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Abstract

We investigate the nature and sources of the decline in the level of employment of working age males in Australia in recent decades, drawing on both Australian Bureau of Statistics labour force survey data and census data. Alternative measures of the male employment rate are considered before settling on two complementary measures: the full-time employment rate and the full-time *equivalent* employment rate. The latter measure weights part-time jobs according to the fraction of a full-time job they represent. We then go on to estimate models of the determinants of these two employment rates using data from the population censuses conducted between 1971 and 2001. We construct a pseudo panel by 'stacking' the seven census data sets (Deaton 1997, Kapteyn *et al* 2005). This facilitates the tracing of birth cohorts over time, in turn making it possible to control for cohort unobserved heterogeneity that may bias cross-sectional estimates of effects of other characteristics, in particular age and year/time period. We produce evidence that a number of factors have contributed to the decline in male employment, including growth in educational enrolment and attainment, the decline in couple households with dependent children, growth in income taxes and welfare replacement rates, growth in labour productivity and changes in the structure of labour demand away from traditionally male-dominated industries. Significantly, we find that, all else (observable) constant, more recent birth cohorts have higher employment rates than earlier birth cohorts.

1. Introduction

Employment of working-age males in Australia declined substantially over the 1970s, 1980s and 1990s. Various studies have sought to investigate this decline, taking a variety of approaches. Available data has, however, been a significant constraint on inquiries into the issue, the data essentially consisting of regular and irregular cross-sectional surveys, which fall far short of ideal. For example, substantial new insights would be generated by a long-running panel over this period, allowing labour market behaviour of individual males over time to be examined, but no such panel exists.

Although the available data do impose significant constraints on the inroads that can be made into understanding the drivers of the decline in male employment, unexploited opportunities do remain, one of which we explore in this paper. Specifically, we seek to quantify the contributions of potential sources of the decline in male employment by creating a 'stacked' cross-sectional dataset from census data gathered over the period 1971 to 2001 (Deaton 1997 and Kapteyn *et al* 2005). That is, using the data from the seven censuses conducted between 1971 and 2001, individuals are grouped according to birth cohort to analyse changes over time in the employment rate of each cohort. Thus, instead of tracing individuals over time (as is undertaken with panel data), the analysis traces birth cohorts over time. We are therefore able to treat the stacked cross-sectional data as a cohort-level panel, sometimes referred to as a pseudo-panel.

A benefit of this approach is that it makes explicit the potential for distinct effects of age, birth cohort and year (time period). Age effects essentially reflect the impact of lifecycle factors on labour market outcomes. Cohort effects reflect secular trends that lead to different positions of age profiles for different cohorts. They typically embody a number of unobserved effects, including cohort size effects, generational differences in attitudes and cohort-specific government policies. Cohort effects can also arise conditional on other characteristics, even though not present in the unconditional distribution. For example, conditional on educational attainment, differences in innate ability by cohort may exist, leading to biased estimates of educational attainment effects, even without any difference in the unconditional distribution of innate ability across cohorts. Year effects are aggregate effects that synchronously move all cohorts on to different age profiles. They include business cycle conditions, changes in the structure of labour demand and changes to government policies that affect all birth cohorts.

The potential for cohort effects is especially important because of their implications for studies using single cross-sections. Estimates of age effects from a single cross-section are susceptible to confounding cohort influences – that is, employment rates by age in a given year will have differences by age that embody both age effects and cohort effects. These are conceptually different effects and it is important to distinguish between them. Most studies make inferences on age effects from single cross-sections, and are therefore subject to the criticism that they confound these two effects.

While using a time series of cross-sections does not of itself achieve full identification of cohort, year and age effects, appropriate parameterisation of one of these effects can identify all three effects as well as deliver unbiased estimates of the effects of other factors. In this study, we attempt to parameterise year effects, thereby identifying estimates of cohort and age effects. We take this approach because year effects are more amenable to parameterisation than are cohort and age effects, and because age effects, and to a lesser extent cohort effects, are less 'black boxes' than are year effects. Parameterisation of year effects can be thought of as an attempt to open the year effects 'black box', which is achieved by including variables thought able to capture the underlying drivers of the year effects.

Our approach to parameterising year effects draws on previous research and public debate to inform the variables included. Much interest has revolved around the relative roles of increases in early retirement (and the reasons for changes to early retirement patterns), changes in demand for particular skill groups, changes to government income support and income taxation policy (and their interaction with changes in the demographic characteristics of the population, such as the growth in lone parent families), changes in female labour supply and increases in educational enrolment of young persons. We attempt to investigate these and other factors through appropriate construction of explanatory variables.

Before proceeding, it is useful to place the Australian experience in an international context. The decrease in male employment is not unique to Australia. Declines in male employment have occurred in most developed countries (see, for example, OECD 2008), suggesting that at least part of the explanation lies in factors not specific to Australia. Growth in per capita incomes, technological changes, increases in female labour force participation and rising educational attainment are some of the factors that, superficially at least, developed countries appear to have in common that could negatively impact on male employment. That declining male employment has occurred in many other countries should not, however, preclude investigation of government policy and other country-specific effects, since large differences

in levels of participation and in timing and magnitude of declines are evident across countries. With respect to government policy, it should also be emphasised that there are in any case many commonalties across western countries in government policies instituted in the post-war period. Investigation focusing specifically on Australia is therefore very valuable, not only for shedding light on the Australian experience, but also for the incidental value it may have to other western countries.

The plan of the remainder of the paper is as follows. Section 2 discusses previous literature and places the contribution of this paper in the context of this literature. Section 3 presents descriptive information on trends in male employment in Australia in recent decades, describing changes in the employment rate and the contributions of changes in its component parts – participation, unemployment, full-time employment, part-time employment and hours worked by part-time workers. Section 4 presents the analysis of the census data, and Section 5 concludes.

2. Previous Literature

A substantial volume of Australian research in the early 1980s sought to explain the decline in male employment in the 1970s. Stricker and Sheehan (1981) attributed the mid-1970s decline in older male participation to increased unemployment and a cohort effect deriving from WWII veterans becoming eligible for pensions. Merrilees (1982, 1983) concurred with Stricker and Sheehan, adding that increased access to other pensions was also a factor. Moir (1982) likewise supported the contentions of Stricker and Sheehan and Meriliees, but also went on to argue that there was little evidence of changes to the structure of labour demand working against older males.

Hughes (1984) provided a further potential supply-side explanation of the decline in employment of older males, advancing the theory that an 'accumulated ripple effect of real wage increases' may have acted to reduce labour supply of older workers. The argument is that the positive income effect of higher wages subsequently induced increased early retirement. Miller (1983) provided further support for the argument that the decline was primarily driven by withdrawal of labour supply, presenting evidence that retirement expectations reported in a survey in 1973 predicted 85 per cent of the mid-1970s decline in male employment.

There was little further inquiry into the issue until the mid-1990s, when Borland (1995) investigated the decline over the longer time frame of the mid-1970s to the early 1990s. He

found decreased participation by older men, men with low levels of educational qualifications and men with potential earnings in the middle ranges of the earnings distribution. Borland identified limited work opportunities as the dominant factor underlying these patterns. Kenyon and Wooden (1996), however, emphasised increased participation in full-time education as an important factor. Also noted by Borland (1997) and Kenyon and Wooden (1996) is the interaction between labour demand changes and outside option changes – in particular, increased pensions and increased assets (especially associated with home ownership).

Connolly and Kirk (1996) focused on full-time participation of males aged 45-54 years over the period 1978 to 1995, examining the impacts of various macroeconomic factors. They find significant effects for income tax rates, receipts from dwelling rent, services share of GDP and 'consumer loan affordability', a variable they construct which depends on house prices, interest repayments per household and post-tax income. More recently, Kennedy and Hedland (2003) examined labour market participation using census data over the period 1981 to 2001, finding the decline greatest for those with no post-school qualifications.

