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# LABOUR ECONOMICS

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# Is Being Single Better? An Analysis of Employment Structure and Wages of Japanese Female Workers

*Sanae Tashiro*, Rhode Island College, Providence

## Abstract

*Using the 1993-2010 Japanese Panel Survey of Consumer data, this paper examines Japanese women's labour force participation and determinants of earnings by marital status with a particular focus on the unmarried. Estimates confirm that experience and education increase women's labour force participation, but age reduces it among unmarried women and increases it among the married. Estimates further show weak evidence of a 1.4 per cent wage penalty for being single. Age, high education, and full-time employment status produce a wage premium for women, regardless of their marital status, but experience has no effect on unmarried women's earnings and reduces married women's wages by 2.3 per cent. Occupational differences have a large effect on earnings: professional and technical occupations offer high wage premiums for women, regardless of their marital status. Industry differences also matter: unmarried women in the finance/insurance/real estate industry and married women in public administration earn sizable wage premiums.*

Keywords: Women's employment, Labour force, Participation, Wage, Marital status

JEL classification: J21, J24, J31

## 1. Introduction

Japan faces a sharp increase in the elderly population, a steady decline in fertility, and a predicted reduction in population. Moreover, increases in marriage postponement among young people (Clark *et al.* 2010; Lesthaeghe, 2010; and others), in the population of never-married women (Clark *et al.* 2010; Lesthaeghe, 2010; Matsukura *et al.* 2007; Ueda, 2007; and others), and in the number of both 'freeters'<sup>1</sup> and 'NEETs'<sup>2</sup> (Clark *et al.*

<sup>1</sup> A 'freeter' is an individual who lack full-time employment or are unemployed or are freelancers.

<sup>2</sup> A 'NEET' is a young individual who are not educated, employed and trained.

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2010; Ohta *et al.* 2008; Kondo, 2007; and others) further accelerate these developments and have raised additional concerns and debate about the workforce population.

The traditional gender division of labour in households (Ross, 1987), long career interruptions for childbirth indicated by an M-shaped labour supply curve (Kawata and Naganuma, 2010; Matsukura *et al.* 2007; and others), and the income tax system (Yamada, 2011; Akabayashi, 2006; and others) in Japan are likely to discourage or limit women, particularly married ones, from participating in the labour market, and lead many either to abandon their careers (Matsukura *et al.* 2007) or to seek contingent employment (Genda *et al.* 2010; Osawa, 2005; and Houseman and Osawa, 1995). The traditional seniority-based wage system also has given less advantage to women, who are less likely to commit to lifetime employment.<sup>3</sup>

In recent years, however, the traditional gender division of labour in households has started to change from male-breadwinner households to dual-earner households (Fukuda, 2013). The structure of employment has also started to change to a merit-based pay system, which emphasizes employees' skills and training (Shimizu and Higuchi, 2010; Ohta *et al.* 2008; and Atoda and Tachibanaki, 1991). Concurrently, educational attainment among Japanese women has increased substantially (Kishi, 2014; Kawaguchi and Ueno, 2013; Kambayashi *et al.* 2008; Osawa, 2005; and others) and the numbers of employed female workers and of those who want to be employed have increased significantly (Kawaguchi and Ueno, 2013; Hausmann *et al.* 2012; and Matsukura *et al.* 2007). Also, firms are under economic pressure to lower labour costs and increase profits (Osawa, 2005; and Houseman and Osawa, 1995).

Given dramatic changes in the marriage market, the workforce population, employment structure, and economic conditions in Japan, further study is warranted to analyze the employment status of Japanese female workers as the role of women in the labour market becomes more important. This paper builds upon the literature on labour supply and wages by investigating whether being single is better than being married for women in the Japanese labour market. It further provides new evidence regarding the determinants of labour force participation and earnings of female Japanese workers, and attempts to offer tactics to improve labour market welfare among women in Japan. To accomplish these goals, I estimate the wage equation utilizing Heckman's sample selection model with the 1993-2010 Japanese Panel Survey of Consumer data.

This study first finds weak evidence for a 1.4 per cent wage penalty among single women, who are more likely than married ones to participate in the labour market. Age increases the wages of all women as well as labour force participation among married women, yet it reduces labour force participation among unmarried women. Experience, on the other hand, has a positive impact on the decision to participate in the labour force among women, yet it reduces married women's wages by 2.3 per cent and has no effect on the earnings of unmarried women. Education increases the earnings of women, and the premiums increase as the level of education increases; in particular, unmarried and married women with 'at least a Bachelor's degree' earn 21.3 per cent and 22.8 per cent, respectively, more than their counterparts with less than a high school diploma.

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<sup>3</sup> Lifetime employment is defined as a stable and long-term employment commitment between a worker and an employer rather than a permanent employment contract (Ono, 2010; and others).

This study further confirms that full-time employment<sup>4</sup> offers higher earnings premiums relative to part-time employment<sup>5</sup> for women, and differences in earnings premiums within employment status are smaller for unmarried women relative to married ones. The effect of occupations on earnings is prominent – professional and technical occupations offer high wage premiums of 27.6 per cent and 35.7 per cent, respectively, for the unmarried and 42.9 per cent and 57.5 per cent, respectively, for married women, relative to their counterparts. Similarly, industry differences have a varied effect on the wages of Japanese female workers – unmarried women in the finance/insurance/real estate industry earn an 11.3 per cent wage premium, while married ones in public administration earn a 11.1 per cent premium.

This study has a few important findings. First, women's labour force participation and wages are influenced by marital status. Second, there is weak evidence for a small wage penalty for being single. Third, being single, work experience, and high educational attainment increase women's labour force participation. Lastly, attainment of high education, full-time employment, and professional and technical occupations produce higher earnings for Japanese women, regardless of their marital status. The findings in this study highlight issues in the ongoing debate concerning the welfare of Japanese women in the labour market. These include work-family balance, marriage and fertility decisions, an increased number of contingent employees and limited human capital investment that negatively impacts women's labour force participation and earnings, and also an overrepresentation in lower-paid occupations that leads to occupational segregation among women in the workforce.

This paper makes two notable and new contributions. First, it offers deeper insights into understanding Japanese women's labour force participation decisions and the factors contributing to differences in the wages of Japanese female workers, with particular attention to the unmarried. It further provides useful implications for workers (especially women), firms, and policy makers in reevaluating existing work conditions and policies, and identifies new ways to promote women's employment, reduce wage differentials among women, improve worker status, and increase the Japanese workforce population.

## 2. Empirical Strategy

The objective of this paper is to investigate the recent trends of the employment structure and the earnings of Japanese female workers by marital status, with particular attention to unmarried ones, using the Japanese Panel Survey of Consumers (JPSC) for the years 1993-2010. It further investigates the factors contributing to differences in labour force participation and wages among married and unmarried women in an attempt to examine whether being single is advantageous over being married in the Japanese labour market.

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<sup>4</sup> Full-time employment is defined as employment with predetermined working hours per week of about 40 hours (e.g., eight hours a day, five days a week), according to the Labour Force Survey conducted by the Statistics Bureau of the Ministry of Internal Affairs and Communications.

<sup>5</sup> Part-time employment is defined as employment with fewer than 40 work hours per week (e.g., six or up to eight hours a day, three or up to five days a week), according to the Labour Force Survey conducted by the Statistics Bureau of the Ministry of Internal Affairs and Communications.

The empirical analyses are centered on estimating the standard wage equation, and thus researchers must be aware of potential endogeneity bias, heterogeneity bias, and sample selection bias into employment (Semykina and Wooldridge, 2010; Newmark and Korenman, 1994; and others). Since the wages of an individual are estimated over the life cycle in this study, education can be treated as exogenous, consequently endogeneity bias is inevitably an issue. Furthermore, individuals in the data sample in this study are drawn from a homogeneous population, so the heterogeneity bias is not inherited. Hence, I focus on the treatment of sample selection bias when I estimate the wage equation. To do so, I employ the following Heckman's sample selection model, which considers a random sample of  $I$  observations and equations for respondent  $I$ , using a data sample that includes both working and non-working individuals.

$$\begin{aligned} y_{1i}^* &= x_{1i}\beta_1 + \varepsilon_{1i} \\ y_{2i}^* &= x_{2i}\beta_2 + \varepsilon_{2i} \end{aligned} \quad (i = 1, \dots, I) \quad (1-1)$$

The sample selection model consists of: (i) a participation equation; and (ii) a resultant outcome equation as follows.

$$y_{1i} = \begin{cases} 1 & \text{if } S_{1i}^* > 0 \\ 0 & \text{if } S_{1i}^* \leq 0 \end{cases} \quad (1-2)$$

where  $y_{1i}^*$  determines whether or not respondent  $i$  has participated in the labour force.

$$y_{2i} = \begin{cases} 1 & \text{if } S_{2i}^* > 0 \\ - & \text{if } S_{2i}^* \leq 0 \end{cases} \quad (1-2')$$

where  $y_{2i}^*$  is observed when  $y_{1i}^*=1$ , whereas  $y_{2i}$  need not take on any value when  $y_{1i}^* \leq 0$ , and it defines whether a respondent  $i$  at time  $t$  supplies labour in the labour market.

The likelihood of labour force participation being observed depends on socio-economic variables,  $(x_{1i})$ , which include the respondent's: (i) marital status; (ii) age; (iii) experience; (iv) education; (v) metropolitan living status; (vi) number of children; (vii) parents' cohabitation with financial sharing; (viii) housing tenure and (ix) spouse's age.

The actual log hourly wage of a respondent  $i$  at time  $t$ ,  $(\ln(w_{it}))$ , is a function of control variables,  $(x_{2i})$ , which include the respondent's: (i) age; (ii) age squared; (iii) experience; (iv) experience squared; (v) education; (vi) metropolitan living status; (vii) employment status; (viii) occupation; (ix) industry and (x) a mean zero individual error term at time  $t$ ,  $(\varepsilon_i)$ . I also control for a respondent's marital status. The sample selection model is estimated with Heckman's two-stage procedure.

### 3. Data

This paper uses microdata obtained from the 1993-2010 waves of the Japanese Panel Survey of Consumers (JPSC) conducted by the Institute for Research and Household Economics. The JPSC gathers information on the demographic status of 1500 Japanese females aged 24-34 (Cohort A born in 1959-1969) in 1993, adds 500 Japanese females

aged 24-34 (Cohort B born in 1970-1973) in 1997, adjoins 836 Japanese females aged 24-29 (Cohort C born in 1974-1979) in 2003, and further appends 636 Japanese females aged 24-28 (Cohort D born in 1980-1984) in 2008, initially containing 30,744 observations (see, appendix A1 for details on the initial data sample). The JPSC contains respondents' age, educational attainment, marital status, employment status, metropolitan living status, wage, weeks worked, and family members' characteristics.

In this study, I use several socio-economic variables. The respondents' education dummy variables are constructed for five education levels: less than a high school diploma, high school diploma or equivalent (GED), technical or trade school diploma, Associate degree, and at least a Bachelor's degree. The respondents' work experience is measured in total years of work after graduation.<sup>6</sup> Other variables of interest include age, employment status, marital status, number of children, parents' cohabitation with financial sharing, housing tenure, metropolitan living status, occupation, and industry.

In addition, in the 1993-2010 JPSC data, earnings are defined by three different measures: (1) monthly or weekly salary; (2) daily earnings and (3) hourly wage. The hourly wage for individuals who reported daily earnings is calculated as the daily earnings divided by the hours worked per day. The hourly wage for individuals who reported a monthly or weekly salary is calculated by: (i) obtaining the salary per day (which is calculated as the monthly or weekly salary divided by the working days per month or week) and (ii) salary per day divided by hours worked per day. The hourly wage for individuals who reported daily earnings is calculated as earnings per day divided by hours worked per day. The hourly wage for respondents who reported it is used as reported. The calculation of hourly earnings for each individual is performed prior to pooling the data.

In order to examine the employment structure and the wages of Japanese female workers, I construct a dataset that includes both working and non-working individuals for estimation. The likelihood of labour force participation being observed depends on various socio-economic variables, ( $x_{it}$ ), which are shown in equation (1). Respondents who reported invalid responses<sup>7</sup> on spouse's age and/or spouse's annual income are eliminated from the sample.

In addition, the actual log hourly wage of a respondent  $i$  at time  $t$ , ( $\ln(w_{it})$ ), is a function of control variables, ( $x_{2t}$ ), which is also shown in (1). The hourly earnings in the data sample are top coded at ¥15,180. The data sample is further restricted to respondents who have valid hourly earnings and those who reported hourly earnings of at least ¥150 per hour.<sup>8</sup> The log hourly wage, which is a dependent variable, is then calculated based on the hourly earnings. After these restrictions, the sample size for the wage equations for the 1993-2010 JPSC data, defined as the labour force participation data, is reduced to 30,712 (see, table 1 for details of this data sample).

<sup>6</sup> The respondent's work experience is calculated as the sum of total months of work after graduation in the first survey year and total months of work in each year thereafter, and then this sum is divided by 12 months to obtain total years of work after graduation.

<sup>7</sup> Invalid responses refer to the value expressed as '99', '999', or '9999' submitted by respondents in a questionnaire in the survey.

<sup>8</sup> The data sample includes respondents who earn less than the minimum wage (that refers to the national weighted average amount per hour), which was set at 583 yen in 1993 and 730 yen in 2010. See details on minimum wages in Japan at the Ministry of Health, Labour and Welfare.

## 4. Descriptive Analysis

This section first summarizes relevant individual characteristics of the sample data and the recent trends of labour force participation and of employment status among Japanese women by marital status and by cohort, using the labour force participation data.

Table 1 shows selected characteristics of individual respondents. In the 1993-2010 JPSC sample, approximately 30 per cent of respondents are unmarried with a mean age of 31, while the remaining 70 per cent are married with a mean age of 35. Educational attainment of unmarried women is similar to that of married ones; however, about 23 per cent of unmarried women and 12 per cent of married women hold at least a Bachelor's degree, and 33 per cent of unmarried women and 43 per cent of married women hold a high school diploma or equivalent. More educated women seem to be more likely to remain unmarried. As expected, more than 84 per cent of unmarried women have no children, while 86 per cent of married women have at least one child.

Table 1 also shows that mean experience (that is, total years of work after graduation) is about 13 years for unmarried women and 10 years for married ones, while mean experience in the full sample is about 11 years. It is evident that unmarried women have more work experience than married ones. Approximately 88 per cent of unmarried women and 54 per cent of married ones are in the labour force, while about 64 per cent of the full sample was participating in the labour market during the period 1993-2010. These results confirm that unmarried women have more work experience than married ones and are more likely than married women to participate in the labour force.

Figure 1, which offers additional insights into the trends of labour force participation among Japanese women by marital status, offers some interesting findings. The percentage of labour force participation among unmarried women for the period 1993-2010 is fairly consistent (87-90 per cent), while that among married women increased over time (42 per cent in 1993 and 61 per cent in 2010). As a result, the labour force participation of women in Japan has been on an upward trend for the last two decades. The figure confirms that married women are slowly increasing their labour force participation in Japan although unmarried women are more likely to participate in the labour market.

In terms of women's employment selection by marital status, figure 2 shows that the percentage of unmarried women in full-time regular employment is slowly falling after it peaked at 75 per cent in 1995, while that among married women increases over time with the exception of 2010. The figure also illustrates that the percentage of women who hold dispatch/fixed-term/other contingent employment<sup>9</sup> is small; however, it is increasing over time for both unmarried and married women. In particular, the increase in the percentage among unmarried women in 2010 is remarkable, and it is possible that the significant reduction in full-time regular employment is explained by the increase in dispatch/fixed-term/other contingent employment among unmarried ones. Additionally, the percentage of both unmarried and married women who hold

<sup>9</sup> Dispatch/fixed-term/other contingent employment is classified as non-regular employment. More precisely, a 'dispatched' temporary (or 'Haken') worker is defined as a worker who is employed and dispatched by a temporary labour agency, a 'fixed-term' worker is defined as a worker who is hired to perform a specialized job under the terms of a contract and for a specified period of time, such as contract employees (or 'Keiyaku Shyain'). See, detail for Asano (2011).

part-time contingent employment has been increasing over time except in 2010, and married women are more likely than unmarried women to select part-time contingent employment that allows more flexible work arrangements (Okumura and Islam, 2011).

Table1 - Labour Force Participation Data: 1993-2010

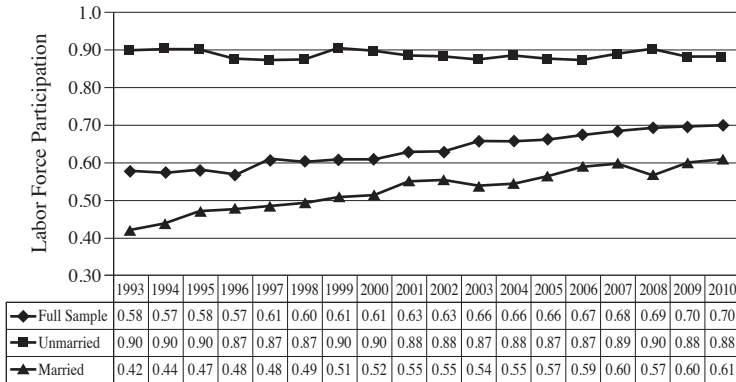
	<i>All Sample n=30712</i>			<i>Unmarried n=9333</i>			<i>Married n=21379</i>		
	<i>Total</i>	<i>Mean</i>	<i>S.D</i>	<i>Total</i>	<i>Mean</i>	<i>S.D</i>	<i>Total</i>	<i>Mean</i>	<i>S.D</i>
Age	30712	33.96	6.163	9333	31.42	5.936	21379	35.07	5.927
Experience (= Total Years of Work)	30712	10.94	7.897	9333	12.89	7.302	21379	10.09	7.996
Education									
Less than HS Diploma	1920	0.063	0.242	598	0.064	0.245	1322	0.062	0.241
High School Diploma or Equivalent	12397	0.404	0.491	3118	0.334	0.472	9279	0.434	0.496
Technical or Trade School Diploma	5255	0.171	0.377	1501	0.161	0.367	3754	0.176	0.380
Associate Degree	6421	0.209	0.407	1962	0.210	0.407	4459	0.209	0.406
At least Bachelor's degree	4719	0.154	0.361	2154	0.231	0.421	2565	0.120	0.325
Labour Force Participation									
In the Labour Force	19682	0.641	0.480	8252	0.884	0.320	11430	0.535	0.499
Not in the Labour Force	11030	0.359	0.480	1081	0.116	0.320	9949	0.465	0.499
Number of Children									
Zero	10683	0.348	0.476	7844	0.840	0.366	2839	0.133	0.339
One	5374	0.175	0.380	652	0.070	0.255	4722	0.221	0.415
Two	10036	0.327	0.469	526	0.056	0.231	9510	0.445	0.497
Three or more	4619	0.150	0.357	311	0.033	0.179	4308	0.202	0.401
Housing Tenure									
Housing Tenure (yes=1)	20152	0.656	0.475	6140	0.658	0.474	14012	0.655	0.475
Housing Tenure (no=1)	10530	0.343	0.475	3179	0.341	0.474	7351	0.344	0.475
Metropolitan Living Status									
Living in a Large City	7918	0.258	0.437	2871	0.308	0.462	5047	0.236	0.425
Living in a Medium City	18151	0.591	0.492	5381	0.577	0.494	12770	0.597	0.490
Living in a Small City	4585	0.149	0.356	1064	0.114	0.318	3521	0.165	0.371
Living & Financial Status									
Living & sharing finance w/ parents (yes=1)	10611	0.346	0.476	6121	0.656	0.475	4490	0.210	0.407
Living & sharing finance w/ parents (no=1)	19999	0.651	0.477	3177	0.340	0.474	16822	0.787	0.410
Partner/Spouse									
Age	21379	37.72	6.992	-	-	-	21379	37.72	6.992
Annual Income	19997	536.1	293.6	-	-	-	19997	536.1	293.6

\*Housing Tenure: 30 out of 30712 (or 14 out of 9333 unmarried and 16 out of 21379 married) respondents had invalid responses.

\*Metropolitan Living Status: 58 out of 30712 (or 17 out of 9333 unmarried and 41 out of 21379 married) respondents had invalid responses.

\*Living & Financial Status: 102 out of 30712 (or 35 out of 9333 unmarried and 67 out of 21379 married) respondents had invalid responses.

Figure 1 - Recent Trends of Labour Force Participation by Marital Status: 1993-2010 (unit: per cent)



## 5. Empirical Results

This section examines the estimation results of the Heckman's sample selection model. The analyses of the model for the estimated equation are conducted for three specifications: (1) all respondents; (2) unmarried women only; and (3) married women only, using table 2, in an attempt to analyze how selected socioeconomic factors and marital status impact the labour force participation and the wages of Japanese female workers.

### *Effects of Socio-economic Factors on Labour Force Participation and Wages*

Estimates presented in column (1) in table 2 show that the coefficient of being single on earnings is negative, which indicates that unmarried women suffer a wage penalty of 1.4 per cent ( $\exp(0.014)-1$ ), but it is only statistically significant at the 10 per cent level. Hence, there is weak evidence for a small wage penalty for being single. Column (2) in the table further reveals that the effect of being single on labour force participation is positive and is highly statistically significant. It confirms that unmarried women are more likely than married ones to participate in the labour market, which is consistent with existing studies (Okumura and Islam, 2011; Kishi, 2009; and others).

Columns (1)-(2) in the table also suggest that, over all, age increases the labour force participation of women as well as the wages of Japanese female workers by 5.2 per cent. This trend persists for married women, if equations are estimated separately by marital status, as shown in columns (3)-(6). For unmarried women, however, age increases their wage by 7.7 per cent, while it reduces their labour force participation. These results indicate that labour force participation among unmarried women tends to contract as they age, even if a wage premium associated with age is present. Therefore, increasing the workforce population in Japan requires policies to encourage the participation of both female and older workers in the labour market.

