3.2	2.5	2.5	2.5	2.3	1.8	1.6
Females		13.2	13.8	12.0	19.4	40.5	34.9	30.3	29.3	30.9	25.1	17.7	22.0	43.3	54.0	55.3	47.2	37.2	36.9	37.6	33.3	27.0	23.0
Total		14.1	14.8	12.8	20.8	43.3	37.3	32.3	31.2	33.0	26.9	19.0	23.5	46.2	57.7	59.0	50.4	39.7	39.4	40.2	35.5	28.8	24.6
Males	<b>35-44</b>	0.9	0.9	0.8	1.3	2.8	2.4	2.1	2.0	2.1	1.7	1.2	1.5	2.9	3.7	3.7	3.2	2.5	2.5	2.5	2.3	1.8	1.6
Females		10.0	10.6	9.3	15.9	34.2	30.2	26.9	26.6	28.5	23.6	16.8	21.2	42.2	53.3	55.2	47.7	38.2	38.4	39.6	35.4	28.9	24.7
Total		10.9	11.6	10.2	17.2	37.0	32.6	29.0	28.6	30.6	25.3	18.0	22.7	45.2	56.9	58.9	50.9	40.7	40.9	42.1	37.6	30.8	26.2
Males	<b>45-54</b>	1.9	1.9	1.6	2.6	5.3	4.6	4.0	3.8	4.1	3.4	2.4	3.1	6.2	8.1	8.7	7.7	6.2	6.4	6.7	6.1	5.0	4.3
Females		11.3	11.6	9.7	15.6	32.2	27.8	24.0	23.2	24.6	20.3	14.5	18.6	37.9	49.5	53.0	47.1	38.4	39.4	41.3	37.8	31.5	27.3
Total		13.2	13.5	11.3	18.2	37.5	32.4	28.0	27.0	28.7	23.6	16.9	21.7	44.1	57.6	61.7	54.8	44.6	45.7	48.0	43.8	36.5	31.6
Males	<b>55-59</b>	5.8	6.0	5.1	8.3	17.2	15.0	12.9	12.2	12.5	9.8	6.7	8.2	16.0	20.2	21.2	18.7	15.1	15.3	16.0	14.6	12.3	10.9
Females		3.7	3.8	3.2	5.2	10.7	9.2	7.8	7.4	7.5	6.0	4.1	5.0	9.8	12.4	13.0	11.4	9.2	9.3	9.7	8.8	7.5	6.6
Total		9.4	9.8	8.4	13.5	28.0	24.1	20.7	19.6	20.0	15.8	10.8	13.2	25.7	32.6	34.3	30.1	24.2	24.6	25.7	23.4	19.8	17.5
Males	<b>60-64</b>	3.9	4.0	3.5	5.9	12.6	11.3	9.9	9.6	10.0	8.1	5.7	7.0	13.7	16.8	17.0	14.3	11.3	11.2	11.5	10.4	8.6	7.5
Females		2.0	2.1	1.8	3.0	6.4	5.6	4.9	4.7	4.9	3.9	2.7	3.3	6.5	8.0	8.0	6.8	5.4	5.3	5.4	4.9	4.1	3.5
Total		5.8	6.1	5.3	8.9	19.0	16.9	14.8	14.3	14.9	12.0	8.4	10.4	20.2	24.8	25.0	21.0	16.6	16.4	16.9	15.3	12.7	11.1
<b>Males</b>	<b>All</b>	31.0	32.0	27.2	43.9	91.2	78.8	68.3	66.0	69.3	55.9	38.8	47.7	92.5	114.7	117.3	100.2	78.9	78.5	80.8	72.7	60.1	52.0
<b>Females</b>	<b>All</b>	52.7	54.8	47.1	76.8	160.6	139.0	120.8	117.0	123.5	100.8	71.1	88.9	175.9	222.0	230.1	198.7	158.3	158.7	163.5	146.5	120.4	103.5
<b>TOTAL</b>	<b>All</b>	83.7	86.8	74.3	120.7	251.8	217.8	189.1	183.0	192.7	156.7	110.0	136.5	268.3	336.7	347.4	298.9	237.3	237.2	244.3	219.2	180.5	155.4

Source: Author's own calculations. 2000 data is computed using Monthly data from January to August.

Table A2 Hidden Unemployment Estimates by Age and Gender, USA, 1979-2000, at a 4 per cent unemployment rate benchmark