The Australian Bureau of Statistics (ABS) (2003) undertook a cohort analysis similar in spirit to the current study, although they restrict their focus to identifying cohort, year and age effects, and as such do not investigate the factors underpinning cohort and year effects. The study uses data from the June Labour Force Survey over the period 1981 to 2001, examining unemployment and participation rates of persons born between 1937 to 1957. In order to identify the model, they assume the sum of the year effects is zero and exclude two year dummies.[1] Their assumption on year effects is particularly important, implying a narrow definition that requires year effects be only temporary – and indeed zero in aggregate over the period examined. They find a significant cohort effect on male participation, with more recent cohorts having lower participation. However, this result is potentially an artefact of the assumption that year effects are zero over the full period.

Aside from the ABS (2003) study, a limitation of the existing Australian research is that it has not considered the potential for cohort effects. This matters, because a frequently cited concern is that cohort effects driven by unobserved differences in attitudes or other characteristics, or by size differences in cohorts, could drive effects attributed to changes in age effects or effects attributed to policies or other 'year' effects.

[1] This information on the methods used is based on correspondence with the authors. The methods are not discussed in the paper itself.

The contribution of the current paper to the existing literature primarily stems from the use of the census data to construct a cohort-level panel. However, our contribution also derives from a focus on the broader issue of full-time equivalent employment rates (e.g., compared with participation rates, or even employment rates, which do not take into account the increase in the part-time employment share of all employment), and consideration of a longer time-frame than most of the existing research.

3. Male employment rates in Australia in recent decades

In this section we present descriptive information from the ABS labour force surveys on male employment rates over recent decades. This includes consideration of alternative measures of the employment rate. We also examine the nature of changes in the male employment rate by identifying the contributions to the overall decline of each of the component parts of the employment rate.

What is the appropriate employment rate?

Aside from the fact that the focus should be on 'working-age' males, there is unlikely to be a consensus on the appropriate employment rate measure. Candidates include the participation rate, employment-population rate, full-time employment-population rate, full-time equivalent employment-population rate and hours worked per working-age male. The measure adopted will inevitably depend on the purpose. If the level of labour resource usage is the focus, an 'hours worked' measure is probably the most appropriate. However, the concern of this study is with the decrease in the employment of males. For example, if the average working hours of full-time workers increased and exactly offset the effects of a decreased rate of full-time employment, this could in fact be considered two negative outcomes – an increase in the number with no access to full-time jobs, and an increase in 'overworked' workers – neither of which would show up using an hours worked per working age male measure. An 'employment rate' measure would therefore seem more relevant to the issue examined in this study.[2]

Of particular concern to policy makers and commentators has been the decline in full-time employment among males. This motivates our examination of the full-time employment-population rate. However, we also examine the full-time *equivalent* employment rate, on the basis that this gives the most accurate representation of non-utilisation of working age males:

[2] In any case, hours worked for full-time workers are not reported in all census data sets, which are the data used for the pseudo-panel analysis undertaken in Section 4.

clearly, a part-time job represents a different labour market outcome to no job. Thus, the notion underlying the full-time equivalent employment rate is that a full-time job is the 'ideal', and is defined to occur when weekly hours are equal to or exceed 35. The extent of inadequacy of a labour market outcome is, furthermore, assumed proportionate to the shortfall of working hours from 35; for example, a person working 17.5 hours is treated as having half a full-time job. Specifically, we define the full-time equivalent employment rate as:

$$FTE = \frac{FT + PT\left(\overline{H}_{PT}/35\right)}{Population} \qquad (1)$$

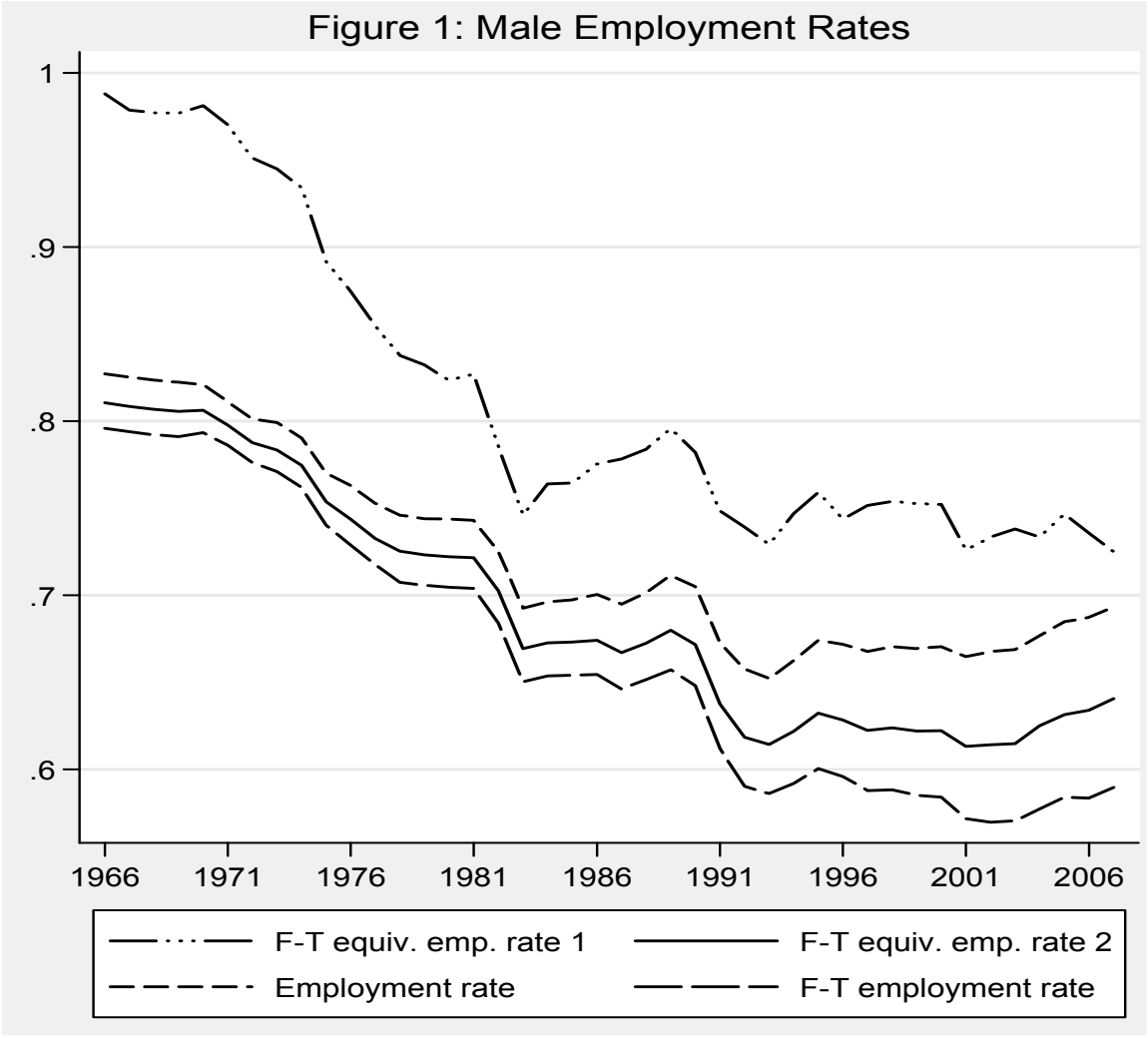
where FT is the number employed full-time, PT is the number employed part-time and $\overline{H}_{PT}$ is the average weekly hours of part-time workers. Note also that we prefer this measure to the employment rate, which does not distinguish full-time jobs from part-time jobs, and to the participation rate, which additionally does not distinguish unemployment from employment.

Figure 1 presents, using estimates from the ABS labour force surveys, alternative measures of male employment rates over the period 1966 to 2007.[3] All are for rates of employment of men aged 15 years and older, and no measure adjusts for changes in the proportion of males over 15 who are of 'working' age (under 65 years). 'F-T equiv. emp. rate 1' is a total hours usage type of measure of the employment rate. It is equal to mean hours worked per male aged 15 and over divided by 35 (or equivalently, the proportion employed multiplied by mean hours per employed male divided by 35). Thus, males working more than 35 hours per week have an individual employment rate greater than 1. 'Employment rate' is the standard employment rate, equal to the proportion of males aged 15 years and over who are employed. 'F-T equiv. emp. rate 2' is our preferred employment rate measure when taking into account part-time employment, and is defined by Equation (1). 'F-T employment rate' is the proportion of males aged over 15 years that is employed full-time.