Table 2 - Heckman's Sample Selection Estimates of Earnings for Women by Marital Status: 1993-2010 Dependent Variable: Log Hourly Wage

<i>Independent Variables</i>	<i>All Sample</i>		<i>Unmarried</i>		<i>Married</i>	
	<i>Selection Two-Step</i>		<i>Selection Two-Step</i>		<i>Selection Two-Step</i>	
	(1)	(2)	(3)	(4)	(5)	(6)
	<i>Outcome Equation</i>	<i>Participation Equation</i>	<i>Outcome Equation</i>	<i>Participation Equation</i>	<i>Outcome Equation</i>	<i>Participation Equation</i>
Unmarried (yes=1)	-0.014* (0.008)	0.638*** (0.037)	-	-	-	-
Age	0.051*** (0.005)	0.032*** (0.002)	0.074*** (0.007)	-0.039*** (0.006)	0.018*** (0.006)	0.059*** (0.004)
Age Squared	-0.001*** (0.000)	-	-0.001*** (0.000)	-	0.000 (0.000)	-
Experience (= Total Service Length in Years)	-0.012*** (0.002)	0.132*** (0.002)	-0.007 (0.005)	0.163*** (0.005)	-0.023*** (0.003)	0.128*** (0.002)
Experience Squared	0.000 (0.000)	-	0.000 (0.000)	-	0.001*** (0.000)	-
High School with Diploma (yes=1) (E2)	-0.026** (0.013)	0.102*** (0.039)	-0.010 (0.019)	0.270*** (0.084)	-0.017 (0.017)	0.036 (0.044)
Technical or Trade School (yes=1) (E3)	0.028** (0.014)	0.176*** (0.043)	0.039* (0.021)	0.536*** (0.100)	0.036** (0.018)	0.052 (0.048)
Associate Degree (yes=1) (E4)	0.036*** (0.013)	0.194*** (0.042)	0.062*** (0.021)	0.685*** (0.101)	0.037** (0.018)	0.048 (0.047)
At least Bachelor's Degree (yes=1) (E5)	0.195*** (0.015)	0.378*** (0.045)	0.202*** (0.023)	0.845*** (0.095)	0.221*** (0.020)	0.178*** (0.052)
Full-Time: Regular	0.302*** (0.006)	-	0.261*** (0.011)	-	0.317*** (0.008)	-
Contingent: Dispatch & Fixed-Term, Other	0.207*** (0.011)	-	0.193*** (0.017)	-	0.205*** (0.015)	-
Metropolitan Living (Big City)	0.147*** (0.009)	0.063* (0.032)	0.156*** (0.014)	0.046 (0.083)	0.128*** (0.012)	0.062* (0.036)
Semi-Metropolitan Living (Medium City)	0.049*** (0.008)	0.013 (0.028)	0.062*** (0.013)	-0.084 (0.076)	0.038*** (0.010)	0.023 (0.031)
Professional/Specialist/Mgmt/Teacher (O1)	0.316*** (0.015)	-	0.244*** (0.024)	-	0.357*** (0.020)	-
Programmer/Nurse/ Nutritionist (O2)	0.391*** (0.013)	-	0.305*** (0.021)	-	0.454*** (0.018)	-
Office Administration (O3)	0.192*** (0.011)	-	0.149*** (0.018)	-	0.209*** (0.014)	-
Manufacturing & Operations (O4)	0.084*** (0.013)	-	0.027 (0.022)	-	0.125*** (0.016)	-
Services and Sales (O5)	0.148*** (0.012)	-	0.080*** (0.020)	-	0.184*** (0.015)	-
Manufacturing (I1)	-0.042*** (0.012)	-	0.019 (0.016)	-	-0.083*** (0.016)	-
Retail Trade (I2)	-0.118*** (0.011)	-	-0.032** (0.016)	-	-0.164*** (0.015)	-
Finance/Insurance/Real Estate (I3)	0.054*** (0.014)	-	0.107*** (0.018)	-	0.020 (0.020)	-
Service (I4)	-0.055*** (0.010)	-	-0.028** (0.014)	-	-0.070*** (0.014)	-
Public Administration (I5)	0.081*** (0.013)	-	0.028 (0.020)	-	0.105*** (0.018)	-
Children (I)	-	-0.581*** (0.039)	-	-0.012 (0.129)	-	-0.620*** (0.041)

Table 2 - Heckman's Sample Selection Estimates of Earnings for Women by Marital Status: 1993-2010 Dependent Variable: Log Hourly Wage (continued)

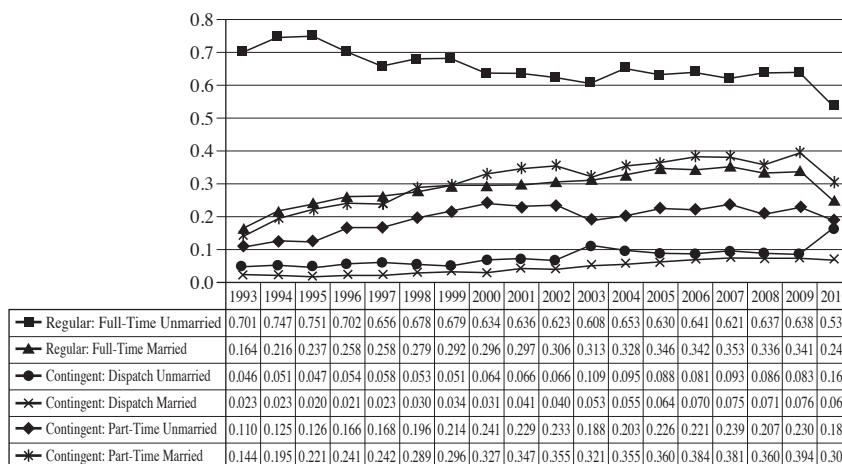
Independent Variables	All Sample		Unmarried		Married	
	Selection Two-Step		Selection Two-Step		Selection Two-Step	
	(1)	(2)	(3)	(4)	(5)	(6)
	Outcome Equation	Participation Equation	Outcome Equation	Participation Equation	Outcome Equation	Participation Equation
Children (2)	-	-0.846*** (0.037)	-	-0.092 (0.132)	-	-0.908*** (0.040)
Children (3 or more)	-	-0.901*** (0.042)	-	-0.207 (0.148)	-	-0.971*** (0.045)
Living & Sharing Finance w/ Parents (yes=1)	-	-0.215*** (0.026)	-	-0.340*** (0.074)	-	-0.203*** (0.029)
Home Ownership (yes=1)	-	0.066*** (0.023)	-	0.095 (0.064)	-	0.028 (0.025)
Respondent's Spouse's Age	-	-0.006*** (0.001)	-	-	-	-0.022*** (0.003)
Constant	5.778*** (0.084)	-1.104*** (0.076)	5.284*** (0.125)	1.073*** (0.200)	6.520*** (0.121)	-1.236*** (0.082)
Lambda	-0.080*** (0.021)	-	-0.042* (0.022)	-	-0.164*** (0.026)	-
Sigma	0.387	0.387	0.351	0.351	0.410	0.410

Notes: Standard errors are shown in parentheses. \*\*\*, \*\*, \* indicate significant at the 1%, 5% and 10% levels, respectively.

Table 2 further shows that the coefficients of experience on labour force participation among unmarried and married women are positive and are statistically significant. However, the coefficients of experience on earnings for both unmarried and married women are negative, and they are statistically significant only for married women. These results suggest that experience reduces married women's wages by 2.3 per cent and has no effect on unmarried women's earnings. This unexpected finding likely results from Japanese women's short job tenure (Nakata and Ryoji, 2002; and others), career interruptions due to marriage and childbearing (Kawata and Naganuma, 2010; Matsukura *et al.* 2007), and/or limited career choices, which prevents them from acquiring experience that offers a lifetime wage premium (Ono, 2010).

Estimates in columns (1)-(2) show that the coefficients of education are positive and are statistically significant, which confirm that education increases Japanese women's wages and labour force participation. Yet, the trends are somewhat different by marital status. The likelihood of labour force participation among unmarried women increases as educational attainment increases, while increases in participation among married women are limited to those with an educational attainment of 'at least a Bachelor's degree'. In the case of earnings, the premiums are only apparent for those with educational attainment of 'Associate degree' (6.4 per cent for unmarried and 3.8 per cent for married) and 'at least a Bachelor's degree' (22.4 per cent for unmarried and 24.7 per cent for married). These results suggest that higher levels of education produce a higher wage premium for women in Japan.

Figure 2 - Employment Status by Marital Status: 1993-2010 (unit: per cent)



### ***Effects of employment status, occupations and industries on wages***

Turning to employment status, estimates presented in columns (1), (3) and (5) in table 2 show that the coefficients of full-time employment, which include full-time regular and dispatch/fixed-term/other contingent, on the wages of Japanese female workers are all positive and are highly statistically significant. More precisely, for unmarried women, the wage premiums associated with full-time regular employment and full-time dispatch/fixed-term/other contingent are 29.8 per cent and 21.3 per cent, respectively. For married women, those premiums are 37.3 per cent and 22.8 per cent, respectively. These results indicate a positive return to full-time employment on the earnings of female workers relative to part-time employment, and smaller wage premium differences within employment status for unmarried women relative to married ones.

Estimates in column (1) in table 2 further reveal that the coefficients of occupations on the wages of Japanese female workers are all positive and are highly statistically significant. For unmarried women, those who are in professional (O1) and in technical & healthcare support (O2) occupations earn 27.6 per cent and 35.7 per cent, respectively, more than unmarried ones who are in 'other' occupations (O6<sup>10</sup>). Similarly, married women who are in these occupations earn 42.9 per cent and 57.5 per cent, respectively, more than their counterparts. Although the wage premiums are apparent for women in all occupations, except for unmarried women who are in manufacturing and operation (O4), professional occupations and technical & healthcare support occupations produce even larger earning premiums for women, confirming the hypothesis that occupational choice has a large influence on Japanese women's earnings (Nakata and Ryoji, 2002).

Examining the effect of industries on the wages of women, estimates in column (1) in table 2 shows that the coefficients of finance/insurance/real estate (I3)

<sup>10</sup> 'Other' occupations (O6) include self employed, small business owner, or others.

and public administration (I5) are positive and statistically significant, while those of the manufacturing (I1), retail trade (I2) and service (I4) industries are negative and statistically significant. Different trends are observed, if the equations are estimated separately by marital status. Unmarried women who are in the finance/insurance/real estate industry (I3) earn 11.3 per cent more than unmarried women who are in 'other' occupations (I6),<sup>11</sup> while married women who are in public administration (I5) earn 11.1 per cent more relative to their counterparts. On the other hand, women who are in the retail trade (I2) and the service (I4) industries suffer a sizable wage penalty, regardless of their marital status. These results also confirm that industry selection matters in maximizing earnings for Japanese women.

### ***Discussion on Japanese Women's Labour Market Outcomes***

In light of the empirical findings in this study, there are a few potential reasons for explaining the small wage penalty for unmarried women in Japan. One is that the earnings of unmarried women are less sensitive to work experience. This is because the traditional seniority-based wage system has given less advantage to women, who are less likely to commit to lifetime employment, and has offered less firm-specific human capital investment, both of which prevent the unmarried from obtaining high earnings. There is also a decline in the percentage of unmarried women in full-time regular employment and an increase in contingent employment among new entrants to the labour market and female workers of all cohorts (Asano *et al.* 2013; Kishi, 2009; and others) due to changing labour market conditions during 'Japan's lost decades'. Non-regular employees not only experience job insecurity, serial job changing, and less firm-specific human capital investment, but also have lower wages and slower earning growth relative to regular workers (Kishi, 2013; Sano, 2012; Esteban-Pretel *et al.* 2011; and others); hence, unmarried women are likely to suffer a wage penalty in the labour market in Japan.

It is also worth noting the challenges that female workers in Japan have long faced. First, Japanese women, in general, receive low appraisal points from employers (Nakata and Ryoji, 2002), and Japanese female workers do not benefit from the lifetime employment system (Ono, 2010; and others). Thus, the effect of job tenure, age and experience (Nakata and Ryoji, 2002; and Genda and Kurosawa, 2001) on the wages of women is less than with men in Japan. In addition, the return to education on the earnings of Japanese female workers is declining (Kambayashi *et al.* 2008), even though educational attainment among Japanese women is increasing (Sano, 2012 and others) over time. Empirical findings in this study confirm that the effect of human capital investment on female workers' labour market outcomes is weak in Japan.

Second, Japanese women are overrepresented in lower-paid occupations, such as clerical and service occupations, and Japanese female workers are likely to experience occupational segregation in the workplace (Nakata and Ryoji, 2002). This is partially caused by one's occupational choice, which is explained by the choice of academic majors that Japanese women select – mainly humanities, arts-education,

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<sup>11</sup> 'Other' industries (I6) include farming/fishing/forestry, mining/construction, and transportation/utilities, or others.

home economics, and social science – relative to those of Japanese men that are focused on engineering or social science (Nakata and Ryoji, 2002). This occupational selection leads Japanese women to land in lower-paid positions in the clerical and service sector, which is increasingly dominated by contingent employees in recent years (Asano *et al.* 2013). Given this, Japanese women, who are in the manufacturing or service industries and/or in contingent employment, are worse off compared to their counterparts, regardless of their marital status, as confirmed by estimates in this study.

Lastly, Japanese women are more likely (than Japanese men) to encounter career interruption, re-employment difficulties, and a deterioration of skills in periods of non-labour-participation due to marriage and childbearing (Nakamura and Ueda, 1999). Because Japanese firms have more incentives to hire new high school or college graduates over mid-career workers for internal promotions (Hashimoto and Kondo, 2012; and others) and engage less in mid-career hires (Kambayashi and Kato, 2011; and others), women who marry and bear children tend to have negative labour market outcomes in Japan (Kishi, 2009; and others). This potentially contributes to decreases in marriage among those who are educated and committed to the labour market in Japan.

## 6. Concluding Remarks

This paper examines the determinants of labour force participation and the recent wage trend among female Japanese workers, and further analyzes the factors contributing to differences in their wages by marital status. To measure these effects, I estimate the wage equation utilizing Heckman's sample selection model with the 1993-2010 Japanese Panel Survey of Consumer data.

This study finds weak evidence for a 1.4 per cent wage penalty among unmarried women, although they are more likely than married ones to participate in the labour market. Age increases both the wages of all women and labour force participation among married women, but it reduces unmarried women's labour force participation. Experience increases labour force participation among all women, yet it has no effect on the earnings of unmarried women, while it reduces married women's wages by 2.3 per cent. Education increases the earnings of all women, and the premium increases as the level of education increases; in particular, unmarried and married women with 'at least a Bachelor's degree' earn 21.3 per cent and 22.8 per cent, respectively, more than their counterparts with less than a high school diploma.

This study further confirms that full-time employment status offers higher earnings premiums relative to part-time employment status for all women, and that differences in wage premiums within employment status are smaller for unmarried women than for married ones. The effect of occupations on earnings is prominent – professional and technical occupations offer high wage premiums for both unmarried and married women. Industry differences have varied effects on the wages of Japanese female workers – unmarried women in the finance/insurance/real estate industry and married women in public administration earn the largest wage premiums.

This paper extends existing studies on labour force participation and wage differentials among female Japanese, with particular attention to unmarried women, by utilizing the 1993-2010 Japanese Panel Survey of Consumer data. The findings of

this study have a few important implications. First, women's labour force participation and wages are influenced by marital status. Second, there is weak evidence for a small wage penalty for being single. Third, being single, work experience, and high educational attainment promote women's labour force participation. Lastly, high education, full-time employment, and professional and technical occupations produce higher earnings for Japanese women, regardless of their marital status.

The findings in this study echo issues in the ongoing debate concerning the welfare of women in the Japanese labour market. Desires for work-family balance influence work, marriage and fertility decisions, leading to an increased number of contingent employees and limited human capital investment. These outcomes, in turn, negatively impact earnings, and accelerate an overrepresentation of women in lower-paid occupations that leads to occupational segregation. The results of this study are useful for developing policies to increase the female workforce population, reduce wage differentials among female workers, improve worker status, and reduce job segregation in the Japanese labour market.

## Appendices

### Appendix A1 - Initial Data Observations by Cohort: 1993-2010

Panel #	Year	Age	Total	Cohort	Obs	Cohort	Obs	Cohort	Obs	Cohort	Obs
1	1993	24-34	1500	A	1500						
2	1994	25-35	1415	A	1415						
3	1995	26-36	1341	A	1341						
4	1996	27-37	1289	A	1289						
5	1997	24-38	1749	A	1249	B	500				
6	1998	25-39	1628	A	1193	B	435				
7	1999	26-40	1537	A	1131	B	406				
8	2000	27-41	1481	A	1098	B	383				
9	2001	28-42	1421	A	1057	B	364				
10	2002	29-43	1373	A	1030	B	343				
11	2003	24-44	2139	A	980	B	323	C	836		
12	2004	25-45	1980	A	944	B	312	C	724		
13	2005	26-46	1870	A	904	B	292	C	674		
14	2006	27-47	1774	A	875	B	278	C	621		
15	2007	28-48	1706	A	847	B	271	C	588		
16	2008	24-49	2284	A	828	B	260	C	560	D	636
17	2009	25-50	2168	A	799	B	255	C	541	D	573
18	2010	24-51	2089	A	778	B	246	C	522	D	543
All	1993-2009	24-51	30744	Cohort A	19258	Cohort B	4668	Cohort C	5066	Cohort D	1752
Born Year	1959-1984	-	-	1959-1969	-	1970-1973	-	1974-1979	-	1980-1984	-

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# Outcomes for Teenage Mothers in the First Years after Birth

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## Abstract

*This study compares the educational, employment, health and partnership outcomes of teenage mothers with outcomes of women first giving birth in their twenties and those without children. The study finds that teenage motherhood has a range of negative effects, some of which worsen over time (e.g. educational outcomes) and others diminish over time (e.g. employment effects). Although some of the associations of teenage motherhood with poorer outcomes in the first years after birth are unlikely to be causal since they disappear after ensuring treatment and control group are comparable, other associations remain strong. Propensity score matching analysis suggests that relative to childless women: teenage mothers are less likely to complete Year 12, be employed, and be in good health; they are more likely to smoke; and have less personal income.*

**Keywords:** Teenage mothers, Educational outcomes, Health outcomes, Labour market outcomes

**JEL classification:** J12, J13, J16

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## 1. Introduction

Teenage motherhood is a critical policy issue in many countries. The major concern is that early childbearing interferes with human capital investment, causing young mothers to be disadvantaged in the labour market and in relationship outcomes, and to be more likely to rely on welfare. This in turn has negative consequences for themselves, their children and society. Indeed, amongst single mothers, teenage mothers are over-represented in welfare participation. For example, in Australia around one-third of single Parenting Payment recipients whose youngest child is less than six years old had their first child before age 20, while only one per cent of single mothers were teenage mothers (Jeon, Kalb and Vu, 2011).

Although teenage motherhood is less common in Australia than in many other OECD countries, socio-economic outcomes for teenage mothers are comparatively poor (see Jeon, Kalb and Vu, 2008). Teenage mothers can therefore benefit from well-designed social policy interventions to help improve their outcomes.

Teenage mothers' outcomes have been widely studied. Earlier research tends to establish a link between teenage motherhood and a wide range of outcomes without investigating whether the link is causal. In recent studies, the focus has been on determining whether the poor outcomes experienced by teenage mothers are caused by teenage motherhood or by selection bias.

In Australia, Webbink, Martin and Visscher examine whether teenage motherhood has a causal impact on smoking, drinking and body size (2008) and on human capital investment (2011). The current study complements those two studies by considering the impact of teenage motherhood on additional outcomes, such as educational, labour market, partnership and health outcomes. Thus, this study broadens the evidence base for Australia.

Establishing whether or not there is a causal link between teenage motherhood and later outcomes has important policy implications. If causality is found to be likely, then policies that prevent early childbearing can help improve later outcomes for disadvantaged women. However, if poor outcomes are due to selection bias, a different type of policy may be more relevant: for example, addressing the underlying factors driving teenage motherhood and poor outcomes later in life. Although we cannot 'prove' causality with the available data, we can rule out causality in some cases, while in other cases, causality remains a possibility.

The rest of the paper proceeds as follows. Section 2 summarises the literature on outcomes of teenage mothers. Sections 3 and 4 respectively describe the methods and data. Section 5 presents the estimation results while section 6 summarises and concludes.

## 2. Literature Overview

Education is a major pathway through which teenage motherhood could affect a woman's later outcomes. The late teenage years is when young people prepare for high-school completion and make decisions regarding further education. Pregnancy and motherhood during this period may reduce the time available for and raise the opportunity cost of schooling to the young woman, reduce her investment in it, and thus worsen her educational outcomes (Levine and Painter, 2003). However, on the reverse,

leaving school early may also lead to teenage motherhood due to a low opportunity cost of time, or early school leaving and teenage pregnancy are both caused by another (unobserved) factor. In fact, Jeon, Kalb and Vu (2011) observe that most teenage mothers seemed to have left school before becoming pregnant, potentially supporting one of the latter two relationships.

Teenage motherhood can affect a woman's labour market outcomes through its impact on her education and/or work experience, as childbearing and caring are likely to keep her out of the labour market for some time (indirect effects). Fletcher and Wolfe (2008) find that teenage mothers have lower annual earnings in adulthood than other comparable women. This could be due to lower education and/or less work experience, but motherhood could also reduce the energy a woman has for other activities, thus lowering her productivity (direct effect). Poorer labour market outcomes will thus necessitate greater welfare reliance among teenage mothers.

A woman's standard of living also depends on the presence and 'quality' of a partner. Since men are often still the main breadwinners, partnership can be an important pathway for women to escape from poverty and disadvantage. Teenage mothers are likely to be more constrained than other women in their choice of a partner. This could be because childbearing and caring responsibilities reduce the amount of time that a young mother has to search for a partner, or because children from a previous relationship discourage potential partners. As a result teenage mothers may be less likely to be partnered (Bradbury, 2006) or they are more likely to have a poorly educated and unemployment-prone partner (Ermisch and Pevalin, 2005).

The effect of teenage motherhood on health outcomes is theoretically ambiguous. On the one hand, teenage motherhood could adversely affect health outcomes. This could be because childbearing and caring responsibilities at an early age, usually as a single parent<sup>1</sup> and with limited resources and experience, are stressful and detrimental to a woman's mental and physical health. An alternative pathway for the effect could be through reduced choices and opportunities. For example, poor educational, labour market and partnership outcomes may affect teenage mothers' mental health, and induce unhealthy behaviours or lifestyles. On the other hand, teenage motherhood could also have a positive effect on health outcomes. This is because early motherhood may change the priorities of young women, steering them away from risky behaviours for the sake of their children.

There is ample evidence that teenage motherhood has significant negative impacts on a range of outcomes, even after selection bias is accounted for. For example, using a matching method, Chevalier and Viitanen (2003) find that teenage motherhood decreases the probability of continued schooling after age 16 by 12-24 percentage points. Using biological fertility shocks to instrument for age at first birth, Miller (2011) finds an increase of nine per cent in earnings per year of delay in motherhood, with three per cent being due to an increase in wages and six per cent to an increase in work hours. Webbink, Martin and Visscher (2008), who use Australian twins data and an instrumental variable (IV) method to account for selection, find that teenage mothers smoke on average 2.6-4 years longer and are less likely to quit smoking than

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<sup>1</sup> In the US, 83 per cent of births to teenagers are outside a marriage, and among Blacks this rate is 96 per cent (Hamilton *et al.* 2005).

their (twin) sisters. Teenage motherhood is also found to raise the probability of being overweight, especially at age 40 or older.

In contrast, several other studies find little causal impact of teenage motherhood. For example, using the difference-in-difference method, Brien, Loya and Pepper (2002) find that while teenage mothers have lower test scores than their counterparts without children, the effects of motherhood itself are negligible. In a more recent study using Australian twins data, Webbink, Martin and Visscher (2011) find no difference in educational attainment between teenage mothers and their identical twin sisters, suggesting little evidence of a negative causal effect of teenage childbearing on educational attainment. Geronimus and Korenman (1992) find no significant effect of teenage childbearing on the probabilities of employment and welfare participation once unobserved family characteristics are taken into account (using sibling data). Using similar methods to Webbink, Martin and Visscher (2008) on 25-year-old Americans, Fletcher (2012) finds that teenage motherhood has little effect on smoking and obesity, but may reduce drug use and binge drinking in the short term.

