Policy Influences on the Female Part-time Participation Rate in Australia

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<u>Abstract</u>
We estimate an error-correction model for the female part-time labour force participation rate, using Australian aggregate time-series data from the 1970s to the present. We find encouraged and discouraged worker effects, the child dependency ratio, real childcare costs, educational participation, and the ratio of pensions to unemployment benefits to be significant determinants of the participation rate. An alternate specification also shows effects from Family Tax Benefit and female wages. The large rise in female labour force participation over this period seems to have had mainly labour demand and demographic drivers.

1. INTRODUCTION

The female part-time labour force participation rate has risen sizeably in Australia over the last few decades. It has, however, remained flat over recent years.

At the recent G20 meeting in Brisbane, international leaders committed to reduce the gap in participation rates between men and women by 25 per cent by 2025.[1] Policy attention has also turned to increasing labour force participation due to the downward pressure placed on the overall participation rate by demographic change.

A particular reason to examine the part-time participation rate in Australia is that the activity requirements of several governmental welfare-to-work policies only require part-time participation. Further, workplace relations legislation has also changed recently to allow parents the right to request part-time work.

In addition to examining the effects of policy-relevant variables on the female part-time participation rate, another purpose of this study is to improve the modelling of this variable in the Department of Employment's FoCUS macroeconomic model (see Connolly 2011 for an overview of this model). For this purpose, analysis of the ABS estimates for the female part-time participation rate was required (to fit in with other aggregate data used in the model). The current set of equations for the female part-time participation rate in this model is based on Connolly and Badhni (1998), who estimated that the female part-time participation rate was determined by the part-time employment-population ratio (representing the encouraged worker effect), the expected after-tax real wage and educational participation. Given recent policy changes that are likely to have influenced the female part-time participation rate (e.g. the introduction of the Child Care Benefit and Rebate, Family Tax Benefit, and the Welfare to Work reforms) and the additional years of data that are now available, it is timely to re-examine this work.

Following the earlier paper, we use an Engle-Granger (two-step error correction) procedure. In our preferred equation, using data from 1976 onwards, we also employ instrumental variables for the female part-time employment-population ratio. This variable, representing the encouraged worker effect, is estimated to have a positive and significant effect on the female part-time participation rate. The incidence of long-term unemployment is estimated to have a significant negative effect. This indicated the presence of an indirect discouraged worker effect, as a rise in the incidence of long-term unemployment represents a weakening in labour market conditions and may result in women becoming discouraged in their search for employment.

The child dependency ratio and real childcare fees are both estimated to have a significant and negative effect on female part-time participation. The female part-time participation rate is estimated to respond positively to educational participation, with the combined secondary and tertiary participation rate found to have a significant effect. The ratio of the (non-activity-tested) pension payment rate to the (activity-tested) unemployment allowance payment rate is estimated to have a significant negative effect on female part-time participation in the labour force.

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[1] G20 Leader's Communique https://g20.org/wp.../brisbane_g20_leaders_summit_communique1.pdf

We also tested a range of other policy-relevant variables, including the Welfare to Work policy changes, female wages, and Family Tax Benefit, but did not estimate them to be statistically significant with a plausible sign.

Using the long-run equation, three-quarters of the rise in female part-time participation since 1976 is accounted for by the encouraged worker effect, and another 20 per cent by the fall in the child dependency ratio.

An alternative specification, allowing estimation back to 1972, was also estimated. The main difference is that the female part-time unemployment rate, lagged one quarter, was used as the main indicator of the encouraged/discouraged worker effect instead of the instrumental variables estimate of the female part-time employment-population ratio. The results were broadly similar. However, the estimated encouraged worker effect was much smaller and the other effects correspondingly larger. In addition, significant effects were estimated for Family Tax Benefit and female wage levels. (A positive response was estimated to the real rate of payment of Family Tax Benefit and this may represent some women shifting from the full-time labour force to the part-time labour force.)

The structure of the paper is as follows. In Section 2, we review the literature on the determinants of the female part-time participation rate. Section 3 describes the underlying model of the labour market and Section 4 the data and methods. The econometric estimates are then presented in Section 5. Section 6 provides a discussion of the results and concludes the main body of the paper. Appendices detail data sources, instrumental variables for the employment-population ratio, and tests for stationarity and cointegration.

2.   LITERATURE REVIEW

2.1   Introduction

While there exists a wide range of Australian and international literature that examines the determinants of overall female labour force participation, there is less research available that focuses specifically on part-time participation. In addition, Birch (2005) found through a literature review that the range of estimates from Australian studies into female labour force participation remain varied despite improvements in econometric methodologies over the last few decades.

In order to gain a better understanding of the implications of government policies on the female part-time participation rate, it is important to examine the relevant influences on female part-time participation. In this literature review, we aim to explore what existing literature, especially in the Australian context, contains about the determinants of the female part-time labour force and about the impacts of government policies on female labour force participation.

2.2   Determinants of Female Labour Force Participation

Educational Attainment
Various authors have shown that educational attainment has a significant positive effect on

female labour force participation in Australia (including Evans and Kelley 2008; Kennedy et al 2009; Gong 2010), with research also indicating that the effect is stronger for women than for men (Kennedy et al 2009). Connolly and Badhni (1998) found a significant positive effect of the female Year 12 retention rate on female part-time participation in Australia, while the female tertiary educational participation rate was not found to be significant.

Jaumotte (2004) found for a panel of 17 OECD countries that the positive effect of educational attainment on the overall female participation rate could be decomposed into a negative effect on female part-time participation and a positive effect on female full-time participation. Conversely, Thévenon (2013) found for a panel of 18 OECD countries that when institutional controls were added, the number of years in education had a positive effect for part-time employment but a negative effect for full-time employment. Studies in which the authors have looked into gross flows between non-work, part-time work and full-time work for women find that the level of education increases the propensity to move into full-time work, and decreases the probability of non-work, as compared with staying in part-time work (Blank, 1989 for the United States; OECD, 2010 for a panel of 17 OECD countries). That said, Falzone (2000) found that the level of education had an insignificant negative effect on the probability of part-time employment compared with full-time employment for married women in the United States. However, Del Boca (2002) found the level of schooling to have an insignificant positive effect on mothers' participation in Italy.

Number of Young Children
The presence of young children is found to have a significant negative effect on female labour force participation in Australia (Evans and Kelley 2008; Gong 2010). The results are concentrated for children under the age of five years, with older children found to have a lesser impact on female labour supply (Evans and Kelley 2008), and children aged 16-27 years found to have a positive effect on participation (Gong 2010). That said, Kennedy et al (2009) suggest that the extent of this negative impact associated with childbirth has been reducing since 1981 for women of childbearing age in Australia.

The research shows that an increase in the number of young children has a negative effect on both part-time and full-time female participation (Jaumotte, 2004 for a panel of 17 OECD countries; Rammohan and Whelan, 2007 for Australia), with the effect found to be higher for part-time employment (Rammohan and Whelan 2007). In contrast, Buddelmeyer et al (2004) suggest that the fertility rate had a positive effect on the part-time employment rate for a panel of 14 European countries. Similarly, several researchers have found that the presence of young children increases the probability of working part-time, as compared with working full-time (Bardasi and Gornick, 2000 for Canada, Germany, Italy, the United Kingdom and the United States; Falzone, 2000 for the United States; OECD, 2010 for a panel of 17 OECD countries). Specifically, Smith et al (2003) found that the effect was only significant for countries that had a relatively high share of part-time jobs available (Britain and Denmark), with the effect found to be insignificant for countries with less availability of part-time work (West Germany and Ireland). It has also been put forward by Blank (1989) that, for the United States, an increase in the number of preschool-aged children increases the propensity of full-timers to move into non-work but does not increase the propensity to move into part-time work. Powell (1998) has suggested for Canada that the effect of young children is insignificant on the employment status of married mothers when controlling for

childcare costs.

Childcare
The OECD (2010) found consensus that childcare costs had a significant negative effect on mothers' hours of work (including Andren, 2003 for Sweden; Kornstad and Thoresen, 2007 for Norway; Wrohlich, 2006 for Germany; Powell, 1998 for Canada; Breunig and Gong, 2010 for Australia), with the results concentrated on mothers with younger children. In particular, Powell (1998) found that childcare costs had a negative effect on both part-time and full-time employment of married mothers, although the elasticity was greater for full-time employment. Further, Andren (2003) found that a decrease in childcare costs would induce a transition from part-time to full-time employment for single mothers in Sweden. Choné et al (2003) also found that an increase in childcare expenditure in France increases the probability of half-time work and reduces the probability of overall employment for women with children under three years old. The empirical evidence, however, has been mixed with several Australian researchers finding the impact of childcare costs to be very small or insignificant on partnered women's participation rate decisions (for example, Rammohan and Whelan 2007; Kalb and Lee 2008). Rammohan and Whelan (2007) thus suggest that government policies that reduce childcare costs may not lead to a significant increase in female labour force participation.

However, Breunig et al (2012) state that measurement error in the price of childcare can explain why previous Australian studies have found partnered women's labour supply to be unresponsive to childcare prices. Using improved price data, the authors found a statistically significant negative elasticity of partnered women's labour force participation with respect to the price of childcare. Connolly and Trott (2014) also found real childcare fees had a statistically significant negative effect on female full-time participation in Australia.

The literature also indicates that the quality and availability of childcare are important determinants of female labour force supply. For example, Breunig et al (2011) found a significant negative relationship between the difficulties with child-care affordability, quality and availability in areas of Australia and the labour supply and hours worked of partnered women and lone parents living in those areas. Further, Del Boca (2002) found that an increase in the availability of publically-funded childcare (which, while of high quality, is limited in the availability of slots and of the hours of care) would lead to an increase in participation of married mothers in Italy.

Childcare Subsidies and Benefits
Childcare subsidies reduce the costs of childcare and would thus increase the return on market work. Many researchers have found that public childcare spending stimulates mostly full-time employment of women, with a negative effect on part-time employment (Andren, 2003 for Sweden; Choné et al, 2003 for France; Jaumotte, 2004 for a panel of 17 OECD countries; Thévenon, 2013 for a panel of 18 OECD countries). That said, Powell (1998) found a significant positive effect for both part-time and full-time employment of married mothers in Canada, although the effect was greater for full-time employment. Jaumotte (2004) accounted for the potential endogeneity of public childcare spending by instrumenting by its lagged values. By contrast, Blau and Kahn (2013) found the effect of public childcare spending to be insignificant on the female participation rate for a panel of 17 OECD countries. Evans and Kelly (2008) also found no significant effect on mothers' participation

of the 1996 increase in the government childcare payment for working mothers in Australia.

Unlike childcare subsidies, child benefits have been found to have a negative effect on participation of women. Connolly and Trott (2014) found that the real Family Tax Benefit payment rate in Australia had a significant negative effect on female full-time participation in the labour force. Jaumotte (2004) found for a panel of 17 OECD countries that child benefits had a negative impact on part-time participation of women, as for women working part-time the income effect from child benefits is likely to be large enough to induce a reduction in participation. Buddelmeyer et al (2004) also found a significant negative effect of child benefits on the part-time employment rate for a panel of 14 European countries. Conversely, Thévenon (2013) found for a panel of 18 OECD countries that spending on family benefits per child had no significant effect on part-time employment.

Kornstad and Thoresen (2007) analysed the impact of the home care allowance reform of 1998 in Norway. The reform was a tax-free child benefit for families with children aged one to two years that was reduced as centre-based childcare use increased. The reform created a disincentive to utilise centre-based childcare and the authors found that married mothers' probability of working full-time declined, as did their labour supply. Wrohlich (2006) conducted two policy simulations for Germany and found that a reform increasing the number of government subsidised childcare slots (conditional on the employment of the mother) had a greater effect on increasing mothers' participation rates and working hours than a reform to abolish parents' fees for existing slots for children aged three to six years (independent of parents' employment status). Azmat and Gonzalez (2009) examined the effects of a 2003 Spanish tax reform. The authors found that an increase in family deductions per child had a negative effect on mothers' employment, while a new tax credit for employed mothers of young children (working at least 50 per cent full-time equivalent hours) had a positive effect on mothers' employment.

Paid Parental Leave
Paid parental leave can increase mothers' attachment to the labour market as they may be more likely to return to their employers. Blau and Kahn (2013) found for a panel of 17 OECD countries that the number of weeks of parental leave had a positive effect on women's overall participation rate. Also for the OECD, Jaumotte (2004) found that paid parental leave stimulates mostly full-time participation of women (with an insignificant effect on part-time employment), while Thévenon (2013) found the effect of spending on leave and birth grants per childbirth to be positive for full-time employment but negative for part-time employment of women. That said, the duration of paid leave is found to have a negative impact on both the part-time and overall female employment rate (Thévenon 2013). Jaumotte (2004) further found that a long period of parental leave (above the equivalent of 20 weeks full pay) had a significant negative impact on only full-time participation (with the effect on part-time participation found to be insignificant).

In Australia, the labour force classification of people on paid and unpaid parental leave differs due to the Australian Bureau of Statistics (ABS) definition of employment. In the ABS Labour Force Survey, employees absent from work for less than four weeks up to the end of the reference week are defined as employed (ABS 2007). Employees away from work for more than four weeks up to the end of the reference week are defined as employed if they received pay for some or all of the four week period to the end of the reference week. Thus,

while women on paid parental leave are counted as employed for the duration of their leave, women taking unpaid parental leave will only be classified as employed for the first four weeks, at which point they will be defined as either unemployed or not in the labour force.