All four measures of the rate of employment of males exhibit substantial declines after 1966. Indeed, these are dramatic changes. The total hours per male measure (F-T equiv. emp. rate 1) has the biggest percentage point decline. Among the other three measures, the decline is largest for the full-time employment rate, followed by the second full-time equivalent employment rate measure and then the crude employment rate. Using census data, we are only able to examine the period 1971 to 2001, but it is evident from Figure 1 that most of the

[3] Mean hours of full-time and part-time workers are not *separately* available from 1966 to 1970. To produce the 'F-T equiv. emp. 1' over this period we have assumed the ratio of mean part-time hours to mean full-time hours remained unchanged from 1966 to 1971 (at the 1971 ratio).

decline in employment for males between 1966 and 2007 occurred between 1971 and 2001 (and in fact most of this decline was between 1971 and the early 1990s).



Source: ABS Cat. No's 6202.0, 6203.0, 6204.0, 6204.0.55.001.

It is useful to re-express Equation (1) in a manner that allows us to quantify the contributions of components consisting of commonly-reported labour market statistics (or straightforward transformations of those statistics):

$$FTE = PR\left(1-UE\right)\left(S_{FT}+\left(1-S_{FT}\right)F_{PT}\right) \qquad (2)$$

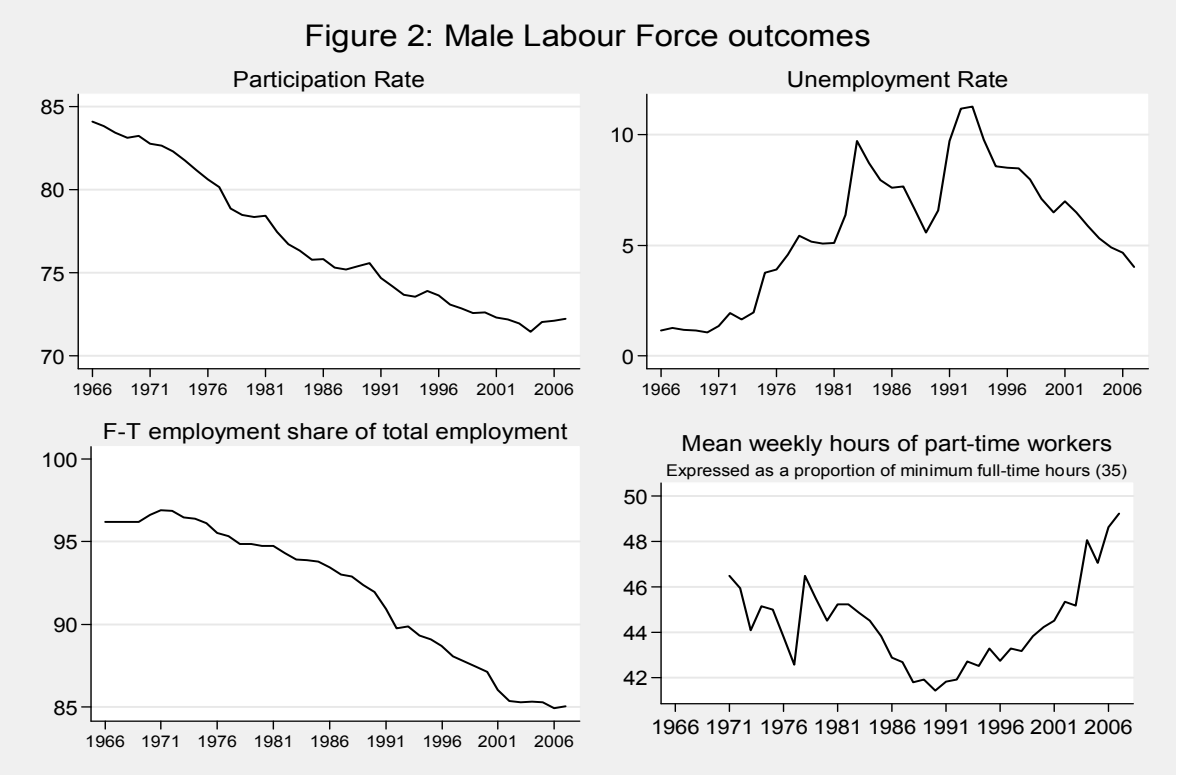
where:

- PR is the participation rate (proportion choosing to work);
- UE is the unemployment rate (the proportion of those choosing to work not successful in obtaining work);

— S_{FT} is the full-time share of employment (proportion of those successful in obtaining work who obtain full-time work); and

— $F_{PT} = \overline{H}_{PT} / 35$ is the average fraction of a full-time job that a part-time job represents.

Using Equation (2), we can obtain information on the nature of the changes in the full-time equivalent employment rate in terms of changes in the above four quantities. Figure 2 presents graphs of each of these four quantities over the 1966 to 2007 period. Over the full period, the first three components – the participation rate, the unemployment rate and the full-time share of employment – appear to have contributed to the decline. The drop in the participation rate is very large and sustained over the entire period, falling from 84 per cent in 1966 to 72 per cent in 2003, before recovering slightly. The full-time share of employment also fell dramatically after 1975, from 96 per cent to 85 per cent in 2007. The unemployment rate, although falling from the early 1990s, was still somewhat higher in 2007 than in 1966, and therefore also made some contribution to the decline in the full-time equivalent employment rate.



Source: ABS Cat. No's 6202.0, 6203.0, 6204.0, 6204.0.55.001.

Table 1 attempts to quantify the contribution of each component of the full-time equivalent employment rate to the overall decline between 1971 and 2001 (the period spanned by the

available censuses). Panel A presents a 'standard' decomposition analysis of the change in the full-time equivalent employment rate. For each component, it shows the percentage point change in the employment rate that results from changing the component from its 1971 level to its 2001 level, holding all other components constant (at 1971 levels in the first data column and at 2001 levels in the second data column). Estimates are consistent with the indications from Figure 2 of the relative contributions of the four components. Both columns show the participation rate as the single most important component, followed by the full-time share of employment, the unemployment rate and then mean hours of part-time workers.

Table 1: Components of the change in the full-time equivalent employment rate, 1971 to 2001 (Labour Force Survey data)

A. Percentage point change attributable to change in each component		
	Holding other components at 1971 levels	Holding other components at 2001 levels
Participation rate	-10.53	-9.39
Unemployment rate	-3.69	-3.00
F-T share of employment	-5.09	-4.32
F-T equiv. of P-T job	-.033	-.131
Actual change in F-T equiv. emp. rate	-18.28	-18.28
B. Log change in each component of the full-time equivalent employment rate		
Participation rate	-0.140	
(1 – UE)	-0.047	
$(S_{FT} + (1 - S_{FT})F_{PT})$	-0.068	
Full-time equivalent emp rate	-0.255	

Notes: (1 - *UE*) – proportion of those participating who find a job (1 minus the unemployment rate); $(S_{FT} + (1 - S_{FT})F_{PT})$ – full-time equivalent employment rate of those employed.

Panel B takes a different approach, using the fact that the full-time employment rate can be expressed as the product of three components: the participation rate, the unemployment rate and the full-time equivalent employment rate of the employed. The third component represents an amalgam of the third and fourth components in Panel A. The changes in the log of each of these three components are reported in Panel B, with the sum of these changes equal to the change in the log full-time equivalent employment rate. Inferences are broadly consistent with those from Panel A. The decrease in the participation rate accounts for just over half the decline in the employment rate, the decrease in the full-time equivalent employment rate of the employed further accounts for just over a quarter of the decline and the increase in the unemployment rate is responsible for the remaining fifth of the decrease in the aggregate full-time equivalent employment rate.

From one perspective, the important finding from Table 1 is that, while the decline in the participation rate is the single most important component of the decline in male employment, it does account for less than 60 per cent of the decline. The increase in the rate of unemployment accounts for about one-fifth of the decline, while the growth in the part-time share of employment accounts for a further one-quarter. Focusing only on the participation rate, as some authors have done, is therefore missing over two-fifths of the decline in male employment.