Some authors argue that teenage motherhood only brings forward motherhood in time, so over the life cycle, the effect of teenage motherhood is not different from the effect of later motherhood. Using miscarriages as an IV, Hotz, McElroy and Sanders (2005) show that while teenage mothers appear less likely to receive a high-school diploma, they appear to offset this by being more likely to obtain a General Educational Development certificate later in life and by working much more over their early adulthood than if they had delayed childbearing. Hotz, McElroy and Sanders (2005) also find teenage mothers to have higher levels of earnings during adulthood than if they had postponed motherhood. Moreover, while teenage childbearing seems to increase public aid expenditures immediately after a teen birth, this 'negative' consequence is short-lived, in that teenage mothers use less public aid in their late twenties as their earnings rise and their children age. On the one hand, these findings concur with Bronars and Grogger (1994) who, exploiting the natural experiment of 'twin births first', find that the short-term adverse effects of unplanned births on labour force participation, poverty and welfare reciprocity dissipate over time for white unwed mothers. On the other hand, Hotz, McElroy and Sanders' (2005) findings disagree with Taniguchi (1999), who finds that women who experience early childbearing are more likely to experience a higher wage penalty.<sup>2</sup>

Most of the empirical studies on teenage motherhood focus on educational and labour market outcomes. Recently, there has been rising interest in the impact of teenage motherhood on partnership and health outcomes. Selection bias seems the strongest with respect to educational outcomes, with much evidence indicating that teenage mothers would have low educational outcomes even if they had not had a child as a teenager. This is consistent with Jeon, Kalb and Vu (2011) who, based on Australian data, find that the majority of teenage mothers had already left school before they were pregnant.

There is considerable evidence that results differ a great deal by method.

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<sup>2</sup> Bronars and Grogger (1994) examine the effect of unplanned births while Taniguchi (1999) considers the timing of births on women's wages. Neither study focuses specifically on teenage mothers.

Studies that use the IV method tend to find much stronger negative estimates of the effects of teenage motherhood than those that use sibling difference to control for unobserved family characteristics.<sup>3</sup> This could be because the sibling method relies crucially on the assumption that the only unobserved characteristics that affect teenage motherhood are related to family background. The assumption that siblings do not differ with respect to unobserved individual characteristics, such as innate abilities and motivation, is especially strong when the siblings are not identical twins.

Overall, even though the evidence is mixed, the balance of the evidence suggests that teenage motherhood has an adverse causal impact on a wide range of outcomes, including school completion, educational attainment, employment, earnings, welfare reciprocity, partnering status, quality of partner and health.

### 3. Methods

To examine the effects of teenage motherhood on outcomes, a reduced-form model is specified:

$$Y_i = \alpha + \beta_T T_i + \beta_X X_i + \varepsilon_i \quad (1)$$

where  $i$  indexes individuals,  $T$  is a binary variable capturing whether a woman had a first birth at ages 15-19, and  $X$  is a vector of controls.  $\alpha$ ,  $\beta_T$  and  $\beta_X$  are parameters to be estimated, with  $\beta_T$  capturing the total direct effect of teenage motherhood on the outcome in question, holding constant other observable factors.

A methodological issue arises because teenage motherhood is potentially endogenous. Thus, while a significant negative relationship between teenage motherhood and an outcome may show that teenage motherhood is associated with a poorer outcome, it does not prove that teenage motherhood *per se* leads to the outcome. Ignoring the potential endogeneity of teenage motherhood may lead to biased and inconsistent estimates of its impact on later outcomes. Teenage mothers may be different from other young women in many regards, and it might be these other characteristics that drive a difference in outcomes. To address this heterogeneity of young women, we need to compare teenage mothers to women who are as much like them as is possible.

Our data do not support the use of IV approaches used by Bradbury (2006) or fixed effect approaches (based on sibling or twin data) used by Webbink, Martin and Visscher (2008, 2011). Therefore to address the potential selection into teenage motherhood based on observables, this study uses the propensity score matching (PSM) method. PSM estimates the treatment effect (of teenage motherhood) by comparing a treated case (teenage mother) with an untreated case (non-teenage mother) that is as similar to the treated case as possible. Specifically, the PSM process involves three steps. The first step obtains the propensity score, which is the predicted

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<sup>3</sup> Ribar (1999) confirms this by applying the two methods to the same data. He argues that if the unobserved individual-specific factors influencing fertility and socio-economic status are at least as strongly related as the unobserved family-specific factors influencing fertility and socio-economic status, then the sibling difference estimates represent a lower bound on the estimated effects of teenage motherhood.

probability of being a teenage mother given a woman's characteristics. The second step matches a teenage mother with a non-teenage mother based on their propensity scores. Individuals that can be matched to a teenage mother form a control group. In the last step, the average treatment effect (impact of teenage motherhood on outcome) is estimated as the mean difference in the outcome between the treatment group and the control group.

Two methods will be used to match a teenage mother with a non-teenage mother. In the first method (kernel matching), a 'synthetic' counterfactual is created for each teenage mother, based on the kernel-weighted average of the characteristics of the nearest non-teenage mothers with closer neighbours receiving higher weights. The second method (calliper matching) matches a teenage mother with one or more non-teenage mothers if the difference in propensity scores between the teenage mother and the non-teenage mother is less than a specified limit. For both methods, the likelihood of a match can be raised by setting a larger bandwidth, but this would be at the expense of the match quality (resulting in higher standard errors).

The more explanatory variables are available for the estimation of the propensity score equation, the more plausible it is that selection on unobservables is minimised as well (since selection is mostly captured by the observed characteristics) and that the estimated effect using PSM can be interpreted as causal. Previous overseas studies which have used PSM to estimate the impact of motherhood include Levine and Painter (2003) for the US, Chevalier and Viitanen (2003), and Goodman, Kapman and Walker (2004) for the UK, and Simonsen and Skipper (2006) for Denmark. Unfortunately, only a limited number of explanatory variables are available for this study, so our results have to be interpreted with caution.

## 4. Data

### *Data sources*

This study draws on data from two surveys: the Longitudinal Study of Australian Children (LSAC) and Household, Income and Labour Dynamics in Australia (HILDA).

HILDA is a longitudinal survey of Australian households collecting information on all individuals for a number of randomly selected households on a yearly basis. HILDA started in 2001 and has been run annually, with each year corresponding to a wave. It covers approximately 13,000 individual respondents living in more than 7,000 households. HILDA collects information on a large number of individual characteristics, such as education, health, labour force participation, income, and a broad range of characteristics for all adults living in the household; and household characteristics, such as the number and age of children, and the number of adults in the household.<sup>4</sup>

LSAC is a panel data survey that follows around 10,000 children and their families. At the time of the study, six years of information over four waves were available. There are two birth cohorts of around 5,000 children each. Children in the birth (B) cohort were three to 19 months old when the study began in 2004, while children in the kindergarten (K) cohort were four to five years old at the start. This study only uses the B-cohort. Data are collected from the children's parents, childcare

<sup>4</sup> Detailed information on HILDA is available on the website <http://melbourneinstitute.com/hilda/>. For discussion of the design of the HILDA Survey refer to Wooden and Watson (2007).

providers or teachers, and the child once they are old enough. Information is collected on many early childhood issues, such as health, parenting, family relationships, education, childcare, family support, and separated families, but also on the well-being and labour market participation of the parents.<sup>5</sup>

In LSAC, the focal children are followed over time, and information on the mothers of the children is collected when available. All women in LSAC are thus mothers, either teenage mothers (i.e. women who have become a mother during their teenage years) or older mothers (i.e. women who have become a mother in their twenties or later). HILDA, in contrast, tracks all adults living in selected households over time. HILDA data do not only contain teenage mothers and older mothers but also childless women.

To make HILDA mothers roughly comparable to LSAC B-cohort mothers (whose children are aged between three and 19 months in 2004) while still retaining a sufficiently large number of teenage mothers, we only include HILDA mothers whose children are up to three years old in the 2004 wave. Since the number of mothers aged 15-29, who had their first child as a teenager, is not very large (fewer than 200 in each survey) and since LSAC does not contain childless women, we pool both data sets. In particular, most of the analysis is based on LSAC B-cohort wave 1 and HILDA wave 4 (both carried out in 2004). Our pooled estimation sample has just over 300 observations on teenage mothers. The average age at which teenage mothers have their first child is 18.2. Figure B1 shows the age distribution of having the first child.

For robustness checks, using outcomes at slightly older ages, we also include LSAC waves 2 and 3, and HILDA waves 6 and 8 (carried out in 2006 and 2008 respectively). The estimation samples are restricted to women up to age 29 in 2004, 31 in 2006 and 33 in 2008.

### **Key variables**

We consider 11 outcomes, which are classified into four groups:

- Educational outcomes: Year 12 completion and having a post-school qualification, where a post-school qualification can be a university degree or a non-degree qualification;
- Labour market outcomes: employment status (i.e. employed or not employed) and personal income (measured as total income from all sources in current dollars per week);
- Health outcomes: physical health status, psychological distress, feelings of depression,<sup>6</sup> and smoker status;
- Partnership outcomes: partnering status, partner's employment status and family income (family income is the same as personal income if the woman is single, and it equals her personal income plus her partner's income if the woman has a partner).

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<sup>5</sup> More information is available from <http://www.growingupinaustralia.gov.au/>.

<sup>6</sup> Psychological distress is defined as the respondent 'being nervous', 'being so sad that...', or 'everything being an effort' in LSAC and being 'nervous', 'so down that...', and 'worn out' in HILDA in the last four weeks. Depression is defined as being 'so sad that...' in LSAC, and 'so down that...' in HILDA. Index values for these two indicators refer to the frequency with which these feelings are experienced, ranging from one (all of the time) to five (none of the time), so a higher value on the index indicates better mental health.

Furthermore, we apply a lower age limit for most of the analysis, as some ages are too young for certain outcomes to have been achieved. In particular:

- Year 12 completion, having post-school qualification, employment status, personal income and family income are analysed for women aged 20 or above;
- Having a university degree is analysed for women aged 23 or above;
- Physical health status and smoker status are analysed for all women;
- Psychological distress and feelings of depression are analysed for all women;
- Partnering status is analysed for women aged 20 or above with children only;<sup>7</sup>
- Partner's employment status is analysed for partnered women aged 20 or above with children only.

### **Descriptive statistics**

Table 1, which contains the means of the regression variables for our 2004 estimation sample, shows that childless women are less likely to have a partner than teenage mothers, who are in turn less likely to have a partner than older mothers. For the other ten outcomes, teenage mothers have poorer outcomes than older mothers, who in turn have poorer outcomes than childless women, except on mental health variables. For most outcomes and characteristics, the means for older mothers and childless women are statistically significantly different from the means for teenage mothers.

Table 1 - Descriptive Statistics of LSAC and HILDA Estimation Samples

	<i>LSAC</i>		<i>HILDA</i>		
	<i>Teenage mothers</i>	<i>Older mothers</i>	<i>Teenage mothers</i>	<i>Older mothers</i>	<i>Childless women</i>
<b>Outcomes</b>					
Completed Year 12 <sup>a</sup>	0.321	0.647 ***	0.250	0.604 ***	0.807 ***
Post-school qualification <sup>a</sup>	0.396	0.611 ***	0.214	0.461 ***	0.572 **
Employed <sup>a</sup>	0.151	0.443 ***	0.250	0.412 ***	0.863 *
Personal income in \$/week <sup>a</sup>	235	254 ***	84	171	495
Having good or better health	0.838	0.906 ***	0.800	0.898 **	0.910 ***
Being a smoker	0.618	0.286 ***	0.598	0.302 ***	0.237 ***
Psychological distress index (1=often distressed; 5=never distressed)	4.280	4.327 **	3.668	3.892	3.829 ***
Depression index (1=often feeling depressed; 5=never feeling depressed)	4.436	4.584 **	4.008	4.330 *	4.213 ***
Partnered <sup>a,b</sup>	0.704	0.864	0.464	0.781 ***	
Partner employed <sup>a,b,c</sup>	0.784	0.937	0.846	0.920 ***	
Family income in \$/week <sup>a</sup>	529	881 ***	292	695 ***	785 ***
<b>Control variables</b>					
<i>Own background characteristics</i>					
Age	18.878	25.965 ***	18.538	26.614 ***	20.871 ***
School completion (ref: Year 9 or less)	0.252	0.057 ***	0.214	0.051 ***	0.061 ***
Year 10-11 only	0.564	0.296 ***	0.604	0.345 ***	0.305 ***
Year 12 <sup>d</sup>	0.184	0.647 ***	0.182	0.604 ***	0.635 ***

<sup>7</sup> Partnership outcomes are only considered for women with children, since for childless women, not having a partner when they are aged 20 to 29 cannot be interpreted as a good or a bad outcome. However, when children are present, having someone with whom to share the caring responsibilities is likely to make partnered women better off than single women.

Table 1 - Descriptive Statistics of LSAC and HILDA Estimation Samples (continued)

	LSAC		HILDA		
	Teenage mothers	Older mothers	Teenage mothers	Older mothers	Childless women
Post-school qual. (ref: No qual.)	0.736	0.389 ***	0.846	0.539 ***	0.645 ***
Non-degree qualification <sup>e</sup>	0.264	0.416	0.154	0.257 ***	0.171 ***
University degree		0.195 ***		0.204 ***	0.184 ***
Parents separated by age 14	0.207	0.184 ***	0.506	0.262	0.239 ***
No parent employed at age 14	0.098	0.045 ***	0.186	0.057 ***	0.045 ***
Religion (ref: No religion)	0.433	0.236 **	0.346	0.239 ***	0.266 ***
Catholic	0.201	0.276 ***	0.109	0.175 **	0.206 *
Other Christian	0.250	0.389 ***	0.128	0.373 ***	0.245 ***
Other religion	0.104	0.093	0.013	0.057	0.038 **
Religion not known	0.012	0.005 ***	0.404	0.156	0.244 ***
Indigenous Australian	0.159	0.038 ***	0.207	0.038 ***	0.031 ***
Migrant status (ref: Australian born)	0.915	0.817 ***	0.929	0.866 ***	0.854 **
Migrant from an ESB country	0.030	0.058	0.045	0.042	0.036
Migrant from an NESB country	0.055	0.125 ***	0.026	0.092 ***	0.110 ***
Residence (ref: Metropolitan)	0.390	0.502 ***	0.449	0.548 ***	0.691 **
Regional residence	0.530	0.443 ***	0.506	0.423 **	0.291 *
Remote residence	0.079	0.054 **	0.045	0.029	0.018
<i>Parental characteristics</i>					
Par. migrant status (ref: No migrant parent)	0.722	0.582 ***	0.735	0.634 ***	0.603 **
One parent is migrant	0.136	0.148	0.129	0.164	0.181
Both parents are migrants	0.142	0.270 **	0.135	0.202 ***	0.216 *
<i>Family characteristics</i>					
Living with parents	0.317	0.085 ***	0.276	0.050 ***	0.516 ***
Mixed family <sup>f</sup>	0.530	0.134	0.410	0.090 ***	0.390 ***
Number of children	1.195	1.709 ***	1.103	1.443 ***	
<i>Age of youngest child (ref: 0 years)</i>					
1 year	0.884	0.859 ***	0.718	0.439	
2 years	0.116	0.141 ***	0.141	0.252	
3+ years			0.096	0.164	
			0.045	0.145	
<i>Partner's characteristics</i>					
Partner's employment (ref: No partner)	0.393	0.136 ***	0.441	0.233 ***	0.755 ***
Partner employed	0.491	0.810 ***	0.355	0.706 ***	0.223 ***
Partner not employed	0.117	0.054 ***	0.204	0.061 ***	0.022 ***
Observations	164	1,700	156	456	2,653

Sources: LSAC (wave 1) and HILDA (wave 4), women aged up to 29 years only.

Notes: \*, \*\* and \*\*\* denote sample means that are significantly different from the means for teenage mothers at the 10%, 5% and 1% level respectively. (a) Outcome measured for women aged 20 or over only; (b) Outcome measured for women with children only; (c) Outcome measured for partnered women only. Partnership outcomes for all women aged 15-29 are shown under 'partner's characteristics'; (d) Excludes non-school Year 12 equivalent qualifications; (e) Includes all certificate- and diploma-level qualifications; (f) A mixed family contains other people living with a couple or a nuclear family (which includes parent(s) and dependent child(ren) only), or at least two people who are not part of a couple.

## 5. Results

### Basic regression results

Before presenting the PSM results, we first report the results from simple regressions of the relevant outcomes on teenage motherhood and older motherhood status while controlling for as many relevant characteristics as available in the data. Summary results are presented in Table 2, with full results available in A1-A3. These provide a reference point for the results in the following subsection.

These results show that, mostly, outcomes for teenage mothers are worse than for older mothers and childless women. Outcomes for older mothers are also generally worse than for childless women, at least with regard to labour market outcomes and income, which is as expected due to the presence of young children. These negative associations are often substantial and significant for several of the analysed outcomes. For example, comparing the negative association of teenage motherhood with employment to the average rate of employment in the sample, we observe that the employment rate is decreased by over two-third for teenage mothers. The only exceptions are for the mental health outcomes, where childless women appear to do the worst and older mothers fare best.<sup>8</sup> However, examining the summary statistics in table 1, this may be due to differences between HILDA and LSAC. Childless women are only observed in HILDA, while the other two types of women appear in both surveys. As a result, the reference group of childless women may capture the difference between HILDA and LSAC rather than the difference between childless women and mothers. The summary statistics indicate that childless women do slightly worse with regard to mental health outcomes but not to the extent estimated in table 2.

Table 2 - Effects of Motherhood Status on Outcomes in the First Three Years After Birth <sup>a</sup>

Outcome	Mean outcome in estimation sample	Number of teenage mothers	Effect of motherhood status <sup>b</sup>		Number of observations	(Pseudo) R-squared
			Teenage mother	Older mother		
Year 12 completed	0.682	77	-0.442 ***	-0.175 ***	3,230	0.072
Post-school qualification	0.576	77	-0.113	0.008	3,227	0.051
Employed	0.583	77	-0.434 ***	-0.404 ***	3,155	0.265
Personal income in \$/week	332.0	77	-53.3	-231.5 ***	3,142	0.358
Having good health	0.898	223	-0.018	0.039 *	3,588	0.043
Being a smoker	0.299	196	0.183 ***	0.021	2,766	0.132
Psychological distress index	4.041	220	0.363 ***	0.493 ***	3,595	0.111
Depression index	4.380	220	0.267 ***	0.366 ***	3,587	0.067
Partnered	0.837	77	0.023		2,139	0.128
Partner employed	0.931	48	-0.027		1,763	0.138
Family income in \$/week	848.64	77	-98.6	-224.4 ***	3,154	0.378

Source: Estimated from LSAC (wave 1) and HILDA (wave 4), women aged up to 29 years only

Notes: a) Full results are available in A1-A3. b) Reference category: childless women.

\* significant at 10%, \*\*significant at 5%, \*\*\*significant at 1%.

<sup>8</sup> Similar results are obtained when mental health outcomes are defined as binary indicators of experiencing psychological distress and feelings of depression respectively, at least 'some of the time'.

Given that a large proportion of teenage mothers already left school before becoming pregnant, most of the large marginal effect on Year 12 completion cannot be attributed to teenage motherhood. However, while other women may catch up with their schooling at a slightly later stage (i.e. in their early 20s), teenage mothers are less likely to do this, widening the gap in education.

One of the control variables included is whether the respondent lives with her parents. Although these have on average no or a negative impact on post-school qualifications or personal income, when interacted with being a teenage mother, living with parents seems to exert a small positive impact on outcomes, suggesting that these parents provide some support to their daughters. However, the effect of teenage motherhood remains largely unchanged, and given the small number of teenage mothers and the more complex interpretation of results, regressions with interaction terms are not reported.

The next section investigates how many of these associations remain after matching teenage mothers to similar women in the older mothers and the childless women categories.

## **PSM results**

### ***Propensity score equations***

First we estimate propensity score equations. Table 3 presents the average marginal effects of a range of characteristics on the probability of being a teenage mother. The probability of being a teenage mother serves as the propensity score in the PSM estimation. The distribution of the propensity score presented in figure B2 shows that the propensity to become a teenage mother is less than 20 per cent for most women in the sample (even for those women who became a teenage mother). The difference in outcomes between a teenage mother and a non-teenage mother with similar propensity scores is attributed to teenage motherhood.

Several background characteristics are associated with the likelihood of being a teenage mother. For the pooled sample combining the HILDA and LSAC samples (column 1), Year 10 completion is associated with a reduction by 14 percentage points in the probability of being a teenage mother, while women with Christian beliefs are 4.7 to 5.4 percentage points less likely than non-religious women to become a mother in their teens.<sup>9</sup> Own migrant status and parental migrant status have almost zero, and insignificant, associations with the probability of being a teenage mother. Indigenous status is a strong predictor of teenage motherhood, with Indigenous women being 8.6 percentage points more likely to become a teenage mother than non-Indigenous women.

Parental employment status at age 14 is relevant as well, with women who had no parent employed at age 14 being 4.2 percentage points more likely to be a teenage mother.<sup>10</sup> The father's total unemployment duration during childhood is also important (see column 3), but is only collected for HILDA respondents. Residents of regional

<sup>9</sup> Given that we only consider teenage mothers who had their first childbirth at age 15 or over, completion of Year 10 should have occurred before childbirth.

<sup>10</sup> Parental employment at age 14 is defined differently in HILDA and LSAC. In HILDA, the survey includes a direct question on employment at age 14 for each parent, whereas in LSAC, parental employment at age 14 is only asked for the main breadwinner. We assume that if the main breadwinner is not employed that the other parent (if present) is also not employed.

areas are respectively 3.5 percentage points more likely to be a teenage mother than metropolitan residents. Similar results on the probability of being a teenage mother are obtained when using the HILDA sample only, except that parental separation by age 14 is only significant in the HILDA sample (table 3, columns 2 and 3).

Table 3 - Marginal Effects on the Probability of Being a Teenage Mother

	<i>HILDA and LSAC pooled (1)</i>	<i>HILDA only (2)</i>	<i>HILDA only (extra variable) (3)</i>
At least Year 10	-0.140 ***	-0.093 ***	-0.086 ***
Religion (ref: No religion)			
Catholic	-0.047 ***	-0.039 **	-0.038 *
Other Christian	-0.054 ***	-0.043 **	-0.043 **
Other religion	-0.007	-0.063	-0.060
Religion not known	-0.001	0.017	0.018
Indigenous Australian	0.086 ***	0.080 ***	0.076 ***
Migrant status (ref: Australian born)			
Migrant from an ESB country	0.001	0.000	0.000
Migrant from an NESB country	-0.011	0.000	0.000
Father unemployed for at least 6 months when growing up			0.027 *
Parental status at age 14			
Parents separated by age 14	0.012	0.033 ***	0.033 ***
No employed parents at age 14	0.042 **	0.038 **	0.033 *
Parental migrant status (ref: No migrant parent)			
One parent is migrant	-0.016	-0.019	-0.017
Both parents are migrants	-0.012	-0.002	-0.003
Residence (ref: Metropolitan)			
Regional residence	0.035 ***	0.035 ***	0.035 ***
Remote residence	0.032	0.029	0.030
Observations	4,169	2,331	2,327
Pseudo R-squared	0.11	0.151	0.156
Number of teenage mothers	304	142	142

Source: Estimated from LSAC (wave 1) and HILDA (wave 4), women aged up to 29 years only.