The Encouraged and Discouraged Worker Effects
Birch (2005) reviewed the Australian literature and found consensus that a rise in the female unemployment rate resulted in women reducing their labour supply. More recently, Gong (2010) found that the unemployment rate at the State/Territory level had a significant negative impact on married women's participation rate in Australia. The female unemployment rate (or State/Territory unemployment rate in Gong 2010) represents the discouraged worker effect, as women withdraw from the labour force as they become discouraged in their ability to find employment. Jaumotte (2004) found for a panel of 17 OECD countries that while the female unemployment rate had a negative effect on full-time participation, the effect was positive on the female part-time participation rate. Connolly and Badhni (1998) found that the female part-time employment to population rate had a significant positive effect on female part-time participation in Australia, indicating a strong encouraged worker effect.

The Added Worker Effect
The male unemployment rate represents the added worker effect as married women increase their participation in order to account for the household wealth effect of their husbands' losing work. Birch (2005) found consensus with the Australian literature that the male unemployment rate had a positive effect on female labour force participation. Jaumotte (2004) found for a panel of 17 OECD countries that the male unemployment rate had a negative effect on part-time participation and a positive effect on full-time participation, as women would increase hours worked. In order to account for the potential endogeneity of the unemployment rates, Jaumotte (2004) defines them with respect to a larger age group (15-64 years instead of 25-54 years) and instruments them by their lagged values as well as all the exogenous variables of the model.

Income
Women are found to be more responsive to both their own wage changes and their husbands' wage changes than are their partners (Breunig and Gong, 2008 for Australia). Jaumotte (2004) stated for the OECD that women are more sensitive to a reduction in their net wage because they have the option of 'home production' which is not taxed. Australian researchers find that an increase in the wage rate has a significant positive effect on women's labour force participation and number of hours worked (Birch 2005), with the impact found to be larger on the probability of part-time employment compared with full-time employment for mothers (Rammohan and Whelan 2007). In contrast, Powell (1998) found for Canada that while the wage had a significant positive effect on both part-time and full-time employment, the effect was stronger for full-time employment. Connolly and Badhni (1998) found for Australia that the expected after-tax real wage had a significant positive effect on female part-time participation, although the effect was found to be low compared with the effect on male part-time participation. With regards to the husband's income, Evans and Kelley (2008) found for Australia a significant negative effect on the wife's labour force participation and hours worked, while Falzone (2000) found for the United States that the husband's income had a significant positive effect on the probability

of a married woman working part-time rather than full-time.

Birch (2005) found consensus that Australian studies show that increases in family income result in women reducing their labour supply, with Rammohan and Whelan (2007) finding that an increase in non-labour income reduces the likelihood of the mother observed to be working, both full-time and part-time. For Italy, Del Boca (2002) found the level of household income to have a negative effect on married mothers' participation. The research literature also indicates that other household income increases the probability of married women participating in part-time work compared with full-time work for countries that have a greater availability of part-time work, including for Germany (Bardasi and Gornick 2000) and for Britain and Denmark (Smith et al 2003).

Taxation
The marginal tax rate refers to the amount of tax paid on an additional dollar of income. High marginal tax rates may create a disincentive to increase labour force participation. Sundström and Stafford (1992) found that an increase in the marginal tax rate for full-time workers relative to part-time workers led to a rise in female part-time employment in Sweden. Similarly, the authors found that when marginal tax rates were reduced the proportion of part-time employment declined, particularly for women, and hours worked amongst female part-timers rose. In contrast, Bosch and van der Klauuw (2012) found that lower marginal tax rates had an insignificant negative effect on Dutch employed women's hours worked. The authors suggested that the dominance of the income effect may be due to the positive attitude in the Netherlands towards part-time work.

Marginal and average effective tax rates take into account the interaction of the tax and social security systems. The literature has shown that effective tax rates tend to be high for low-wage part-time workers, one-earner households and for families with children (Toohey and Beer, 2004 for Australia; Payne et al, 2007 for Australia; OECD, 2010 for a panel of 17 OECD countries). These households with higher effective tax rates face a disincentive to increase hours of work and may be more likely to be in the part-time labour force. For example, the OECD (2010) showed that countries with large part-time shares also tend to have marginal effective tax rates above the OECD average. Payne et al (2007) also suggest that the rise in partnered mothers' part-time employment in Australia over 1996 to 2013 might relate to the higher effective tax rates mothers face as they increase hours worked towards full-time employment. However, it was not feasible to construct a series of marginal effective tax rates for this study and instead a variable for marginal tax rates used.

The researchers further suggest that effective tax rates are high for low-income families with children compared with families on higher income levels (Toohey and Beer 2004; Payne et al 2007). In particular, Toohey and Beer (2004) examined average effective tax rates in Australia and found for low-income families that, in some cases, a one hour increase in the mother's hours of work was found to make the family financially worse off.

Gong and Breunig (2013) used HILDA data to examine the impacts of the 2004 and 2006 Australian welfare reforms on lone mothers. The 2004 reform reduced the taper rates for the means-tests for Family Tax Benefit A and B from 30 per cent to 20 per cent, which decreased the marginal effective tax rate over the taper region. The authors found the reform to have a positive effect on hours worked by working lone mothers who changed

jobs, in particular for those with lower education and with fewer and older children, but did not have a significant effect on the future employment probability of non-workers. The 2006 reforms included a tightening in the eligibility of the income-support payment for parents. The research showed that tighter welfare rules had a concentrated effect on the future employment probability for those with lower education.

Several researchers have examined the marginal tax rate for second earners. For the OECD, the tax incentive to share market work between spouses was found to have a positive effect on female part-time participation (Jaumotte 2004) and on the part-time employment rate (Thévenon 2013). In addition, Buddelmeyer et al (2004) found for a panel of 20 OECD countries that the labour tax rate has a significantly negative correlation with the part-time employment rate, which the authors suggested could refer to a high marginal tax rate on the second earner.

Bosch and van der Klauuw (2012) examined the impact of a change from tax allowances to tax credits in the Netherlands. The reform was found to have a significant positive effect on female participation, as the tax credit removed the disincentive of working at a low income associated with the tax allowance.

Income-support Payments
Jaumotte (2004) states that the disincentive to participate in the labour force resulting from government benefits is particularly high for those with low potential earnings, including low-skilled people (a group that contains a large fraction of single mothers). Buddelmeyer et al (2004) found that the unemployment benefit replacement ratio (the ratio of the total payment received when unemployed to that received when in employment) is negatively linked to the part-time employment rate for both a panel of 20 OECD counties and a sub-panel of 14 European countries. This result could represent an 'unemployment trap' for part-time workers given their relatively low level of earnings compared with full-time workers.

The OECD (2010) also examined the effect of the net replacement rate on part-time employment for a panel of 17 OECD countries. The net replacement rate is the ratio of net household income received when a member of the household is not employed (and is receiving social assistance benefits) to that received when that member of the household is working part-time. The authors found that the net replacement rate decreases the probability of a part-time worker moving into full-time work, and increases their probability of non-work.

Employment Protection Legislation
Buddelmeyer et al (2004) found that employment protection legislation had a significant positive effect on the part-time employment rate for both a panel of 20 OECD counties and for a sub-panel of 14 European countries. The authors attributed this effect to the strictness of employment protection legislation for full-time positions encouraging firms to utilise more flexible employment arrangements. Jaumotte (2004) also found that employment protection legislation had a positive influence on female part-time participation for a panel of 17 OECD countries. In contrast, Thévenon (2013) found for a panel of 18 OECD countries that the strictness of employment protection legislation had a negative effect on female part-time employment. This result could indicate, as Buddelmeyer et al (2004) suggested,

that employment protection legislation in some countries may directly limit the use of part-time employment.

Industry Composition
The share of the services sector in the economy was found to have a positive impact on the part-time employment rate (Buddelmeyer et al, 2004 for a panel of 14 European countries; Thévenon, 2013 for a panel of 18 OECD countries), while the public sector share of employment had a significant negative effect on the part-time employment rate (Thévenon 2013).

3. METHODS

An important issue that arises from previous analyses to which reference is made in the literature review is about the structure of demand and supply in the labour market and the implications this has for the econometric methods used to estimate policy influences on the participation rate. There are three main alternative frameworks:

1. Both labour force participation and employment are constrained by labour supply (this is often the implicit assumption in microeconometric analyses such as Breunig, Gong and King 2012 who used hours worked as their measure of labour supply). With the exception of those who are structurally and frictionally unemployed, everyone who wants a job can get a job with their desired working hours at the going wage rate. In this case, we would expect to see a very close correspondence between movements through time in the labour force participation rate and the employment-population ratio, with the unemployment rate unresponsive to labour demand factors (such as real GDP and real labour costs). In this case, microeconometric estimation methods (such as logit or probit regression analysis) or macroeconometric methods, with no adjustment for labour demand factors and a larger choice of dependent variables, are suitable.
2. Labour force participation is constrained by labour supply factors and employment is constrained by labour demand factors. In this case, not everyone who wants a job at the going wage rate can get one, but labour force participation is independent of how hard it is to get a job. Also, we would expect to see little correspondence between movements through time in the labour force participation rate and the employment-population ratio, except when labour supply and labour demand factors are coincidentally moving in the same direction. The unemployment rate should be highly responsive to both labour supply and labour demand factors. In this case, if a macroeconomic analysis is conducted, it may be suitable to use simple estimation methods such as Ordinary Least Squares, but choosing the correct dependent variable is important (i.e., the participation rate and not employment, hours worked or the employment/population ratio). These considerations also apply to microeconometric analyses, except that in this case it may be difficult to obtain data on the most suitable dependent variable (because data may not be available on hours of work desired by unemployed people in unit-record datasets).
3. The structure is similar to (2) above, but the labour force participation rate adjusts to changes in labour demand through the encouraged/discouraged worker effect. In this case, labour force participation is partly determined by how hard it is to get a job. Also, the closeness of the relationship between movements through time in the labour force

participation rate and the employment-population ratio depends upon the strength of the encouraged/discouraged worker effect, as does the responsiveness of the unemployment rate to labour demand factors. If the encouraged/discouraged worker effect parameter is one, then an increase (or decrease) in the employment/population ratio induces a matching increase (or decrease) in the participation rate, with no corresponding change in the unemployment rate. In this case, it may be necessary to use more sophisticated estimation methods in macroeconomic analyses, such as Instrumental Variables or Two Stage Least Squares regression analysis, and also to use more sophisticated methods if a microeconometric analysis is attempted.

The implications of the labour market structure for the relationships among the participation rate, the employment-population ratio and the unemployment rate arises because these three variables are linked by the following identity:

$$PR_t = EPR_t/(1 - UR_t/100) \tag{1}$$

where PR_t is the participation rate;
EPR_t is the employment-population ratio expressed as a percentage; and
UR_t is the unemployment rate.

Now the time series since mid-1966 for the participation rate, the employment-population ratio and the unemployment rate, for the female part-time labour force, will be examined to see how well they fit the three alternative labour market structures outlined above.

The participation rate and the employment-population ratio are shown in Figure 1. There has been a very close correspondence between these two variables, especially in the late 1960s and the early 1970s when the labour market was tight and the female part-time unemployment rate was low.

Figure 1:   **Female Part-time Participation Rate and Employment to Population Ratio in Australia** (per cent of civilian working-age population, quarterly seasonally adjusted)
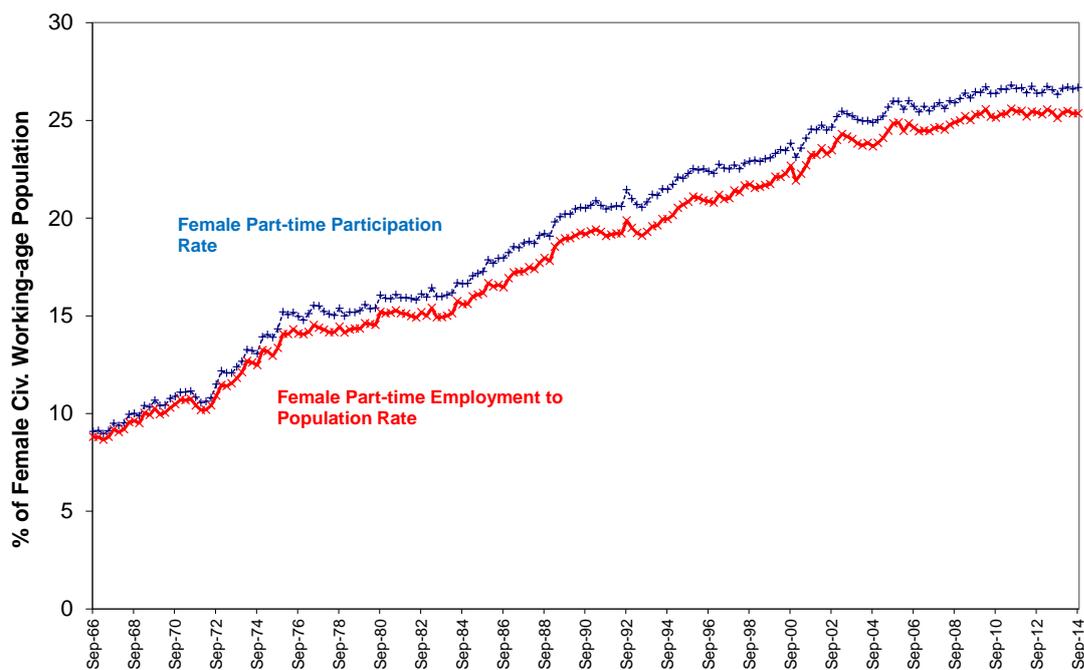
Source: ABS (2014), *Labour Force, Australia, Detailed, October 2014*, Cat. No. 6291.0.55.001, with both variables adjusted for ABS Labour Force Survey redefinitions as explained in Connolly (2008). Data are for the middle month of each quarter (i.e., February, May, August and November).

