

# Reductions in Aggregate Unemployment as ‘A Free Lunch’

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## Abstract

*This paper looks at the effects of changes in the age composition of the labour force on aggregate male and female unemployment rates. While it has been common to look at aggregate participation rate changes in terms of a weighted average over age groups this seems not to be the case for unemployment. We show in this paper that changes in the age composition of the labour force (driven mainly by changes in the age distribution of the population) has affected the aggregate unemployment rates in a systematic and, with hindsight, predictable manner. Amongst other things, we show that in the past decade or so, policy makers have benefited from a not inconsequential “free lunch” in that changes in the age composition of the labour force have been pulling the aggregate unemployment rates down below what it would otherwise be by around one percent of the labour force. We also show that this free lunch is now coming to an end.*

## Introduction

This paper looks at the effects of changes in the age composition of the labour force on aggregate male and female unemployment rates. Given that there have been persistent changes in the proportional representation of various age groups in the labour force and given also the existence of age related differences in the unemployment rate, it is reasonable to conjecture that changes in the age composition of the (population and the) labour force have had a discernable impact on the aggregate unemployment rate. To explore this issue we need to decompose movements in the aggregate unemployment rates into a component which reflects changes in the weighting of different age groups and a component which reflects

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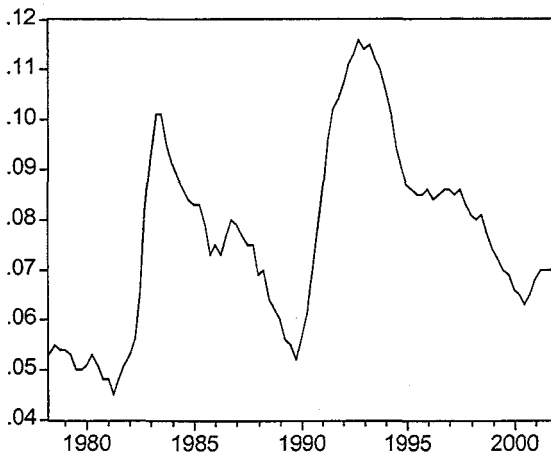
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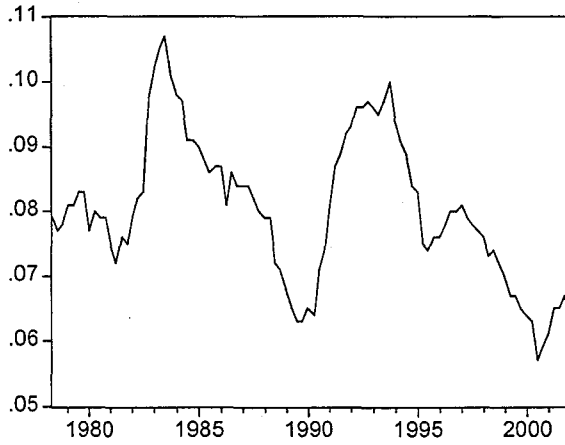
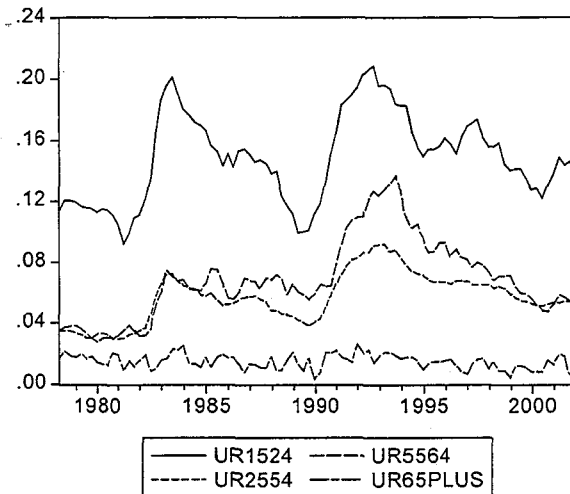
changes due to variations in the unemployment rate for each age group. There are various ways in which this could be done. In this paper a purely statistical (shift-share) decomposition is used to identify the two components. We begin by looking at what the evidence tells us about the evolution of both unemployment rates and the age composition of the labour force for males and females in Australia since 1978.

### Recent History of the Aggregate Unemployment Rate for Males and Females

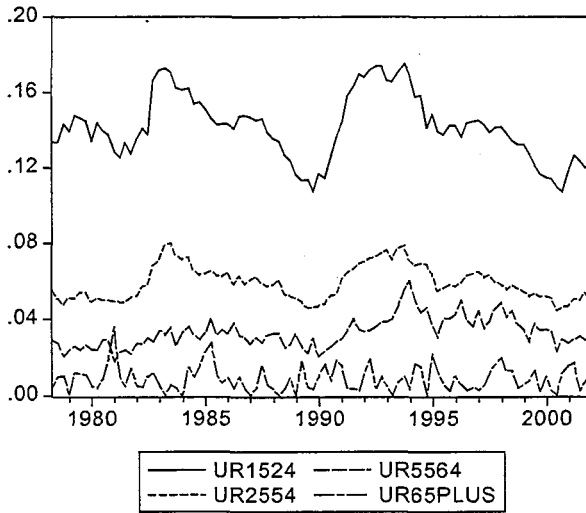
Figures 1a and 1b show the behaviour of the aggregate male and female unemployment rates on a quarterly basis over the period 1978:2–2002:1.<sup>1</sup> With respect to males we notice that the peak unemployment rate is higher in the second of the two recessions and that the trough unemployment rate was lower prior to the start of the first recession than it was prior to the start of the second. Indeed, the general impression given is consistent with a rising trend unemployment rate. With respect to females we notice that the peak unemployment rate is lower in the second of the two recessions and that the trough unemployment rate was lower prior to the start of the second recession than it was prior to the start of the first. Unlike the case for males, the general impression here is consistent with a falling trend unemployment rate.