Notes: \*significant at 10%, \*\*significant at 5%, \*\*\*significant at 1%.

Applying the PSM approach appears to work well in making the treatment group (teenage mothers) and control group (non-teenage mothers) more comparable. When comparing the treatment and control groups in terms of their mean characteristics before and after applying the weights, obtained through one of the PSM approaches, the means in the two groups have become much more similar after applying the weights.<sup>11</sup>

### **Computing the average treatment effect on the treated**

Applying the PSM method allows us to attribute differences in outcomes between a teenage mother and a non-teenage mother to the effect of teenage motherhood, conditional on the treatment and control group being sufficiently similar on observed

<sup>11</sup> A4 compares the means of the treatment and control groups before and after the matching. Most explanatory variables are statistically different between the two groups before the matching, but no significant differences remain after the matching.

and unobserved characteristics after the PSM weighting. Computing the average difference in outcome across all teenage mothers for each outcome, we obtain the Average Treatment effect on the Treated (ATT). The ATT estimates for 2004 (including women with children up to the first three years after birth) are presented in table 4. For each outcome, there are six estimates.

Table 4 - Effects of Teenage Motherhood on Outcomes (ATT) in the First Three Years After Birth, Based on Various Propensity Score Matching Methods

	<i>Kernel, bandwidth 0.001 (1)</i>	<i>Kernel, bandwidth 0.01 (2)</i>	<i>Calliper, bandwidth 0.001 (3)</i>	<i>Calliper, bandwidth 0.01 (4)</i>	<i>Same as (1) compared with older mothers only (5)</i>	<i>Same as (1) compared with childless women only (6)</i>
<i>Completed Year 12</i>						
Estimate	-0.257 ***	-0.241 ***	-0.252 **	-0.249 ***	-0.183 **	-0.395 ***
Number in control group	2,020	2,450	208	221	1,592	281
<i>Post-school qualification</i>						
Estimate	-0.161 **	-0.149 **	-0.166 **	-0.156 **	-0.168 **	-0.081 **
Number in control group	2,001	2,447	206	220	1,597	281
<i>Employed</i>						
Estimate	-0.271 ***	-0.272 ***	-0.222 **	-0.209 **	-0.153 **	-0.567 ***
Number in control group	2,060	2,449	212	222	1,595	281
<i>Personal income</i>						
Estimate	-.49 **	-.49 **	-.48 *	-.50 **	-.28 **	-.123 **
Number in control group	2,018	2,437	211	220	1,635	281
<i>Having good or better health</i>						
Estimate	-0.063 *	-0.042 *	-0.088 **	-0.064 *	-0.078 *	-0.072 **
Number in control group	2,395	2,718	358	416	1,446	883
<i>Being a smoker</i>						
Estimate	0.296 ***	0.262 ***	0.313 ***	0.289 ***	0.233 ***	0.349 ***
Number in control group	2,011	2,233	297	342	1,290	595
<i>Psychological distress index</i>						
Estimate	0.001 **	0.035 **	-0.125 **	-0.087 **	-0.197 **	0.117 **
Number in control group	2,447	2,725	380	414	1,429	882
<i>Depression index</i>						
Estimate	-0.063 **	-0.022 **	-0.133 **	-0.078 **	-0.197 **	0.035 **
Number in control group	2,454	2,718	366	403	1,419	928
<i>Partnered</i>						
Estimate	-0.127 *	-0.148 **	-0.157 **	-0.163 **	-0.127 *	
Number in control group	1,592	2,055	198	215	1,592	
<i>Partner employed</i>						
Estimate	-0.071 *	-0.051 *	-0.103 *	-0.106 *	-0.071 *	
Number in control group	1,278	1,611	119	130	1,278	
<i>Family income</i>						
Estimate	-209 ***	-219 ***	-249 ***	-257 ***	-212 ***	-18 ***
Number in control group	2,019	2,449	208	221	1,591	281

Source: Estimated from LSAC (wave 1) and HILDA (wave 4), women aged up to 29 years only.

Notes: Standard errors (not shown) are bootstrapped with 50 replications. \*significant at 10%, \*\*significant at 5%, \*\*\*significant at 1%. For each outcome, the number of treated observations is the same as the number of teenage mothers in table 2. Also see notes of table 1.

The first two estimates are based on the kernel method (see columns 1 and 2), where for each teenage mother, a 'synthetic' counterfactual is created based on the kernel-weighted average of the characteristics of the nearest non-teenage mothers. This method has the advantage of using most non-teenage mothers in establishing the 'counterfactual' case for a teenage mother. The kernel weight depends on the propensity score of each non-teenage mother compared to the propensity score of the nearest teenage mother. The closer a non-teenage mother is to a teenage mother in terms of propensity score, the higher is the weight applied to that non-teenage mother in creating the 'counterfactual' case for a teenage mother.

Two alternative bandwidths are used for the kernel method: 0.001 and 0.01.<sup>12</sup> When the chosen bandwidth is smaller, the kernel weight placed on closer neighbours is relatively larger. A bandwidth can be thought of as a 'tolerable difference'. The higher the chosen bandwidth is, the more likely it is to find a non-teenage mother that can be matched to a teenage mother, yet the less likely it is that they are a good match. The distribution of the kernel matching weights (with bandwidth 0.001) is presented in figure B3.<sup>13</sup>

The next two estimates are based on the calliper method (see columns 3 and 4 in table 4). This method matches a teenage mother with one or more non-teenage mothers if the difference in propensity scores between the teenage mother and the non-teenage mother is less than a specified limit (the bandwidth). The calliper method gives equal weight to all matched observations and ignores all unmatched observations. As such, only a limited number of non-teenage mothers are used in calculating the counterfactual outcomes. Again, two bandwidths (0.001 and 0.01) are used for this matching method.

We also compute two other estimates, both using the kernel method with a bandwidth of 0.001. The first estimate is based on a comparison between teenage mothers and older mothers only (see column 5) and the second estimate is based on a comparison with childless women only (see column 6). For all PSM estimations, we only use treated observations whose propensity scores lie in the 'common support' region. A teenage mother is said to satisfy this condition if her predicted propensity score is smaller than the maximum propensity score amongst older mothers and/or childless women, and larger than the minimum propensity score amongst this group.

Examining the results in table 4, we can make a number of observations. First, a comparison with the regression results in table 2 shows that although several estimated effects have become somewhat smaller, more of the estimated effects are now significant with some effects even remaining of equal size or slightly bigger. However, reassuringly, most of the counterintuitive differences in mental health outcomes between teenage mothers and childless women are now much less significant, and much smaller in size.

Second, the kernel method (columns 1 and 2) produces larger estimates (in absolute value) for employment status, while the calliper method (columns 3 and 4) produces larger estimates for most other outcomes. However, the two sets of estimates are of the same order of magnitude. For example, the kernel method with a bandwidth

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<sup>12</sup> Chevalier and Viitanen (2003) also use these two bandwidths.

<sup>13</sup> Treated observations all have weight one.

of 0.001 suggests that teenage motherhood reduces the probability of employment by 27.1 percentage points, whereas the calliper method with the same bandwidth suggests a smaller (but still similarly sized) reduction of 22.2 percentage points. While the kernel method with a bandwidth of 0.001 attributes 6.3 percentage points of a decrease in the probability of having good or better health to teenage motherhood, the corresponding reduction predicted by the calliper method is larger in magnitude, at 8.8 percentage points.

Third, while increasing the bandwidth always increases the number of matches, its impact on the magnitude of the estimated effect can be either positive or negative. In general, estimates based on the two bandwidths are broadly similar. For example, the kernel method with a bandwidth of 0.001 (column 1) suggests that teenage motherhood reduces the probability of completing Year 12 by 25.7 percentage points, while the same method with a bandwidth of 0.01 (column 2) suggests the reduction is 24.1 percentage points. Similarly, the calliper method with a bandwidth of 0.001 (column 3) and 0.01 (column 4) suggests that teenage motherhood reduces weekly personal income by \$48 and \$50 respectively.

Fourth, the impact of teenage motherhood is larger when comparing teenage mothers with childless women (column 6) than when comparing with older mothers (column 5). For example, while teenage mothers have only \$28 less in average weekly personal income compared with older mothers, they have \$123 less compared with childless women. This pattern is consistent with the raw patterns observed in table 1 in section 4 and the regression results in table 2, which suggest that the mean outcomes of older mothers lie somewhere between those for teenage mothers and those for childless women.

To assess potential longer-term effects, we also estimate the impact of teenage motherhood in later years. The results, presented in A5, do not show a clear pattern, with the association of teenage motherhood with some outcomes increasing over time yet decreasing for others. This could be at least partly because of the small number of teenage mothers that remain in the survey in later years.<sup>14</sup>

The impact of teenage motherhood on educational outcomes worsens over time. For example, while teenage motherhood is associated with a reduced probability of Year 12 completion by 26 percentage points in the first three years after birth, the corresponding reduction increases to 32 percentage points in the fifth year and remains at 32 percentage points two years later. This could be because childless women are more likely than teenage mothers to accumulate further education as they age, which widens the gaps in educational outcomes between the two groups. In addition, the youngest group of teenage mothers (i.e. the group that had a child before turning 17 years of age) was more likely to be excluded from the analysis of educational outcomes in table 4 since they would not have reached the age of 20 within three years of their last childbirth. This youngest group is likely to be most affected with regard to their school completion outcome. No such effect is found for post-school qualifications.

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<sup>14</sup> The attrition rates for teenage mothers are significantly higher than for other women. In LSAC, 37 per cent of teenage mothers who were in our estimation sample in wave 1 had left the survey four years later, compared with 19 per cent for other women. In HILDA, the corresponding attrition rates were 97 per cent and 75 per cent respectively. The attrition rate for HILDA adult respondents over the same period was 20 per cent.

In contrast, the impact of teenage motherhood on employment diminishes over time. In particular, teenage motherhood is associated with a reduction in the probability of working by 27 percentage points in the first three years after birth, but this drops to 26 and 18 percentage points respectively in the fifth and seventh years after birth. This is likely to reflect the increasing tendency for mothers to increase labour supply as their child grows up. In addition, it may be the case that teenage mothers who do better in this regard are also more likely to remain in the survey.

Overall, the PSM analysis shows that although not all of the observed associations between teenage motherhood and outcomes can be attributed to the causal impact of teenage motherhood, several strong associations remain after applying the matching approach. Some of these may be causal.

## 6. Summary and Conclusion

This study has used data from the LSAC (waves 1-3) and HILDA (waves 4, 6, 8) surveys to examine educational, labour market, health and partnership outcomes of young women who became a mother during their teenage years and compared them with outcomes of women who became a mother in their twenties and those who do not have children yet. Descriptive statistics indicate that on average, teenage mothers have considerably poorer outcomes than older mothers, who in turn have considerably poorer outcomes than childless women.

The PSM approach, which allows comparison of outcomes for women who have similar propensities to become a teenage mother, shows that a large part of these associations are due to selection bias. However, although several of the observed associations are not due to the causal impact of teenage motherhood, the indication is that some associations remain strong even after controlling for differences between teenage mothers and other women. In particular, PSM analysis suggests that relative to similarly characterised childless women, teenage mothers are 40 percentage points less likely to complete Year 12 (however, part of the educational disadvantage pre-dates teenage motherhood with school-leaving occurring before pregnancy), 57 percentage points less likely to be employed and 35 percentage points more likely to be a smoker. Relative to childless women, teenage mothers have \$123 less in weekly personal income and are seven percentage points less likely to have good health or better than good health.

Examining outcomes after two and four additional years respectively, the disadvantage with regard to the outcomes listed above has remained to a large extent. The disadvantage with regard to education appears to deepen in the years after birth, while the disadvantage with regard to employment reduces, presumably because mothers can increase their labour supply as their children grow up. However, the difference in income (both in personal and family income) appears to become larger over time, possibly due to the different career opportunities available to teenage mothers (and their partners, if present) compared to other women.

The results are subject to the limitations in the PSM method. This method rests crucially on the assumption that assignment to treatment (i.e., becoming a teenage mother) is purely random, given the probability of treatment (our predicted propensity score). Thus, it is difficult to precisely pin down the effect of teenage

motherhood on outcomes. On the one hand, the observed effect is overstated because several factors, such as unobserved personal characteristics that are important in shaping a woman's outcomes, cannot be controlled for, and unfortunately we have a limited number of explanatory variables to use in the model to predict the probability of teenage motherhood. On the other hand, the observed effect of teenage motherhood on outcomes could be understated if we do not account for the indirect effects because teenage motherhood is strongly associated with educational outcomes and education has a strong effect on outcomes, especially labour market outcomes.

It appears that young teenage mothers are disadvantaged because they have children, which is compounded by the fact that they have children at such a young age. Child bearing and caring responsibilities associated with having children are impediments to a woman's labour market activity while having children at a young age is also an obstacle to human capital accumulation.

Accordingly, policies aimed at reducing early motherhood should help improve outcomes for young women. In addition, there is evidence that labour market outcomes improve as children get older. This indicates that childcare assistance remains an important policy direction to focus on; not only to support employment but also to ensure young mothers can complete Year 12 and/or obtain some post-school qualification. Teenage mothers have on average substantially lower education levels compared to other women, which negatively impacts on their employment outcomes over their lifetime (as shown by Jeon, Kalb and Vu, 2011). Successful early assistance is likely to have long-term effects for these women's outcomes over their lifetimes. This may be particularly relevant to Indigenous women who are disproportionately more likely to become a teenage mother and who have much higher fertility rates compared to other women, negatively affecting their labour force participation (Hunter and Daly, 2013).

## Appendix A

Table A1 - Effects of Teenage Motherhood and Other Factors on Educational and Labour Market Outcomes in the First Three Years After Birth

	Completed Year 12 (1)	Post-school qualification (2)	Employed (3)	Personal income (4)
Mean outcome of estimation sample	0.682	0.576	0.583	332.016
# teenage mothers	77	77	77	77
Motherhood status (ref: Childless woman)				
Teenage mother	-0.442 ***	-0.113	-0.434 ***	-53.254
Older mother	-0.175 ***	0.008	-0.404 ***	-231.458 ***
Living with parents	-0.045	-0.095 ***	0.024	-52.310 *
Parental status at age 14				
Parents separated by age 14	-0.101 ***	-0.088 ***	-0.034	-18.073
No employed parents at age 14	-0.122 **	-0.034	-0.015	-51.175 *
Religion (ref: No religion)				
Catholic	0.075 ***	0.036	0.034	4.139
Other Christian	-0.003	0.041	-0.01	-28.644 *
Other religion	-0.004	0.057	-0.078 *	-29.094
Religion not known	-0.098 **	-0.067	-0.028	-34.635
Indigenous Australian	-0.167 ***	-0.052	-0.105 *	55.396 *
Migrant status (ref: Australian born)				
Migrant from an ESB country	0.012	0.029	-0.007	39.843
Migrant from an NESB country	0.085 *	-0.151 ***	-0.090 *	-7.564
Residence (ref: Metropolitan)				
Regional residence	-0.089 ***	-0.056 **	0.047 **	-46.357 ***
Remote residence	-0.096 *	-0.013	0.065	2.339
Par. migrant status (ref: No migrant parent)				
One parent is migrant	-0.021	0.022	-0.018	-18.813
Both parents are migrants	-0.034	0.078 **	-0.021	-11.86
Mixed family				
Number of children			-0.075 ***	43.429 ***
Age of youngest child (ref: 0 years)				
1 year			0.094 ***	
2 years			0.074	
3+ years			0.119 *	
Partner's employment (ref: No partner)				
Partner employed			0.113 ***	-69.357 ***
Partner not employed			-0.097 *	1.149
Age				
Age squared			0.015 ***	233.363 ***
School completion (ref: Year 9 or less)				
Year 10-11 only		0.124 **	0.131 **	-10.908
Year 12		0.292 ***	0.217 ***	-23.284
Post-school qual. (ref: No qual.)				
Non-degree qualification			0.089 ***	15.369
University degree			0.113 ***	99.135 ***
Employed				258.955 ***
Observations	3,230	3,227	3,155	3,142
(Pseudo) R-squared	0.072	0.050	0.265	0.352

Source: Estimated from LSAC (wave 1) and HILDA (wave 4), women aged up to 29 years only.

Notes: \*significant at 10%, \*\*significant at 5%, \*\*\*significant at 1%. Also see notes of table 1.

## A2 - Effects of Teenage Motherhood and Other Factors on Health Outcomes in the First Three Years After Birth

	<i>Having good health (1)</i>	<i>Distress index (2)</i>	<i>Depression index (3)</i>	<i>Being a smoker (4)</i>
Mean outcome of estimation sample	0.898	4.041	4.380	0.299
# teenage mothers	223	220	220	196
Motherhood status				
Teenage mother	-0.018	0.363 ***	0.267 ***	0.183 ***
Older mother	0.039 *	0.493 ***	0.366 ***	0.021
Living with parents	0.003	0.100 *	0.058	-0.083 **
Parental status at age 14				
Parents separated by age 14	0.004	-0.087 **	-0.100 **	0.065 **
No employed parents at age 14	-0.084 **	-0.05	-0.098	0.027
Religion (ref: No religion)				
Catholic	0.012	-0.024	-0.014	-0.027
Other Christian	0.008	0.012	0.022	-0.131 ***
Other religion	-0.052	-0.06	-0.054	-0.156 ***
Religion not known	0.045 **	-0.076	-0.161 **	-0.032
Indigenous Australian	-0.025	-0.097	-0.084	0.119 *
Migrant status (ref: Australian born)				
Migrant from an ESB country	-0.009	0.058	0.058	0.061
Migrant from an NESB country	0.01	-0.003	-0.114	-0.159 ***
Residence (ref: Metropolitan)				
Regional residence	0.009	0.037	0.030	-0.021
Remote residence	0.041	0.138 *	0.088	-0.01
Par. migrant status (ref: No migrant parent)				
One parent is migrant	-0.021	-0.008	-0.005	0.027
Both parents are migrants	-0.007	-0.067	-0.088	-0.002
Mixed family	0.001	-0.048	-0.053	0.086 **
Number of children	-0.015	-0.046 *	-0.054 *	0
Age of youngest child (ref: 0 years)				
1 year	-0.001	-0.085 *	-0.072	-0.036
2 years	-0.042	-0.445 ***	-0.277 **	0.183 *
3+ years	-0.078	-0.468 ***	-0.472 ***	-0.047
Age	-0.001	-0.057	-0.104 *	0.004
Age squared		0.001	0.002 **	
School completion (ref: Year 9 or less)				
Year 10-11 only	0.051	0.110 *	0.099	-0.070
Year 12	0.076 **	0.196 ***	0.209 **	-0.214 ***
Post-school qual. (ref: No qual.)				
Non-degree qualification	0.021	0.010	0.026	-0.051 *
University degree	0.060 ***	0.061	0.120 **	-0.166 ***
Observations	3,588	3,595	3,587	2,766
(Pseudo) R-squared	0.043	0.111	0.067	0.131

Source: Estimated from LSAC (wave 1) and HILDA (wave 4), women aged up to 29 years only.

Notes: \*significant at 10%, \*\*significant at 5%, \*\*\*significant at 1%. Also see notes of table 1.

## A3 - Effects of Teenage Motherhood and Other Factors on Partnership Outcomes in the First Three Years After Birth

	<i>Partnered (1)</i>	<i>Partner employed (2)</i>	<i>Family income (3)</i>
Mean outcome of estimation sample	0.837	0.931	848.64
# teenage mothers	77	48	77
Motherhood status			
Teenage mother	0.023	-0.027	-98.596
Older mother			-224.446 ***
Living with parents			-60.136
Parental status at age 14			
Parents separated by age 14	-0.017	-0.01	31.599
No employed parents at age 14	-0.017	-0.012	-62.588
Religion (ref: No religion)			
Catholic	0.042	-0.011	28.311
Other Christian	0.056 **	-0.01	12.301
Other religion	0.087 **	-0.072 *	-85.249 *
Religion not known	-0.007	-0.07	-28.367
Indigenous Australian	-0.173 ***	-0.180 **	53.781
Migrant status (ref: Australian born)			
Migrant from an ESB country	0.027	-0.002	116.664 *
Migrant from an NESB country	0.02	-0.021	-58.458
Residence (ref: Metropolitan)			
Regional residence	0.049 **	-0.027 *	-71.959 ***
Remote residence	0.092 **	0.009	66.377
Par. migrant status (ref: No migrant parent)			
One parent is migrant	-0.035	0.008	-21.719
Both parents are migrants	0.007	0.005	-0.293
Mixed family			-10.141
Number of children			32.583 *
Partner's employment (ref: No partner)			
Partner employed			671.180 ***
Partner not employed			144.242 **
Age	0.017 ***	0.005 *	222.088 ***
Age squared			-3.989 ***
School completion (ref: Year 9 or less)			
Year 10-11 only	0.154 ***	0.153 **	31.832
Year 12	0.215 ***	0.188 ***	44.926
Post-school qual. (ref: No qual.)			
Non-degree qualification	0.012	0.011	18.158
University degree	0.112 ***	0.038 *	192.837 ***
Employed			245.967 ***
Observations	2,139	1,763	3,154
(Pseudo) R-squared	0.128	0.138	0.377

Source: Estimated from LSAC (wave 1) and HILDA (wave 4), women aged up to 29 years only.

Notes: \*significant at 10%, \*\*significant at 5%, \*\*\*significant at 1%. Also see notes of table 1.

## A4 - Comparison of Treatment and Control Groups Before and After Matching

	<i>Unmatched</i>		<i>Matched</i>	
	<i>Mean of treatment group</i>	<i>Mean of control group</i>	<i>Mean of treatment group</i>	<i>Mean of control group</i>
At least Year 10	0.831 ***	0.948	0.829	0.862
Both parents are migrants	0.195	0.208	0.184	0.189
Catholic	0.156 *	0.254	0.158	0.135
Indigenous Australian	0.117 ***	0.037	0.118	0.108
Migrant from an ESB country	0.039	0.038	0.026	0.016
Migrant from an NESB country	0.078	0.086	0.079	0.078
No parent employed at age 14	0.078	0.051	0.066	0.069
One parent is migrant	0.091 *	0.168	0.092	0.091
Other Christian	0.208 ***	0.372	0.211	0.217
Other religion	0.130 *	0.073	0.132	0.142
Parents separated by age 14	0.325 **	0.214	0.316	0.322
Regional residence	0.584 **	0.438	0.579	0.603
Religion not known	0.156 ***	0.051	0.145	0.161
Remote residence	0.026	0.044	0.026	0.014

Source: Estimated from LSAC (waves 1-3) and HILDA (wave 4, 6, 8).