The correlation coefficient between these two variables, using the sample period of August 1967 through November 2014 was +0.999. This very high correlation indicates that the labour market structure is unlikely to correspond with that implied by alternative (2) above. However, neither alternatives (1) nor (3) can be ruled out on the basis of this evidence alone.

Another noteworthy feature of Figure 1 is that the female part-time participation rate and employment/population ratio have risen sizeably in Australia over the last several decades. More recently, however, both of these variables have diverged from this trend and remained flat over recent years.

One potential problem with the comparison shown in Figure 1 is that both of the variables in it are for the female part-time labour force and also both are based on ABS Labour Force Survey data. Since this is a sample survey covering around a third of a per cent of the adult civilian population and since the female part-time labour force was only 21.2 per cent of the total labour force in December 2014[2], it is likely that at times, random errors would be relatively large and have the same or very similar effects on both of these ratios.

Such random errors would largely cancel each other out when the female part-time unemployment rate is the variable of interest. Accordingly, the other method used to conduct a quick assessment of how well labour market developments since mid-1966 have

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[2] Calculated from seasonally adjusted data in ABS (2015), *Labour Force, Australia, December 2014*, ABS Cat. No. 6202.0. Since the female part-time participation rate has risen substantially since the mid-1960s as shown in Figure 1, the female part-time labour force would have been less than 21.2 per cent of the total for most of this period.

supported each of the three alternative labour market structures outlined above is to compare the female part-time unemployment rate with the overall[3] labour demand/population ratio (see Appendix A for details of how this variable was constructed). It is important to note that the female part-time unemployment rate would have almost no direct feedback effect on the overall labour demand/population ratio[4]. This is because female part-time unemployment is not a component of overall labour demand. This indicates that the direction of causation of co-movements in the two series is likely to be from the overall labour demand/population ratio to the female part-time unemployment rate and not in the reverse direction.

The time series of these two variables since mid-1966 is shown in Figure 2.

Figure 2: **Female Part-time Unemployment Rate and Overall Labour Demand to Population Ratio in Australia**
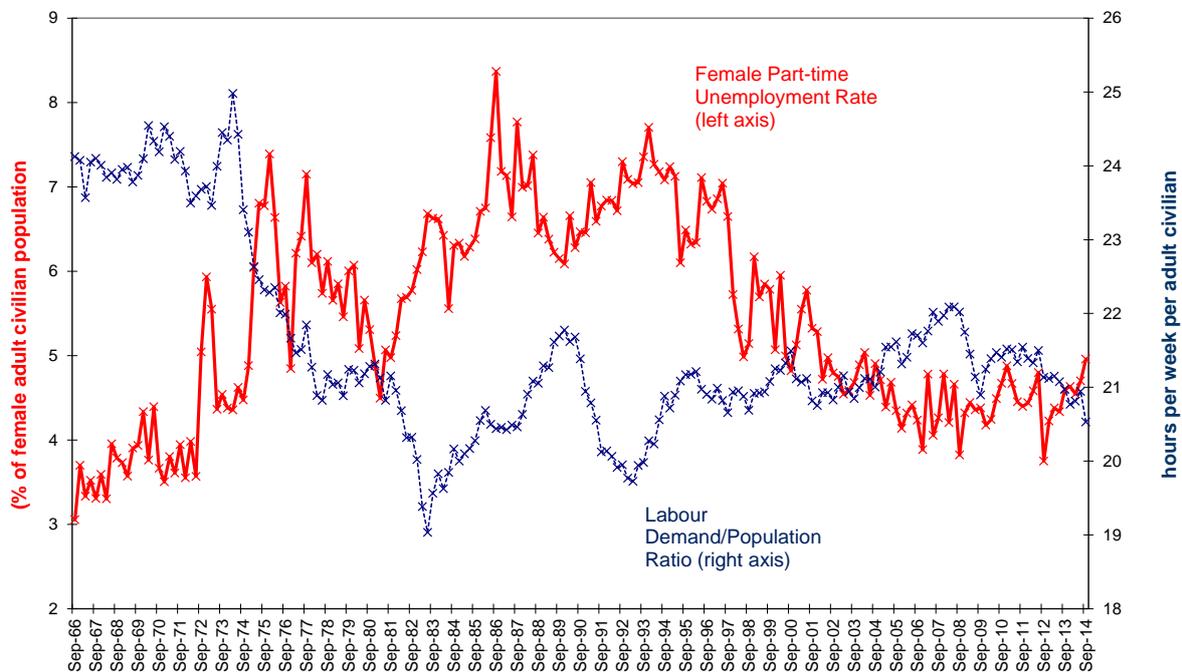
Source: The female part-time unemployment rate was calculated from seasonally adjusted estimates in ABS (2014), *Labour Force, Australia, Detailed, November 2014*, Cat. No. 6291.0.55.001, with adjustments for ABS Labour Force Survey redefinitions as explained in Connolly (2008). Data are for the middle month of each quarter (i.e., February, May, August and November). See Appendix A for an explanation of the construction of the variable for the labour demand to population ratio.

As can be seen from Figure 2, there is a negative relationship between the female part-time unemployment rate and the overall labour demand/population ratio. The correlation coefficient between these two variables, using the sample period of August 1966 through

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[3] i.e., for the whole labour market.

[4] The only direct feedback effect that could conceivably arise is from the denominator of the female part-time unemployment rate being the female part-time labour force, which is a small component of the adult population (the denominator for the overall labour demand/population ratio). However, an increase (or decrease) in the female part-time labour force is highly unlikely to cause an increase (or decrease) in the adult population.

August 2014, was -0.64. The statistical significance of this negative relationship between these two variables was explored by estimating two simple auxiliary regressions with the female part-time unemployment rate as the dependent variable and a constant term and the overall labour demand/population ratio (contemporaneous in the first regression and lagged by one quarter in the second regression) as the explanatory variables. The equation with the lagged overall labour demand/population ratio was estimated to reduce the already slim probability of simultaneity bias between the two variables even further. The results for the equation with the contemporaneous overall labour demand/population ratio, and then the equation with the lagged overall labour demand/population ratio, were:

$$\text{URFPA}_t = \quad 18.2 \quad - \quad 0.591*\text{LDP}_t \tag{2}$$
$$\quad\quad (16.4) \; (-11.5)$$

Sample Range: 1966Q3 to 2014Q3 (193 observations);   F-statistic = 133
Durbin-Watson Statistic = 0.29; Standard error of regression = 0.914
Mean of dependent variable = 5.42; Standard deviation of dependent variable = 1.19
R-squared = 0.411;   Adjusted R-squared = 0.408
Condition(X) number = 33.6

$$\text{URFPA}_t = \quad 17.9 \quad - \quad 0.579*\text{LDP}_{t-1} \tag{3}$$
$$\quad\quad (16.2) \; (-11.3)$$

Sample Range: 1966Q4 to 2014Q4 (193 observations);   F-statistic = 128
Durbin-Watson Statistic = 0.28; Standard error of regression = 0.912
Mean of dependent variable = 5.43; Standard deviation of dependent variable = 1.18
R-squared = 0.402;   Adjusted R-squared = 0.399
Condition(X) number = 33.6

In both equations (2) and (3), the numbers in parentheses underneath the coefficient estimates are the estimated t-statistics. The subscript 't' refers to the time period (in quarters) and:
URFPA_t is the female part-time unemployment rate (as a per cent of the female part-time labour force); and
LDP_t and LDP_{t-1} are the overall labour demand/ ratio, contemporaneously and lagged one quarter respectively.

The results for both these auxiliary regressions are very similar: the negative relationship between the female part-time unemployment rate and the overall labour demand/population ratio is statistically significant at a high probability (at better than the one per cent level of statistical significance). This indicates that the labour market is unlikely to fit alternatives (1) or (2). For different reasons in each of these, a significant negative relationship between these two variables would not be expected.

The key implication of these two assessments (of the variables shown in Figures 1 and 2) is that alternative (3) for the labour market structure is the most likely to apply to the female part-time labour force for the period since the mid-1960s. Further, the encouraged/discouraged worker effect is likely to be somewhere between zero and one. The closeness of the relationship between the participation rate and the employment-

population ratio implies that it is likely to be closer to one than zero. However, since there is a possibility of simultaneity bias between these two variables, then it is prudent to use estimation techniques (such as Two Stage Least Squares estimation or other Instrumental Variables techniques or lagging the employment-population ratio) to reduce this simulataneity bias.

4. DATA

Based largely on past findings in the literature, but also on the availability of Australian data, we constructed relevant aggregate data series to conduct a quantitative analysis of the determinants of the female part-time participation rate. Variables representing female part-time labour force participation, the encouraged/discouraged worker effect, educational participation, the child dependency ratio, real childcare costs, the real unemployment benefit payment rate and the incidence of long-term unemployment, as well as some additional variables that were not included in the final equations, are described below. Technical details are provided in Appendices A, B and C.

4.1   Female Part-Time Participation Rate

The labour force participation rate, as defined by the Australian Bureau of Statistics (ABS), is the percentage of the civilian population aged 15 years or over who are in the civilian labour force (whether employed or unemployed). The female part-time participation rate is further defined as the percentage of the female civilian population aged 15 years or over who are either employed part-time or are unemployed and looking for part-time work.

The female part-time participation rate series was not adjusted for demographic effects as, unlike for the female full-time series (see Connolly and Trott, 2014), the demographic effects influencing the female part-time participation rate tend to cancel each other out. This occurs because there is a high proportion of both youth and mature-age women in the female part-time labour force. Further information on demographic effects on the female part-time participation rate is contained in Appendix A.

4.2   Female Part-Time Employment Rate (Encouraged Worker Effect)

The employment-population ratio is used to represent the encouraged worker effect, which we expect to have a significant positive effect on the female part-time participation rate. Figure 1 above illustrated the correlation between the female employment-population ratio and the female part-time participation rate, with a flattening in both series observed over recent years.

The encouraged worker effect occurs when people enter the labour force during good economic times as they perceive their chances of finding employment to have improved. In the same way, a discouraged worker effect occurs during economic downturns as potential workers withdraw from the labour force rather than continue their search for work.

Connolly and Badhni (1998) found that the female part-time employment to population rate had a significant positive effect on female part-time participation in Australia, indicating a strong encouraged worker effect.

Given the two series are closely linked by identity (1), using the actual employment-population ratio as an explanatory variable for the participation rate can lead to simultaneity or endogeneity bias in the econometric estimates. Connolly and Trott (2014) used fitted values of the employment-population ratio from an Instrumental Variables estimation, instead of the actual variables for the employment-population ratio, in order to reduce the potential for endogeniety or simultaneity bias in their estimates for the female full-time participation rate. The same method is utilised in this study for the female part-time participation rate. The preferred estimate for this equation is provided in Appendix B.

4.3   *Educational Participation Rate*

Educational participation is expected to have a positive effect on female part-time labour force participation. It possible for young women to combine education with part-time labour force participation and, for many young women participating in tertiary education, there is a financial imperative to participate in the part-time labour force. Connolly and Badhni (1998) found a significant positive effect of the female Year 12 retention rate on female part-time participation in Australia, while the female tertiary educational participation rate was not found to be significant. The preferred variable used in this study is the combined (secondary and tertiary) educational participation rate for females aged 15-24 years. The series is shown in Figure 3 overleaf. However, this variable could only be extended back to the March quarter 1975 and so, for alternative regressions with a longer sample period, the female retention rate to Year 12 in school was used instead (since it was available back to the mid-1960s).

Figure 3: **Educational Participation Rate for Women and Girls aged 15-24 Years**
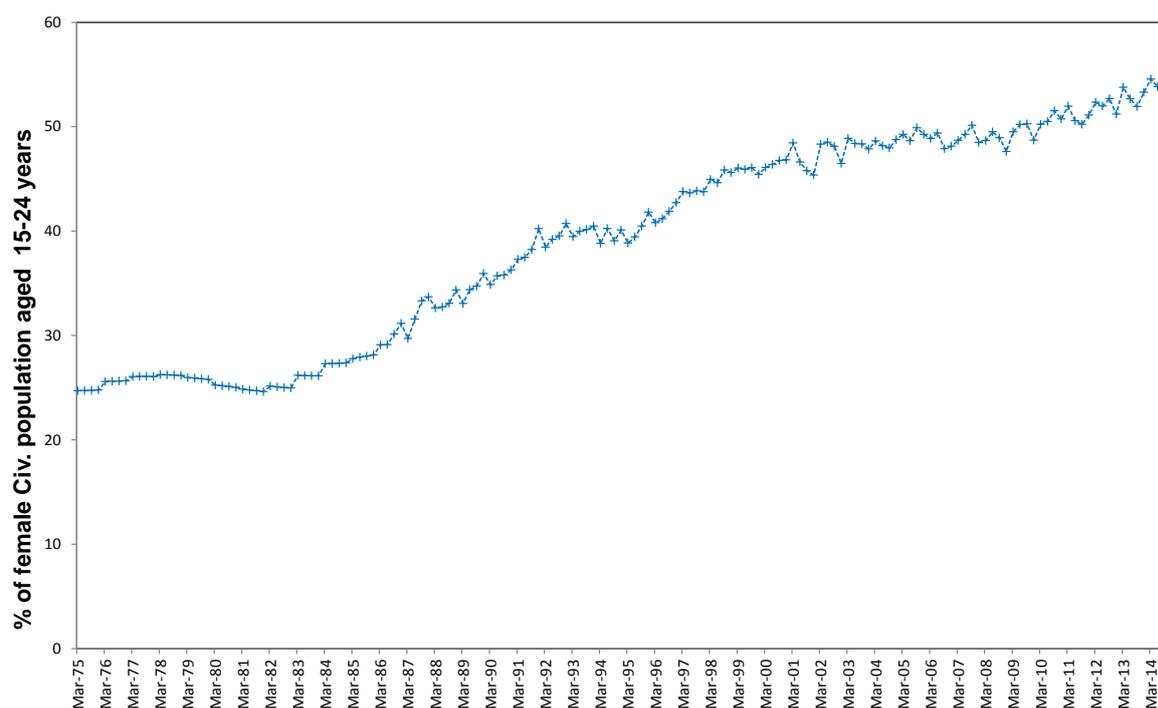

Sources: ABS Labour Force Survey (*Labour Force, Australia, Detailed, Electronic Delivery*, ABS Cat. No. 6291.0.55.001 back to April 1986, spliced with DEETYA data before then (see Appendix A for further details).