**Figure 1a.** Unemployment Rate for Males – Australia 1978:2–2002:1

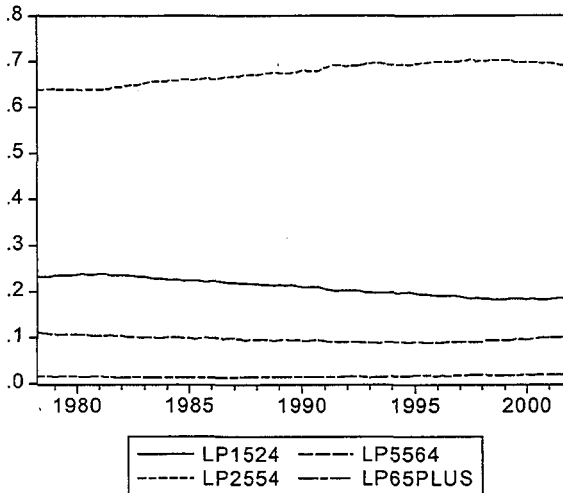


**Figure 1b. Unemployment Rate for Females – Australia 1978:2–2002:1****Figure 2a. Male Unemployment Rate by Age Groups 1978:2–2002:1**

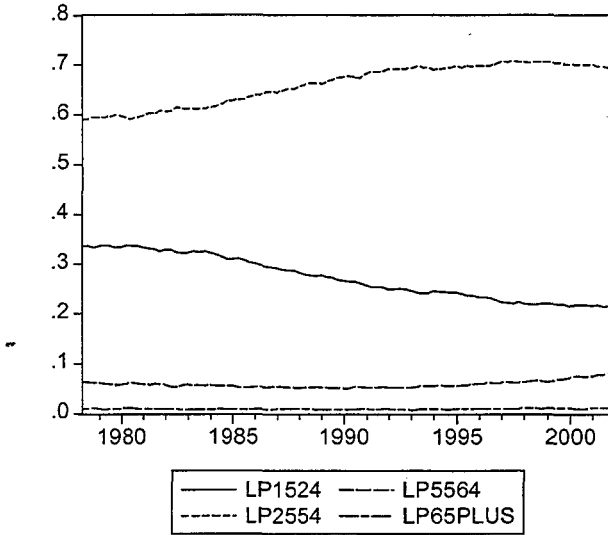
**Figure 2b.** Female Unemployment Rate by Age Groups 1978:2–2002:1



**Figure 3a.** Male Labour Force: Proportions of Total by Age Groups 1978:2–2001:4



**Figure 3b.** Female Labour Force: Proportions of Total by Age Groups 1978:2–2001:4



Figures 2a and 2b show unemployment rates by broad age groups<sup>2</sup> while Figures 3a and 3b show the proportion of the labour force in the various age groups over time. In Figure 2 we see that the unemployment rate for both males and females aged 15-24 years is in every period the highest of all the age groups. (Notice this implies that if the share of that age group in the labour force were to fall, the aggregate unemployment rate must necessarily fall – more on this shortly.) Another striking feature of the information given to us in Figure 2a is that if we compare unemployment rates for each age group at the peak of the two recessions we find that the peak level for the 15-24 age group is about the same but for males aged 25-54 and 55-64 the peak level in the second recession is much higher than for the first. In Figure 2b, which gives data for females, we see that the peak level for the 15-24 and 25-54 age groups (together they make up around 92% of the female labour force) is about the same for both recessions although, as we have already seen, the *aggregate* female unemployment rate was lower in the second than the first. By itself this suggests that we are on the right track in thinking that changes in age composition of the labour force are playing an important role in determining movements of the aggregate unemployment rate over time.

Figures 3a and 3b show the proportions of the total male and female

labour force over the age of 15 taken up by different age groups over the period 1978:2–2002:1. The proportion of both males and females in the prime working age group (25–54) was rising until 1997/98 but has been falling since then. Also evident is that there has been a persistent fall in the proportion of the male and female labour force in the age group 15–24 over the whole of the period since 1980/81 (although the rate of decline has been slowing since the mid-nineties – more on this in a later section of the paper) and that the proportions of the male and female labour force in the age groups 55–64 and 65 plus have been rising, at least in the latter part of the period under consideration.

Given that there have been persistent changes in the proportional representation of various age groups in the labour force and given also the existence of age related differences in the unemployment rate, it is reasonable to conjecture that changes in the age composition of the population and the labour force have had a discernable impact on the aggregate unemployment rate. To explore this issue we need to decompose movements in the aggregate unemployment rates into a component which reflects changes in the weighting of different age groups and a component which reflects changes due to variations in the unemployment rate for each age group.

### **Decomposition of Changes in the Aggregate Unemployment Rate into Rate Composition Components**

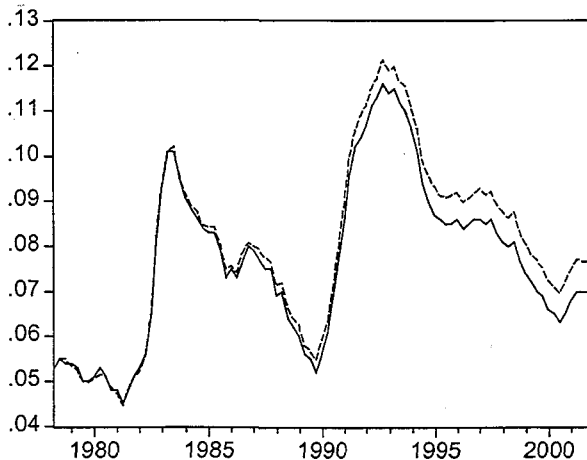
It is a truism to say that the aggregate unemployment rate is the weighted sum of the unemployment rates across age groups, where the weights are the proportion of the total labour force made up of people in that age group. Given this, there are two proximate sources of change in the aggregate unemployment rate. First, the value of the aggregate unemployment rate will change if there is a change in the unemployment rates for any of the individual age groups. Second, the aggregate unemployment rate will change if there is a change in the age profile of the labour force. Over time both factors are likely to change, so that both elements will be contributing to any recorded change in the aggregate unemployment rate.