Notes: \*, \*\* and \*\*\* denote sample means that are significantly different between the treatment and control groups at the 10%, 5% and 1% level respectively. Estimates are based on the kernel matching method with a bandwidth of 0.001.

## A5 - Effects of Teenage Motherhood on Outcomes (ATT) in the First Seven Years After Birth, Based on the Propensity Score Matching Method

	<i>Years 0-3</i> <i>(1)</i>	<i>Years 4-5</i> <i>(2)</i>	<i>Years 6-7</i> <i>(3)</i>
<i>Completed Year 12<sup>a</sup></i>			
Estimate	-0.257 ***	-0.324 ***	-0.315 ***
Number in control group	2,020	1,716	1,613
Number treated	76	69	46
<i>Post-school qualification<sup>b</sup></i>			
Estimate	-0.161 **	-0.187 **	-0.121 **
Number in control group	2,001	1,703	1,606
Number treated	76	69	46
<i>Employed</i>			
Estimate	-0.271 ***	-0.260 ***	-0.178 **
Number in control group	2,060	1,747	1,633
Number treated	77	70	47
<i>Personal income</i>			
Estimate	-49.027 *	-136.387 ***	-102.387 **
Number in control group	2,018	1,709	1,605
Number treated	77	70	47
<i>Having good or better health</i>			
Estimate	-0.063 **	-0.051 **	-0.047 **
Number in control group	2,395	1,694	1,744
Number treated	207	144	93

## A5 - Effects of Teenage Motherhood on Outcomes (ATT) in the First Seven Years After Birth, Based on the Propensity Score Matching Method (continued)

	Years 0-3 (1)	Years 4-5 (2)	Years 6-7 (3)
<i>Being a smoker</i>			
Estimate	0.296 ***	0.162 **	0.254 **
Number in control group	2,011	1,835	2,019
Number treated	179	117	91
<i>Psychological distress index</i>			
Estimate	0.001 *	-0.070 **	0.010 **
Number in control group	2,447	2,043	1,720
Number treated	208	190	92
<i>Depression index</i>			
Estimate	-0.063 *	-0.060 **	-0.003 **
Number in control group	2,454	2,048	1,736
Number treated	207	187	92
<i>Partnered</i>			
Estimate	-0.127 **	-0.072 **	-0.041 **
Number in control group	1,592	1,303	1,204
Number treated	75	69	46
<i>Partner employed</i>			
Estimate	-0.071 ***	0.024 **	0.017 **
Number in control group	1,278	802	747
Number treated	48	39	27
<i>Family income</i>			
Estimate	-209.195 ***	-317.784 ***	-251.860 **
Number in control group	2,019	1,716	1,612
Number treated	76	69	46

Source: Estimated from LSAC (waves 1-3) and HILDA (wave 4, 6, 8), women aged up to 29 years only for first year, up to 31 for second year and up to 33 for third year.

Notes: Estimates are based on the kernel matching method with a bandwidth of 0.001. Standard errors (not shown) are bootstrapped with 50 replications. \*significant at 10%, \*\*significant at 5%, \*\*\*significant at 1%. Also see notes of table 1.

### Appendix B

Figure B1 - Age Distribution of Having the First Child Amongst Teenage Mothers

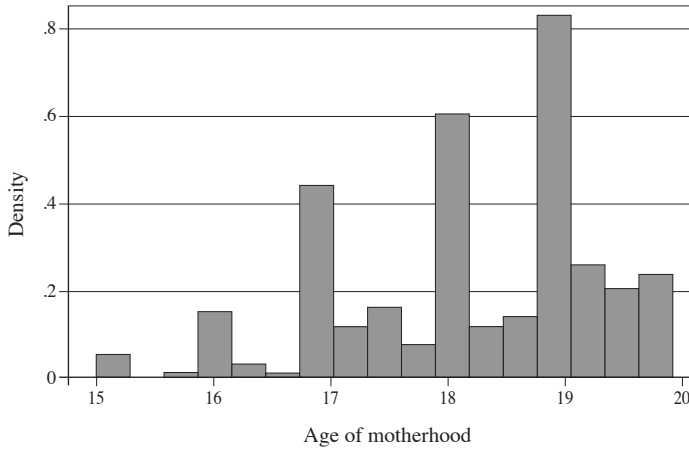
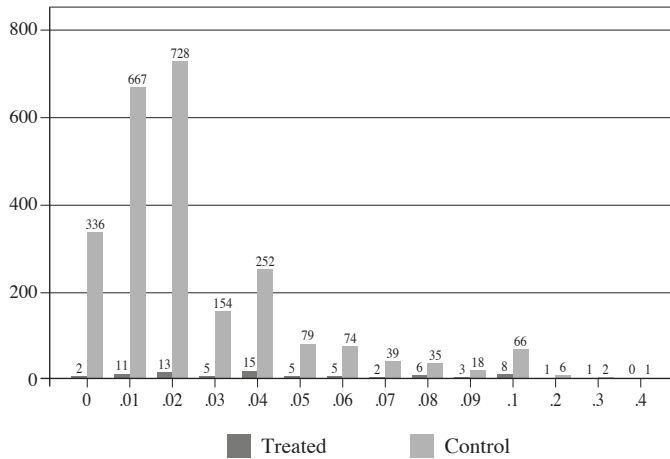
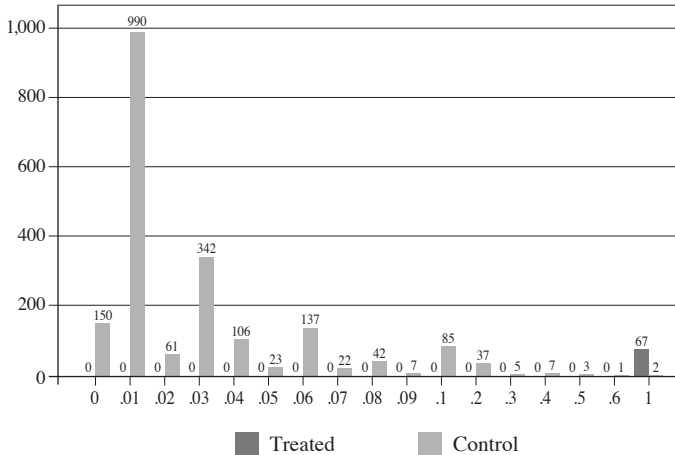


Figure B2 - Frequency Distribution of Propensity Score



Source: Estimated from LSAC (wave 1) and HILDA (wave 4), women aged up to 29 years only.  
 Notes: Treated: teenage mothers; Control: older mothers and childless women.

Figure B3 - Frequency Distribution of Kernel Matching Weight



Source: Estimated from LSAC (wave 1) and HILDA (wave 4), women aged up to 29 years only.

Notes: Treated: teenage mothers; Control: older mothers and childless women; bandwidth = 0.001.

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# The Premium for Part-time Work in Australia

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## Abstract

*We use fixed effects and difference-in-differences methodologies to investigate the nature of Australia's part-time wage premium, a phenomenon not observed in other countries. Salary sacrifice and non-cash benefits, previously unexplored explanations, are eliminated. The premium is not explained by occupation and it is observed for people with only one change of employment status and for those with multiple changes. We find that changing from full-time to part-time work with the same employer results in a large and sustained increase in the hourly wage, whereas a temporary decrease in the hourly wage accompanies a change from part-time to full-time work with the same employer. Notably, we find no significant wage change when a move between full-time and part-time work is accompanied by a change of employer.*

Keywords: Part-time employment, Wage differentials, Labour supply

JEL classifications: J31, J32, J33

## 1. Introduction

According to the Australian Bureau of Statistics (ABS, 6202.0) approximately 30 per cent of employed Australians currently work fewer than 35 hours per week, nearly double the rate three decades ago. The trend towards part-time work is not unique to Australia, with Chile, Greece, Ireland, Italy and Turkey recently experiencing increasing proportions of employed persons working part-time. Even so, Australia has the third highest rate of part-time employment among the 34 countries in the Organization for Economic Cooperation and Development (OECD), behind only the Netherlands and Switzerland.<sup>1</sup>

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<sup>1</sup> In each year since 2009, approximately 37 per cent of workers in the Netherlands were employed for fewer than 30 hours per week. In Switzerland the figure was 26 per cent, in Australia 25 per cent and in the United Kingdom 24-25 per cent. All statistics quoted in this paragraph appear in OECD, 2012. Kishi (2004, p.234) points to the increasing incidence of part-time work in Japan.

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In most OECD countries, including Australia, part-time workers are predominantly women aged 25-54 years. Compared with the OECD average, Australia has slightly smaller proportions of part-time workers who are older than 54 years and who are men aged 25-54, and a slightly larger proportion of part-time workers who are younger than 25 years (OECD, 2010, p.264). Part-time workers in Australia are less unionised than full-time workers to similar extent as in most OECD countries (OECD, 2010, p.223). As in Britain (Manning and Petrongolo, 2008; Connolly and Gregory, 2009) and other OECD countries (Bardasi and Gornick, 2008), in Australia, part-time employees commonly have low paying occupations, such as services and sales, while full-time employees are more typically found in high paying occupations such as managers and professionals. As with occupation, part-time employees in Australia tend to be concentrated in low paying industries, such as retail trade, accommodation and food services, while full-time employees are typically concentrated in high paying industries like manufacturing and mining (ABS, 3659.0).

There is concern in Australia about the high rate of part-time employment because part-time jobs are perceived as paying lower wages, having irregular work schedules, lower job security and fewer career opportunities than full-time jobs (Burgess, 2005; Australian Government, 2003). Whereas in most OECD countries part-timers are entitled to receive the same contractual pay and working conditions as equivalent full-time workers (on a pro-rata basis), in Australia there is no specific statutory requirement to treat part-time and full-time workers equally. All permanent employees in Australia have the same safety net of minimum entitlements for wages, leave, dismissal protection, etc. (OECD, 2010, p.218), but approximately 50 per cent of Australian part-time workers are employed on a casual, rather than permanent, basis. In contrast, less than ten per cent of full-time workers are casual. By definition, casual employees do not have access to paid annual leave or paid sick leave (ABS, 6105.0) although they do receive an hourly wage loading in compensation, and many casuals do not receive paid public holidays, notice of dismissal or redundancy pay (Campbell, 2004).

Approximately half of OECD countries require employers to notify part-time employees who want to work longer hours of full-time vacancies when they arise. Some also require employers to give existing underemployed part-time workers preferential treatment when filling full-time vacancies. Few such rights exist in Australia. Full-time workers who are parents of school-aged children have the right to request part-time work in most OECD countries and employers can only refuse such requests on serious business or operational grounds. Rights to work part-time for non-parents are less common but several countries give specific rights to part-time work to carers of adults, workers who are sick or disabled, those pursuing education or training and older workers. Australia has been one of the least generous of the OECD countries when it comes to the right to request part-time work (OECD, 2010, pp.217-219).

The average hourly wage of part-time workers is indeed lower than that of full-time workers, both in Australia and in many other countries (OECD, 2010, p.221). However, when the attributes of workers and jobs are taken into account, a large, 'adjusted' part-time wage premium is observed in Australia (Booth and Wood,

2008), a result that is at odds with what is observed in the United Kingdom (Connolly and Gregory, 2009) and, to a lesser extent, in the United States (Hirsch, 2005). The objective of this study is to explore the nature of that premium. This is important not only because a substantial, and increasing, number of Australians are working part time, but also because a premium (or a penalty) for part-time work suggests a lack of competition in the labour market and has implications for productivity.

We make four contributions to what is known about the phenomenon. First, we find that the premium cannot be explained by the level of non-cash benefits and salary sacrifice received by full-time and part-time employees. Second, we find that the premium is present across occupations. Third, the premium exists for those who change their employment status multiple times as well as for those with only one such change. Finally, having constructed a time path of wage differentials up to two years after a move between part-time and full-time work, we find the premium persists only for those who remain with the same employer.

## 2. Economic Theory and Australian Labour-Market Institutions

### *Economic Theory*

The textbook explanation of a part-time wage penalty given homogenous jobs and workers, is the existence of quasi-fixed costs, such as the costs of recruiting and training new employees (Hyclak *et al.* 2005, p.58). The effect of quasi-fixed costs is compounded if part-time workers have higher turnover rates than full-time workers (Casey, *et al.* 1997). A part-time wage penalty will also occur if there is an excess supply of part-time workers who are unwilling or unable to move between part-time and full-time jobs and if employers do not view part-time and full-time workers as perfect substitutes. Many part-time workers have family responsibilities and, therefore, have a high opportunity cost of time spent in employment. The flexible working conditions of part-time jobs make them attractive, in which case the theory of compensating wage differentials suggests there will be a part-time wage penalty. Part-time workers might limit their job search to areas close to home in which case employers with monopsony power in local labour markets are able to offer them hourly wages that are lower than the full-time wage (Ermisch and Wright, 1993, pp.113-115).

On the other hand, a part-time wage premium could be explained by non-cash benefits that form part of total remuneration. Some non-cash benefits constitute a quasi-fixed cost, in which case part-time workers are less likely to receive them and a wage premium may be paid in compensation (Blank, 1990; Montgomery and Cosgrove, 1995). Alternatively, in businesses that face periods of fluctuating demand, part-time workers who are employed to work during peak times only will be more productive than identical full-time workers who would be idle for much of the time. Furthermore, it is possible that part-time workers will be more productive than full-time workers in jobs where productivity declines rapidly with long hours of work (Booth and Ravallion, 1993).

### ***Australian Labour Market Institutions***

Unlike other countries, Australia's industrial relations system provides a number of minimum wages in 'award agreements' covering various occupations and industries.<sup>2</sup> The minimum wages set in Australia appear to be among the highest in the world (Waring and Burgess, 2011; Whiteford, 2013, p.26) leading to a wage distribution that has historically been more compressed than in countries such as the United States and the United Kingdom (Gornick and Jacobs, 1996). Although the wage distribution in Australia has widened since the 1990s, in 2005 it was the 13th most compressed of the 28 countries in the OECD (Whiteford, 2013, pp.26-27). This relatively low level of overall wage dispersion implies that any part-time/full-time wage differential in Australia will be smaller than those found elsewhere. Yet the evidence from Booth and Wood (2008) suggests it is larger.

The number of Australian workers hired on a casual basis has been growing, and currently they account for approximately 23 per cent of employed people (ABS, 6359.0). Casual workers do not have access to paid annual leave or paid sick leave and they also lack other rights, such as notice of dismissal. Industrial law requires casual workers be paid a 25 per cent loading on the relevant minimum wage in compensation for lack of such entitlements (Campbell, 2004, p.93).<sup>3</sup> Of course, workers – casual or otherwise – can be paid a wage rate above the legal minimum, in which case the effect of the loading will be reduced and may be eliminated altogether. Nevertheless casual employment provides a reason to expect a part-time wage premium because a larger percentage of part-time than full-time workers are employed on a casual basis and therefore qualify for the casual loading (ABS, 6105). Consequently, casual status should be held constant when estimating the part-time/full-time wage differential.

High effective marginal tax rates for a second income earner in a family also provide a reason to expect a part-time wage premium in Australia. If a second income is earned, a family may no longer be eligible for certain tax exemptions and social programs such as the Family Tax Benefit, thereby increasing the effective tax rate. Employers who want to hire part-time workers will need to pay them a premium to compensate for the high effective marginal tax rate (Booth and Wood, 2008). Therefore, a control for marital status should be used when estimating part-time/full-time wage differentials.

In Australia, certain industrial awards specify that all workers in a given industry be paid penalty rates for working outside of normal hours, such as evenings, weekends and public holidays. Both part-time and full-time workers can receive penalty rates, but if they are more common for one group than the other, this will give rise to a part-time/full-time wage differential. Hence, there is a need to control for working a standard versus nonstandard work schedule in estimating part-time/full-time wage differentials.

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<sup>2</sup> Minimum wages have remained a key feature of wage-setting procedures in Australia despite changes to the industrial relations system over the past decade, the most notable being the introduction of the Work Choices legislation in 2006, which attempted to decentralise wage bargaining and reduce award coverage, and its replacement in 2009 with the Fair Work Act, which at least partially reversed some of these changes.

<sup>3</sup> See Fair Work Australia, Miscellaneous Award 2010 (s.10.4).

Unpaid overtime is common in Australia (Wooden, 2001) and is another factor that might contribute to a part-time wage premium. Salaried individuals may work long hours at certain stages of their careers, on the expectation of being rewarded by promotion later on. High levels of unpaid overtime may also be worked by individuals who simply enjoy their jobs (Hirsch, 2005). Unpaid overtime is likely to be more common among full-time workers because many part-time workers intentionally choose to work short hours so they can engage in family-related activities. Indeed, a survey conducted by The Australia Institute found that, on average, full-time employees work 70 minutes of unpaid overtime per day while part-time employees work 23 minutes per (working) day (Fear and Denniss, 2009). Individuals who work long hours each week for a constant weekly salary will have a calculated hourly wage (usual weekly wages and salaries divided by hours usually worked per week) that is lower than the hourly wage in their employment contracts, so with unpaid overtime more common among full-time than among part-time workers a part-time wage premium will be observed. Furthermore, people employed on part-time contracts who regularly work a lot of overtime, are likely to be classified as full-time based on the hours they report usually working per week. This is particularly important for Australian studies since the upward trend in unpaid overtime appears to be more widespread in Australia than in other OECD countries (Campbell, 2007).

In summary, both economic theory and Australian labour market institutions offer several explanations for the existence of a part-time/full-time wage differential but neither unambiguously predicts either a part-time wage penalty or a part-time wage premium.

### **3. Literature Review**

#### ***Cross-Sectional Studies***

Early cross-sectional studies using United States data, such as Owen (1978) and Long and Jones (1981), found adjusted part-time wage penalties in excess of ten per cent after controlling for various worker and job characteristics, but not for self-selection into part-time work. Later studies that corrected for self-selection bias using a Heckman-type correction procedure (Heckman, 1979) typically also found significant part-time wage penalties (Simpson, 1986; Main, 1988; Ermish and Wright, 1993). An exception was Blank (1990), who controlled for selection into part-time work and found a small part-time wage premium for women.

Rodgers (2004) estimated part-time/full-time wage differentials for Australian men and women. After controlling for worker and job attributes, and self-selection into non-employment, part-time and full-time employment, the author found part-time wage premiums of nine and three per cent for women and men, respectively. However, neither premium was statistically significant.

There have also been studies of specific occupations. Most found part-time wage penalties (Montgomery and Cosgrove, 1995; Lettau, 1997; Manning and Petrongolo, 2008), but one found a small part-time wage premium (Hirsch and Schumacher, 1995). The three studies from the 1990s also investigated the receipt of fringe benefits, such as medical insurance, by full-time and part-time workers and found that part-time workers had lower total compensation than equivalent full-time workers.

There have been two cross-national comparisons of part-time/full-time wage differentials, both based on cross-sectional data from the Luxemburg Income Survey (LIS). Gornick and Jacobs (1996) found part-time wage penalties for both genders in the United States, Canada and Australia, and for women, but not men, in the United Kingdom. Bardasi and Gornick (2008) found part-time wage penalties for women in Canada, Germany, Italy, the United Kingdom and the United States but not Sweden.

### ***Longitudinal Studies***

Recent studies have used longitudinal data to control for unobservable worker characteristics. They have found small, or non-significant, part-time wage differentials.

In the United States, Hirsh (2005) used panel data from the Current Population Survey Outgoing Rotation Group and found a part-time wage premium of less than two per cent for both men and women. He also examined possible asymmetries of moving between full-time and part-time work. For women, he found a premium for changing from full-time to part-time work that was larger in magnitude than the penalty suffered by changing from part-time to full-time work, while the reverse was true for men. On the other hand, Hirsch found part-time wage penalties of around five per cent for workers changing occupation and industry at the same time as changing their part-time/full-time status. Unlike British studies that focus on the lack of availability of part-time work in highly paid industries and occupations, he suggests that the wage differential probably reflects workers moving into and out of career jobs (Hirsch, 2005, p.542).

In the United Kingdom, Connolly and Gregory (2009) used the New Earnings Panel to estimate part-time/full-time wage differentials for women and to assess their respective wage growth over time. With experience and job tenure as the only controls, the authors found a part-time wage penalty of 11 per cent but this fell to just two per cent when controls for work experience and tenure were broken down, first into their part-time and full-time components, and then into high, medium and low skilled occupations. The authors also found that a move from full-time to part-time work was associated with an immediate wage penalty of seven per cent, which was brought about by an occupational downgrading and/or a change of employer, rather than by the part-time nature of the job. The penalty continued for four years, but became smaller each year. On the other hand, women switching from part-time to full-time employment earned a premium, but only after the first year of full-time employment.

Booth and Wood (2008) used longitudinal data from the first four waves of the Household, Income and Labour Dynamics in Australia (HILDA) Survey to control for time-invariant, unobserved heterogeneity. They found that part-time women who were not on casual contracts earned approximately ten per cent more per hour than their full-time counterparts. The premium was 15 per cent for women who were part-time and casual. In contrast, part-time, non-casual men earned a 15 per cent premium over comparable full-time men, but the premium was ten per cent for men who were part-time and casual. Therefore, part-time wage premiums appear to be much higher for both men and women in Australia than in the United States and the United Kingdom. The authors conducted several robustness tests and explored the potential for asymmetric wage effects of moving between full-time and part-time employment, all of which

were consistent with their primary results. With a 12-year panel of HILDA data now available, we further explore the magnitude and nature of the part-time premium in the remainder of this paper.