4. Analysis of changes in employment rates using a time-series of cross-sections

Data

The data we use to investigate sources of changes in the male employment rate comprise the publicly released unit record files for the one per cent samples of the Australian censuses over the period 1981 to 2001, as well as grouped data for the 1971 and 1976 censuses. A valuable feature of the census data is that the census is conducted every five years and respondent ages are recorded in five-year categories. This makes it possible to trace (five-year) birth cohorts over time, since each person in the population advances one five-year age category from one census to the next.

Although the census data lack important information, and having only seven cross-sectional data points is far from ideal, important insights into the sources of changes in the male employment-population ratio are nonetheless likely to be forthcoming. The unit record files for the one per cent samples contain individual-level information on a variety of personal and household characteristics, including family structure, country of birth, educational attainment, labour force status at the time of the census and personal and household income. Unit record files for the 1971 and 1976 censuses have not been released by the ABS, but we obtained grouped data making possible analysis that includes these two censuses.[4]

While the census datasets are, generally speaking, suitable for our purposes, several issues in relation to these datasets warrant specific mention. The first issue concerns the timing of the censuses. The four censuses to 1986 were conducted on 30th June, while the last three were conducted in early August (see Table A1). There may therefore be seasonal effects for the first four censuses compared with the last three. There may furthermore be 'day of the week effects' present, although all were conducted on a weekday, and generally mid-week.

[4] The grouped data obtained from the ABS was derived from the full census in 1976 and a 50% sample of the census in 1971. The 1971 census is the earliest for which the required data could be obtained because the ABS does not hold unit record files for earlier censuses.

Problems also arise in relation to obtaining measures of employment rates. The labour force status information available from the census data does not precisely match the labour force survey. The census is a snapshot of Australia at the date of the census, with labour force status and hours worked defined with respect to the week preceding the survey. An important implication is that some employed persons will have reduced or zero hours due to sickness or holidays. We do not attempt to adjust for this. A further issue for the construction of the full-time equivalent employment rate variable is that hours of employment are reported in categories which vary across the census unit record files (see Table A1). In constructing full-time equivalent employment rates, we take two approaches. The first simply uses all the available information for each census to construct the most accurate estimate. The second approach aims for consistency across the censuses by assigning persons to one of only three hours categories: 0-14 (or 0-15), 15-34 (or 16-34) and 35 or more. This produces a less precise employment rate for each census, but one that is consistently defined across all seven of the censuses.[5]

Table 2 presents various employment rates. The first two panels compare the census data with estimates derived from the labour force surveys. The censuses give consistently lower estimates of both full-time and full-time equivalent employment rates, in the order of 2 to 3 percentage points lower for full-time equivalent employment rates, and 4 to 5 percentage points lower for full-time employment rates. Given the approach taken to defining the employment status and hours worked when using the census data, it is to be expected that estimates will be lower. For example, full-time workers who happened to take sick or holiday leave in the week preceding the census will be classified as part-time employed or not employed, whereas the labour force surveys will treat them as full-time workers. The relative consistency of the differential means that changes over the period are quite similar for the two data sources, although the censuses do give slightly smaller decreases in employment rates than the labour force surveys.

[5] Between 3 and 5 per cent of employed persons in each census have hours recorded as 'not stated'. These workers are assumed to have the same distribution of hours worked as workers who reported working hours. We did consider an alternative approach to using the information on hours worked in the censuses to construct full-time equivalent employment of part-time workers, which is to use mean hours of part-time workers from the labour force surveys. However, we decided against this, since it would impose the same value for mean hours on all part-time workers in the census year, regardless of birth year (and education).

Table 2: Males employment rates 1971 to 2001

	1971	1976	1981	1986	1991	1996	2001	Change 1981 to 2001	Change 1971 to 2001
A. Comparisons between labour force survey and census estimates									
Full-time employment rates – Males aged 15+ years									
Labour force surveys	79.11	73.98	70.34	65.83	60.41	59.01	56.96	-13.38	-22.15
Census	-	-	65.74	61.09	55.90	54.07	53.15	-12.59	-
Full-time equivalent employment rates – Males aged 15+ years									
Labour force surveys	80.30	75.44	72.20	67.77	63.02	62.47	61.51	-10.69	-18.79
Census (No. 1)	-	-	69.54	64.60	60.26	59.23	59.21	-10.33	-
Census (No. 2)	-	-	69.60	64.99	60.50	59.48	59.58	-10.02	-
B. Effects of sample restrictions									
Census employment rate estimates – Males aged 15-64 years									
Full-time	-	-	72.46	67.93	62.30	61.15	60.02	-12.44	-
Full-time equivalent A	-	-	76.46	71.68	67.03	66.77	66.60	-9.86	-
Full-time equivalent B	-	-	76.52	72.11	67.29	67.04	67.01	-9.51	-
Census employment rate estimates – Native-born males aged 15-64 years									
Full-time	81.14	78.42	72.25	67.89	62.71	62.18	60.92	-11.33	-20.22
Full-time equivalent A	82.66	80.29	76.25	71.69	67.49	67.89	67.59	-8.66	-15.07
Full-time equivalent B	82.54	80.11	76.31	72.13	67.75	68.17	68.01	-8.30	-14.53

Notes: The estimates from the labour force surveys are not seasonally adjusted and are the mean of May and August estimates in 1971 and 1976, June estimates in 1981 and 1986, and August estimates in 1991, 1996 and 2001. Full-time equivalent employment rate A is obtained using all available information on hours worked to construct the measure. Full-time equivalent employment rate B is obtained by first classifying employed persons into one of three hours categories in order to produce an employment rate consistently defined across all 7 censuses.

Cohort analysis methods

As the term 'pseudo-panel' implies, our approach involves treating the census datasets as a single panel, whereby we have up to seven observations on each 'population group'. A population group can in principle be defined in terms of any observable characteristics, but usual practice is to attempt to restrict to time invariant characteristics, so that the individuals represented by a population group are the same across all cross-sectional datasets. Hence the term 'cohort analysis', since we trace over time cohorts defined by characteristics that do not change over time. Time-invariant characteristics available in cross-sectional unit record data are, needless to say, few in number. Indeed, birth year is often the only unambiguously fixed observed characteristic by which population groups can be defined.

While cohort data of the kind being used in this study cannot reveal dynamics within cohorts – for example, changes in an individual's labour force status from one census to the next – it can do much of what would be expected of panel data. In particular, the cohort data can be used to control for unobservable cohort fixed effects (as can be done with panel data for individuals). Cohort data also has some advantages over panel data. It does not suffer from attrition, quantities examined are almost always means, which are much less susceptible to

measurement error (although we are not restricted to means, since quantities such as medians and other quantiles can also be tracked) and we can transform the unit record data (e.g., take logs) before obtaining the statistic of interest. Deaton (1997) does identify a potential problem of attenuation bias arising from 'error in variables', which in turn derives from the fact that cohort effects are sample means. However, if samples sizes within each cohort 'cell' are reasonably large, the attenuation bias will be small enough to ignore.

Given the usual interpretation of cohort analysis, each 'observation' for a cohort should be representative of the same group of people, which led us to define cohorts by birth year only. Even in this case, there are two sources of changes in cohort composition: migration and deaths. We take two steps to minimise changes in cohort composition from these sources. First, to reduce attrition due to death, we restrict to persons under the age of 65 years, which is also motivated by the fact that our primary interest is in males of working age. Second, we exclude immigrants from our analysis. This implies that changes in employment deriving from outcomes for immigrants will not be uncovered. These steps do not eliminate changes in composition due to deaths prior to 65 years of age or emigration, both of which will reduce cohort sizes over time, and which will bias results to the extent that emigrants and those who die younger differ in labour market outcomes from other members of the cohort.

The lower two panels of Table 2 present employment rates showing the effects of the sample selection restrictions – that is, restricting to 15-64 year olds and to those born in Australia. Employment rates among males aged 15-64 years are somewhat higher, reflecting the low participation of males aged 65 years and over. The age restriction results in more muted decreases in employment rates, implying increased male life expectancy beyond age 64 and/or ageing of the male population is partially responsible for the decline in the male employment rate. Restricting to native-born males further attenuates the decreases in employment rates, suggesting employment rates among immigrants aged 15-64 years have dropped more than is the case for native-born males and/or changes to the immigrant population share have acted to decrease the employment rate. Nonetheless, substantial drops in employment rates for native-born males aged 15-64 years are evident.[6]

[6] In addition to undertaking analysis on cohorts defined by birth year, we also considered examining cohorts defined by both birth year and educational attainment, restricting to males over 25 years on the basis that most educational attainment occurs by age 25, such that the composition of such cohorts is close to constant over time. However, the census data showed substantial increases in educational attainment for all birth cohorts over the entire period, implying the composition of cohorts defined by birth year and educational attainment changes substantially across the censuses. We therefore do not report this analysis.