Combining the school and tertiary educational participation rates was considered sensible, especially for teenagers, because there have recently been structural breaks in the teenage school and tertiary educational participation rates as a result of State and Territory Government policies to increase the school leaving age from 15 years to 17 years.

4.4   Ratio of Pension to Unemployment Allowance Payment Rates

The ratio of pension to unemployment allowance payment rates is expected to have a negative effect on the female part-time participation rate. Pensions, such as the Disability Support Pension, and income-support payments which are paid at the pension payment rate such as Carer Payment, are generally not activity tested and so people paid at this rate would not usually be expected to participate in the labour force. In contrast, receipt of Newstart Allowance and other unemployment allowances including Youth Allowance (Other than Full-time Students) entails a requirement to undergo activity testing or to obtain an exemption from activity testing (such as for reasons of incapacity). Therefore, people receiving unemployment allowances would generally be expected to participate in the labour force. A higher pension payment rate, relative to the unemployment allowance payment rate, is likely to induce some women to leave the part-time labour force (or refrain from entering it) because if they are able to obtain the pension instead of an unemployment allowance, they would receive a higher rate of payment without a requirement for labour force participation. Patterns in this ratio are shown in Figure 4 overleaf.

Figure 4: **Ratio of Pension to Unemployment Allowance Payment Rates**
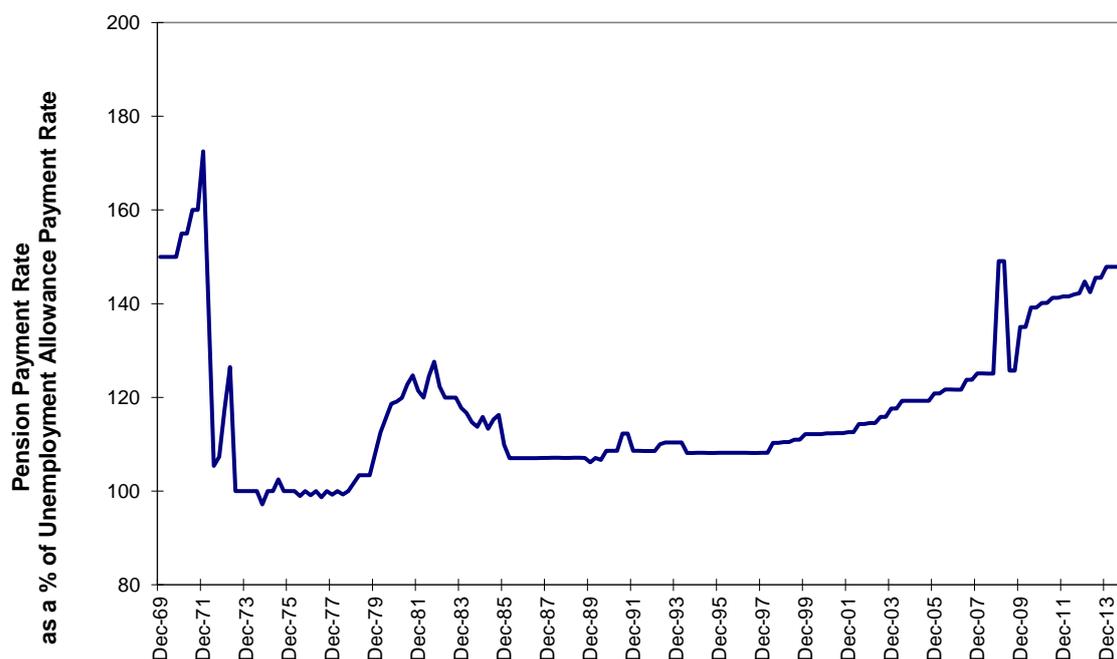
Sources: See Appendix A for explanation.

4.5   *Child Dependency Ratio*

A lower child dependency ratio would be expected to increase the labour force participation of females. The presence of young children has been found to have a significant negative effect on female labour force participation in Australia (Evans and Kelley 2008; Gong 2010). Rammohan and Whelan (2007) found a significant negative effect of the number of young children on both part-time and full-time female employment in Australia, with the effect found to be greater for part-time employment. The alternative versions of this variable used in this study are:

1) the ratio of the number of children aged 0-5 years to the number of women aged 15-54 years (variable CDF005)
2) the ratio of the number of children aged 6-14 years to the number of women aged 15-54 years (variable CDF614)
3) the ratio of the number of children aged 0-14 years to the number of women aged 15-54 years (variable CDF014).

Alternatives 1) and 2) were tested because as shown in the literature review, it is possible that the presence of dependent children aged below school-attendance age could have a larger dampening effect on female labour force participation than the presence of school-aged dependent children. However, if these two effects can't be distinguished from each other, the combined ratio presented as alternative 3) above would be most suitable.

4.6   Long-Term Unemployment Incidence (Indirect Discouraged Worker Effect)

Long-term unemployment incidence refers to the number of persons unemployed for one year or longer as a proportion of total unemployment. The incidence of long-term unemployment is expected to have a negative effect on female participation in the part-time labour force. The growth in the incidence of long-term unemployment represents a weakening in labour market conditions and may result in people becoming discouraged in their search for employment, instead choosing to withdraw from the labour force until labour market conditions improve.

4.7   Childcare Affordability

Real childcare fees are expected to have a negative effect on female participation in the labour force. While many Australian studies have found the effect of childcare costs to be insignificant, Breunig et al (2012) state that measurement error in the price of childcare can explain why previous Australian studies have found partnered women's labour supply to be unresponsive to childcare prices. Using improved price data, the authors found a statistically significant negative elasticity of partnered women's labour force participation with respect to the price of childcare. Connolly and Trott (2014) also found real childcare fees had a statistically significant negative effect on female full-time participation in Australia. The series is shown in Figure 5 below.

Figure 5: **Real Childcare Fees in Australia**
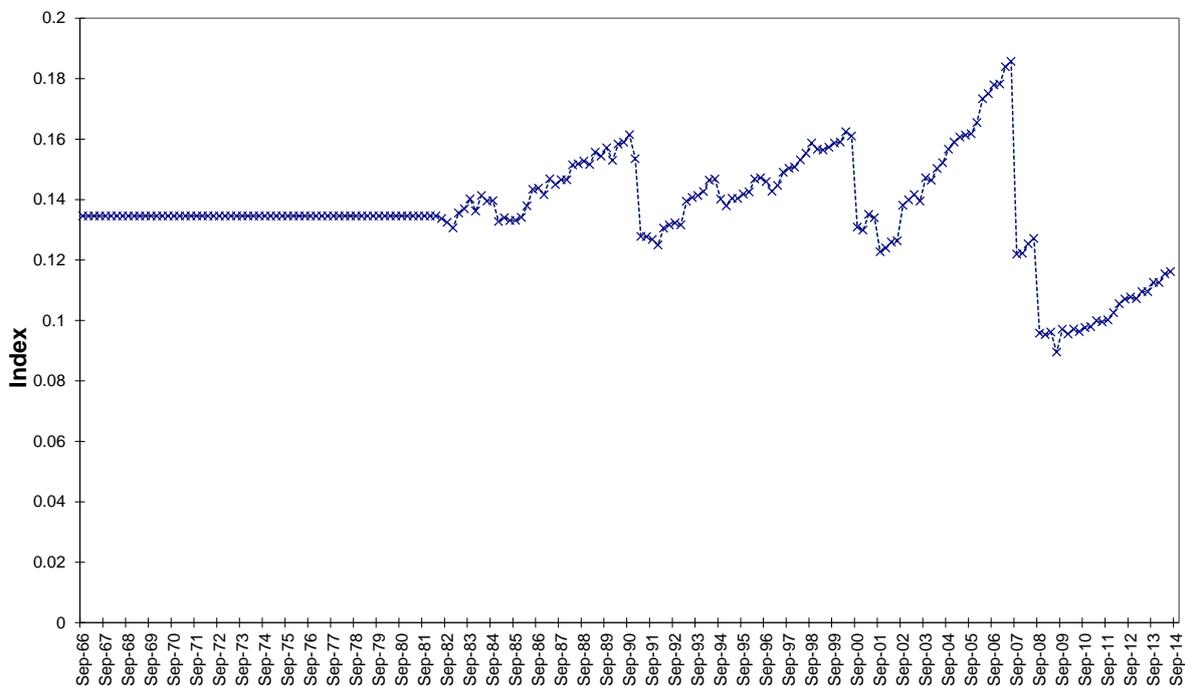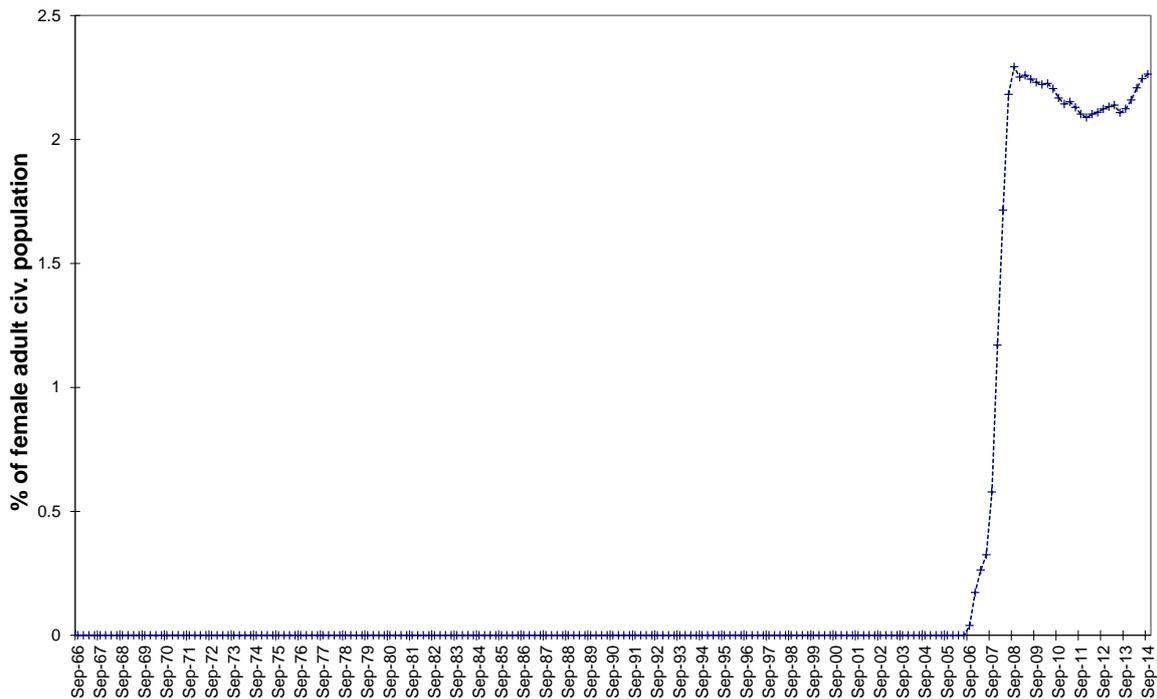

Source: See Appendix A.

The ABS series for net childcare costs is only available from March quarter 1982 and real childcare costs were assumed to be unchanged before then for the series shown in Figure 5 and used in the analysis.

4.8   Stock/Population Ratio for the Female Welfare to Work Target Group

The proportion of the female Welfare to Work Target Group Stock in the female adult civilian population aged 15 years or older (see Appendix A for definitions) is expected to have a positive sign. The Welfare to Work policy introduced new part-time participation requirements for members of these target groups. Thus, it is expected that an increase in the number of people in these target groups with respect to the overall population, would increase the part-time participation rate. Developments in this variable are shown in Figure 6 below. Further details can be found in Appendices A and C.

Figure 6: **Stock/Population Ratio for the Female Welfare to Work Target Group**

Source: See Appendix A.

4.9   Real Expected Returns to Labour Force Participation

Connolly and Badhni (1998) estimated that the female part-time participation rate responds positively to the expected after-tax real wage. A more sophisticated version of this variable, the real expected return to labour force participation, was used instead in the current analysis. This variable was constructed as the average of after-tax wages and unemployment benefits, weighted by the relative numbers of employed and unemployed. Details of the compilation of the data series are provided in Appendix A.

4.10   Ratio of Female to Male Average Weekly Earnings

As shown in the literature review in Section 2 of this paper, several authors in both Australia and overseas developed countries have estimated that a rise in female earnings, relative to male earnings, would have a positive effect on female participation in the labour force. This is expected to apply to the part-time labour force and not just the full-time labour force and

so a relative wage variable was calculated for the current analysis and a positive response to this variable is expected. That is, given a relative real wage rise, the incentive to supply more labour would be more lucrative in the female part-time worker market, than the incentive to opt for more leisure[5] (and supply less labour). Details of the compilation of the data series are provided in Appendix A.

4.11   Marginal Income Tax Rate

The marginal income tax rate refers to the amount of tax paid on an additional dollar of income. High marginal income tax rates may create a disincentive to increase labour force participation. The ratio of the female part-time marginal income tax rate to the female full-time marginal income tax rate is expected to have a negative effect on female part-time participation. Sundström and Stafford (1992) found that an increase in the marginal tax rate for full-time workers relative to part-time workers led to a rise in female part-time employment in Sweden. Details of the series used in this study can be found in Appendix A. The series is shown in Figure 7 below.