#### 4. The Models

First, we replicate Booth and Wood's (2008) results using a reduced-form model, which is estimated separately for men and women using pooled OLS and fixed-effects, both with clustered standard errors, which are robust to both heteroskedasticity and correlation over time for the same individual. Model 1 is:

$$\log(\text{wage}_{i,t}) = \beta_1 P_{i,t} + \beta_2 C_{i,t} + \beta_3 (P^*C)_{i,t} + \mathbf{X}_{i,t} \boldsymbol{\gamma} + \mu_i + \varepsilon_{i,t} \quad (1)$$

where  $P_{i,t}$  is a binary variable equal to one if person  $i$  is employed part-time in year  $t$ ;  $C_{i,t}$  equals one if person  $i$  is employed on a casual contract in year  $t$  (zero otherwise);  $(P^*C)_{i,t}$  is the interaction between part-time and casual status;  $\mathbf{X}_{i,t}$  is a set of observed characteristics of employee  $i$  and his or her job in year  $t$  (including an intercept);  $\mu_i$  represents unobserved time-invariant attributes of employees; and  $\varepsilon_{i,t}$  is an idiosyncratic error. The parameters of interest are  $\beta_1$ , which is the average log-wage differential between part-time, non-casual workers and full-time, non-casual workers, and  $\beta_1 + \beta_3$ , which is the average log-wage differential between part-time, casual workers and full-time, casual workers. Like Booth and Wood (2008), we do not model selection into employment with a separate equation. However, the fixed-effects estimation procedure will eliminate selection bias that operates purely through the individual-specific error,  $\mu_i$ . In other words, if employed people have time-invariant characteristics that make them different from people who are not employed then the FE estimators will be consistent.<sup>4</sup>

Model 1 assumes that the effect on wages of changing into, and out of, part-time jobs is symmetric, as is the effect of changing into, and out of, casual jobs. These assumptions are relaxed in Model 2 which, like Model 1, controls for time-invariant, unobserved heterogeneity among employees.

$$\Delta \log(\text{wage}_{i,t-1/t+k}) = \beta_1^a P_{i,t-1/t} \text{joiner}_{i,t-1/t} + \beta_2^a \text{newemp}_{i,t-1/t+k} + \beta_3^a (P_{i,t-1/t} \text{joiner}_{i,t-1/t} * \text{newemp}_{i,t-1/t+k}) + \beta_4^a C_{i,t-1/t+k} \text{stayer}_{i,t-1/t+k} + \beta_5^a C_{i,t-1/t+k} \text{cleaver}_{i,t-1/t+k} + \beta_6^a C_{i,t-1/t+k} \text{joiner}_{i,t-1/t+k} + \Delta \mathbf{X}_{i,t-1/t+k} \boldsymbol{\gamma}^a + \Delta \varepsilon_{i,t-1/t+k}^a \quad (2a)$$

$$\Delta \log(\text{wage}_{i,t-1/t+k}) = \beta_1^b P_{i,t-1/t} \text{pleaver}_{i,t-1/t} + \beta_2^b \text{newemp}_{i,t-1/t+k} + \beta_3^b (P_{i,t-1/t} \text{pleaver}_{i,t-1/t} * \text{newemp}_{i,t-1/t+k}) + \beta_4^b C_{i,t-1/t+k} \text{stayer}_{i,t-1/t+k} + \beta_5^b C_{i,t-1/t+k} \text{cleaver}_{i,t-1/t+k} + \beta_6^b C_{i,t-1/t+k} \text{joiner}_{i,t-1/t+k} + \Delta \mathbf{X}_{i,t-1/t+k} \boldsymbol{\gamma}^b + \Delta \varepsilon_{i,t-1/t+k}^b \quad (2b)$$

Equation (2a) is estimated using only those observations where the individual works full time in year  $t-1$  (full-time starters) and Equation (2b) is estimated using only those observations where the individual works part-time in year  $t-1$  (part-time starters).

<sup>4</sup> Fixed-effects estimation does not eliminate all forms of selection bias but using a Heckman-like correction to Model 1 would require (strictly exogenous) instrumental variables, which are difficult to find. Weak instruments introduce problems of their own. (See, Vella, 1998, pp.156-157).

Full-time starters are divided into full-time stayers, who continue to work full-time (the control group), and part-time joiners, who switch to part-time work in year  $t$  (the treatment group, *Pjoiner*). Part-time starters are divided into part-time stayers, who continue to work part-time (the control group), and part-time leavers, who switch to full-time work in year  $t$  (the treatment group, *Pleaver*).<sup>5</sup> Model 2 also contains controls for changes in casual status that occur simultaneously with the wage change. Casual stayers (*Cstayer*) are casual in both years  $t-1$  and  $t+k$ ; casual leavers (*Cleaver*) are casual in year  $t-1$  and non-casual in year  $t+k$ ; casual joiners (*Cjoiner*) are non-casual in year  $t-1$  and casual in year  $t+k$ . The excluded category consists of people who are non-casual in both periods. Changes from year  $t-1$  to year  $t+k$  in other control variables,  $\Delta X$ , are also included.

Model 2 is used to investigate whether the effect of changing to, or from, part-time work is affected by a concurrent change of employer (*newemp*). Equations (2a) and (2b) are estimated with the interaction parameter,  $\beta_3$ , set to zero, and also with no constraint on  $\beta_3$  thereby allowing the effect of changing employment status to be different for those who simultaneously change employers and those who do not.  $k = 0, 1, 2, \dots$  traces out the effect on wages several years after changing between full-time and part-time employment.

## 5. The Data

The models are estimated using a 12-year panel of unit-record data from Release 12 of the HILDA Survey, which is a representative sample of people living in Australian households. (See, Summerfield *et al.* 2012, pp.116-118 for details). People aged 15 years and older have been interviewed each year and data on family and household characteristics, income and work have been recorded. These responding people constitute the unbalanced panel used in this study.<sup>6</sup>

The HILDA data have several major advantages for this study compared with other Australian data sets. The data allow an estimate of each employee's usual hourly wage in his or her main job, which is the job from which the most pay is usually received each week. Usual, weekly, gross wages and salary in the main job, adjusted for inflation using the consumer price index, was divided by hours per week usually worked in the main job. Hours and wages and salary are recorded as continuous variables. The use of usual gross earnings and usual hours of work is preferred to gross earnings and hours of work in the week prior to the interview, which may be an atypical week for the worker. As in previous Australian studies, in this paper a part-time worker is defined as someone who usually works less than 35 hours per week in his or her main job. We use hours of work in the main job, rather than in all jobs combined, because we are interested in the nature of part-time jobs.

The HILDA data set provides a considerable amount of demographic data on employees, such as age, sex, marital status, education and geographic location. There are also data on the attributes of respondents' jobs, such as casual status, type of work schedule, occupation, industry, workplace size and whether in the public or private sector.

<sup>5</sup> Restrictions concerning other changes in employment status are imposed on the sample when Model 2 is estimated.

<sup>6</sup> A detailed discussion of the HILDA survey can be found in Wooden and Watson (2007).

The major disadvantage of the HILDA data for the purpose of this study is that hours worked includes paid and unpaid overtime, but unpaid overtime hours are not separately recorded. Although our calculated wage reflects the 'true' hourly payment for what is actually worked, the inclusion of unpaid overtime in hours worked will result in a calculated hourly wage that is lower than the wage stated in the employment contract. The second deficiency of the HILDA data is that work experience, which is reported as years in paid work, makes no distinction between full-time and part-time work experience. The same applies to job tenure. This is likely to lead to an understatement of the full-time/part-time wage differential and would be of concern if a part-time penalty had been found, as its size would have been overstated. But in Australia a part-time premium has been found, and it is likely to be an understatement.

## 6. Descriptive Statistics

To verify Booth and Wood's (2008) results with the 12-year panel we applied the same exclusions: individuals must be employees, aged 18 to 64 years, not full-time students, not in the armed forces, farming or fishing; they must work less than 100 hours per week and earn an hourly wage between one and 160 dollars.<sup>7</sup> Individuals must also have valid data on the control variables, details of which are given below. To estimate Model 1 we used a sample consisting of people who satisfy these conditions in at least two consecutive waves of HILDA data, thereby ensuring that the wage differentials in the data are not due to any deterioration in human capital associated with a substantial break in employment. Model 2 was estimated using a sample comprised of people who satisfy these conditions in at least four consecutive waves.

Five specifications of Model 1, the same ones reported by Booth and Wood (2008), were estimated. In the first specification  $X_{it}$  includes only dummy variables for (all but one of) the years covered by the longitudinal data and provides an estimate of the raw part-time/full-time wage differentials for men and women. Specification 2 also includes binary variables for holding a single job, whether the main job involves a regular day-time schedule, is a fixed-term contract, and was acquired through a labour-hire firm. Also included are the individual's country of birth, age, marital status and geographic location. Education and quadratics for job tenure and employment experience are added to form Specification 3. Workplace size, union membership, public/private sector, and industry are appended to form Specification 4 and occupation is added to form Specification 5. After deleting observations with missing data on one or more of these control variables, the sample used to estimate all specifications of Booth and Wood's model contains 5,319 men with 29,199 observations (2,494 part-time and 26,705 full-time) and 5,497 women with 28,937 observations (12,287 part-time and 16,650 full-time).<sup>8</sup>

<sup>7</sup> Very few people in the data set usually work 100 or more hours per week in their main job. These outliers would be likely to cause errors in the calculation of the hourly wage. The majority of people with hourly wages greater than \$160 only earned these high wages in one wave, worked less than five hours work per week and/or had low levels of education. Many individuals earning less than one dollar per hour recorded high weekly hours and/or low weekly wages.

<sup>8</sup> There were 37,184 and 38,021 person-year observations for males and females, respectively, after imposing the same exclusions as Booth and Wood (2008). These were reduced to 34,734 and 35,510 as a result of requiring valid observations on all control variables. The requirement that there be at least two consecutive observations per person produced the final sample of 29,199 male-year observations and 28,937 female-year observations.

Descriptive statistics underlying Model 1 are presented in table 1. They show that average hourly wages are lower for part-time men and women than for their full-time counterparts but the differential is statistically significant for men only. We also see that part-time and full-time employees are systematically different, suggesting that at least part of the 'raw' part-time wage penalty can be attributed to differences in the observable (productivity-related) characteristics of the two groups and the attributes of the jobs they hold. For example, part-time men and women are more likely to be employed on a casual basis, less likely to hold only one job, less likely to work a regular day-time schedule and less likely to be employed on a fixed-term contract than their full-time counterparts.

Table1 - Descriptive Statistics for Full-time and Part-time Men and Women, Model 1

Variable	Men		Women	
	Full-time	Part-time	Full-time	Part-time
Hourly wage (\$)	31.75	27.98 ***	27.21	26.76
Usual hours per week	44.73	22.42 ***	41.76	21.45 ***
Casual <sup>a</sup>	0.08	0.57 ***	0.06	0.39 ***
One job only <sup>a</sup>	0.95	0.79 ***	0.95	0.85 ***
Regular day-time schedule <sup>a</sup>	0.80	0.59 ***	0.85	0.73 ***
Fixed-term contract <sup>a</sup>	0.09	0.07 *	0.11	0.08 ***
Employed via labour hire firm <sup>a</sup>	0.03	0.05 **	0.02	0.03
Age (years)	39.29	39.81	39.25	42.00 ***
Married <sup>a</sup>	0.56	0.43 ***	0.46	0.64 ***
Cohabiting <sup>a</sup>	0.13	0.10 **	0.16	0.10 ***
Widowed, divorced or separated <sup>a</sup>	0.06	0.06	0.14	0.11 *
Never married <sup>a</sup>	0.25	0.41 ***	0.25	0.14 ***
Urban location <sup>a</sup>	0.72	0.69	0.74	0.65 ***
Inner regional location <sup>a</sup>	0.19	0.22	0.17	0.24 ***
Outer regional location <sup>a</sup>	0.08	0.08	0.08	0.09
Remote location <sup>a</sup>	0.01	0.01	0.01	0.01
Australian born <sup>a</sup>	0.75	0.76	0.74	0.79 **
Born in other English speaking country <sup>a</sup>	0.11	0.09	0.10	0.09
Born in a non-English speaking country <sup>a</sup>	0.14	0.15	0.16	0.12 **
Tenure with current employer (yrs)	7.68	5.01 ***	7.19	6.43 **
Experience (yrs)	20.60	19.73	18.22	18.98 *
Postgraduate degree <sup>a</sup>	0.06	0.04	0.05	0.03 ***
Graduate diploma/certificate <sup>a</sup>	0.06	0.07	0.09	0.07
Bachelor degree <sup>a</sup>	0.16	0.15	0.23	0.16 ***
Advanced diploma/diploma <sup>a</sup>	0.09	0.08	0.12	0.10 *
Certificate III or IV <sup>a</sup>	0.29	0.19 ***	0.14	0.18 ***
Year 12 <sup>a</sup>	0.16	0.22 **	0.17	0.16
<=Year 11 or unknown <sup>a</sup>	0.19	0.26 **	0.20	0.31 ***
Trade union member <sup>a</sup>	0.33	0.26 **	0.33	0.28 ***
Public sector job <sup>a</sup>	0.23	0.23	0.35	0.31 **
Firm size <20 <sup>a</sup>	0.31	0.41 ***	0.26	0.40 ***
Firm size 20-99 <sup>a</sup>	0.31	0.31	0.34	0.32
Firm size 100-499 <sup>a</sup>	0.24	0.18 ***	0.23	0.16 ***
Firm size >=500 <sup>a</sup>	0.15	0.09 ***	0.17	0.11 ***
Person-year observations	26,705	2,494	16,650	12,287
Number of people	5,319		5,497	

Source: HILDA, Waves 1-12.

\*, \*\* and \*\*\* indicate a difference that is significantly different from zero at the 5%, 1% and 0.1% levels.

Notes: <sup>a</sup> Measured as a proportion. <sup>b</sup> Means are weighted by cross sectional probability weights.

To identify the effect of employment status on wage rates using longitudinal data there must be a reasonable number of changes in status between adjacent years. Table 2 presents transition matrices for Model 1, men and women. The off-diagonal entries show the number of observations involving a change of status. Compared with the data used by Booth and Wood (2008), our data show many more transitions. Notably, where there is no distinction between moving into a particular employment state and moving out of it, the smallest number of transitions in our data set is  $(24+28=)$  52 for men, and  $(53+48=)$  101 for women, who move between part-time-non-casual and full-time-casual employment. The corresponding numbers in Booth and Wood's (2008) study were 17 and 24.

Table 2 - Transition Matrices Showing Changes of Employment Status, Model 1

		Men			
		<i>Part-time &amp; casual</i>	<i>Part-time &amp; non-casual</i>	<i>Full-time &amp; casual</i>	<i>Full-time &amp; non-casual</i>
<i>Year t-1 ↓</i>	<i>Year t →</i>				
Part-time & casual		623	74	192	226
Part-time & non-casual		57	506	28	237
Full-time & casual		158	24	854	608
Full-time & non-casual		163	226	450	19454
		Women			
		<i>Part-time &amp; casual</i>	<i>Part-time &amp; non-casual</i>	<i>Full-time &amp; casual</i>	<i>Full-time &amp; non-casual</i>
<i>Year t-1 ↓</i>	<i>Year t →</i>				
Part-time & casual		2610	568	227	393
Part-time & non-casual		315	4883	48	874
Full-time & casual		173	53	317	284
Full-time & non-casual		233	861	186	11415

Source: HILDA, Waves 1-12.

Note: Numbers are unweighted counts of transitions, based on pairs of consecutive waves.

## 7. Results

### Model 1

Part-time/full-time wage differentials in each of the five specifications of Model 1 are presented in table 3. Full results for Specification 3, the specification preferred by Booth and Wood (2008), appear in appendix A1. The Breusch-Pagan Lagrange multiplier test leads to the rejection of the hypothesis that  $\mu_i = 0$  in Model 1, indicating that either random effects or fixed effects is preferred to pooled OLS. The Hausman test indicates that fixed effects is preferred to random effects in all 5 specifications. Consequently, the discussion below is focussed on the fixed-effects estimates.

The results from the fixed-effects model are remarkably stable across the five specifications and indicate large part-time wage premiums for both men and women. Specification 3 indicates that there is a statistically significant part-time wage premium of 12.5 per cent for men employed on casual contracts and 17.0 per cent for men who are non-casuals. For women, there is a part-time wage premium of 13.2

per cent for casuals and 10.3 per cent for non-casuals, both of which are statistically significant. These results are very similar to those found by Booth and Wood (2008). Our fixed-effects coefficients on the P\*C interactions in Model 1 have the same sign (negative for men and positive for women) as those of Booth and Wood (2008) but are not statistically significant at the five per cent level. In this respect our results differ from those of Booth and Wood (2008) who report t-statistics for their interactions that are statistically significant at the five per cent level, whereas ours have p-values of 0.089 for men and 0.101 for women.<sup>9</sup> Therefore, we conclude that the part-time wage premiums for casuals and non-casuals are not significantly different, neither for men nor for women. Adding industry and occupation dummies has little effect on the fixed-effects coefficients. To explore the nature of the premium produced by fixed effects, we conduct some sensitivity tests on Specification 3.

Table 3 - Part-time/Full-time Wage Differentials, Model 1

Spec.	Casual Status	Men		Women	
		Pooled OLS	Fixed Effects	Pooled OLS	Fixed Effects
1	Non-casual	-0.155 **	0.155 ***	-0.009	0.103 ***
	Casual	n.s.	*	n.s.	n.s.
2	Non-casual	-0.131 *	0.159 ***	-0.045 **	0.100 ***
	Casual	n.s.	n.s.	*	n.s.
3	Non-casual	-0.072 **	0.113 ***	0.019	0.129 ***
	Casual	-0.116 *	0.170 ***	-0.001	0.103 ***
4	Non-casual	n.s.	n.s.	n.s.	n.s.
	Casual	-0.077 **	0.125 ***	0.029	0.132 ***
5	Non-casual	-0.046	0.171 ***	0.022 *	0.107 ***
	Casual	n.s.	n.s.	n.s.	n.s.
5	Non-casual	-0.015	0.130 ***	0.042	0.139 ***
	Casual	-0.011	0.173 ***	0.044 ***	0.110 ***
5	Non-casual	n.s.	n.s.	n.s.	n.s.
	Casual	-0.002	0.132 ***	0.047 *	0.140 ***

Source: HILDA, Waves 1-12.

\*, \*\* and \*\*\* beside a coefficient indicates significantly different from zero at the 5%, 1% and 0.1% levels. Asterisks or n.s. on the line between coefficients indicates a significant difference, or no significant difference (n.s.), between the PT/FT wage differential for non-casual and casual employees.

Note: Standard errors are cluster robust.

### Sensitivity Tests on Model 1, Specification 3

Overall, the part-time wage premium is robust to the sensitivity tests we performed. First, we graphed the average hourly wage against weekly hours of work and found

<sup>9</sup> Aside from the larger size of our sample, a possible explanation is that we used the ABS definition of casual status with the survey question being 'Does your employer provide you with paid holiday/sick leave?' whereas Booth and Wood (2008) used a self-identification measure based on the survey question 'Looking at (showcard) which of the following best describes your current contract of employment? Employed on a fixed term contract; employed on a casual basis; employed on a permanent or ongoing basis; other.'

that the highest wage rates, for both men and women occur at fewer than ten hours per week, while the lowest wage rates are for people working more than 70 hours per week. To test whether the observed part-time premiums are being driven by these extreme observations, the fixed-effects model was re-estimated after dropping 1,694 observations with weekly hours of work below ten or above 70. Another 210 observations with an hourly wage less than five dollars were also dropped as they seem unrealistically low. The results, which appear in Panel A of table 4, indicate that outliers explain some of the part-time premium, particularly for men and women on casual contracts. When the outliers are excluded there is a 14.8 per cent part-time wage premium for non-casual men and a significantly smaller 7.8 per cent part-time wage premium for casual men. For non-casual women the part-time wage premium is 9.8 per cent, while for casual women the premium is 8.4 per cent, which are not significantly different. Additional sensitivity tests (discussed below) also exclude the 1,904 outliers from the sample.

The second test indicates that the part-time wage premium is not sensitive to the 35-hour cut-off. Specification 3 of the fixed-effects model was re-estimated with the cut-off set at the OECD definition of part-time employment, 30 hours per week (see Panel B), and at the definition consistent with most Australian awards, 38 hours per week (Panel C). Significant part-time premiums are observed at both cut-offs, for men and women, casual and non-casual.

Next, we found that measurement errors in hours of work are not responsible for the part-time wage premium. Weekly work hours recorded in the HILDA data are clustered at 38 and at the end of five hourly intervals, which is suggestive of measurement errors. With the hourly wage calculated as usual weekly gross wages and salary in the main job divided by hours per week usually worked in the main job, an error in weekly hours worked, random or otherwise, will lead to an error in the calculated hourly wage, and possibly to an error in part-time status. If hours of work are overstated (understated), then the hourly wage will be understated (overstated) and the employee might be classified as full (part) time. We tested whether our results are driven by errors in recorded hours worked per week by re-estimating the model after dropping the 641 observations that involve a change of employment status resulting from a change in weekly work hours that is five or less in absolute value. This eliminates small changes in hours worked that are likely to result in a change of employment status. The impact is seen in Panel D of table 4; the part-time wage premiums remain for men and women, casual and non-casual, and they are slightly larger than those in Panel A.

We also found that the part-time wage premium is fairly constant across age groups for women, but for men the premium is somewhat related to age and casual status. Men tend to work part time when they are young or old, whereas women tend to work part-time when they are middle aged. To test whether the part-time wage premium is concentrated in particular age groups we re-estimated Specification 3 of the fixed-effects model separately for men and women in three age groups: younger than 30 years, between 30 and 50 years inclusive, and older than 50 years. The results are given in Panel E of table 4. There is a statistically significant part-time wage premium in all cases except for middle-aged men employed on casual contracts.

Table 4 - Sensitivity Analysis of the Part-time/Full-time Wage Differential, Model 1, Specification 3

<i>Sensitivity to</i>		<i>Casual Status</i>	<i>Men</i>	<i>Women</i>
A	Outliers, namely hours <10 or >70 or wage < \$5 or >\$160	Non-casuals	0.148 *** **	0.098 *** n.s.
		Casuals	0.078 ***	0.084 ***
B	Definition of PT work = 30 hours/week	Non-casuals	0.182 *** *	0.119 *** n.s.
		Casuals	0.106 ***	0.099 ***
C	Definition of PT work = 38 hours/week	Non-casuals	0.122 *** **	0.097 *** n.s.
		Casuals	0.061 ***	0.087 ***
D	Random errors in self-reported hrs/week	Non-casuals	0.157 *** **	0.101 *** n.s.
		Casuals	0.082 ***	0.087 ***
E	Age group <30 years old	Non-casuals	0.224 *** **	0.114 *** n.s.
		Casuals	0.091 **	0.111 ***
	30-50 years old	Non-casuals	0.099 ***	0.090 ***
		Casuals	n.s.	n.s.
	>50 years old	Non-casuals	0.050	0.084 ***
		Casuals	0.149 ***	0.125 ***
F	Number of PT/FT changes 0 or 1	Non-casuals	0.224 *** **	0.114 *** n.s.
		Casuals	0.091 **	0.111 ***
	0 or >1	Non-casuals	0.099 ***	0.090 ***
		Casuals	n.s.	n.s.
		Non-casuals	0.050	0.084 ***
		Casuals	0.149 ***	0.125 ***
G	Occupation Managers & professionals	Non-casuals	0.186 *** n.s.	0.096 *** n.s.
		Casuals	0.133 ***	0.131 ***
	Technical, trades, community & personal service workers	Non-casuals	0.156 ***	0.110 ***
		Casuals	n.s.	n.s.
	Clerical, admin & sales workers	Non-casuals	0.102 ***	0.130 ***
		Casuals	0.102 ***	0.130 ***
H	Occupation Machine operators, drivers & labourers	Non-casuals	0.184 *** n.s.	0.127 *** n.s.
		Casuals	0.169 **	0.102 *
	Machine operators, drivers & labourers	Non-casuals	0.210 ***	0.145 *
		Casuals	**	*
	Machine operators, drivers & labourers	Non-casuals	0.071 *	0.062 n.s.
		Casuals	0.028 n.s.	0.079 ***
Machine operators, drivers & labourers	Non-casuals	n.s.	n.s.	
	Casuals	0.062 n.s.	0.071 ***	
Machine operators, drivers & labourers	Non-casuals	0.111 **	0.027 n.s.	
	Casuals	n.s.	n.s.	
Machine operators, drivers & labourers	Non-casuals	0.083 *	0.066 n.s.	
	Casuals	0.083 *	0.066 n.s.	
H	Time period 2001-2004	Non-casuals	0.143 *** n.s.	0.096 *** n.s.
		Casuals	0.093 **	0.097 ***

Table 4 - Sensitivity Analysis of the Part-time/Full-time Wage Differential, Model 1, Specification 3 (continued)

<i>Sensitivity to</i>		<i>Casual Status</i>	<i>Men</i>	<i>Women</i>
2005-2008		Non-casuals	0.145 ***	0.127 ***
			n.s.	n.s.
		Casuals	0.097 **	0.121 ***
2009-2012		Non-casuals	0.175 ***	0.134 ***
			n.s.	n.s.
		Casuals	0.128 ***	0.128 ***
I	>= 2 consecutive obs	Non-casuals	0.137 ***	0.086 ***
			**	n.s.
		Casuals	0.072 ***	0.071 ***
J	Salary Sacrifice & Non-Cash Benefits	Non-casuals	0.181 ***	0.150 ***
			n.s.	n.s.
		Casuals	0.139 ***	0.150 ***

Source: HILDA, Waves 1-12.