It is desirable to have a rule which will enable us to 'decompose' changes in the aggregate unemployment rate into two components: (i) that part which reflects the effect on the aggregate unemployment rate of changes in the unemployment rate in the individual age groups, and (ii) that part which reflects the effect on the aggregate unemployment rate of changes in the age structure of the labour force. There exist in principle

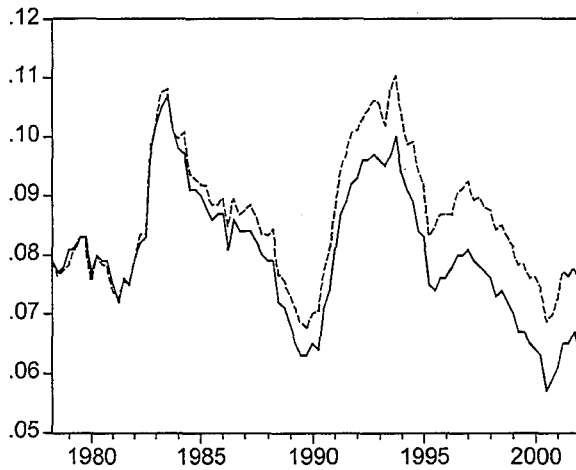
a variety (indeed, an infinite variety) of procedures by which we might decompose the movement of a composite index into the movements of its constituent parts (these methods are often called shift-share analysis). The method adopted here (and described in detail in Appendix A to this paper) for decomposing a weighted aggregate into 'composition' and 'rate' components involves using the arithmetic mean of current and base year values of one variable as the weight to be applied each period to the change in the other variable.<sup>3</sup>

Applying this philosophy to our problem allows us to decompose the observed change in the aggregate unemployment rate into two components, one 'the rate component' (*ratec*), measures the effect of 'micro' changes in the unemployment rates of individual age groups as they respond to changing economic and financial regimes etc and the second, the 'composition component' (*compc*), measures the effect of changes in the age composition of the labour force. With knowledge of these two terms for each successive period we can generate a series for the aggregate unemployment rate with the effects of compositional change removed thus arriving at a series which will show us the effects on the aggregate unemployment rate of changes in the 'rates' alone.

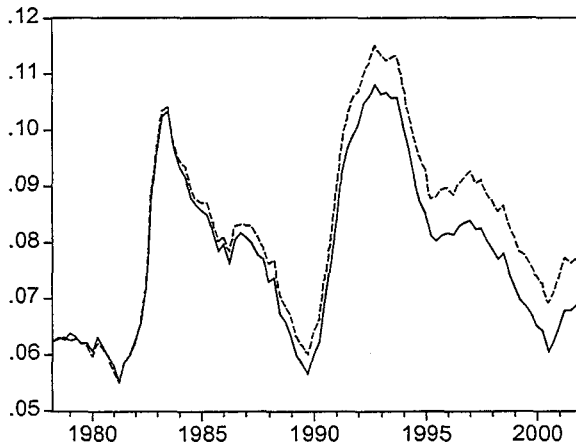
**Figure 4a.** Males: Actual Unemployment Rate (solid line) and Unemployment Rate with Composition Effects Removed (dashed line)



**Figure 4b.** Females: Actual Unemployment Rate (solid line) and Unemployment Rate with Composition Effects Removed (dashed line)



**Figure 4c.** Persons: Actual Unemployment Rate (solid line) and Unemployment Rate with Composition Effects Removed (dashed line)





Figures 4a and 4b depict the series for the aggregate male and female unemployment rates which have been purged of the (cumulative) effects of compositional change. For comparison the original series is also given in each figure. Both figures show that the rate effects alone would have yielded a higher aggregate unemployment rates than we have seen over most of the period. In other words, composition change, that is changes in the age distribution of the labour force, have worked, particularly since the mid to late eighties, to make the aggregate male and female unemployment rates noticeably lower than they would otherwise be.<sup>4</sup>

Figure 4c reports the implied unemployment rate for persons<sup>5</sup> which has been purged of the (cumulative) effects of compositional change together with the recorded unemployment rate for persons. The gap between the two curves in 2001 is in the order of 1% of the labour force.<sup>6</sup>

Why have changes in the age distribution of the labour force worked to make the aggregate male and female unemployment rates significantly lower than it would otherwise be? The reason is ready to hand. In the previous section we noted that there had been a persistent fall in the proportion of the aggregate male<sup>7</sup> and female<sup>8</sup> labour force in the age group 15-24 over most of the period we are interested in. This fall (which is true of both the 15-19 and 20-24 age groups) coupled with the fact that for both males and females this age group has the highest unemployment rate is the reason why compositional change has acted to lower the aggregate unemployment rate. Indeed, a detailed shift-share decomposition of the aggregate change into rate and composition components for the whole period 1978/9-2001<sup>9</sup> (Table 1a) shows that for males the changing weight for the 15-24 age group alone acted to make the 2001 aggregate unemployment rate 0.006 lower than it would otherwise have been (Table 1a, sum of first two data rows in *compc* column).<sup>10</sup> Since the national rate was 0.070 on average in 2001 that reduction is not an insignificant amount. A detailed shift-share decomposition for females (Table 1b) shows that the changing weight for the 15-24 age group alone acted to make the 2001 aggregate unemployment rate 0.017 lower than it would otherwise have been (Table 1b, sum of first two data rows in *compc* column). Since the national female unemployment rate was 0.064 on average in 2001 that reduction also is not an insignificant amount.