With an age restriction of 15-64 years, and with ages classified into five-year bands, we have 70 cells (observations) over the 7 census years, each cell comprising a birth cohort by census year combination. There are 16 five-year birth cohorts that are in the 15-64 years age range in at least one of the census years, beginning with persons born in 1906-1910 and ending with persons born in 1981-1985. The general form of a cohort model of the employment rate is given by:

$$ER_{ct} = \alpha + \beta \mathbf{x}_{ct} + \mu_t + \theta_c + u_{ct} \qquad (3)$$

where ER_{ct} is the employment rate of cohort c in year t, μ_t is an economy-wide 'year' effect, θ_c is a cohort fixed effect capturing the effects of time-invariant unobservable characteristics specific to the cohort, u_{ct} is an unobserved effect for cohort *c* in year *t* and $\mathbf{x}_{ct}$ is a vector of characteristics of cohort *c* in year *t*, which will include age and which can include interactions with μ_t and θ_c. This model is not identified because of linear dependence between age, cohort and year. At a minimum, one of age, μ or θ needs to be omitted, or at least restricted in a manner that enables model identification. This amounts to an argument that, after inclusion of the variables contained in the vector $\mathbf{x}$, one of these effects is zero – that is, there is either no age effect, or no year effect, or no cohort effect. We chose to parameterise year effects, achieved by including variables that attempt to capture economy-wide changes over time affecting the level of male employment. These variables are discussed in the following subsection.[7]

Determinants of employment rates – Choice of explanatory variables

Decisions of variables to include in our models are based on assessments of characteristics likely to impact on employment rates, in turn informed by previous research. Implicit in this process is the goal of obtaining variables adequately parameterising year effects. Consistent with previous research, we adopt a 'demand-and-supply' framework in deciding on appropriate variables to include in our analysis, the logical consequence of which is consideration of the factors impacting on labour supply and labour demand over the period examined.

Factors likely to affect labour supply include wage rates on offer, income tax rates, welfare payment levels, other income (including labour market earnings of other household

[7] Parameterising year effects and including cohort dummies can be interpreted as estimating a fixed effects panel data model, with effects fixed over cohorts rather than individuals. Diagnostic tests often conducted for fixed effects models are all valid for cohort fixed effects models.

members), wealth holdings (particularly for older males) and educational attainment (which affects the 'quality' or 'efficiency units' of supply and is also possibly associated with different labour supply preferences). Factors affecting labour demand are less straightforward to identify. While aggregate demand fluctuations may be important, perhaps more important for a study of this kind are changes in the *structure* of labour demand, which can result from technology changes and from changes in industry structure associated with changes in output demand (in turn deriving from both domestic and international factors).[8]

While a supply and demand framework is generally likely to be appropriate for examination of the factors impacting on male employment rates, we also need to be cognisant of potential 'wedges' between demand and supply, in the form of minimum wages or other trade barriers acting to constrain the quantity traded. In particular, the wage setting institutions in Australia have undergone considerable change over the period under study, which in turn has impacted on wage outcomes and has therefore likely impacted on employment rates.

In deciding on the specific factors to investigate, we in part draw on previous Australian research, which has asserted roles for the following factors:

- welfare payments levels and eligibility criteria, and their interaction with demographic changes (e.g., Stricker and Sheehan 1981, Merrilees 1982, 1983, Moir 1982, Connolly and Kirk 1996, Kenyon and Wooden 1996, Borland 1997)
- changes to the industrial structure causing a decrease in demand for older and lower skill males (e.g., Stricker and Sheehan 1981, Moir 1982, Borland 1995, Kennedy and Hedley 2003)
- ripple effects of increased real wages, acting to increase early retirement via a positive wealth effect (e.g., Hughes 1984, Gregory 1993)
- rates of home ownership and levels of other asset holdings, including superannuation (e.g., Connolly and Kirk 1996, Kenyon and Wooden 1996, Borland 1997)
- income tax rates (e.g., Connolly and Kirk 1996)
- enrolment in education courses (e.g., Kenyon and Wooden 1996)

Other potential factors we might consider that do not appear to have been investigated by previous Australian research include:

- increased female labour force participation;

[8] Clearly, labour needs to be assumed heterogeneous, since we cannot sensibly argue labour demand changes drive any changes in relative labour usage of different groups in the community otherwise. Thus, we implicitly assume imperfect substitutability between labour 'products' defined by characteristics such as sex, age and educational attainment.

- changes to community attitudes to work, family and society, which could be argued to have altered preferences and therefore labour supply behaviour (and may manifest as cohort or even year effects); and
- changes in wage setting institutions and outcomes.

With regard to the growth in female employment, Jacobsen (1999) posits that sectoral labour demand changes in the US have favoured growth in female employment and, correspondingly, have been to the detriment of male employment. Jacobsen also identifies the potential for increases in female labour supply, deriving from changing technology of non-market production and family compositional changes, which would also act to decrease demand for male labour. Increased female participation could further act to reduce male labour supply via a positive income effect for partnered males. Thus, the growth in female participation could potentially be associated with negative effects on both supply of labour by males and demand for male labour.

Many of the above-mentioned factors have multiple dimensions to them, so that their effects on labour supply and labour demand are complex and varied. For example, the income support system has been modified in numerous ways over the last three decades, so that multiple variables may be required to capture the effects of these changes. Interactions between the above factors are also likely to be important. For example, a number of demographic changes have occurred – such as population ageing, increases in sole parent households and increased educational attainment – which would act to accentuate or attenuate the impact of the income support system on labour supply.

A constraint for the analysis of cohort data is that all variables must be defined in terms of characteristics of the cohort or the census year, or both (that is, a time-varying characteristic of the cohort, or a feature of a census year effect impacting differentially on cohorts). Further restricting the analysis is that cohort data provide relatively few observations, and therefore few degrees of freedom, limiting the number of explanatory variables that can be included. Note also that time-invariant cohort characteristics are redundant/not identified in the estimated models because the models include cohort dummies.

Given the above considerations, as well as limitations imposed by data availability, we arrived at the following set of variables:[9]

[9] Details on the construction of the variables that are derived from sources other than the census data are provided in the Appendix.

- Unemployment benefit replacement rate (UB_REPLACE): Value of the unemployment benefit for a single adult as a proportion of the first decile of the distribution of male weekly ordinary time earnings. This is included as a factor potentially impacting on labour supply. It varies only across census years, not cohorts.
- Income tax rate (INC_TAX): Proportion of male average weekly full-time earnings payable in income tax. This aims to capture effects on labour supply of income tax rates and varies only across years.
- Labour productivity (LAB_PROD): Real GDP per hour worked in the 'market sector', indexed to 100 in 2001-02. This variable is intended to capture positive income effects of increased productivity on labour supply. It varies only across census years.
- Female labour market participation (FEM_ER_YR): Full-time equivalent employment rate of females aged 15-64 years, obtained from the census data. Varies only across years. Increased female participation is likely to negatively impact on male labour demand and supply.
- Share of employment of 'male' industries (MALE_IND). This is intended to capture effects of changes in the structure of labour demand. It was obtained by defining as 'male' industries the four 1-digit level ANZSIC industries which have the highest proportion of workers who are male. These industries are mining; electricity, gas and water; construction; and transport and storage (and are the four industries with the highest male share of employment across the entire thirty-year period). The proportion of all employment in those industries is then obtained in each year. This variable varies only across years. [10]
- Student enrolment (STUDENT): Proportion of the cohort enrolled in full-time education, derived from the census data. This is likely to be associated with reduced labour supply.
- Educational attainment: Proportion of the cohort with a bachelor's degree (DEGREE) and proportion of the cohort with other post-school qualifications (OTH_POST-SCH). Both variables are derived from the census data. They potentially capture the 'quality' composition of labour supply and possibly also labour supply preferences (which may depend on educational attainment).