\*, \*\* and \*\*\* beside a coefficient indicates significantly different from zero at the 5%, 1% and 0.1% levels. Asterisks or n.s. on the line between coefficients indicates a significant difference, or no significant difference (n.s.), between the PT/FT wage differential for non-casual and casual employees.

Notes: <sup>a</sup> Standard errors are cluster robust. <sup>b</sup> The 1,904 outliers on hours and wage were excluded from all sensitivity tests.

Panel F of table 4 shows the premium exists for people who change employment status once only and also for people who change their employment status multiple times. These results were obtained from separate fixed-effects estimations using the 4,505 men who never change employment status and (a) the 510 men who change employment status once only, and (b) the 304 men who changed multiple times. Fixed-effects were also estimated using the 3,754 women with no change of status and (a) the 1,064 women who changed employment status exactly once, and (b) the 679 women with multiple changes.

We estimated the part-time/full-time wage differential separately for four occupational groups (see Panel G of table 4). For men there is a part-time premium for all occupations except clerical, administrative and sales workers. Women in all occupations experience a part-time premium except machine operators, drivers and labourers. For technical, trades, community and personal service workers the part-time premium is significantly larger for non-casuals than for casuals.<sup>10</sup>

The part-time/full-time wage differential was estimated separately for the periods 2001-2004, 2005-2008 and 2009-2012, the latter being after the global financial crisis (GFC) hit the Australian economy (see Panel H of table 4). The part-time premium is observed for both men and women in all three periods and it is largest in the post-GFC period.

We also tested the sensitivity of our results to the constraint that individuals contribute data to the sample only if they have valid observations in at least two

<sup>10</sup> We also estimated the part-time/full-time wage differential separately for 19 industry groups but in most cases the samples were too small for the results to be meaningful.

consecutive waves of HILDA data. This requirement eliminated 5,259 observations on men and 5,953 observations on women, so it is relevant to ask whether doing so introduced bias into our results. Panel I of table 4 shows that the part-time wage premium remains for men and women, casual and non-casual, although in each case it is a little smaller than in Panel A.

### ***Salary Sacrifice and Non-Cash Benefits Included in the Hourly Wage***

The results discussed above, and the analysis of Booth and Wood (2008), are based on a measure of weekly labour income that excludes salary sacrifice and non-cash benefits.<sup>11</sup> If full-time employees receive larger amounts from these sources than part-time employees then their exclusion from the hourly wage could explain the part-time wage premium. This possibility was explored using data from Waves 10 through 12 of our sample, which are the only waves in which salary sacrifice and non-cash benefits are recorded. Outliers defined in Panel A of table 4 were excluded. The subset contains data on 3,217 males (8,353 male-years) and 3,244 females (8,331 female-years).

The same specifications of Model 1 were estimated but the set of control variables in Specifications 2 to 5 was expanded to include a binary variable equal to one if the individual supervises others in his or her main job, a higher wage being expected for supervisors, *ceteris paribus*. We also included three dummy variables indicating whether the individual's pay is set by a collective agreement, an individual agreement, a combination of the two, or (the excluded category) by an industrial award. These variables account for the possibility suggested by Booth and Wood (2008, p.132) that the premium results from employers paying wages that are above awards rates to employees on collective or individual agreements.

The results indicate that the premium is not a compensating differential for salary sacrifice and non-cash benefits, it is not explained by the method of setting pay, nor is it a loading for supervisory duties. The fixed-effects estimates in Specification 3 indicate substantial, statistically significant part-time wage premiums (see Panel J, table 4). The premium is 13.9 per cent for men employed on casual contracts and 18.1 per cent for men who are non-casuals. For women, there is a part-time wage premium of 15.0 per cent for both casuals and non-casuals.

### ***Model 2***

The fixed-effects assumption of symmetry is relaxed in the difference-in-differences equations of Model 2. We modified the control variables, dropping those that showed little variation 'within' employees and simplifying others. This resulted in a set of controls for changing casual status, changing employer, moving between single and multiple jobs, shifting between standard and non-standard work schedules, changing from a fixed contract to some other type of employment contract, as well as for joining or leaving a trade union, moving between public-sector and private-sector jobs, changing between jobs with and without supervisory duties, and two controls for switching to a job with a small firm and to a job with a large firm.

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<sup>11</sup> For information on the two variables, see Kecmanovic and Wilkins, 2011.

With the sample consisting of at least four consecutive observations on each individual, we were able to estimate Model 2 with  $k=0, 1$  and  $2$ , obtaining estimates of wage changes from the year immediately prior to a change of employment status, to the year immediately after, as well as one and two years beyond. We consider three cases. In Case 1 the control group consists of people who do not change employment status between years  $t-1$  and  $t$ , while the treatment group consists of people who do change status between years  $t-1$  and  $t$ ; no further restrictions are placed on either group. To determine how sensitive the results are to the definitions of the treatment and control groups, two additional sets of restrictions were imposed on the sample. In Cases 2 and 3, the control group consists of people who are never observed to change employment status. In Case 2, the treatment group has no change of employment status prior to that which occurs between years  $t-1$  and  $t$ . In Case 3, the treatment group has exactly one change of status prior to year  $t+2$ , namely the change that occurs between years  $t-1$  and  $t$ . Table 5 shows the numbers of transitions between full-time and part-time employment, with and without a change of employer, for men and women in each of Cases 1, 2 and 3.

Table 5 - Transition Matrices Showing Changes of Employment Status, Model 2

		<i>Men</i>					
		<i>All</i>		<i>No change of employer</i>		<i>Change of employer</i>	
<i>Year t-1 ↓</i>	<i>Year t →</i>	<i>Part-time</i>	<i>Full-time</i>	<i>Part-time</i>	<i>Full-time</i>	<i>Part-time</i>	<i>Full-time</i>
<u>Case 1</u>							
Part-time		531	319	481	198	50	121
Full-time		237	12,944	133	11,524	104	1,420
<u>Case 2</u>							
Part-time		209	178	194	97	15	81
Full-time		183	11,537	93	10,315	90	1,222
<u>Case 3</u>							
Part-time		209	144	194	73	15	71
Full-time		45	11,537	26	10,315	19	1,222
		<i>Women</i>					
		<i>All</i>		<i>No change of employer</i>		<i>Change of employer</i>	
<i>Year t-1 ↓</i>	<i>Year t →</i>	<i>Part-time</i>	<i>Full-time</i>	<i>Part-time</i>	<i>Full-time</i>	<i>Part-time</i>	<i>Full-time</i>
<u>Case 1</u>							
Part-time		4,057	826	3,748	627	309	199
Full-time		658	7,324	490	6,546	168	778
<u>Case 2</u>							
Part-time		2,152	550	2,026	404	126	146
Full-time		342	4,827	241	4,286	101	541
<u>Case 3</u>							
Part-time		2,152	320	2,026	215	126	105
Full-time		175	4,827	128	4,286	47	541

Source: HILDA, Waves 1-12.

Note: Numbers are unweighted counts of transitions, based on pairs of consecutive waves.

To begin, however, Model 2 with  $k=0$  was estimated using the same sample of two or more consecutive observations for each person as was used to estimate Model 1.<sup>12</sup> The results appear in table 6, labelled Case 0. They are consistent with the results from Model 1 in that they show substantial premiums for part-time work and penalties for full-time work, for both men and women. The results, however, are not symmetric. For men the premium for part-time work is smaller (12.0 per cent) than the penalty for full-time work (14.4 per cent). For women the reverse is observed; the premium for part time work (14.2 per cent) is larger than the penalty for full-time work (11.6 per cent).

Table 6 - Part-time/Full-time Wage Differentials, Model 2

Case	Change of Status	Period	Men	Women
			Cumulative Effect	Cumulative Effect
0	Pjoiner	t-1/t	0.120 ***	0.142 ***
0	Pleaver	t-1/t	-0.144 ***	-0.116 ***
1	Pjoiner	t-1/t	0.114 ***	0.133 ***
		t-1/t+1	0.015	0.054 ***
		t-1/t+2	0.040	0.047 ***
1	Pleaver	t-1/t	-0.126 ***	-0.106 ***
		t-1/t+1	-0.050	-0.024
		t-1/t+2	-0.039	-0.017
2	Pjoiner	t-1/t	0.093 **	0.145 ***
		t-1/t+1	-0.009	0.052 *
		t-1/t+2	0.016	0.041 *
2	Pleaver	t-1/t	-0.133 **	-0.098 ***
		t-1/t+1	-0.085 *	-0.023
		t-1/t+2	-0.063	-0.011
3	Pjoiner	t-1/t	0.176 *	0.112 ***
		t-1/t+1	0.049	0.076 **
		t-1/t+2	0.068	0.056 *
3	Pleaver	t-1/t	-0.090 *	-0.050 *
		t-1/t+1	-0.075	-0.021
		t-1/t+2	-0.099	-0.003

Source: HILDA, Waves 1-12.

\*, \*\* and \*\*\* indicates significantly different from zero at the 5%, 1% and 0.1% levels. Note: OLS estimates with cluster robust standard errors.

The results for Cases 1-3 also appear in table 6.<sup>13</sup> Full results for Case 1 are given in appendix A2. The wage changes with  $k=0$  are all large (greater than 10 per cent), highly statistically significant and display the same form of asymmetry as in Case 0. What is noteworthy about Case 1 for men, and for women for switch from part-time to full-time work, is that by year  $t+1$ , the effect of a change in employment status is practically small and not significantly different from zero. For women who change from full-time to part-time work, the effect one and two years later is statistically significant

<sup>12</sup> The outliers specified in Panel A of table 4 were excluded. Salary sacrifice, non-wage benefits and type of contract were not included because these variables are available only in recent waves of HILDA data.

<sup>13</sup> Full results for all cases in tables 6 and 7 are available from the authors on request.

but about one third the size of the initial effect of 13.3 per cent. As in Case 1, there is a substantial, asymmetric, immediate effect on the wage of changing employment status in Cases 2 and 3 but there is no evidence that it is sustained, except for women who switch from full-time to part-time employment. For these women the effect after two years is statistically significant and 4.1 per cent (Case 2) and 5.6 per cent (Case 3).

Finally, we investigate whether the effect on the wage of changing between full-time and part-time work is different for those who change employers and those who do not. Assuming (a) unpaid overtime is more common among full-time, than among part-time, workers and (b) people who change between full-time and part-time work with the same employer are more likely to retain the same contracted hourly wage than people who simultaneously change employer, then any change in the hourly wage – as measured with HILDA data – will be inversely related to the change in hours worked. Furthermore, as Hirsch (2005, p.541) points out, a change in full-time/part-time status is less likely to be mismeasured for workers who simultaneously change employer.

The variable  $newemp_{i,t-1/t+k}$  in Model 2 equals zero if the individual has the same employer in every year from  $t-1$  through  $t+k$ , and equals one otherwise.<sup>14</sup> The results are presented in table 7. In Case 0, the contemporaneous wage premium associated with changing to part-time employment is statistically significant only if the employer is unchanged. There is a statistically significant contemporaneous wage penalty for changing to full-time employment for both men and women, with or without a change of employer. For men, the penalty is larger with a change of employer; for women, it is larger with no employer change.

In Cases 1, 2 and 3 there is stronger evidence of a wage change when the individual remains with the same employer when changing employment status than when he or she simultaneously changes employer. In all three cases, women experience a wage premium associated with switching to part-time work provided they stay with the same employer. The premium decreases over time but after two years it is at least eight per cent and statistically significant. A sustained wage premium is also observed for men who switch to part-time work without changing employers in Case 1. In Cases 2 and 3 the statistical evidence is weaker, possibly because of small numbers of males changing employment status, particularly in Case 3 where only 19 men change to part-time work with a different employer. On the other hand, when a change to part-time employment is accompanied by a change of employer there is no evidence of a sustained part-time wage premium for men, and only a little evidence of a part-time wage premium for women in Case 2.

In all three cases, women experience an immediate wage penalty associated with switching to full-time work if they remain with the same employer. However, with time the penalty quickly decreases and becomes statistically non-significant. For men who do not change employers, there is evidence of a temporary full-time wage penalty in Cases 1 and 2, but not Case 3. On the other hand, when a change to full-time employment is accompanied by a change of employer there is little evidence of a full-time wage penalty for women. For men, the evidence is mixed. A large, statistically significant, immediate full-time wage penalty is observed in Cases 2 and 3, but not Case 1.

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<sup>14</sup> A change of job within the same firm does not constitute a change of employer.

Table 7 - Part-time/Full-time Wage Differentials, With and Without a Change of Employer, Model 2

Case	Change of Status	Period	Men		Women	
			Cumulative Effect		Cumulative Effect	
			Same Employer	Different Employer	Same Employer	Different Employer
0	Pjoiner	t-1/t	0.182 ***	0.021	0.163 ***	0.060
0	Pleaver	t-1/t	-0.137 ***	-0.174 *	-0.121 ***	-0.099 **
1	Pjoiner	t-1/t	0.163 ***	0.044	0.152 ***	0.061
		t-1/t+1	0.085 **	-0.055	0.085 ***	-0.018
		t-1/t+2	0.115 **	-0.020	0.077 ***	-0.011
1	Pleaver	t-1/t	-0.123 ***	-0.138	-0.113 ***	-0.075 *
		t-1/t+1	-0.067 *	-0.008	-0.031 *	-0.002
		t-1/t+2	-0.062	0.002	-0.029	0.008
2	Pjoiner	t-1/t	0.142 ***	0.033	0.159 ***	0.104 **
		t-1/t+1	0.056	-0.063	0.085 **	-0.013
		t-1/t+2	0.109 *	-0.048	0.083 ***	-0.027
2	Pleaver	t-1/t	-0.110 *	-0.264 **	-0.106 ***	-0.054
		t-1/t+1	-0.062	-0.163	-0.022	-0.027
		t-1/t+2	-0.035	-0.135	-0.020	0.008
3	Pjoiner	t-1/t	0.209 **	0.128	0.131 ***	0.052
		t-1/t+1	0.145 *	-0.073	0.118 **	-0.014
		t-1/t+2	0.163	-0.042	0.109 **	-0.035
3	Pleaver	t-1/t	-0.056	-0.253 **	-0.061 **	-0.011
		t-1/t+1	-0.052	-0.143	-0.023	-0.017
		t-1/t+2	-0.077	-0.147	-0.011	0.012

Source: HILDA, Waves 1-12.

\*, \*\* and \*\*\* indicates significantly different from zero at the 5%, 1% and 0.1% levels. Note: OLS estimates with cluster robust standard errors.

## 8. Concluding Remarks

The only previous longitudinal study of the full-time/part-time wage differential in Australia found large part-time wage premiums for both men and women, a result that is at odds with studies from other countries. Using 12, rather than four, years of longitudinal data we find part-time wage premiums for men and women on casual employment contracts of 12.5 and 13.2 per cent, respectively, and for non-casual men and women the premiums are 17.0 and 10.3 per cent, respectively.

Having verified the results of the earlier study, we then proceeded to investigate the nature of the premium. The premium does not result from the loading received by employees on casual employment contracts, many of whom work part-time. The premium is not explained by outlying observations on weekly hours of work or the hourly wage, although it is reduced, particularly for people on casual contracts, when outliers are excluded from the data set. Nor is the premium an artefact of how part-time employment is defined. Random errors in reporting weekly work hours theoretically could explain the premium but empirically they do not appear to do so. Age sheds only a little light on the nature of the part-time wage premium as it

is detected for all age groups, except men aged 30-50 years who are employed on casual contracts. Similarly, the premium is observed in three out of four occupational groups, the exceptions being men in clerical, administrative or sales occupations, and women who are machine operators, drivers or labourers. People who change employment status once only and people who change multiple times both experience a part-time wage premium. The premium is observed throughout the period 2001-2012 and has increased since the GFC.

We found no evidence that the part-time wage premium is a payment to part-time workers in compensation for receiving less in non-cash benefits or salary sacrifice than their full-time counterparts. When wages and salaries include salary sacrifice and are augmented with the value of non-cash benefits, the fixed-effects estimates indicate a statistically significant part-time wage premium of at least 14 per cent for both men and women, regardless of whether or not they are employed on casual contracts. Nor is there evidence in support of Booth and Wood's (2008) conjecture that the premium results from employers paying wages that are above awards rates to employees on collective or individual agreements. The premium is observed whether or not the payment method (collective agreement, individual agreement, a combination of the two, or industrial award) is held constant.

Difference-in-difference models reveal that both men and women experience substantial and sustained hourly wage increases when they switch from full-time to part-time work with the same employer. Smaller but statistically significant hourly wage reductions are experienced immediately after changing from part-time to full-time work without a change of employer but two years later the decrease is small and not statistically significant. There is scant evidence of a part-time wage premium (or penalty) when the change of employment status is accompanied by a change of employer.

The results from our dynamic model are consistent with Booth and Wood's (2008, p.132) conjecture that full-time workers are more likely to work unpaid hours than part-time workers. Notably, the one study that found a part-time wage penalty with longitudinal data, Connolly and Gregory (2009), used contracted hours of work to calculate the hourly wage. We were unable to test the unpaid-overtime hypothesis directly because paid and unpaid hours of work are not distinguished in the HILDA data; that is a task for future research into Australia's premium for part-time work.

## Appendix

## Appendix A1- Full Estimates of Model 1, Specification 3

	Men		Women	
	Pooled OLS	Fixed Effects	Pooled OLS	Fixed Effects
Part-time	-0.116 *	0.170 ***	-0.001	0.103 ***
Casual	-0.009	0.037 **	-0.059 *	0.021
Part-time#casual	0.039	-0.044	0.030	0.029
One job only	0.017	-0.029 **	-0.029	-0.011
Standard schedule	-0.061 ***	-0.013	-0.037 **	-0.016
Fixed contract	0.031 *	0.005	0.035 **	0.008
Labour hire firm	0.068 *	0.067 ***	0.107 **	0.052 **
Vic	-0.020	0.036	-0.064 ***	0.022
Qld	-0.021	-0.037	-0.052 ***	0.033
SA	-0.099 **	-0.040	-0.075 **	0.003
WA	0.022	0.019	-0.008	-0.025
Tas	-0.084 *	-0.012	-0.017	-0.054
NT	0.028	0.044	0.014	-0.011
ACT	0.110 **	0.066	0.102 ***	-0.028
Married	0.149 ***	0.040 **	0.083 ***	0.037 *
De facto	0.118 ***	0.026 *	0.088 ***	0.039 **
Sep, divorced, widowed	0.097 **	0.042 *	0.058 **	0.033
Born other ES country	0.036	-	0.024	-
Born NES country	-0.100 ***	-	-0.048 **	-
Inner regional	-0.070 ***	-0.018	-0.047 ***	-0.046 **
Outer regional	-0.044	0.008	-0.066 **	-0.043
Remote area	0.069	0.075	0.009	0.078
25-29 yrs old	0.038	0.011	0.053 **	0.012
30-34 yrs old	-0.006	-0.031	0.021	-0.007
35-39 yrs old	-0.057	-0.077 **	-0.015	-0.025
40-44 yrs old	-0.095	-0.109 ***	-0.032	-0.054
45-49 yrs old	-0.175 *	-0.139 ***	-0.066	-0.072 *
50-54 yrs old	-0.227 *	-0.138 ***	-0.100 *	-0.087 *
55-64 yrs old	-0.229 *	-0.146 ***	-0.098 *	-0.090 *
Tenure	0.008 ***	-0.001	0.010 ***	0.001
Tenure-sq	0.000 *	0.000	0.000 **	0.000
Experience	0.027 ***	0.037 **	0.024 ***	0.034 **
Experience-sq	0.000 ***	-0.001 ***	0.000 ***	-0.001 ***
Postgraduate	0.556 ***	0.096	0.466 ***	0.168 ***
Grad dip/cert	0.489 ***	0.093 *	0.390 ***	0.123 **
Bachelor	0.460 ***	0.006	0.358 ***	0.088 *
Diploma	0.262 ***	0.061	0.180 ***	0.061
Certificate 3/4	0.163 ***	0.076 **	0.070 ***	0.035
Year 12	0.153 ***	-0.103 *	0.103 ***	0.018
Constant	2.673 ***	2.881 ***	2.719 ***	2.668 ***
Person-yr observations	29,199	29,199	28,937	28,937
F-statistic	49.718 ***	39.948 ***	64.550 ***	30.442 ***
Breusch-Pagan $\chi^2$ stat		33,800.2 ***		17,065.2 ***
Hausman $\chi^2$ stat		702.9 ***		527.3 ***

Source: HILDA, Waves 1-12.

\*, \*\* and \*\*\* beside a coefficient indicates significantly different from zero at the 5%, 1% and 0.1% levels.

Note: Standard errors are cluster robust.