We have seen that the main reason why changes in the age composition of the labour force have been working to lower the unemployment rate is that over the period there has been a marked fall in the proportion of the labour force made up of people aged 15-24 (but especially those aged 15-19) and this is the group who have the highest unemployment rate (over twice the average rate for prime age males and females). They

have been making up a falling contribution of the labour force for two reasons. First their share of the population is falling (over the period we are interested in the proportion of persons aged 15-24 in the total population has fallen from 0.19 to 0.14). This is the main reason for the fall in their share of the labour force. A second reason is that they have been staying on in education longer than their predecessors.<sup>11</sup>

**Table 1a.** Males: Contribution to Change in the Aggregate Unemployment Rate between 1978 and 2001 Computed using Equation (3) in Appendix A

Age Group	<i>ratec</i>	<i>compc</i>	row sum
15-19	0.002	-0.004	-0.002
20-24	0.003	-0.002	0.001
25-34	0.007	-0.001	0.006
35-44	0.004	0.002	0.006
45-54	0.003	0.001	0.004
55-59	0.001	0.000	0.001
60-64	0.001	0.000	0.000
65+	0.000	0.000	0.000
column sum	0.021	-0.005	0.016

**Table 1b.** Females: Contribution to Change in the Aggregate Unemployment Rate between 1978 and 2001 Computed using Equation (3) in Appendix A

Age Group	<i>ratec</i>	<i>compc</i>	row sum
15-19	-0.003	-0.012	-0.015
20-24	0.000	-0.005	-0.005
25-34	-0.002	-0.001	-0.002
35-44	0.001	0.002	0.003
45-54	0.001	0.003	0.003
55-59	0.000	0.000	0.001
60-64	0.000	0.000	0.000
65+	0.000	0.000	0.000
column sum	-0.003	-0.012	-0.015

The results reported in Table 1a also show that, taking the changing shares of all age groups into account, the unemployment rate for males was one half of one percent lower than it would otherwise have been in 2001 due to changes in the age composition of the labour force. In other words, around 1/3 of the reduction in the aggregate unemployment rate between the start and end of our sample period (i.e 0.005/0.016) is due to changes in the age composition of the labour force. Looking at Table

1b, we see that, taking the changing shares of all age groups into account, the female unemployment rate was a little over one percent (0.012) lower than it would otherwise have been in 2001 due to changes in the age composition of the labour force. In other words, around 4/5 of the reduction in the aggregate unemployment rate for females between the start and end of our sample period (i.e. 0.012/0.015) appears to be due to changes in the age composition of the labour force.

Earlier, we noted that there was a marked difference in peak unemployment rates between the two recessions. The sources of change in the contribution of different age groups to the aggregate unemployment rate between the two recession episodes can also be explored using 'shift-share' analysis. Table 2a and 2b report rate and composition components calculated to enable a comparison between the unemployment rate(s) at the two recession peaks.<sup>12</sup> We see that the net contribution of the 15-24 age group to the difference between the unemployment rate at the two peaks was negative (for both males and females but much more so for females) and that this was mainly due to a reduction in the weight given to the 15-19 age group between the two peaks. So for both males and females (but especially the latter) the recession would have been more severe had the proportion of the labour force which is made up of the 15-24 (and especially 15-19) year olds not fallen between the two peaks. Indeed, the tables reveal that, but for the dramatic fall in the proportion of the labour force made up of both males and females in the 15-24 age group, the unemployment rate for males would have been  $\frac{1}{2}$  of 1% of the labour force higher at its peak while for females it would have been 1% higher. These are not insignificant amounts.

**Table 2a.** Males: Contribution to Change in the Aggregate Unemployment Rate between the Two Peaks Computed using Equation (3) in Appendix A

Age Group	<i>ratec</i>	<i>compc</i>	row sum
15-19	0.001	-0.004	-0.003
20-24	0.002	-0.002	0.000
25-34	0.008	-0.001	0.007
35-44	0.006	0.002	0.008
45-54	0.002	0.002	0.004
55-59	0.003	-0.001	0.002
60-64	0.003	0.000	0.003
65+	0.000	0.000	0.000
column sum	0.025	-0.005	0.020

**Table 2b.** Females: Contribution to Change in the Aggregate Unemployment Rate between the Two Peaks Computed using Equation (3) in Appendix A

Age Group	<i>ratec</i>	<i>compc</i>	row sum
15-19	-0.001	-0.011	-0.012
20-24	0.003	-0.004	-0.001
25-34	-0.002	0.000	-0.002
35-44	0.001	0.003	0.004
45-54	0.002	0.003	0.004
55-59	0.001	0.000	0.000
60-64	0.000	0.000	0.000
65+	0.000	0.000	0.000
column sum	0.003	-0.010	-0.007

We have seen that the changing age distribution of the labour force has tended to lower the aggregate unemployment rate over much of the period we are interested in. An obvious question to ask is: How long will this last?