Figure 7:   **Ratio of Female Part-time to Full-time Marginal Income Tax Rate in Australia**
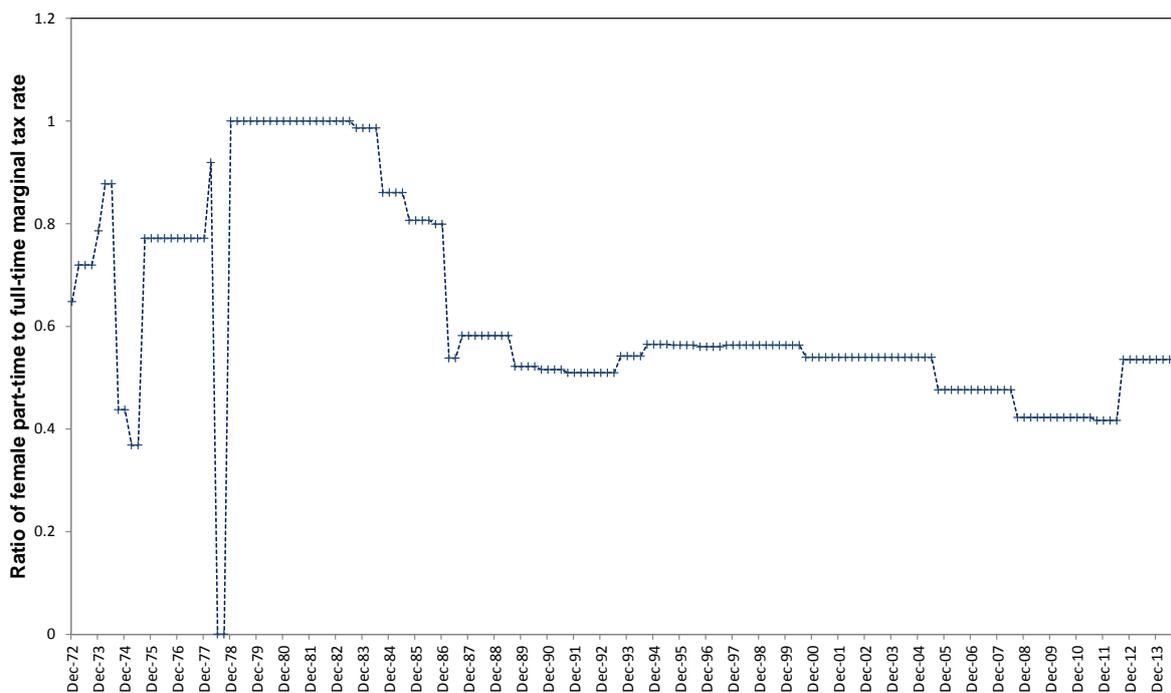
Sources: See Appendix A.

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[5] Leisure is used here in the strict economic theory sense, which comes from the development of the Consumption Leisure Trade-Off. That is, the use of leisure is not intended to mean only 'pleasurable' activities; rather it includes any activity which is not paid employment. This may include, for example, voluntary work or caring for one's own children.

4.12   Paid Parental Leave

A relatively unsophisticated variable was constructed to assess the potential effect of universally available, Government-provided Paid Parental Leave on the female part-time participation rate in Australia. The variable that was constructed is a dummy variable which is equal to zero before the introduction of the Australian Government's Paid Parental Leave scheme in the March quarter of 2011 and equal to one from this quarter onwards. This variable is relatively unsophisticated, because before this time, paid parental leave was available for many working parents, but provided by employers rather than the Australian Government. However, it was not possible to construct a consistent, reliable and sufficiently long time series of the percentage of workers covered by employer-provided paid parental leave to enable a more sophisticated variable to be generated.

5.   ECONOMETRIC ESTIMATION OF THE DETERMINANTS OF THE FEMALE PART-TIME PARTICIPATION RATE

The first step in estimation of the female part-time participation rate was to examine whether this series and its explanatory variables have unit roots. An extensive series of tests for unit roots, both on the null hypothesis of no unit root (KPSS[6] test) and a null hypothesis of a unit root (Augmented Dickey-Fuller test and Weighted Symmetric Tau test) were conducted, with the results shown in Appendix D. The testing showed that the dependent variable was highly likely to be integrated of the first order, I(1), but not the second order, I(2). The testing also showed that both the actual and fitted female employment-population ratio and the other explanatory variables, for both the participation rate equation and the Instrumental Variables equation (presented in Appendix B) for the female part-time employment-population ratio, are likely to be at most I(1). The testing also showed that both of these dependent variables are likely to be cointegrated with their explanatory variables.

Since the series are co-integrated, an Engle-Granger two-step estimation procedure was followed[7]. The first-step is to estimate the regression in levels to determine the long-term relationship. The second step is to re-estimate the equation in changes, and include the lagged estimated error term from the first step as one of the explanatory variables.

The variables for the ratio of female to male average weekly earnings, the ratio of female part-time to full-time marginal income tax rates and Paid Parental Leave were estimated to be insignificant and were not included in the preferred equation. Further, the variable for the Welfare to Work policy changes was also excluded as it was found to be either insignificant or, in regressions where the variable had a significant t-statistic, the estimated coefficient did not have the plausible sign. Also, the combined child dependency ratio (i.e., 0-14 years) was estimated to perform better than both ratios (0-5 years and 6-14 years) included as separate explanatory variables in the equation.

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[6] See Kwiatkowski et al. (1992).

[7] The use of the Engle-Granger procedure rather than the Johansen-Juselius matrix cointegration method is explained in Connolly and Badhni (1998) for the female part-time participation rate equation and in Connolly and Trott (2014) for the female full-time participation rate.

The preferred first-stage (long-run) regression was estimated to be:

$$PRFPA_t = 12.8 + 0.788*EPRFPAFI_t + 0.0340*ERTF154Q_t - 7.76*CDF014_t$$
$$(7.62) \quad (13.4) \quad\quad (1.96) \quad\quad\quad (-6.38)$$

$$- 1.69*LTUI_{t-1} - 0.0117*PENUB_t - 6.93*CCHILDCF_{t-4} \quad\quad\quad (4)$$
$$(-2.77) \quad\quad (-3.73) \quad\quad\quad (-4.76)$$

Sample Range: 1976Q1 to 2014Q3 (155 observations);   F-statistic = 6308
Durbin-Watson Statistic = 1.11; Standard error of regression = 0.258
Mean of dependent variable = 21.4; Standard deviation of dependent variable = 4.05
R-squared = 0.996;   Adjusted R-squared = 0.996
Condition(X) number = 270
T-statistics in parentheses under coefficients. Subscript t refers to the time period (in quarters).

where:
$PRFPA_t$ is the female part-time participation rate (per cent of civilian female population);
$EPRFPAFI_t$ is the female part-time employment to population ratio;
$ERTF154Q_t$ is total educational participation rate (school and tertiary) for women
  aged 15-24 years;
$CDF014_t$ is the child dependency ratio (the ratio of the number of children aged 0-14 years
   to the number of females aged 15-54 years);
$LTUI_{t-1}$ is the long-term unemployment incidence, lagged one quarter;
$PENUB_t$ is the ratio of pension to unemployment benefit payment rates;
$CCHILDCF_{t-4}$ is the index of childcare costs relative to average after-tax earnings, lagged four
   quarters.

The overall level of explanation in the first-stage regression is quite high at 99.6 per cent. The Durbin-Watson statistic is low and provides a signal of positive serial correlation, while the condition(X) number of 270 suggests a severe level of multi-collinearity among the explanatory variables. The presence of serial correlation and multi-collinearity among the regressors indicates that the t-statistics may be unreliable.

The second stage of the Engle-Granger procedure consists of regressing the change in the participation rate on the changes in the explanatory variables in equation (4), the lagged error term from equation (4) and other explanatory variables which would affect the short-term but not the long-term relationship.

The variable for real childcare fees was found to be insignificant in the second-stage regression. The preferred second-stage (short-run) regression was estimated to be:

$$\Delta(PRFPA_t) = 0.0271 - 0.502*UPRFPA_{t-1} - 0.119*\Delta(PRFPA_{t-4}) + 0.354*\Delta(EPRFPAFI_t)$$
$$(0.98) \quad (-7.02) \quad\quad (-1.75) \quad\quad (2.85)$$

$$+ 0.0336*\Delta(ERTF154_t) - 13.2*\Delta(CDF014_t) - 1.62*\Delta(LTUI_{t-1})$$
$$(1.70) \quad\quad (-1.38) \quad\quad (-1.32) \quad\quad (5)$$

Sample Range: 1976Q2 to 2014Q3 (154 observations); F-statistic = 10.6
Durbin-Watson Statistic = 2.04; Standard error of regression = 0.219
Mean of dependent variable = 0.0759; Standard deviation of dependent variable = 0.257
R-squared = 0.302;   Adjusted R-squared = 0.274
Condition(X) number = 3.00.
T-statistics in parentheses under coefficients. Subscript t refers to the time period (in quarters).

where:
$UPRFPA_{t-1}$ is the lagged error term from equation (4);
$\Delta()$ is the first difference operator; and
other variables are as defined in equation (4).

The coefficient on the error-correction mechanism (the residual from the long-run equation) is significant and correctly-signed. This suggests that adjustments towards the long-term participation rate are important in determining the short-term changes in female part-time participation. The adjustment parameter value of -0.502 indicates that half of the adjustment towards the long-run values of the variables appears to take place within a quarter. However, since the variable for real childcare fees in the long-run equation is itself lagged by a year, most of the total adjustment to changes in the current values of variables would appear to take place within two years.

An alternative first-stage equation was estimated, with the female part-time unemployment rate, lagged one quarter to reduce the potential effect of simultaneity bias, used as the main indicator of the encouraged/discouraged worker effect instead of the Instrumental Variables estimate of the female part-time employment-population ratio. This alternative was also estimated as a robustness check on the preferred equation. Also, some slightly different variables to allow a longer time series to be used (for example, the female retention rate to year 12 in schools was used as a proxy variable for the female educational participation rate because it was available for a longer period). The longer time series and the different variable for the main encouraged/discouraged worker effect also meant that some variables which were insignificant and dropped from the preferred equation became significant and were retained in the alternative version. In particular, extending the sample period back to mid-1973 allows the incorporation of data for relative female/male wages at a time when the ratio was lower than any time since the mid-1970s and so a significant response with the expected positive sign was estimated. The results for the long-run equation in the alternative version of the model are as shown overleaf:

$$PRFPA_t = 29.4 + 0.991*RERLF_{t-1} - 25.7*CDF014_t + 6.54*RAWOTEFM_t + 0.0631*RR12SF_t$$

$$(8.55) \quad (10.3) \quad (-16.3) \quad (6.38) \quad (8.31)$$

$$- 0.217*URFPA_{t-1} - 6.03*LTUI_{t-1} - 0.0290*PENUB_t + 6.58*CFTBPR_t - 9.64*CCHILDCF_{t-4}$$

$$(-4.05) \quad (-7.58) \quad (-4.19) \quad (2.89) \quad (-4.00) \quad (6)$$

Sample Range: 1973Q2 to 2014Q3 (166 observations);   F-statistic = 2119
Durbin-Watson Statistic = 0.69; Standard error of regression = 0.407
Mean of dependent variable = 20.9; Standard deviation of dependent variable = 4.39
R-squared = 0.992;   Adjusted R-squared = 0.991
Condition(X) number = 390
T-statistics in parentheses under coefficients. Subscript t refers to the time period (in quarters).

where:
$RERLF_{t-1}$ is the real expected return to being in the labour force (the average of wages and
unemployment benefits, weighted by the relative numbers of employed and
unemployed), lagged one quarter;
$RAWOTEFM_t$ is the ratio of female to male average weekly earnings;
$URFPA_t$ is the female part-time unemployment rate;
$CFTBPR_t$ is the real family tax benefit payment rate (i.e., relative to the female AWOTE
wage);
and other variables are as defined in equations (4) and (5).

This alternative is not the preferred specification for several reasons. As mentioned above, the educational participation variable is only a proxy. Also, extending the sample period back by another three years necessitated assuming that real childcare fees were constant for a further three years back in time. Also, the absolute value of the estimated coefficient (i.e., 0.217) on the main variable representing the encouraged/discouraged worker effect seemed implausibly low.

The results are qualitatively similar, although the coefficients on some of the common variables (particularly the child dependency ratio and long-term unemployment) are larger. The results indicate the possibility that financial incentives and disincentives (as represented by real returns from being in the labour force, the ratio of female to male wages and the real family tax benefit payment rate) may be more significant than would appear from the preferred specification.

The long-run elasticities at the means of the dependent and explanatory variables were calculated for both the preferred (equation 4) and alternative (equation 6) long-run equations and are presented in Table 1.

Table 1: **Long-run Elasticities of the Female Part-time Participation Rate**

Variable	Elasticity in Preferred Model (equation 4)	Elasticity in Alternative Model (equation 6)
Female Part-time Employment-Population Ratio (fitted) (EPRFPAFI)	0.74	n.e.
Female Part-time Unemployment Rate (URFPA)	n.e.	-0.059
Educational Participation Rate (ERTF154Q)	0.063	n.e.
Retention Rate to Year 12 at School (RR12SF)	n.e.	0.20
Child Dependency Ratio (CDF014)	-0.28	-0.98
Incidence of Long-term Unemployment (LTUI)	-0.017	-0.060
Ratio of Pension to Unemployment Benefit Payment Rates (PENUB)	-0.064	-0.16
Real Childcare Costs (CCHILDCF)	-0.044	-0.063
Expected Return to being in the Labour Force (RERLF)	n.e.	0.41
Relative Female/Male Wage (RAWOTEFM)	n.e.	0.26
Real Family Tax Benefit Payment Rate (CFTBPR)	n.e.	0.048

Note: n.e. denotes not estimated in the final version of the equation because not significantly different from zero or of an implausible sign or magnitude in a preliminary equation, or not part of the formulation of the preferred or alternative model.