[10] We also considered a variable 'proportion employed in unskilled occupations' as a measure of the skill composition of labour demand in each year, but were unable to satisfactorily overcome problems of lack of concordance in occupational classifications across the censuses.

- Family status: Proportion of the cohort in:
    - Couples with dependent children (COUP_DEP)
    - Other couple families (OTH_COUP)
    - Sole parent families (SOLE_P)
    - Other families (mainly single persons) (OTH_FAM) (the omitted dummy)

  These four dummy variables are derived from the census data and are likely to capture effects of family composition on labour supply preferences.

Various other variables were considered, but rejected because they were clearly endogenous. One of these deserves specific mention, which is the unemployment rate. Some authors have included the unemployment rate as a parameterisation of year effects, and indeed have attributed all year effects to this variable (e.g., Beaudry and Lemieux 1999). However, we do not include the unemployment rate because it is likely to be endogenous with respect to the employment rate. It is also not going to capture all year effects as we have defined them, since the unemployment rate has moved up and down over the period, but as Figure 3 shows (see below), the employment rate has at every age declined steadily over the entire period.

Characteristics of the data

Table 3 provides information on the distribution of the number of observations (individuals) within each cohort 'cell', where a cell comprises a cohort in one census year. The minimum number of individuals used to produce cohort 'characteristics' is 2,556, implying estimates for these characteristics will be very precise.

Table 3: Distribution of the number of observations within each cohort cell

Minimum	2556
5th percentile	3056
Median	5890
95th percentile	424037
Maximum	503374
Number of cells	70

Notes: A 'cell' is a single cohort-census combination – that is, a single observation in the cohort analysis.

Table 4 presents male population weighted means in each census year of the variables included in the estimated models. The variables attempting to parameterise year effects comprise UB_REPLACE, LAB_PROD, FEM_ER_YR, MALE_IND, INC_TAX and

SKILLED_OCC. Substantial variation over time is evident for all these variables. Importantly, aside from LAB_PROD, none is monotonically increasing in census year. These variables are therefore unlikely to simply be capturing time trends. Nonetheless, we also include a linear time trend (a variable equal to year minus 1971) in the model, intended to capture trend changes that are not picked up by our included explanatory variables for year effects.

Table 4: Population weighted means of explanatory variables – Males aged 15-64 years

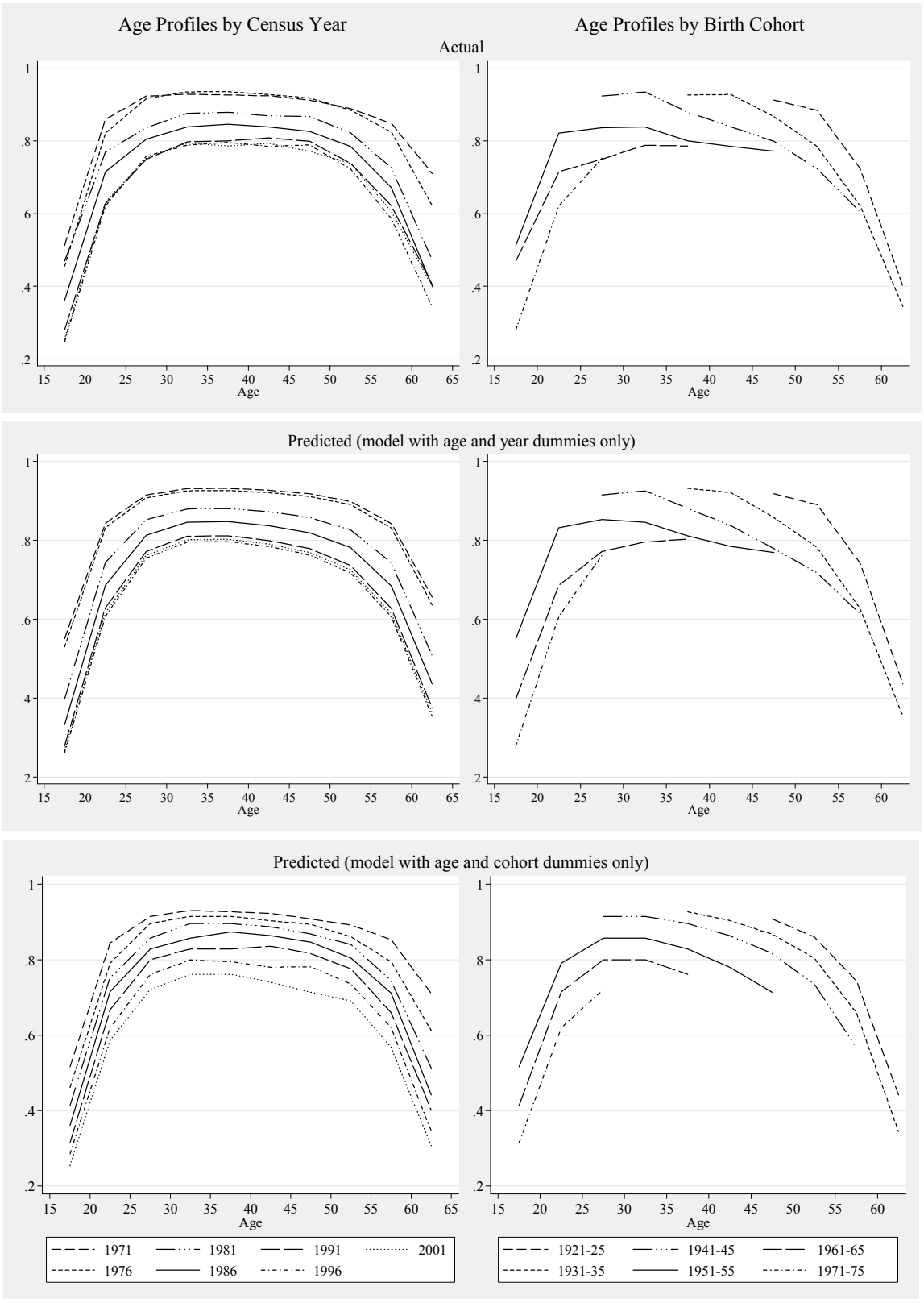
	1971	**1976**	**1981**	**1986**	**1991**	**1996**	**2001**
AGE (years)	36.2	35.0	36.3	36.8	36.7	37.7	38.6
COUP_DEP (%)	54.8	54.1	46.1	44.8	43.6	40.8	39.2
OTH_COUP (%)	29.2	28.4	33.8	31.0	28.5	29.9	30.4
SOLE_P (%)	3.0	3.2	1.3	2.6	3.2	2.9	3.6
DEGREE (%)	3.0	4.3	6.2	7.4	9.9	13.2	14.9
OTH_POST-SCH (%)	31.9	31.1	34.9	37.2	38.7	43.0	46.5
STUDENT (%)	8.1	9.8	6.9	7.3	10.2	9.7	10.4
UB_REPLACE (%)	18.2	35.6	30.8	33.6	40.5	35.6	36.5
INC_TAX (%)	17.6	27.2	34.3	27.5	25.6	26.1	23.9
LAB_PROD (index)	49.4	57.8	64.1	71.1	75	84.8	95.9
FEM_ER_YR (%)	35.1	39.7	40.8	40.6	42.9	44.6	46.4
MALE_IND (%)	16.6	16.9	16.4	16.1	14.3	13.9	13.7

Figure 3 presents full-time equivalent employment rate age profiles derived from the census data, by census year and by birth cohort (for every second cohort).[11] The top panel presents the actual profiles. The profiles by year show how the relationship between the employment rate and age has changed over the seven censuses. The clear pattern evident is that the employment rate has declined at every age. The profiles by cohort show how the employment rate for each cohort has changed over the period as they have aged. Decreases are larger the earlier the cohort – but equally, the earlier cohorts tend to have started with higher employment rates. Significantly, none of the cohort profiles actually cross – that is, each successive cohort has a lower employment rate than preceding cohorts at the same age. Having said that, it looks quite plausible that cohort profiles will in future cross. For example, the WWII (1941-1945) birth cohort appears to have fared especially badly. The early-to-mid-1970s recession seemed to hit employment rates of this cohort very hard, and the cohort continued to suffer declining employment rates thereafter, perhaps because of other changes

[11] From here on, all analysis of full-time equivalent employment rates are for 'Full-time equivalent employment rate B' (which is derived in a consistent manner across all seven censuses). Analysis using the 'Full-time equivalent employment rate A' measure (not reported) produced almost identical results.

in the structure of labour demand away from low-skill workers and because of increased competition from females entering the labour force.