### How Long Can the Free Lunch Continue?

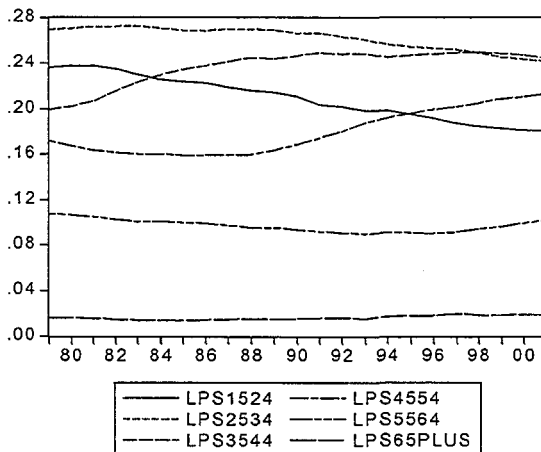
In the previous section we saw that changes in the age distribution (and in particular falling shares for the age group with the highest unemployment rate – the 15-24 age group) have worked to lower the aggregate unemployment rate below what it would otherwise be. At least to the extent that this is due to changes in the age distribution of the population, the ageing of the population has had the effect of providing a purely fortuitous 'free lunch' for politicians and macro policy makers. However, there is good reason to believe that the lunch has been largely if not entirely consumed by now. The reason is that if we look at Figures 3a and 3b it would seem that the reduction in the labour force share of males and females aged 15-24 has been becoming less and less negative over the latter part of the nineteen nineties. However it is also clear that the proportion of the population in the prime working-age groups is also starting to fall and this also will have some impact on the aggregate unemployment rate. Clearly in assessing the future of the free lunch we need to take into account changing shares for all age groups. It is also sensible to take advantage of the Australian Bureau of Statistics (ABS) projections of the labour force into the first part of the 21st Century.

Before proceeding however we should note that, since the sum of the negative changes in labour force shares must equal the sum of the positive changes in labour force shares, the key to the exercise will be the sign and size of the difference between the average unemployment rate

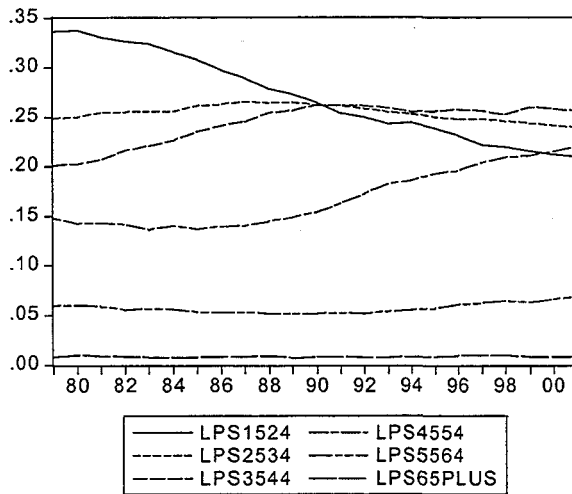
for the groups whose share of the labour force is increasing compared with the average unemployment rate for the groups whose share of the labour force is decreasing.<sup>13</sup> Now if we think of the labour force divided between those aged (say) 15-24 and those 25 and over,<sup>14</sup> a free lunch has been available since the early 1980's essentially because the share of the 15-24 age group which has the highest unemployment rate (for males it averaged 0.148 over the period 1978:2-2002:1 and for females it averaged 0.142) has been falling (their share of the male labour force fell from 0.24 in the early eighties to 0.19 in 2001 while that age group's share of the female labour force fell from 0.33 in the early eighties to 0.21 in 2001) and the share of those aged 25 and over who have a lower unemployment rate (for males it averaged 0.046 over the period 1978:2-2002:1 while for females it averaged 0.060) has been rising (their share of the male labour force rose from 0.77 in the early eighties to 0.82 in 2001 while that age group's share of the female labour force rose from 0.60 in the early eighties to 0.79 in 2001).

When looking at the effects of ageing in the future it would be most unwise to simply extrapolate past events because the 'bulge' in the age distribution is now passing through the prime age groups which not only have a lower unemployment rate than those aged 15-24 but also is now passing between age groups within the prime working-age range where unemployment rate differences are relatively small. As a result, we would not be surprised to find that composition effects are smaller (and possibly much smaller) in the future than they have been in the past.

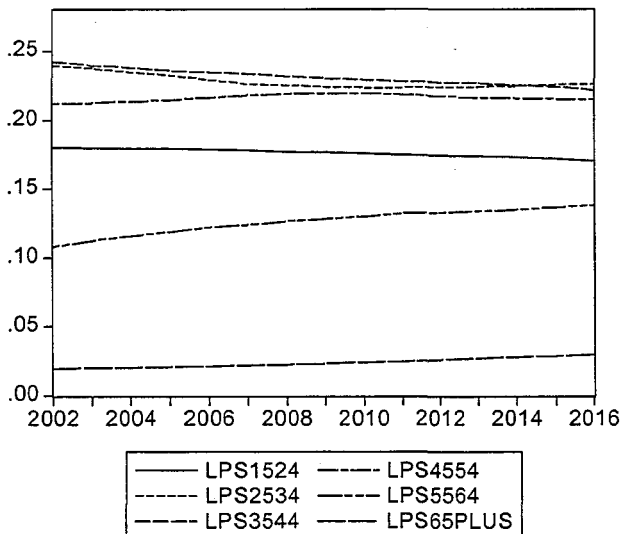
**Figure 5a.** Historical Shares of Aggregate Male Labour Force by Age Group Decile: 1979-2001



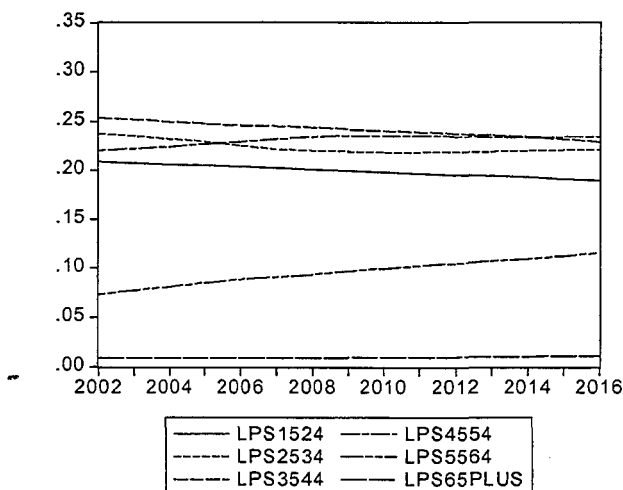
**Figure 5b.** Historical Shares of Aggregate Female Labour Force by Age Group Decile: 1979-2001