As can be seen from Table 1, the elasticity with respect to the female part-time unemployment rate in the alternative version of the long-run equation is implausibly low at around -0.06, especially in light of the findings of Section 3 of a strong link between labour demand and the female part-time unemployment rate.

Interestingly, the coefficient (and therefore the elasticity) with respect to the real Family Tax Benefit payment rate is positive, implying that higher real payment rates for Family Tax Benefit are associated with higher female part-time participation rates. In interpreting this result, it is useful to take note of the finding of Connolly and Trott (2014) that higher real payment rates for Family Tax Benefit are associated with lower female full-time participation rates. A likely explanation for these combined findings is that higher real payment rates for Family Tax Benefit induce some women to move from the full-time labour force to the part-time labour force, or to remain in the part-time labour force when they would have otherwise moved to the full-time labour force.

All of the responses are estimated to be inelastic, except for the response to the child dependency ratio in the alternative version of the model, which is estimated to be unit elastic. Nevertheless, the elasticities for most of the explanatory variables are higher, in absolute terms, in the alternative version of the long-run equation.

6. DISCUSSION AND CONCLUSIONS

The determinants of the female part-time participation rate were found to include the fitted female part-time employment-population ratio (representing the encouraged worker effect), the incidence of long-term unemployment, the child dependency ratio, real

childcare costs, the educational participation rate and the ratio of pension to unemployment benefit payment rates. All of these explanatory variables were statistically significant and had the expected sign in the preferred long-term equation.

A strong encouraged worker effect was estimated in the long-run. The estimated coefficient implies that for every five part-time jobs created, nearly four more women will join the part-time labour force. The effect is also significant in the short-run, but the coefficient is less than half the size.

Female educational participation also had a positive impact on the participation rate. Unlike the encouraged worker effect, the short- and long-run effects were very similar in size. However, quantitatively this effect is fairly small, with nearly five additional enrolments in education needed for every one part-time labour force entrant.

The child dependency ratio was negative in both the preferred long-run and the short-run equations. Surprisingly, the short-run coefficient was actually larger, although it was not statistically significant. Using the long-run coefficient, one extra child per ten women would lead to about 20,000 women exiting the part-time labour force.

The incidence of long-term unemployment (representing an indirect discouraged worker effect) had a negative effect on participation, of very similar size in the short- and long-run (although again the short-run coefficient was not statistically significant). A rise of one-third in this ratio (roughly the range observed in our data) would lead to around 15,000 women exiting the part-time labour force in the long run.

The gap between pension and unemployment benefit payment rates has a negative effect on participation. A rise in this ratio of 50 per cent (again roughly the observed range) would also lead to about 15,000 women exiting the part-time labour force.

Real childcare fees are estimated to have a significant and negative effect on the female part-time participation rate in the long-run. A fall of 30 per cent in fees (equivalent to the introduction of Child Care Rebate) would bring about 35,000 women into the part-time labour force. This variable was insignificant in the short-run.

Some other policy-relevant variables were estimated to be statistically significant in the alternative version of the long-run equation (which has a longer sample period and has the female part-time unemployment rate instead of the female part-time employment-population ratio as the main indicator of the direct encouraged/discouraged worker effect). These were the Real Expected Return to being in the Labour Force, the Ratio of Female to Male AWOTE wages and the Real Family Tax Benefit Payment Rate. Each of these three variables represents some aspect of the financial incentive to participate in the female part-time labour force. Another noteworthy aspect of the alternative long-run equation is that the estimated elasticities were higher than in the preferred long-run equation, except for the variable representing the direct encouraged/discouraged worker effect, where the elasticity was implausibly low. Collectively, these results indicate that financial incentives/disincentives to participate, educational participation and the child dependency ratio may possibly be more important that is apparent in the preferred set of equations.

Nevertheless, the response of the female part-time participation rate to almost all of the explanatory variables, in both the preferred and alternative long-run equations, was estimated to be inelastic. This indicates that although the female part-time participation rate responds to a relatively wide range of influences, it is not very responsive to any particular driver.

Another aspect of the findings is that several policy-relevant variables were not included in the preferred or alternative versions of the set of equations, generally because they were statistically insignificant, but occasionally because they were estimated to have an implausible sign. Notably, this applies to the percentage of the female adult civilian population activated by the Welfare to Work policy changes of mid-2006, the ratio of the marginal income-tax rate of female full-time workers to the marginal income-tax rate of female part-time workers and the dummy variable for universal, government-provided Paid Parental Leave. These findings should not be interpreted as these policies having no effect on the female part-time participation rate, but rather, that we were not able to detect a significant and plausible effect of these policies on the female part-time participation rate with the methods and explanatory variables we used. There are several reasons for this caution about our findings. The most important is that there is very high collinearity among the explanatory variables in both the preferred and alternative versions of the long-run equation. This statistical problem means that it can be difficult to distinguish the separate influence of each of the explanatory variables on the dependent variable and so particular explanatory variables can appear to be statistically insignificant when indeed they are significant. Another reason for caution is that lack of good-quality data meant that some variables, particularly the one for Paid Parental Leave, were relatively unsophisticated. A similar problem applied to the variable for relative marginal income tax rates. This was only a proxy for the ideal variable, which is relative <u>effective</u> marginal income tax rates, but it was unfeasible to construct the latter variable at the level of the overall labour market, given the large number of changes in income-support and family benefits settings for different family types and their interactions with the wage and tax systems.

It is also interesting to consider what our results indicate about the almost 12 percentage points rise in the female part-time participation rate from 1976 to 2014. Using the preferred long-run equation (4), 76 per cent of this rise was accounted for by the encouraged worker effect, 20 per cent by the fall in the child dependency ratio, and 8 per cent by rising educational participation. The other variables either had negligible effects or worked the 'wrong way' – that is, they changed in a way that would be predicted to have a negative effect on the participation rate (e.g. the fall in the value of unemployment benefits relative to pensions). In the alternative long-run equation (6), by contrast, it is the child dependency and educational participation variables which explain most of the rise (67 and 27 per cent respectively), with the encouraged worker effect only accounting for 2 per cent.

Overall, a takeaway message from these results is that in order to raise the female part-time participation rate, it is important to improve the macroeconomic and overall labour market situation as much as feasible, including through appropriate macroeconomic policies. This is because such policies affect the encouraged/discouraged worker effect, both directly through the female part-time employment-population ratio[8] and indirectly through the

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[8] Or through the female part-time unemployment rate in the alternative version of the long-run equation.

incidence of long-term unemployment, which is the key driver of the female part-time participation rate. While many microeconomic policies, such as policies to improve the affordability of childcare, have a potentially useful role to play in raising the female part-time participation rate, it may be unwise to rely on them alone, given that they have been estimated in the current analysis to have a relatively inelastic effect on the female part-time participation rate.

## DEFINITIONS OF, AND DATA SOURCES FOR, VARIABLES

Female Part-time Participation Rate, Employment-Population Ratio and Unemployment Rate

These three variables were calculated for the female civilian population aged 15 years and above for the middle month of each quarter (i.e., February, May, August and November), using data from the ABS Labour Force Survey (monthly survey from February 1978 (*Labour Force, Australia, Detailed, Electronic Delivery*, ABS Cat. No. 6291.0.55.001) and quarterly for the middle month of each quarter beforehand (ABS, *Historical Labour Force Statistics*, ABS Cat. No. 6204.0)), adjusted for ABS Labour Force Survey redefinitions using the methods described in Connolly (2008). The employment-population ratio was expressed as a percentage (i.e., employment/population multiplied by 100), so that it was on the same basis as the participation rate and the unemployment rate. Seasonally adjusted data were used for all three variables.

Demographic Effects on the Female Part-time Participation Rate and Employment-population Ratio

The demographic effects on the female part-time participation rate and employment-population ratio are shown in Figure A.1. Both were calculated by multiplying the average female part-time participation rate, and employment-population ratio, respectively, throughout the sample period for each age group (15-19, 20-24, 25-34, 35-44, 45-54, 55-59, 60-64 and 65+ years) by that age group's share of the female adult (15 years and older) civilian population.

Figure A.1: **The Demographic Effects on the Female Part-time Participation Rate and Employment-population Ratio**
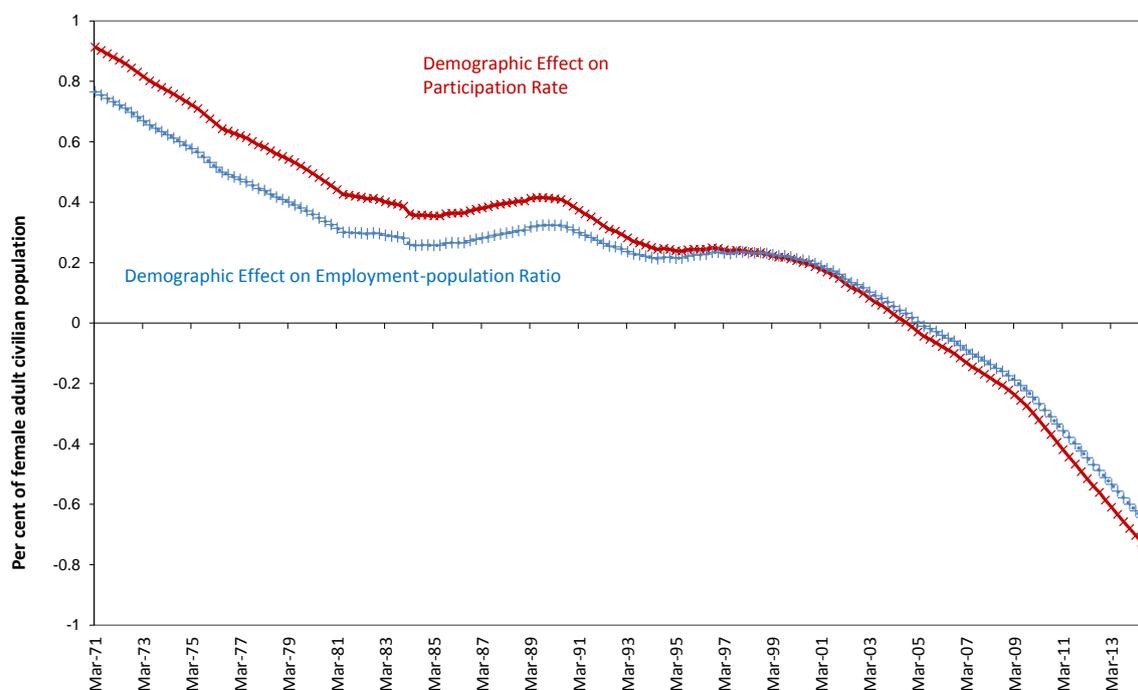
Source: constructed by the authors from ABS (2014), *Labour Force, Detailed, Electronic Delivery, November 2014*, ABS Cat. No. 6291.0.55.001 and ABS, *Historical Labour Force Statistics*, ABS Cat. No. 6204.0.

The downward demographic effect of ageing of the female adult population on the female part-time participation rate is relatively small, as it only represents a change of less than two percentage points over the period of almost five decades from September quarter 1966 to September quarter 2014, compared with a rise in the female part-time participation rate over this period of 18 percentage points. The demographic effect on the female part-time employment-population ratio is slightly smaller than for the participation rate.

Overall Labour Demand/Population Ratio

The overall labour demand/population ratio was constructed by the authors to reflect three aspects of labour demand: fulfilled headcount demand for labour in the form of employment, unfulfilled headcount demand for labour in the form of job vacancies, and changes in the demand for labour arising from changes in the average hours worked per week. The first two of these can be regarded as changes in demand for labour at the extensive margin, while the third can be regarded as changes in demand for labour at the intensive margin. The variable was calculated using the formula in equation A.1:

$$LDP = AHW * (E * JV/RWSE)/P \qquad\qquad\qquad (A.1)$$

Where LDP is the labour demand/population ratio (in hours of labour demand per week per adult civilian), AHW is average hours worked per week, E is total employment (in thousands), JV is ABS Job Vacancies (in thousands), RWSE is the ratio of non-farm wage and salary earners to total employment and P is the adult civilian population (in thousands). Since all of these variables are contemporaneous, the time subscripts have been removed for the sake of brevity.

The source for the Job Vacancies series is ABS (2014), *Job Vacancies, Australia, August 2014*, Cat. No. 6354.0 (and previous issues), from May 1979 through August 2014 (except for the period from August 2008 through August 2009, where the ABS did not publish this series and the econometric estimates of Connolly and Tang (2011) are used) and from ABS (2011), *Modellers' Database, Sep 2010*, ABS Catalogue Number 1364.0.15.003, from August 1966 through February 1979.

The source for the other variables on the right side of equation A.1 is the ABS Labour Force Survey monthly survey from February 1978 (*Labour Force, Australia, Detailed, Electronic Delivery*, ABS Cat. No. 6291.0.55.001) and quarterly for the middle month of each quarter beforehand (ABS, *Historical Labour Force Statistics*), with data for employment adjusted for ABS Labour Force Survey redefinitions using the methods described in Connolly (2008). The labour market and population data are for the civilian population aged 15 years and above for the middle month of each quarter (i.e., February, May, August and November).