Figure 3: Full-time equivalent employment rate age profiles



The age profiles provide a graphical illustration of the potential nature of age, cohort and year effects. Disentangling these three effects is not possible based solely on inspection of these graphs, because of the linear dependence between them, but the graphs are nonetheless informative. They suggest year effects dominate cohort effects, with all ages experiencing a decline in employment rates over the 30 year period.[12] Effects are not uniform, however, implying cohort effects may also be present. In particular, the 'tails' of the age profiles show greater decreases in the employment rates than do the middle sections.

The second and third panels of Figure 3 go further toward shedding light on the relative roles of cohort and year effects. The second panel presents predicted employment rates obtained by estimating employment rate models as a function of age and year dummies, while the third panel presents predicted employment rates obtained by estimating models as a function of age and cohort dummies. The second panel corresponds to predicted profiles when cohort effects are assumed zero and the third panel corresponds to predicted profiles when year effects are assumed zero. Consistent with the inferences from the actual profiles, comparing the predicted profiles with the actual profiles tends to suggest year effects are more important than cohort effects, since the profiles in the second panel appear to more closely resemble the actual profiles. Note that this does not imply it is appropriate to parameterise cohort effects. Indeed, the reverse would seem to be true: the more important are year effects, the more important it is to understand the nature of year effects by parameterising year effects (i.e., attempting to 'open the black box' of year effects).

Model estimation strategy

We estimate models for two dependent variables: the full-time equivalent employment rate and the full-time employment rate. For each model, dummy variables are included for five-year birth cohorts, although we combine the 1905-1910 and 1911-1915 cohorts into a single dummy and similarly combine the 1976-1980 and 1981-1985 cohorts. This is because we have few observations for the cohorts at either extreme. On the basis that the sample size within each cell is large (see Table 5), we assume 'error in variables' is ignorable (see Deaton 1997, p.123).

Predicted values outside the 0 and 1 boundaries of the dependent variable may be generated from linear OLS models. Following Gunderson (1977), we therefore take a logistic transformation of the dependent variable and perform OLS regression on this variable, i.e.,

[12] This would suggest that it is not appropriate to constrain the sum of year effects to be zero, as ABS (2003) do.

$LER = \log\left[ER/(1-ER) \right]$, where ER is the full-time (equivalent) employment rate. The predicted labour force participation can be obtained by solving $\widehat{ER} = \exp\left(\widehat{LER}\right)/\left[1+\exp\left(\widehat{LER}\right)\right]$.[13]

Some caution is required to avoid situations where explanatory variables capture effects other than intended. The potential for such problems is heightened by the 'macro' nature of the analysis, which requires a parsimonious set of explanatory variables, in turn rendering models more susceptible to omitted variable bias. With degrees of freedom at a premium, we explored the potential for adopting a parametric specification for the impact of age on employment rates, rather than including age dummy variables. We found the predicted employment rate age profiles from a quartic specification very closely matched the predicted profile when using age dummies and therefore adopted this specification.[14]

Estimation results

Table 5 contains the parameter estimates. The coefficients on the age variables are all significant. They are difficult to interpret, but the predicted age profiles of full-time equivalent employment rates presented in Figure 4 show clearly the nature of the lifecycle effects they capture. Estimates for the variables for the proportion of the cohort in each family type show that being a member of a couple, and more particularly being in a couple household with dependent children, is associated with a significantly higher full-time (equivalent) employment rate.

The proportion of the cohort holding a bachelor's degree is associated with a negative impact on the employment rate. Consistent with intuition, the greater the proportion of the cohort enrolled in full-time study, the lower the employment rate. Also as expected, point estimates imply the negative effects of student enrolment are larger for full-time employment than for full-time equivalent employment, since many full-time students will be employed part-time.

Aside from the linear time trend, we have a number of variables to parameterise year effects – UB_REPLACE, INC_TAX, LAB_PROD, FEM_ER_YR and MALE_IND. All have statistically significant coefficient estimates in the full-time employment model. Estimates in the full-time equivalent employment model are qualitatively the same, but are slightly smaller

[13] An issue with this approach is that it implies a particular functional form for the relationship between the employment rate and the explanatory variables.
[14] Details are available on request.

in magnitude and are not all statistically significant. This likely reflects the more muted degree of change in the full-time equivalent employment rate, because the growth in part-time employment has partially offset the decline in full-time employment.

Table 5: Regression results (cohort analysis using census data)

	Full-time employment rate		Full-time equivalent employment rate	
	Coefficient	Standard error	Coefficient	Standard error
AGE	1.120**	0.3	1.293**	0.331
AGE^2	-0.042**	0.013	-0.046**	0.014
AGE^3	7.23E-04**	2.20E-04	7.23E-04**	2.43E-04
AGE^4	-4.67E-06**	1.35E-06	-4.67E-06**	1.49E-06
COHORT_1916-20	-0.030	0.118	-0.094	0.13
COHORT_1921-25	0.084	0.187	0.004	0.207
COHORT_1926-30	0.253	0.261	0.185	0.288
COHORT_1931-35	0.357	0.333	0.261	0.368
COHORT_1936-40	0.512	0.411	0.427	0.454
COHORT_1941-45	0.742	0.489	0.664	0.541
COHORT_1946-50	0.980*	0.569	0.893	0.629
COHORT_1951-55	1.126*	0.654	1.001	0.723
COHORT_1956-60	1.326*	0.727	1.152	0.804
COHORT_1961-65	1.528*	0.806	1.304	0.89
COHORT_1966-70	1.815**	0.883	1.565	0.975
COHORT_1971-75	2.077**	0.966	1.810*	1.067
COHORT_1976-85	2.204**	1.051	1.962*	1.161
COUP_DEP	2.070**	0.848	1.633*	0.937
OTH_COUP	1.529*	0.888	1.371	0.981
SOLE_P	-4.032	2.636	-3.895	2.912
DEGREE	-4.048**	1.719	-4.997**	1.899
OTH_POST-SCH	0.503	0.634	0.453	0.7
STUDENT	-2.717**	1.122	-1.967	1.239
UB_REPLACE	-0.105**	0.043	-0.083*	0.047
INC_TAX	-0.168**	0.053	-0.132**	0.058
LAB_PROD	-0.295**	0.132	-0.210	0.146
FEM_ER_YR	0.804**	0.27	0.650**	0.298
MALE_IND	1.293**	0.509	0.971*	0.562
TIME_TREND	0.335*	0.195	0.219	0.215
CONSTANT	-41.517**	9.82	-37.899**	10.848
Number of observations: 70				
Adjusted R-squared	0.994		0.992	

Notes: The dependent variable is the logistic transformation of the employment rate variable. ** denotes significance at the 5% level; * significance at the 10% level. The full-time equivalent employment rate is that obtained when consistent hours categories for part-time workers are used across all 7 censuses.

As expected, the proportion of employment of 'male' industries (MALE_IND) has a positive association with the full-time employment rate and the level of income tax on average earnings (INC_TAX) and the unemployment benefit replacement rate (UB_REPLACE) have

negative associations with the full-time employment rate. Labour productivity (LAB_PROD) also has a negative association with full-time employment, implying the income effect has dominated the substitution effect in the consumption-leisure choice.