**Figure 6a.** Projected Shares of Aggregate Male Labour Force by Age Group Decile: 2002-2016



**Figure 6b.** Projected Shares of Aggregate Female Labour Force by Age Group Decile: 2002-2016



To establish with more clarity the extent of these effects and especially to assess when they might come to an end we will utilise ABS labour force projections. The most recent detailed labour force projections were published in 1999 (ABS, 1999, p 12). Figure 5 shows the actual historical labour force shares by age group decile over the period 1978–2001 while Figure 6 shows the projected shares of the same age groups over the period 2002–2016. To assist the reader we have computed changes in average labour force shares for various age groups for 5-year periods between 1986 and 2016. These are reported in Tables 3a and 3b.

**Table 3a.** Males: Actual (1986-2001) and Projected (2002-2016) Changes in Labour Force Share of Various Age Groups

Age group	Projected change in that age group's share of the aggregate labour force					
	1986-1991	1991-1996	1996-2001	2001-2006	2006-2011	2011-2016
15-24	-0.019	-0.012	-0.011	-0.002	-0.004	-0.005
25-34	-0.002	-0.013	-0.012	-0.012	-0.005	0.002
35-44	0.011	-0.001	-0.003	-0.010	-0.006	-0.006
45-54	0.015	0.025	0.013	0.003	0.002	-0.003
55-64	-0.007	-0.002	0.012	0.019	0.010	0.007
65 plus	0.002	0.002	0.002	0.002	0.003	0.005

**Table 3b.** Females: Actual (1986-2001) and Projected (2002-2016) Changes in Labour Force Share of Various Age Groups

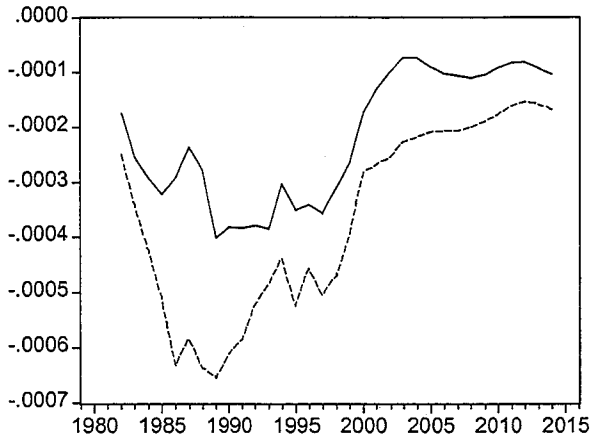
Age group	Projected change in that age group's share of the aggregate labour force					
	1986-1991	1991-1996	1996-2001	2001-2006	2006-2011	2011-2016
15-24	-0.043	-0.023	-0.022	-0.006	-0.007	-0.007
25-34	-0.001	-0.014	-0.007	-0.014	-0.006	0.003
35-44	0.021	-0.004	-0.002	-0.010	-0.008	-0.010
45-54	0.023	0.033	0.023	0.010	0.006	-0.001
55-64	0.001	0.008	0.008	0.020	0.014	0.013
65 plus	0.000	0.001	0.000	0.000	0.001	0.002

Noteworthy is that the fall in the share of the 15-24 age group, which was relatively high over the period 1986-2001, slows considerably after 2001. To best reveal the impact of changes in actual (up to 2001) and projected (after 2001) annual changes in labour force shares by age group decile, a series was generated by summing over first differences in labour force shares but with a constant unemployment rate imposed for each age group (the rates imposed were the average values for the four quarters of 2001).<sup>15</sup> Figure 7 shows the time path for the effect on the aggregate unemployment rate of actual (up to 2001) and projected (after 2001) changes in labour force shares assuming each age group's unemployment rate was held constant at its 2001 level. Since the raw output (especially prior to 2001) was quite noisy we report a 5-year centred moving average of the two series to aid in interpretation. Figure 8 shows the implied values for persons of the effects of changing age distribution of the labour force on the aggregate unemployment rate.<sup>16</sup> Our commentary will be based on the series for persons.

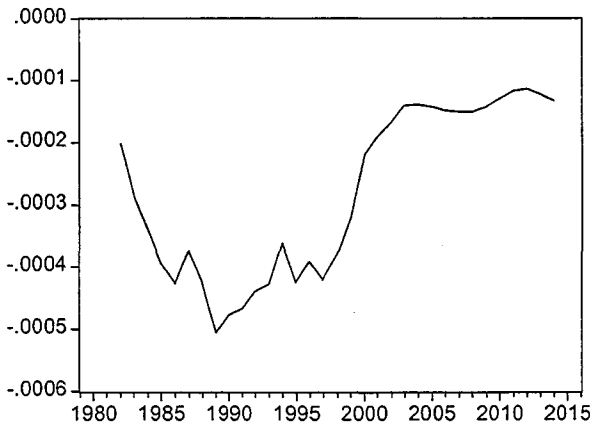
We see only slight negative aggregate composition effects early in the sample period with the effects becoming more and more negative until 1989 when they were at their strongest (ie they were most negative). The series then becomes less negative but by decreasing amounts until 2003 from which time it is not only relatively 'low' but also it continues to become less negative by markedly smaller amounts each period. Any decision as to a cut-off date is necessarily arbitrary but none the less it does seem that 2003 can be regarded as a watershed (and thus as the date at which the free lunch for all intents and purposes comes to an end) in two senses: first, after that date the gains, although they are present, are relatively small and second, it is at that date that the series tends to 'flatten out' in a quite pronounced manner.