An adjustment to the ABS Job Vacancies series was made by dividing it by the ratio of non-farm wage and salary earners to total employment, so that the estimate of unfilled labour demand would apply to the whole labour market and not just the parts of the labour market covered by the ABS Job Vacancies Survey. The ABS Job Vacancies Survey has very good coverage of job vacancies for non-farm wage and salary earners, but less coverage of other employment situations (the Agriculture, Forestry and Fishing industry is excluded from the Survey, as are some job opportunities for employed people who are not wage and salary earners (such as employers, the self-employed, and commission-only sales jobs).

Seasonally adjusted data were used for all variables, including job vacancies, but excepting the civilian population, which is in original terms (the ABS does not seasonally adjust the civilian

population because it has calculated that there is no significant seasonal pattern in the level of the adult civilian population).

Female Educational Participation Rate

From April 1986 onwards, monthly data on school and tertiary educational participation by women aged 15-24 years is available from the ABS Labour Force Survey (*Labour Force, Australia, Detailed, Electronic Delivery*, ABS Cat. No. 6291.0.55.001) in original terms. These data were seasonally adjusted and trended by staff of the Labour Economics Section of the Department of Employment. The participation rate was constructed by dividing the number of women aged 15-24 years who were participating in school and tertiary education in the reference week for the ABS Labour Force Survey by the civilian population of women aged 15-24 years, and then multiplying the result by 100 to express it as a percentage.

In order to obtain a sufficiently long and consistent time series for school and tertiary educational participation, the series was extended back by splicing it with data from the former Department of Employment, Education, Training and Youth Affairs on the full-time higher educational participation rate for females aged 17 to 19 years old and on the school educational participation rate for females aged 15 to 17 years (Department of Employment, Education and Training, 1993).

Child Dependency Ratio

The variables used in this study are the ratios of the number of children aged 0-5, 6-14 and 0-14 years to the number of women aged 15-54 years. Data are obtained from ABS (2015 and previous issues), *Australian Demographic Statistics,* ABS Cat. No. 3101.0.

Long-term Unemployment Incidence

Long-term unemployment incidence is defined as persons unemployed for one year or longer as a proportion of total unemployment. Data are obtained from the ABS Labour Force Survey (*Labour Force, Australia, Detailed, Electronic Delivery*, ABS Cat. No. 6291.0.55.001). This variable is expressed as a percentage by multiplying by 100.

Ratio of Pension to Unemployment Allowance Payment Rates

The indicator variable used for the pension payment rate is the maximum rate of payment of Disability Support Pension (and equivalent pensions such as the Invalidity Pension before the Disability Support Pension was introduced), while the indicator variable used for the unemployment allowance payment rate was the maximum rate of payment of Newstart Allowance (or the Unemployment Benefit before Newstart Allowance was introduced) for a single person aged 22 years or older. The ratio is calculated as the pension payment rate as a percentage of the unemployment allowance payment rates. Both payments are in original terms, current prices and $/fortnight and are obtained from Centrelink, "A Guide to Australian Government Payments", (www.Centrelink.gov.au) and DSS, "Guide to Social Security Law" (www.dss.gov.au).

Real Childcare Costs

This variable is calculated as childcare costs divided by average after-tax wages for women working full-time. The series used for childcare costs is the Consumer Price Index expenditure class 'Child care; Australia' (ABS Cat No. 6401.0, Table 7). To convert this variable to real terms, it is deflated by

after-tax Average Weekly Ordinary Time Earnings (AWOTE) for women working full-time[9]. Average female wages are taken from the ABS *Average Weekly Earnings* release (ABS Cat. No. 6302.0). Average wages are adjusted for both Pay As You Go (PAYG) taxes and also for occasional offsetting payments of tax bonuses. The formula in equation A.2 was used:

$$CCHILDCF_t = CHILDCF_t /[(AWOTEFO_t *(1-(TXPAYG_t +TXPAYG_{t-1})/2)+TXBONUS_t)] \qquad (A.2)$$

where $CHILDCF_t$ is the Consumer Price Index expenditure class 'Child care; Australia' (ABS Cat No. 6401.0, Table 7), $AWOTEFO_t$ is the Average Weekly Ordinary Time Earnings (AWOTE) for women working full-time (in original terms, but there is not a strong seasonal pattern in this series), $TXPAYG_t$ is the total PAYG tax receipts from the ABS NIF-10S data set on the *Modellers' Database* (ABS Cat. No. 1364.0.55.003), divided by the number of employees from the ABS Labour Force Survey (ABS Cat. No. 6291.0.55.003) with the variable with the subscript "t-1" lagged by one quarter, and $TXBONUS_t$ is calculated by the authors from Australian Government *Budget Papers* to reflect the one-off bonus payments made to taxpayers, specifically that paid in 2008-09 to low-income taxpayers in response to the Global Recession.

The series for real childcare fees is available from the March quarter 1982. The series was extended back to the June quarter 1972 by assuming a constant level for the variable between the March quarter 1982 and the June quarter 1972.

Real Expected Returns to Labour Force Participation

The variable representing the real expected return to labour force participation was constructed as the average of after-tax wages and unemployment benefits, weighted by the relative numbers of employed and unemployed, using the following formula:

$$RERLF_t = (UBEN_t * UR_t/100 + AENA_t * (1 - RTIND_t) * (1 - UR_t/100))/CPI_t \qquad (A.3)$$

Where:
$RERLF_t$ is the real expected return to being in the labour force;
$UBEN_t$ is the standardised unemployment allowance payment rate (for a single non-mature-aged adult (currently for those aged 22-59 years), with Rent Assistance assumed to be paid at one third of the maximum rate, in units of \$/week in current prices, and from the same sources as the variable for the ratio of pension to unemployment allowance payment rates;
UR_t is the overall unemployment rate;
$AENA_t$ is average [weekly] earnings on a National Accounts basis, from spreadsheet 17 (i.e., 136401500317.xls) in the NIF-10S data base in ABS (2014) *Modellers' Database, Sep Qtr 2014*, ABS Cat. No. 1364.0.15.003, seasonally adjusted and in units of \$/week in current prices;
$RTIND_t$ is the average rate of income tax paid by individuals, calculated from data in the ABS quarterly *National Accounts* (ABS Cat. No. 5206.0) as income tax payments by households divided by the sum of Compensation of Employees and Gross Mixed Income; and
CPI_t is the headline ABS Consumer Price Index (for All Groups).

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[9] The AWOTE data for this variable mostly come from the ABS *Average Weekly Earnings* publication (ABS Cat. No. 6302.0), but are interpolated (please contact the authors if you require further information about the interpolation process) for the recent quarters when the ABS did not collect and publish the data (the ABS moved from quarterly to biannual collection of this data set after May 2012).

Stock/Population Ratio for the Female Welfare to Work Target Group

The proportion of the female Welfare to Work Target Group Stock (see Appendix C for further details) in the female adult civilian population aged 15 years or older (obtained from the ABS Labour Force Survey (*Labour Force, Australia, Detailed, Electronic Delivery*, ABS Cat. No. 6291.0.55.001)), is used as the explanatory variable to reflect the effects of the Welfare to Work policy. This variable is also expressed as a percentage by multiplying by 100.

Ratio of Female Part-time to Full-time Marginal Tax Rate

This variable used in this study is the female part-time marginal tax rate divided by the female full-time marginal tax rate. The marginal tax rate on female Average Weekly Ordinary Time Earnings (AWOTE) is used for the female full-time marginal tax rate. This series was obtained from the ABS Average Weekly Earnings release (ABS Cat. No. 6302.0). For the recent quarters when this series has not been published by the ABS (which moved from producing it quarterly to producing it biannually after May 2012), it was estimated by the authors, who can provide details of their estimation procedure on request. For the female part-time marginal tax rate, we used a constructed measure of female part-time average weekly earnings. The constructed measure of female part-time earnings was calculated as female Average Weekly Ordinary Time Earnings multiplied by the ratio of part-time to full-time average hours worked for females.

Quarterly tax rates for each tax bracket composed of the income tax rate, and where applicable, the Medicare levy rate, the low-income tax offset and any temporary income tax levies[10]. The Medicare levy rate was applied on income above the Medicare levy threshold for a family with two dependent children (which is higher than the Medicare levy threshold for individuals).

Marginal *effective* tax rates take into account the interaction of the tax and social security systems. Payne et al (2007) suggest that the rise in partnered mothers' part-time employment in Australia over 1996 to 2013 might relate to the higher effective tax rates mothers face as they increase hours worked towards full-time employment. However, it was not feasible to construct a series of marginal effective tax rates for this study.

Ratio of Female to Male Average Weekly Earnings

The series for female and male Average Weekly Ordinary Time Earnings (AWOTE) were obtained from the ABS Average Weekly Earnings release (ABS Cat. No. 6302.0). For the few recent quarters when this series has not been published by the ABS (which moved from producing it quarterly to producing it biannually after May 2012), it was estimated by the authors, who can provide details of their estimation procedure on request.

The data from the ABS Average Weekly Earnings release (ABS Cat. No. 6302.0) are available back to the August quarter 1981. The series were extended back to November 1972 using annual data (for October of each year) from the Reserve Bank of Australia (RBA) *Australian Economic Statistics 1949-50 to 1994-95*, Occupation Paper No. 8. The data from the RBA were only available for male and female average weekly *total* earnings and were linearly interpolated to produce a quarterly series. We then constructed series for male and female average weekly *ordinary-time* earnings by multiplying the interpolated average weekly total earnings data by the ratio between ordinary-time and total earnings from the earliest available quarter that both series were available (August 1981).

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[10] Temporary levies include the Defence-East Timor levy for the 2000-01 financial year, the Flood levy for the 2011-12 financial year, and the Temporary Budget Repair levy for the 2014-15 financial year.

INSTRUMENTAL VARIABLES ESTIMATE OF THE
EMPLOYMENT-POPULATION RATE

In this appendix, the results of the Ordinary Least Squares estimate of the employment-population ratio, which was used in an Instrumental Variables approach to provide fitted values of this ratio for the estimation equation for the female part-time participation rate, are explained. This was done to overcome the potential danger of simultaneity bias on the estimated encouraged/discouraged worker effect. In choosing the explanatory variables or Instruments for this equation, only variables representing labour demand were admitted. This was done so that the estimated effect of the fitted employment-population ratio is genuinely representative of the encouraged/discouraged worker effect (i.e., the participation induced by greater demand for labour).

The explanatory variables for the equation are as follows.

Real Labour Costs

The wage rate variable used was the four-quarterly moving average of the natural logarithm of real labour costs. This variable was constructed by dividing labour costs per hour worked by the price deflator for GDP. The labour cost variable was constructed by:

- adding *National Accounts* (ABS Cat. No. 5206.0) estimates of payroll taxes and fringe benefits taxes to, and subtracting estimates of wage subsidies from, non-farm wages, salaries and supplements to form total labour costs;

- dividing total labour costs by the number of non-farm wage and salary earners, from the ABS NIF-10S data set on the *Modellers' Database* (ABS Cat. No. 1364.0.55.003), converting from quarterly data to weekly data by dividing by 13; and

- converting from weekly data to hourly data by dividing by the average number of hours worked per week by employees (NIF-10S series ANNHW, from the ABS NIF-10S data set on the *Modellers' Database* (ABS Cat. No. 1364.0.55.003)).

An increase in real labour costs is expected to lead to a reduction in the female part-time employment-population rate for two demand-related reasons: an increase in wages paid by businesses leads to a backward move along the labour demand curve; and an increase in the non-wage components of real labour costs leads to an inward shift of the labour demand curve.

Real non-farm GDP per adult

Increases in real GDP are generally accepted to shift the demand curve for labour outward. Whether this shifts the employment-population rate outward depends on whether the increases in real GDP are large relative to the increases in population. Hence, the income variable was expressed as real non-farm GDP per head of the adult civilian population. Non-farm GDP was used in preference to total GDP because farm GDP is affected by volatile factors not directly related to labour demand, such as droughts and floods. Non-farm real GDP was obtained from the ABS quarterly *National Accounts* (ABS Cat. No. 5206.0) and it was divided by the series for the adult civilian population from the ABS Labour Force Survey (ABS Cat. No. 6291.0.55.001).

Share of Services in Real GDP

The share of selected services[11] in real non-rent GDP is expected to have a positive effect on the female part-time employment-population ratio. This is because female workers tend to work in industries which are closely linked to this component of GDP. Dwelling Rent is subtracted from GDP in the latter explanatory variable and in the denominator for both variables because much of the dwelling rent counted by the ABS in its National Accounts is the imputed rent from people living in their own dwellings, and much of the rest of dwelling rent would represent passive income, both of which would have little effect on labour demand.

Growth Rate of Business Credit

Businesses can fund the wages paid to employees either through the money they earn from current production, which would be reflected in the last-described explanatory variable, namely, real non-farm GDP per adult, or they can increase their level of credit (or borrow money for the first time) to fund these wages. Conversely, when businesses are reducing their level of indebtedness by repaying previously borrowed money, they have less funds available for hiring and retaining employees. The growth rate of business credit is thus likely to have a positive effect on labour demand. This effect on labour demand is expected to consist of a positive effect on full-time employment and a negative effect on part-time employment. Therefore, the growth rate of business credit is expected to have a negative effect on the female part-time employment-population ratio. Data on business credit were obtained from the "Statistics" part of the website (www.rba.gov.au) belonging to the Reserve Bank of Australia (RBA) and the explanatory variable was constructed as the change over four quarters in the natural logarithm of total business credit outstanding.