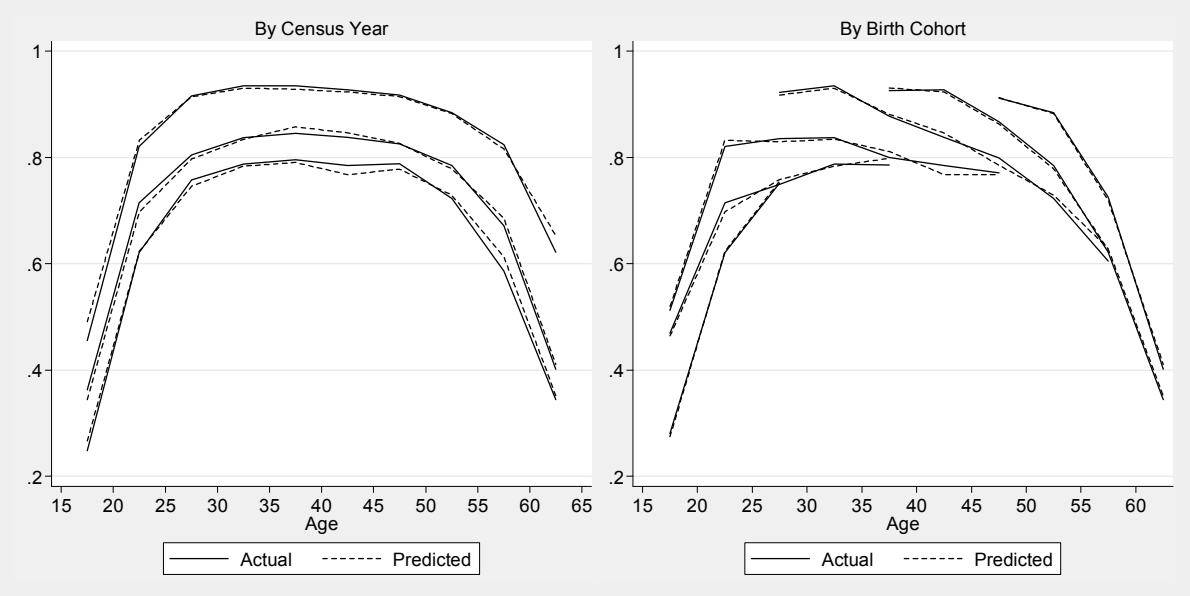
Curiously, the contemporaneous full-time equivalent employment rate of females aged 15-64 years (FEM_ER_YR) is associated with a positive effect on male full-time employment. Our suspicion is that it is picking up some other unexplained year effect, one possibility being business cycle conditions. We therefore estimated a model that included the aggregate unemployment rate to attempt to control for business cycle effects. While this is an endogenous variable, it is difficult to control for business cycle effects without incurring such problems, and other authors have included such a variable in similar models (for example, Beaudry and Lemiuex 1999). In any event, the unemployment rate variable was not significant and, although the magnitude of the coefficient estimate on FEM_ER_YR was slightly smaller in both specifications, it remained significant.[15] We are therefore unable to explain this result.

The cohort dummies capture cohort fixed effects stemming from both observable and unobservable sources. Notable is the pattern of birth cohort dummy coefficient estimates increasing as we move from earlier to later birth cohorts. Thus, all else equal, more recent cohorts in fact 'do better' than earlier birth cohorts. This is more pronounced for full-time employment than full-time equivalent employment. Models estimated without variables parameterising year effects (not reported) show more recent birth cohorts with lower employment rates – i.e. reversing the pattern evident in Table 5. We can therefore infer that economy-wide changes – for example, to the structure of labour demand, welfare replacement rates and income taxes – are the principle drivers of the reduction in male employment. Controlling for these changes, more recent birth cohorts are participating in employment – and more particularly in full-time employment – at higher rates than earlier cohorts.

Figure 4 plots predicted full-time equivalent employment rate age profiles against the actual profiles, by census year (for 1976, 1986 and 1996) and by cohort (for those born 1921-25, 1931-35, 1941-45, 1951-55, 1961-65 and 1971-75). The predicted employment rates very closely track the actual employment rates, suggesting our variables included to parameterise year effects are capturing much of the underlying drivers of the year effects.

[15] Inclusion of the unemployment rate did not significantly impact on any other coefficient estimates.

Figure 4: Predicted full-time equivalent employment rate age profiles



5. Conclusion

The decline in labour force participation, growth in unemployment and growth in the part-time share of all employment that occurred for males between 1971 and 2001 saw the male full-time equivalent employment rate drop by 19 percentage points. This represents fundamental change in the Australian labour market. In this study, we have sought to shed light on the sources of this change by treating the seven censuses conducted between 1971 and 2001 as a single panel dataset – a panel not of individuals, but of birth cohorts.

Estimates obtained imply significant roles in the decline in male employment for the decline in couple households with dependent children, growth in educational attainment, growth in labour productivity and changes in the structure of labour demand away from traditionally male-dominated industries, all of which have occurred in a sustained and substantial fashion over the full 1971-2001 period examined. Estimates also imply that the growth in enrolment in education after 1986, the increase in the unemployment benefit replacement rate between 1971 and 1991, and increases in income taxes payable on labour market earnings between 1971 and 1981 also acted to decrease male employment. Although negative effects of these factors would have been greatest in the aforementioned sub-periods, the net changes in these factors between 1971 and 2001 would nonetheless have contributed to the aggregate decline in male employment.

We also find that growth in female employment has had a *positive* effect on the male employment rate. This does not appear to be attributable to correlation between the female employment rate and business cycle conditions, and therefore remains somewhat puzzling.

A further notable finding of our study is that more recent birth cohorts are, all else equal, more likely to be employed than earlier birth cohorts. This finding is in stark contrast to that of a study by the ABS (2003), which finds the reverse to be true. It would seem that the ABS study obtains the opposite result because it imposes the constraint that year effects in aggregate sum to zero. Casual inspection of Figure 3 suggests that it is inappropriate to impose such a constraint, and that therefore our analysis provides a more accurate picture of cohort effects.

6. Appendix

Table A1: Census dates and hours of work categories for part-time workers

Year	Date of census	Day of the week	Hours categories available
1971	30 June	Wednesday	0-14, 15-19, 20-29, 30-34
1976	30 June	Wednesday	0-14, 15-19, 20-29, 30-34
1981	30 June	Tuesday	0, 1-14, 15-24, 25-34
1986	30 June	Monday	0, 1-15, 16-24, 25-34
1991	6 August	Tuesday	0, 1-15, 16-24, 25-34
1996	6 August	Tuesday	0, 1-15, 16-24, 25-34
2001	7 August	Tuesday	0, 1-15, 16-24, 25-34

Construction of variables that are derived from non-census data sources

UB_REPLACE (UB / DECILE_1)

UB: Unemployment benefit per week for a single adult at the date of the census, obtained from Department of Families, Communities and Indigenous Affairs (FaCSIA) web site on 2 September 2007 at http://www.facsia.gov.au/guides_acts/ssg/ssguide-5/ssguide-5.2.html .

DECILE_1: First decile of the distribution of male weekly total earnings, obtained from ABS Cat. No. 6302.0. This information was not available for 1971. For 1971, we used annual estimates of the national minimum wage produced by the Reserve Bank of Australia (downloaded on 24 August 2007 from OECD.stat at http://stats.oecd.org/wbos/Default.aspx?usercontext=sourceoecd) to create a proxy estimate, assuming the ratio of the first decile of the male wage distribution to this minimum was the same in 1971 as in 1976.

INC_TAX (TAX / AWE)

AWE: Average weekly full-time adult ordinary time earnings at the date of the census. Source: ABS Cat. No. 6302.0.

TAX: Income tax (including Medicare levy, when applicable) payable on AWE. This was calculated based on the income taxation legislation in place at the date of the census.

LAB_PROD

Real GDP per hour worked in the market sector in the year of the census, indexed to 100 in 2001-02. This measure is produced by the ABS as part of its national accounts publication (Cat. No. 5204.0). The ABS definition of the market sector excludes the ANZSIC 1-digit industries 'Property and business services', 'Government administration and defence', 'Education', 'Health and community services' and 'Personal and other services'. These industries are excluded because their outputs are not marketed and/or because their outputs are derived either wholly or primarily by using either deflated input cost data or hours worked as indicators of output.

MALE_IND

Proportion of all employed persons working, at the date of the census, in the 1-digit level ANZSIC industries 'mining', 'electricity, gas and water', 'construction' and 'transport and storage'. Sources: ABS Labour Report No. 56, ABS Cat. No. 6101.0 and ABS Cat. No. 6291.0.55.001.

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