**Figure 7.** Time Path for the Effect on the Aggregate Unemployment Rate of Actual (up to 2001) and Projected (after 2001) Changes in Labour Force Shares (assuming each age group's unemployment rate was held constant at its 2001 level: Males (solid line) and Females (broken line))



**Figure 8.** Time Path for the Effect on the Aggregate Unemployment Rate for Persons of Actual (up to 2001) and Projected (after 2001) Changes in Labour Force Shares (assuming each age group's unemployment rate was held constant at its 2001 level)



Before proceeding to sum up the results of this study, it is important to note that the projections have been made on the assumption that if a group's share of the labour force changes this has no sizeable effect on their unemployment rate. Is our conclusion that the 'free lunch' has, or soon will, for all intents and purposes come to an end sensitive to this assumption? We do not believe so because the projections are consistent with and simply reinforce an understanding arrived at based on actual past experience over the period 1978-2001 namely, that age composition effects have been becoming noticeably less and less pronounced since 1990, if not before. We noted the reasons for this earlier in this section of the paper, namely that the bulge in the age distribution has for all intents and purposes passed completely out of the high unemployment rate 15-24 age group and is now passing through the prime working-age groups where unemployment rates are lower and where differences in unemployment rates are less pronounced (and we noted near the beginning of this section that it was the magnitude of differences in the unemployment rates that was the key to the exercise).

## **Conclusions**

While it has been common to look at aggregate participation rate changes in terms of a weighted average over age groups this seems not to have been the case for unemployment. We have shown that changes in the age composition of the labour force (driven mainly by changes in the age distribution of the population) appears to have affected the aggregate unemployment rates in a systematic (and, with hindsight, predictable) manner. Amongst other things, we have seen that in the past decade or so, policy makers have benefited from a not inconsequential "free lunch" in that changes in the age composition of the population have been pulling the aggregate unemployment rate down below what it would otherwise be (by an amount equivalent to about one percent of the labour force).<sup>17</sup> We also saw that the second recession episode was milder than it otherwise would have been thanks to a reduction in the proportion of the population aged 15-19 between 1982 and 1993.

We investigated the source of this free lunch and saw that it has resulted from a reduction in the proportion of the population in the 15-24 age group as the 'baby-boomers' have worked their way through the population age distribution. We have also shown that this free lunch is likely about to end. Another way to put this is to say that the next federal election will be the last time that politicians and policy economists will be able to take credit for the free lunch which has been made available by the changing age composition of the population.

One important caveat is that we have neglected general equilibrium effects, which would include induced wage changes leading to participation rate changes etc. None-the-less we think the topic is of such interest and the age composition effects in relation to the 15-24 age group so large that this is justified as a first step and that indirect general equilibrium effects would be very much secondary in size and consequence.

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## APPENDIX A. Mathematics of the decomposition algorithm used in this paper

The ratio of Aggregate Unemployment to the Aggregate Labour Force (i.e. the aggregate unemployment rate -  $UR$ ) is the weighted sum of the unemployment rates across age groups ( $i$ ), so that:

$$\frac{U}{LF} = UR = \sum_i \left( \frac{U_i}{LF_i} \right) \left( \frac{LF_i}{LF} \right) \quad (1)$$

where  $U$  is the number unemployed and  $LF$  is the number in the labour force.

For any period, let:  $UR_{it} = U_{it}/LF_{it}$  and  $s_{it} = LF_{it}/LF_t$ , so we may write

$$UR_t = \sum_i (UR_{it})(s_{it})$$

Given the above, an expression for the change in the aggregate unemployment rate between any two periods ( $t$  and  $t-n$ ) may be written as:

$$UR_t - UR_{t-n} = \sum_i (UR_{it})(s_{it}) - \sum_i (UR_{it-n})(s_{it-n}) \quad (2)$$

Clearly, there are two proximate sources of change in the aggregate unemployment rate. First,  $UR$  will change if over time there is a change in the unemployment rates (the  $UR_i$ 's) for the individual age groups. Second,  $UR$  will change if there is a change in the age profile of the Labour Force (that is, the  $s_i$ 's change). Over time both factors are likely to change, so that both elements will be contributing to any recorded change in the aggregate unemployment rate.

Our initial task is to find a mathematical rule which will enable us to 'decompose' changes in the aggregate unemployment rate into two components: (i) that part which reflects changes in the unemployment rate in the individual age groups (this will be some function of terms involving  $(UR_{it} - UR_{it-n})$ ), and (ii) that part which reflects changes in the age structure of the labour force (this will be some function of terms involving  $(s_{it} - s_{it-n})$ ). The method adopted in this paper for decomposing a weighted aggregate into 'composition' and 'rate' components involves using the arithmetic mean of current and base year values as weights. The general principle to be invoked is that "when calculating the contribution of one variable to a difference determined by the operation of two variables as a product, the weights adopted are the mean values of the other variable" (Harris, 1966, p. 97n). Applying this philosophy to our problem, equation (2) may be rewritten as:<sup>18</sup>

$$UR_t - UR_{t-n} = \sum_i 1/2 (s_{it} + s_{it-n})(UR_{it} - UR_{it-n}) + \sum_i 1/2 (UR_{it} + UR_{it-n})(s_{it} - s_{it-n}) \quad (3)$$

The first term on the RHS of the above represents the effect of 'micro' changes in the unemployment rates of individual age groups as they respond to changing economic and financial regimes etc and the second term represents the effect of changes in the age composition of the labour force. We will refer to the first term as the 'rate component' (*ratec*) and the second term as the 'composition component' (*compc*). So (3) may be expressed as

$$UR_t - UR_{t-n} = \text{ratec} + \text{compc} \quad (3')$$

With knowledge of these two terms for each successive (individual) period we can generate a series for the aggregate unemployment rate with the effects of compositional change removed (we will denote this as  $UR^*$ ) thus arriving at a series which will show us the effects on the aggregate unemployment rate of changes in the 'rates' alone. This series can be established by creating an index with:

$$UR_t^* = UR_{t-1}^* + \text{ratec}_t = UR_{t-1}^* + \sum_i 1/2 (lfs_{it} + lfs_{it-1})(UR_{it} - UR_{it-1})$$

and  $UR_0 = UR$  in the initial period (1978:2 in this study).