Female Retention Rate to Year 12 in Schools

The demand for female part-time employment is likely to depend upon the level of education and skills of girls and women in the labour force. While it is possible to construct data series for educational attainment from the ABS publication, *Education and Work* (ABS Cat. No. 6227.0), it is only possible to construct a series as far back as 1979, which isn't sufficiently long for the purposes of this analysis. Also, it is extremely difficult to construct consistently defined series for measures of educational attainment except the percentage with Bachelor's degrees and higher (due to the changes in definitions of educational attainment between 1979 and 2014). However, it is possible to use the Female Retention Rate to Year 12 in Schools as a proxy for female educational attainment. Since there is likely to be a lag between the time that many young women finish year 12 and establish themselves in the labour force, a lag of four quarters was used for this variable.

The demographic effect on the female part-time employment to population ratio

Demographic effects, arising mainly from the ageing of the adult population, are likely to affect labour demand (the female part-time employment to population ratio) in addition to labour supply (the female part-time participation rate). Accordingly, an explanatory variable for these demographic effects, constructed from ABS Labour Force Survey data using the methods explained in Appendix A, was included.

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[11] That is, real Gross Value Added in the following service industries: Wholesale Trade; Retail Trade; Accommodation and Food Services; Financial and Insurance Services; Rental, Hiring and Real Estate Services; Professional, Scientific and Technical Services; Administrative and Support Services; Public Administration and Safety; Education and Training; Health and Community services; Arts and Recreation Services; and Other Services. These service industries were selected because they were more likely than other industries to have high proportions of female and part-time workers.

Combining these explanatory variables, the preferred equation was:

$$EPRFPA_t = -25.7 - 3.40*MA4LRLC_{t-1} + 9.58 * LGDPNFP_{t-1} + 7.79*LGDPNFP_{t-4}$$
$$\ (-14.3)\ (-4.57)\qquad\qquad (5.61)\qquad\qquad (4.83)$$

$$+ 0.193 * SERSHARE_{t-2} - 1.70*D4LBUSCR_t + 0.0292*RR12SF_{t-4} + 0.531*EPRFPAG \qquad (B.1)$$
$$(3.82)\qquad\qquad (-4.06)\qquad\qquad (5.78)\qquad\qquad (2.78)$$

Sample Range: 1976Q1 to 2014Q3 (155 observations); F-statistic = 4640
Durbin-Watson Statistic = 0.95; Standard error of regression = 0.273
Mean of dependent variable = 20.2; Standard deviation of dependent variable = 3.97
R-squared = 0. 995;   Adjusted R-squared = 0.995
Condition(X) number = 738.
Figures in parentheses underneath the coefficients are t-statistics, and the subscript, t, refers to the time period (in quarters).

where:
$EPRFPA_t$ is the female part-time employment to population rate;
$MA4LRLC_{t-1}$ is the four-quarterly moving average of the natural logarithm of real labour costs, lagged by one quarter;
$LGDPNFP_{t-1/t-4}$ is the log of real non-farm GDP per person, lagged by one/four quarter(s);
$SERSHARE_{t-2}$ is the share of services in non-rent real GDP, lagged by two quarters;
$D4LBUSCR_t$ is the change over four quarters in the natural logarithm of business credit;
$RR12SF_{t-4}$ is the female year 12 retention rate, lagged four quarters; and
EPRFPAG is the demographic effect on the female part-time employment-to-population ratio.

The overall level of explanation is high at over 99 per cent. All of the explanatory variables have the expected signs and all appear to be statistically significant. However, the t-statistics are somewhat unreliable for autocorrelation and multicollinearity reasons (the Condition(X) number of 738 indicates that there is severe multicollinearity among the explanatory variables).

WELFARE TO WORK TARGET GROUPS
AND PRELIMINARY DATA ANALYSIS

In the 2005-06 *Budget*, the Australian Government introduced the Welfare to Work policy changes, which included new job search requirements for eligible principal carer parents and people with a disability receiving income-support payments.

New claimants for income support from 1 July 2006, through Parenting Payment Single (PPS) and Parenting Payment Partnered (PPP) were required to participate in the part-time labour force after their youngest child turned 6 years of age. Existing PPS and PPP claimants were required to participate in the part-time labour force after their youngest child turned 7 years or from 1 July 2007 (whichever was the latter). Jobseekers who were previously eligible for the Disability Support Pension (DSP) were required to undergo a Job Capacity Assessment (JCA), and if assessed as being capable of working 15-29 hours, were required to participate in the part-time labour force. Prior to the Welfare to Work changes, none of the groups described above had labour-force participation requirements.

Relevant historical income-support data for principal carer parents (PcPs) and for persons with a disablility (PwDs) was extracted using the Department of Employment's Research and Evaluation Dataset (RED), which in turn is sourced from the ISIS system in Centrelink. Red is a series of SAS dataset files that contain unit record level data for customers on income support payments since 1 July 1998. This time period allows for analysis of the effects of Welfare to Work policy changes introduced in July 2006.

Separate data was obtained for PcPs and PwDs, and the overlap between the two groups during the same time period was identified and removed. The data were disaggregated by gender, new grants and reviews, grandfathered status, benefit type and for PcPs also by age of youngest dependent child, while for PwDs also by PwD sub-category code. The end result was to obtain monthly counts of the disaggregated data since July 2006 by one further disaggregation: whether a person was in the stock, inflow or outflow for a given month.

The explanatory variable that was used in the current analysis was the stock of women (and girls) with a part-time participation requirement as a result of the Welfare-to-Work policy changes, as a percentage of the female adult (15 years and older) civilian population.

Tests of Stationarity, Integration and Cointegration
for the Variables Used in the Analysis

A series of tests, both under the null hypotheses of stationarity (KPSS tests) and integration (Augmented Dickey-Fuller and Weighted Symmetric Tau tests), were conducted to determine the orders of integration of the series for the female part-time participation rate and the female part-time employment-population ratio, and for cointegration between these two series and their determinants. All tests were done in TSP International (Hall and Cummins 2009).

Table D.1: KPSS tests for the variables in participation rate equations

Variable	H₀: Stationarity around mean Test Statistic (ε_μ)	H₀: Stationarity around trend Test Statistic (ε_τ)	Conclusion
PRFPA	1.972****	0.287****	Integrated
Δ PRFPA	0.439*	0.061	Trend and mean stationary
EPRFPAFI	1.797****	0.240****	Integrated
Δ EPRFPAFI	0.213	0.152**	Mean stationary
ERTF154Q	1.820****	0.248****	Integrated
Δ ERTF154Q	0.144	0.133*	Mean stationary
CDEPENDF	1.777****	0.479****	Integrated
Δ CDEPENDF	1.633****	0.112	Trend stationary
LTUI	0.543**	0.396****	Integrated
Δ LTUI	0.229	0.059	Trend and mean stationary
PENUB	1.155****	0.304****	Trend stationary
Δ PENUB	0.204	0.063	Trend and mean stationary
CCHILDCF	0.391*	0.167**	Integrated
Δ CCHILDCF	0.057	0.037	Trend and mean stationary

Note: results are for a lag of 9 quarters on the autocorrelated error term in the KPSS test, and were calculated for the sample period of 1972Q3 to 2014Q3, or the longest available subsample.
****/***/**/* indicate rejection of null hypothesis (stationarity) at 1/ 2.5/ 5 /10% level respectively.

where:
PRFPA is the female part-time participation rate (per cent of civilian female population);
EPRFPAFI is the female part-time employment to population ratio;
ERTF154Q is total education rate (school and tertiary) for women aged 15-24 years;
CDEPENDF is the child dependency ratio (the ratio of the number of children aged 0-14 years to the number of females aged 15-54 years);
LTUI is the long-term unemployment incidence;
RUBEN is the real unemployment benefit payment rate;
CCHILDCF is the index of childcare costs relative to average after-tax earnings.

Table D.2: Augmented Dickey Fuller and Weighted Symmetric (tau) tests for unit roots in the variables in participation rate equations

| Variable | Weighted Symmetric (tau) tests | | Augmented Dickey Fuller Tests | | Conclusion |
	Optimum number of lags	P-value for H_0 of unit root	Optimum number of lags	P-value for H_0 of unit root	
PRFPA	3	0.98	3	0.94	Integrated
Δ PRFPA	2	<0.01	3	<0.01	Stationary
EPRFPAFI	5	0.99	5	0.88	Integrated
Δ EPRFPAFI	4	0.04	4	<0.01	Stationary
ERTF154Q	10	0.94	10	0.74	Integrated
Δ ERTF154Q	9	0.02	9	0.04	Stationary
CDEPENDF	10	1.00	7	0.58	Integrated
Δ CDEPENDF	6	0.23	10	0.07	Unclear
LTUI	10	0.86	10	0.66	Integrated
Δ LTUI	10	<0.01	10	<0.01	Stationary
PENUB	6	1.00	7	0.66	Integrated
Δ PENUB	6	<0.01	6	<0.01	Stationary
CCHILDCF	6	0.08	6	0.13	Unclear
Δ CCHILDCF	5	<0.01	5	0.01	Stationary

Note: results are for the sample period of 1972Q3 to 2014Q3, or the longest available subsample.

Considering both the results of the tests under the null hypothesis of stationarity (KPSS) and integration (Augmented Dickey Fuller and Weighted Symmetric tau), the dependent and explanatory variables are likely to be I(1) at most (i.e., none of the variables are I(2) and some of the variables may be mean or trend stationary). The results for the variables for the quarterly change in the child care dependency ratio (Δ CDEPENDF), the real unemployment benefits payment rate (RUBEN) and real childcare fees (CCHILDCF), are not particularly clear.

<u>Test for cointegration</u>

An Engle-Granger (tau) test for co-integration was conducted between the dependent variable (the female part-time participation rate, PRFPA) and its explanatory variables. The estimated tau statistic from this testing was -4.52 at the optimum number of lags of the lagged dependent variable of 2. There was no estimated probability corresponding to this estimate in the results from TSP International, as a result of the sizable number of explanatory variables, but the large absolute value of the tau statistic implies that this dependent variable is likely to be co-integrated with its explanatory variables.

Tests for the Employment-Population Ratio

A similar set of tests was conducted for the female part-time employment-population ratio, with the results shown in Table D.3. The definitions of the variables in this and the subsequent table are as follows:

EPRFPA is the female part-time employment to population rate;
MA4LRLC is the four-quarterly moving average of the natural logarithm of real labour costs;
GDPNFP is the real non-farm GDP per person;
SERSHARE is the share of services in non-rent real GDP; and
D4LBUSCR is the change over four quarters in the natural logarithm of business credit.

Table D.3: KPSS tests for the variables in employment-population ratio equation

Variable	H$_0$: Stationarity around mean Test Statistic (ε_μ)	H$_0$: Stationarity around trend Test Statistic (ε_τ)	Conclusion
EPRFPA	1.977****	0.206***	Integrated
Δ EPRFPA	0.359*	0.068	Trend stationary
MA4LRLC	1.847****	0.104	Trend stationary
Δ MA4LRLC	0.179	0.102	Trend and mean stationary
LGDPNFP	1.968****	0.232****	Integrated
Δ LGDPNFP	0.081	0.083	Trend and mean stationary
SERSHARE	1.757****	0.388****	Integrated
Δ SERSHARE	0.209	0.056	Trend and mean stationary
D4LBSCR	0.594***	0.084	Trend stationary
Δ D4LBSCR	0.039	0.039	Trend and mean stationary
RR12SF	1.767****	0.402****	Integrated
Δ RR12SF	0.384*	0.130*	Unclear
EPRFPAG	1.640****	0.335****	Integrated
Δ EPRFPAG	0.682***	0.405****	Integrated

Note: results are for a lag of 9 quarters on the autocorrelated error term in the KPSS test, and were calculated for the sample period of 1972Q3 to 2014Q3, or the longest available subsample. ****/***/**/* indicate rejection of null hypothesis (stationarity) at 1/2.5/5/10% level respectively.

Table D.4: Augmented Dickey Fuller and Weighted Symmetric (tau) tests for unit roots in the variables in the employment-population ratio equation.

Variable	Weighted Symmetric (tau) tests		Augmented Dickey Fuller Tests		Conclusion
	Optimum number of lags	P-value for H$_0$ of a unit root	Optimum number of lags	P-value for H$_0$ of a unit root	
EPRFPA	3	0.93	3	0.90	Integrated
Δ EPRFPA	2	<0.01	2	<0.01	Stationary
MA4LRLC	11	0.96	11	0.54	Integrated
Δ MA4LRLC	11	0.01	11	0.02	Stationary
SERSHARE	4	0.80	4	0.85	Integrated
Δ SERSHARE	3	<0.01	7	<0.01	Stationary
LGDPNFP	3	0.77	3	0.43	Integrated
Δ LGDPNFP	2	<0.01	2	<0.01	Stationary
D4LBSCR	11	0.02	11	0.03	Stationary
Δ D4LBSCR	10	0.02	10	0.05	Stationary
RR12SF	10	0.99	10	0.89	Integrated
Δ RR12SF	9	0.06	9	0.07	Stationary
EPRFPAG	8	1.00	9	1.00	Integrated
Δ EPRFPAG	8	0.87	8	0.34	Integrated

Note: results are for the sample period of 1976Q2 to 2014Q3, or the longest available subsample.

Considering both the results of the tests under the null hypothesis of stationarity (KPSS) and

integration (Augmented Dickey Fuller and Weighted Symmetric tau), the dependent and explanatory variables are likely to be I(1) at most (i.e., none of the variables are I(2) and some of the variables may be mean or trend stationary).

Test for Co-integration

An Engle-Granger (tau) test for co-integration was conducted between the dependent variable (the female part-time employment-population ratio, EPRFPA) and its explanatory variables. The estimated tau statistic from this testing was -5.11 at the optimum number of lags of the lagged dependent variable of 2. There was no estimated probability corresponding to this estimate in the results from TSP International, as a result of the sizable number of explanatory variables, but the large absolute value of the tau statistic implies that this dependent variable is likely to be co-integrated with its explanatory variables.

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