Gender	Group	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
Males	<b>16-19</b>	250.8	382.2	461.9	683.2	804.4	461.6	405.0	390.2	310.1	202.2	147.6	170.4	339.0	425.5	383.4	300.4	204.2	203.4	153.4	75.6	40.2	5.6
Females		216.3	329.0	397.8	586.5	685.8	394.0	345.5	332.3	263.8	171.6	125.5	143.0	282.9	354.5	318.3	250.2	170.0	168.5	126.5	62.5	33.3	4.7
Total		467.0	711.3	859.7	1269.6	1490.2	855.6	750.5	722.4	573.9	373.8	273.1	313.4	621.9	780.0	701.7	550.6	374.2	371.8	279.9	138.1	73.5	10.3
Males	<b>20-24</b>	119.3	186.1	231.1	352.0	426.6	252.9	217.2	203.9	155.9	99.1	72.4	86.8	178.2	226.4	199.4	151.6	98.0	92.3	68.3	33.5	17.5	2.5
Females		57.9	90.1	111.9	170.1	205.0	121.0	105.5	98.9	75.8	48.2	35.1	40.8	83.5	105.7	93.3	70.9	45.8	43.1	31.3	15.3	8.2	1.2
Total		177.2	276.2	343.0	522.1	631.6	374.0	322.7	302.8	231.6	147.3	107.6	127.6	261.8	332.1	292.6	222.5	143.8	135.4	99.6	48.8	25.7	3.7
Males	<b>25-34</b>	39.9	63.6	80.9	125.4	154.6	94.1	85.0	84.6	67.6	44.6	33.5	37.7	76.7	96.9	85.5	65.4	42.8	40.7	29.4	14.0	7.0	1.0
Females		172.5	274.9	349.5	541.0	664.8	403.4	366.6	360.4	287.9	189.9	142.5	160.8	326.4	412.2	362.7	276.6	181.7	173.5	124.6	59.2	30.3	4.2
Total		212.4	338.5	430.4	666.3	819.4	497.5	451.6	445.0	355.4	234.5	176.0	198.5	403.1	509.2	448.2	342.0	224.5	214.3	154.0	73.2	37.3	5.2
Males	<b>35-44</b>	39.9	63.6	80.9	125.4	154.6	94.1	85.0	84.6	67.6	44.6	33.5	37.7	76.7	96.9	85.5	65.4	42.8	40.7	29.4	14.0	7.0	1.0
Females		111.1	175.5	221.7	353.6	448.0	278.5	257.5	257.0	209.7	141.3	109.1	128.1	271.7	352.7	321.6	252.4	170.7	168.0	124.9	61.2	32.0	4.5
Total		151.0	239.1	302.6	479.0	602.6	372.6	342.6	341.5	277.3	185.8	142.7	165.8	348.3	449.6	407.0	317.8	213.5	208.7	154.3	75.2	39.1	5.5
Males	<b>45-54</b>	28.2	42.9	52.5	79.2	95.7	57.1	51.4	50.2	40.4	27.4	21.1	24.3	50.9	68.6	64.5	51.7	35.7	35.8	27.2	13.6	7.3	1.0
Females		125.4	190.7	233.4	352.1	424.0	252.8	226.7	221.7	178.0	120.5	92.8	105.1	220.0	297.3	278.4	223.4	154.8	155.3	117.9	58.8	31.6	4.6
Total		153.6	233.5	285.9	431.3	519.6	309.9	278.1	271.9	218.4	148.0	113.9	129.3	270.9	365.9	342.9	275.1	190.5	191.1	145.0	72.3	38.9	5.6
Males	<b>55-64</b>	-16.2	-25.2	-31.3	-47.9	-58.3	-34.8	-31.3	-30.0	-23.5	-15.3	-11.3	-12.3	-25.2	-32.1	-28.6	-22.1	-14.8	-14.5	-10.9	-5.5	-2.9	-0.4
Females		89.6	139.6	173.8	266.0	323.6	192.9	171.6	164.3	128.4	83.2	61.4	66.7	135.9	172.2	153.4	118.5	79.1	77.3	57.7	29.0	15.6	2.2
Total		73.4	114.4	142.4	218.0	265.4	158.2	140.3	134.3	105.0	67.9	50.1	54.5	110.8	140.1	124.8	96.3	64.4	62.8	46.8	23.5	12.6	1.8
<b>Males</b>	<b>ALL</b>	461.9	713.3	875.9	1317.2	1577.6	925.1	812.5	783.5	618.0	402.6	297.0	344.7	696.3	882.3	789.5	612.2	408.8	398.4	296.7	145.1	76.2	10.7
<b>Females</b>	<b>ALL</b>	772.7	1199.7	1488.0	2269.1	2751.2	1642.7	1473.3	1434.5	1143.6	754.8	566.4	644.4	1320.5	1694.5	1527.7	1192.0	802.1	785.7	582.9	286.0	150.9	21.3
<b>Total</b>	<b>ALL</b>	1234.6	1913.0	2363.9	3586.4	4328.8	2567.8	2285.8	2218.0	1761.6	1157.4	863.4	989.2	2016.7	2576.8	2317.2	1804.3	1210.8	1184.1	879.6	431.1	227.0	32.0

Source: Author's own calculations. 2000 data is computed using Monthly data from January to August.



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## Endnotes

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<sup>1</sup> The author is Professor of Economics and Director of the Centre of Full Employment and Equity, University of Newcastle, NSW 2308 Australia.

<sup>2</sup> The choice of the 4 per cent benchmark unemployment rate to represent full employment and conduct sensitivity analysis is not intended to indicate that the authors consider this to be the constraint facing the economy. Mitchell (1998) outlines a model of the economy, which allows the unemployment rate to be reduced to some low frictional figure.