This rule has been used to create the series depicted in Figures 4a and 4b, that is the aggregate male and female unemployment rates which have been purged of the (cumulative) effects of compositional change.

### APPENDIX B. Adding-up Restrictions

It is important that we note the consequences of the adding up restriction that the sum of negative changes in labour force shares must equal the sum of gains in labour force shares.

Imagine we were dealing with only two age groups, one denoted by the superscript 'i' and one denoted by the superscript 'j', then we may write for the aggregate unemployment rate that:<sup>19</sup>

$$UR = \left( UR^i \times \frac{LF^i}{LF} \right) + \left( UR^j \times \frac{LF^j}{LF} \right)$$

and (assuming that the unemployment rates are constant for ease of exposition) the change in the aggregate unemployment rate between any two periods will vary with changes in the age distribution of the labour force such that:

$$\Delta UR = UR^i \times \Delta \left( \frac{LF^i}{LF} \right) + UR^j \times \Delta \left( \frac{LF^j}{LF} \right)$$

But we know that the labour force shares must sum to unity and so we can write the above as:

$$\Delta UR = UR^i \times \Delta \left( \frac{LF^i}{LF} \right) - UR^j \times \Delta \left( \frac{LF^i}{LF} \right) = \Delta \left( \frac{LF^i}{LF} \right) (UR^i - UR^j) \tag{4}$$

### Notes

- 1 All of the data used in this paper has been obtained from the Australian Labour Force Statistics module of DX. Data for Labour Force and Population for Australia by age group copied over as original quarterly data (average of 3 months in the quarter) and unemployment rates for each age group derived as the ratio of seasonally adjusted Unemployment to the seasonally adjusted Labour Force.
- 2 To ensure the Figures involving data for different age groups are able to be read easily some figures will report data for only four age groups, namely 15-24, 25-54, 55-64 and 65 plus. None of the results reported in this paper are sensitive to the age groupings adopted.
- 3 In other words, in a discrete time version of the expression  $d(ab)/dt = a(db/dt) + b(da/dt)$ , the weights (*a* and *b*) will be the mean of their original and final values. In practice for the particular data being studied in this paper different weighting schemes yield essentially the same conclusions.
- 4 It also worked to markedly lower the peak unemployment rate in the second recession below what it would otherwise be – more on this later.
- 5 This has been arrived at by summing the weighted values of the composition constant rates for males and females where the weights are their shares of the labour force.

- 6 Since it is often felt that labour market programs have had very little impact on the aggregate unemployment rate (as distinct from the composition of the unemployed), I am tempted to say (and only partly in jest) that 'Nature' may have contributed more to reducing the unemployment rate over the period than all the labour market programs put together.
- 7 The fall in the share of males aged 15-24 in the labour force reflects both a reduction in that age groups proportion of the total population (from around 24% to around 18%) and a fall in their participation rate (it fell from around 0.78 to 0.75 in the early 80's, it dropped again from 0.75 to 0.72 in the early 90's and it has remained around 0.72 - 0.73 since that time).
- 8 The fall in the share of females aged 15-24 in the labour force (from around 34% in 1978/9 to around 22% in 2001) reflects the dominance of a reduction in that age groups proportion of the total population (from around 23% to around 17%) together with a slight fall in their participation rate (it fell from around 0.78 to 0.74 in the early 90's and it has fluctuated around 0.75 - 0.76 since that time. The participation rate for females in all other age groups rose (and for most age groups quite markedly) over the sample period).
- 9 The start values are the averages for the period 1978:2-1979:1 and the final values are the averages for the period 2001:1-2001:4. Note that in the tables row and column sums might not be exactly equal due to rounding.
- 10 All of the estimates for rate and composition components reported in this paper are arrived at using equation (3) in Appendix A. The findings in Table 1 are very similar to the estimates reported by Mitchell for the period 1978 - 1998 (2000, Table 3.13).
- 11 This is discussed in Lewis and McLean (1998). Interestingly, Chapman and Withers (2001, p 246) show that year 12 retention rates peaked in around 1992 or 93 and have remained roughly constant (perhaps falling a little) since then.
- 12 The decomposition procedure is set out in Appendix A.
- 13 I think this is intuitively obvious but a formal proof is given in Appendix B.
- 14 We can divide the labour force in this manner for illustrative purposes because the 15-24 age group has a higher unemployment rate than all other age groups.
- 15 Effectively what we are doing is generating a series using equation (3) from Appendix A but with  $UR_i$  constant.
- 16 This is computed as a weighted average of the series for males and females given in Figure 7.
- 17 This also means that movements in the recorded unemployment rate will have over-stated the extent to which there have been reductions in the extent of excess demand in the labour market(s).
- 18 It is easy to verify (by expansion and the cancellation of terms) that the expression is formally correct in the sense that the RHS equals the LHS.
- 19 This is simply equation (1) in Appendix A written out for the case where there are only two age groups.