## Appendix A2 - Full Estimates of Model 2, Case 1

	Men			Women		
	Coef <i>t-1/t</i>	Coef <i>t-1/t+1</i>	Coef <i>t-1/t+2</i>	Coef <i>t-1/t</i>	Coef <i>t-1/t+1</i>	Coef <i>t-1/t+2</i>
Pjoiner	0.114 ***	0.015	0.040	0.133 ***	0.054 ***	0.047 ***
Cleaver	-0.071 ***	-0.067 ***	-0.083 ***	-0.067 **	-0.069 **	-0.064 *
Cjoiner	0.016	0.049 *	0.044 *	0.027	0.019	-0.001
Cstayer	0.005	0.024	0.031	-0.035	-0.026	-0.037
Δemployer	0.038 ***	0.053 ***	0.062 ***	0.036 **	0.045 ***	0.050 ***
Δmultijobs	-0.023	-0.026	-0.025	-0.007	-0.003	-0.009
Δschedule	0.013	-0.008	-0.016	-0.030 *	-0.029 *	-0.045 **
Δfcontract	-0.002	0.000	-0.004	-0.005	0.000	-0.004
Δunion	0.033 ***	0.036 ***	0.035 ***	-0.011	0.006	0.007
Δpublic	0.012	0.019	0.018	0.039 **	0.032 *	0.057 ***
Δsupervise	-0.001	0.010	0.012	0.012	0.014 *	0.014 *
Δsmallfirm	-0.012	-0.029 **	-0.037 **	-0.008	-0.016	-0.027
Δbigfirm	0.029 *	0.046 ***	0.064 ***	0.028 *	0.024	0.043 **
constant	0.017 *	0.035 ***	0.060 ***	0.013	0.044 ***	0.063 ***
N	13181	13181	13181	7982	7982	7982
F-statistic	4.779 ***	7.516 ***	7.835 ***	7.790 ***	4.550 ***	6.293 ***

	Men			Women		
	Coef <i>t-1/t</i>	Coef <i>t-1/t+1</i>	Coef <i>t-1/t+2</i>	Coef <i>t-1/t</i>	Coef <i>t-1/t+1</i>	Coef <i>t-1/t+2</i>
Pleaver	-0.126 ***	-0.050	-0.039	-0.106 ***	-0.024	-0.017
Cleaver	-0.016	-0.023	-0.017	-0.027	-0.038 *	-0.020
Cjoiner	0.028	-0.086	-0.083	0.069	0.037	0.016
Cstayer	-0.019	0.007	-0.004	0.011	0.020	0.010
Δemployer	0.050	0.064	0.077 *	0.053 **	0.054 ***	0.045 **
Δmultijobs	-0.006	-0.024	0.004	-0.047 **	-0.048 **	-0.040 **
Δschedule	-0.050	-0.064	-0.024	-0.002	-0.006	-0.017
Δfcontract	0.088 *	0.149 **	0.091	0.006	0.006	0.007
Δunion	0.094 *	0.084 *	0.070	0.003	-0.005	0.020
Δpublic	0.110	0.064	0.076	-0.013	-0.008	0.002
Δsupervise	-0.001	0.002	-0.006	0.010	0.010	-0.007
Δsmallfirm	0.042	0.016	-0.017	-0.039	-0.060 **	-0.035
Δbigfirm	0.140 *	0.116 *	0.048	0.043	0.010	0.037
constant	-0.044 ***	-0.004	0.031	-0.014	0.003	0.018
N	850	850	850	4883	4883	4883
F-statistic	2.485 ***	2.071 **	1.635 ***	5.220 *	2.427 ***	2.264 ***

Source: HILDA, Waves 1-12.

\*, \*\* and \*\*\* beside a coefficient indicates significantly different from zero at the 5%, 1% and 0.1% levels.

Note: Standard errors are cluster robust.

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# School-to-Work Transitions During Volatile Economic Times

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## Abstract

*School-to-work transitions are increasingly contingent upon having appropriate educational credentials therefore leaving school before completing secondary education may result in young people experiencing prolonged periods of precarious employment. Although the Australian economy weathered the recent Global Financial Crisis (GFC) better than many other advanced economies, in August 2009 the combined unemployment and underemployment rate for young people was double the rate for the working age population. During economic recessions, young people tend to delay entry into the labour market preferring remain in school until the economy rebounds and jobs are easier to secure. This paper presents the results of analyses of the Household Income and Labour Dynamics in Australia data tracking the fortunes of three cohorts of young Australians: those who completed school prior to the GFC; those who completed school during the GFC; and those who completed school after the GFC to examine the effect of the crisis on school-to-work transitions.*

Keywords: Transitions, Global financial crisis, Unemployment

JEL classification: I24, I28, J01, J24

## 1. Introduction

Over the past four decades, the Australian economy restructured from a goods producing economy to a service economy as manufacturing moved offshore to nations with cheaper labour. As the Australian labour market restructured and jobs growth became concentrated in highly skilled occupations, Year 12 retention rates doubled and youth unemployment increased. Traditionally, the completion of the Year

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12 certificate was regarded as a pathway into further education, however, it is now regarded as the minimum requirement for entry level jobs. For young people seeking careers, further investment in human capital credentials is essential, fuelling growth in post-secondary education enrolments. During the Global Financial Crisis, the unemployment rate for young people was double the rate for the general population and has remained high ever since, creating uncertainty for young people wishing to transition directly into the labour market. In this paper, we examine transitions between school and employment and/or further study to assess the impact of the Global Financial Crisis on young Australians focussing on levels of engagement. Although the availability of full-time paid employment declines during periods of economic recession, young people may seek to overcome the disadvantages associated with transitioning from education to employment during economic downturns by undertaking post-school study and working part-time until the economy recovers and the labour market rebounds. The remainder of this paper is structured as follows: in section 2 we provide an overview of the economic context before, during and after the GFC; in section 3 we introduce the data and outline our analytical strategy; in section 4 we present the results; and in section 5 we provide a discussion of the findings before summing up the paper in section 6.

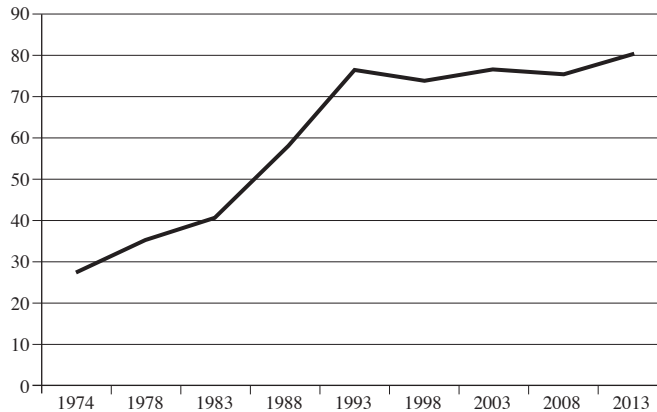
## 2. Context

### *Secondary Education in Australia*

Since the 1970s, the Year 12 apparent retention rate increased from 27.5 to 81 per cent (ABS, 2013). The apparent retention rate doubled between 1983 and 1993 due to the collapse of the youth labour market in the wake of the economic recession of 1982-83 when apprenticeships declined by one-third (Teese and Polesel, 2003). The graph in figure 1 charts the trend over time in the Year 12 apparent retention rate. As senior school populations became increasingly diverse, schools introduced vocational education and training (VET) programs to accommodate the needs of non-academically inclined students (Anlezark *et al.*, 2006). Students may complete VET Certificates I/II/III in conjunction with their Year 12 certificate. Over 40 per cent of senior secondary students participate in VET programs, however, the majority of participants do not complete a certificate level qualification (Karmel, 2012; Keating *et al.*, 2013; Polesel, 2008) suggesting that students are not necessarily attempting to formalise this investment in their human capital.

Despite the overall increase in Year 12 rates, children growing up in economically disadvantaged neighbourhoods have higher non-completion rates than their more advantaged peers (Curtis *et al.*, 2012; Johnston *et al.*, 2014; Polesel, 2008). According to Curtis and McMillan (2008) key indicators of non-completion include: being male; being Indigenous; having low-educated parents; having parents employed in manual occupations; living in a regional/rural area; being a low achiever in Year 9; and attending a government school. The non-completion of Year 12 is associated with poor employment outcomes with one-quarter of early school leavers being unable to find any kind of paid employment in the first eight years after leaving school (Fitzpatrick *et al.*, 2011). Consequently, 50 per cent of those who leave school before completing Year 12 undertake training in the VET sector (Curtis and McMillan, 2008).

Figure 1 - Year 10 to Year 12 Apparent Retention Rates 1974-2013



Source: Authors' calculations using figures published by the ABS (2000 and 2013).

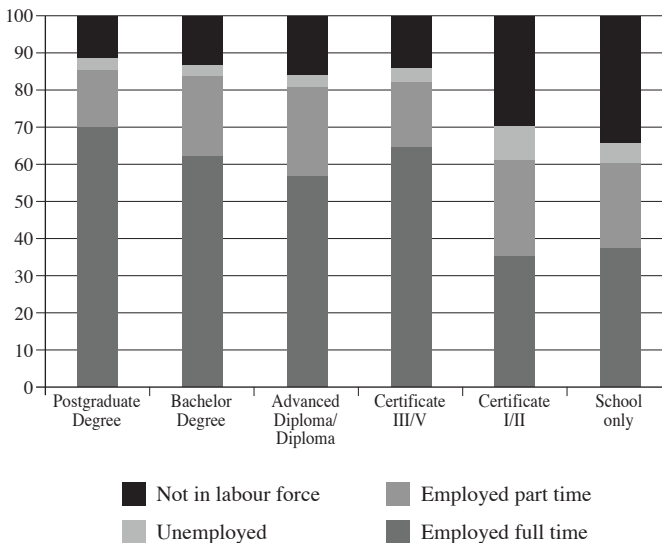
According to the Australian Bureau of Statistics (ABS, 2013), the percentage of young people aged 15 to 19 years engaged in formal study increased from 77 to 81 per cent between 2001 and 2012. The percentage of 20-24 year olds engaged in formal study increased from 34 to 41 per cent (ABS, 2013). Young people aged 15 years or older undertaking a course at an approved institution, such as a secondary school, a Vocational Education and Training (VET) institution, or a university may qualify for a means-tested welfare payment, Youth Allowance, provided by the Australian Government. In order to qualify for Youth Allowance, young people aged between 15 and 20 years who have not completed Year 12 or an equivalent educational qualification need to be engaged in study or training for at least 25 hours per week. These payments are designed to assist young people as they transition between education and employment by discouraging them from leaving school early and encouraging them to undertake further study if they cannot secure full-time employment.

### **Australian Labour Market**

As the Australian economy restructured from a goods producing economy to a service economy, manufacturing sector jobs were replaced by jobs in the service sectors. Highly-skilled professionals now account for a much larger proportion of the workforce due to an increase in the number of occupations classified as 'professions' and an increase in the number of jobs available in each of the professions (van de Werfhorst, 2007). As jobs growth became increasingly concentrated in highly skilled occupations (Biddle, 2007; Curtis and McMillan, 2008; Keating *et al.*, 2013) low-skilled workers became concentrated in sectors with high rates of part-time employment, namely retail and hospitality. Low-skilled jobs in the retail and hospitality sectors offer limited long-term employment opportunities as relatively low proportions of workers in these sectors, regardless of their age, are employed on a full-time basis. In 2012, just 41 per cent of workers employed in the accommodation and food services sector and 50 per cent of workers employed in the retail trade sector were employed on a full-time basis (DEEWR, 2013).

There is a strong correlation between educational attainment and employment status with university-educated persons being more likely to be labour force participants, more likely to be employed on a full-time basis and less likely to be unemployed than those with lower levels of education (ABS, 2014a). For example, 87 per cent of those with a Bachelor degree were participating in the labour force in 2013 compared to just 66 per cent of those without any post-school qualifications. Furthermore, 63 per cent of those with a Bachelor degree were employed on a full-time basis compared to just 38 per cent of those without post-school qualifications. Although those with lower level certificates were slightly more likely than those with no post-school qualification to be in the labour force, their unemployment rate was higher. The graph in figure 2 shows the relationship between level of education and employment status in 2013. Completing a post-school qualification at the level of a Certificate III or higher is associated with higher levels of employment, and full-time employment in particular, indicating that these extra investments in human capital provide financial benefits over the long term.

Figure 2 - Labour Force Status by Level of Education 2013



Source: Authors' calculations using published by the ABS (2014a).

### ***Global Financial Crisis in Australia***

The financial crisis of 2008-09, sometimes referred to as the Global Financial Crisis (GFC), was followed by a prolonged recession (the Great Recession) in many parts of the world, particularly in the US and Europe. It was preceded by an extended period of both stable growth and stable inflation (Hume and Sentence, 2009), during which nominal GDP increased dramatically in many countries including the US (120 per cent), the UK (150 per cent) and Australia (156 per cent) (Pomfret, 2009a: p. 26). Much

of this growth was the result of investment in property pushing prices up and creating asset bubbles in property markets. Central banks kept interest rates low to keep inflation under control, ignoring the role of interest rates as the price of capital, thus fuelling the asset bubble (Pomfret, 2009a). Low interest rates encouraged investors to seek high yield securities (Debelle, 2008) creating a market for the new investment products developed by investment banks.

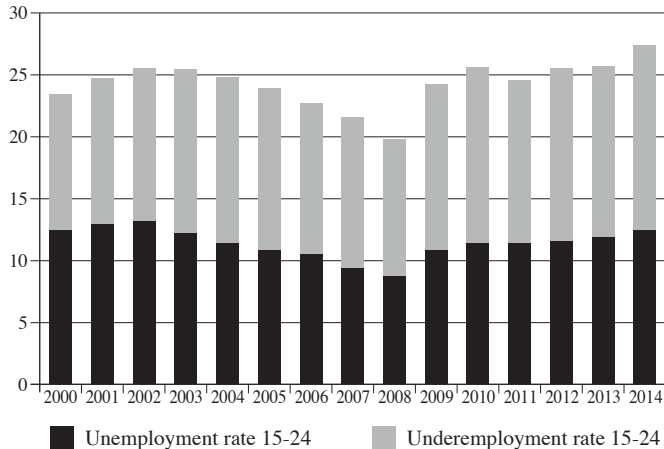
Prior to the GFC, Australia enjoyed 15 years of continuous economic growth between 1993 and 2008 during which average household wealth and average household indebtedness increased significantly. The onset of the GFC led to the collapse of the Australian dollar from \$US0.98 to \$US0.60 between July and October 2008 (Pomfret, 2009b: p. 256) and a 14 per cent decline in the aggregate value of household assets (Green *et al.*, 2009; Wilkins and Wooden, 2009). Household consumption contracted and the household savings rate increased from 1.2 to 8.5 per cent between the March and December quarters of 2008 (Green *et al.*, 2009: p. 344).

The overall unemployment rate increased from 4.1 per cent in February 2008 to 5.8 per cent in August 2009 (ABS, 2014b) and the underemployment rate (the proportion of the labour force employed part-time and seeking to work more hours) increased from 6 to 7.9 per cent during the same period. Consequently, the labour underutilisation rate, the combination of the unemployment and underemployment rates, increased from 10.2 per cent in February 2008 to 13.7 per cent in August 2009. The unemployment rate of those aged between 15 and 24 years increased from 8.8 per cent in February 2008 to 12 per cent in August 2009 and the underemployment rate increased from 11 to 15 per cent. These figures indicate that the GFC had a similar impact on the labour underutilisation rates of young people and of the labour force more generally.

Although the overall unemployment and underemployment rates quickly recovered, the rates for young people aged between 15 and 24 years continued to increase. In February 2014, the unemployment rate for young people was 13 per cent and the underemployment rate was 15 per cent indicating that 28 per cent of young people aged between 15 and 24 years were either seeking a job or were working part-time and wanted to work more hours. The graph in figure 3 charts trends over time in the underutilisation rate of young Australians.

As employment rates stagnated, an increasing proportion of young people delayed their transition into the labour market by completing secondary school and/or undertaking further study at post-school institutions. In this paper, we conduct analyses of longitudinal data collected by the Household Income and Labour Dynamics in Australia (HILDA) project to examine the effect of the GFC on the school-to-work transitions of three cohorts of young people. We seek to address two research questions: (1) Did the GFC encourage young people to complete Year 12; and (2) Did the GFC affect post-school outcomes?

Figure 3 - Underutilisation Rate for 15-24 Year Olds 2000-2014



Source: Authors' calculations using figures published by the ABS (2014b).

### 3. Method

#### Data

HILDA is a panel survey which collects data from the same respondents each year. For the first wave in 2001, a nationally representative sample of Australian households was selected and all members of the chosen households aged 15 years and older were invited to participate providing a total sample size of 13,969 (Summerfield *et al.*, 2011). Each year, household members aged 15 years are added to the sample. We select three cohorts of respondents: those aged 16/17 years in 2004 (the Pre-GFC cohort); those aged 16/17 years in 2006 (the GFC cohort); and those aged 16/17 years in 2008 (the Post-GFC cohort). The pre-GFC cohort completed secondary school during the final stages of a long period of economic growth when youth unemployment rates were relatively low. The GFC cohort completed secondary school during the peak of the economic crisis when youth unemployment rates were historically high. The post-GFC cohort completed secondary school after the peak of the economic crisis had passed but when youth unemployment rates continued to increase. We track each cohort for five years until they are aged 20/21 years. Table A1 in the appendix lists the relevant waves of data for each of the three cohorts.

#### Variables

Our analyses include measures at five time points: T1; T2; T3; T4; and T5. The T1 variables provide our baseline data for comparison purposes and measure respondents' education, employment status, sex, family type, parents' education, parents' occupational prestige, residential location and socio-economic status. The respondent's level of education variable has three categories: still at school; early school leaver and completed Year 12. Completing Year 12 before age 18 years is

possible in some states of Australia. Sex is included as a dummy variable coded 1= female and 0= male. The respondent's employment status variable has three categories: not employed; employed part-time; and employed full-time. It is relatively common for secondary school students to be employed on a part-time/ casual basis (Anlezark and Lim, 2011; Biddle, 2007; Karmel, 2012). The family type variable is coded 1= living with both parents; 2= living with one parent; and 3= other. We do not distinguish between biological parents and step parents.

For parents' education we take the highest level of education of either parent. There are five categories: <Year 12; Year 12; VET; CAE/IT/University; don't know. In 1990, Colleges of Advanced Education (CAE) and Institutes of Technology (IT) were amalgamated and rebadged as universities so we include qualifications from these institutions with university-level qualifications. For parents' occupational prestige, we take the highest occupational status score of either parent. HILDA includes a variable which assigns a value to each occupation using the AUSIE06 index of occupational prestige which ranges from zero (low status) to 100 (high status). The scores assigned to individual occupations reflect the role of occupation in mediating the effects of educational attainment on earnings (McMillan *et al.*, 2009). The distribution is divided into four groups: low (<30); mid (31-69); high (70+); not employed.

The residential location variable is coded: 0= living in capital city/ metropolitan area; and 1= living in regional/ rural area. The socioeconomic status variable is based on the SEIFA (Socio-Economic Index for Areas) Index of Relative Socio-economic Advantage/ Disadvantage value for the residential location at T1. SEIFA is compiled by the ABS using information such as income, occupation and levels of education as markers of relative advantage/disadvantage in a geographical area (ABS, 2006). Due to the size of the samples in each cohort, we recode the deciles into quintiles. The ABS unemployment rate variable is used as an indicator of variation in the unemployment rate between the areas in which the respondents live. It refers to the overall unemployment rate for each area, not specifically the unemployment rate for young people. Generally, unemployment is concentrated in particular suburbs in metropolitan areas and in particular regions outside of the capital cities in each state. We recode the unemployment rate variable into three categories: low = <four per cent; mid= 4.1 to five per cent; high = >five per cent. The descriptive statistics of the three cohorts at T1 are presented in table A2 in the appendix.

Using information at T5, when the respondents were aged 20/21 years, we identify respondents who left school before completing Year 12 and construct a dummy variable coded 1= early school leaver and 0 = school completer. The employment status at T5 variable has three categories: not employed; employed part-time; and employed full-time. The studying at T5 variable has three categories: not studying; studying part-time; and studying full-time. The level of engagement at T5 variable is derived from the employment and study status variables and has three categories: fully engaged (employed full-time with or without study; employed part-time and studying; studying full-time, with or without paid employment); partially engaged (part-time employment and no study or part-time study and no employment); and not engaged (no paid employment and no study). The not engaged group are generally referred to as NEETs (not in education, employment or training).

### **Analytical Strategy**

Initially, we use data from T5, when the respondents were aged 20/21 years to identify the early school leavers and provide the descriptive statistics of early school leavers and school completers in each cohort. Secondly, we construct a series of models to predict the likelihood of being an early school leaver according to cohort, sex, family type, parents' education, parents' occupational prestige, location and SEIFA to answer the first research question, 'Did the GFC encourage young people to complete Year 12?'. We then we focus on post-school outcomes at T5, when the respondents were aged 20/21 years, to answer the second research question, 'Did the GFC affect post-school outcomes?'. We examine three outcomes: engagement in paid employment; engagement in post-school study; and overall engagement. For each outcome, we construct multinomial logistic regression models to examine levels of engagement at T5 according to level of engagement at T1, controlling for the effects of cohort, sex, family type at T1, location at T1, SEIFA at T1, ABS unemployment rate for location at T1 and parents' education. To check the reliability of our models, we carried out post-estimation tests in Stata to test the independence of irrelevant alternatives (IIA) assumption. A robust-based test of the Hausman test specification was used to test whether the inclusion or exclusion of response categories influenced (significantly) the relative risks associated with our outcome variable. The results indicated that there is not enough evidence to reject the null hypothesis of independence of alternatives.

## **4. Results**

### ***The Effect of the GFC on Year12 Completion***

The descriptive statistics at T1 for early school leavers and school completers (identified at T5) in each cohort are presented in table A.3 in the appendix. We conducted t-tests to determine whether the differences between early school leavers and school completers in each cohort were statistically significant. Family type, parents' education, parents' occupational prestige and neighbourhood socio-economic status are associated with being an early school leaver in each cohort. Female students in the GFC and post-GFC cohorts were less likely than their male counterparts to be early school leavers.

To answer our first research question: 'Did the GFC encourage young people to complete Year 12?', we conducted a series of logistic regressions. The results are presented in table 1. In Model 1, we include cohort, sex, family type, location, SEIFA and ABS unemployment rate. In the second model we include parents' education and in the third model we include parents' occupational status. In each of the three models, when we hold all other variables in the model constant, cohort has no effect. Being female decreases the odds of leaving school before completing Year 12 in each of the models, net of the effects of the other factors. Not living with both parents increases the odds of leaving school early. Living in an area with a high rate of unemployment is associated with increased odds of being an early school leaver. This result is somewhat counterintuitive and suggests that the likelihood of being unemployed does not discourage young people from leaving school before completing Year 12. Teese and Polesel (2003) also found that leaving school before completing Year 12 was not associated with the availability of employment opportunities. These results are largely repeated when parents' education is included in Model 2. Furthermore, parents' education is negatively associated with being an early school leaver. Students

with university-educated parents were less than one-third as likely as those with low-educated parents to leave school before completing Year 12, net of the effects of the other factors. In the third model, we replace parents' education with parents' occupational status and find that, holding all other variables in the model constant, having a parent in a high status occupation decreases the odds of being an early school leaver.

Table 1 - Logistic Regression Models Estimating the Odds Ratios for Being an Early School Leaver

	<i>Model 1</i>		<i>Model 2</i>		<i>Model 3</i>	
	<i>Odds ratio</i>	<i>Std. err.</i>	<i>Odds ratio</i>	<i>Std. err.</i>	<i>Odds ratio</i>	<i>Std. err.</i>
<b>Cohort (ref. Pre-GFC)</b>						
GFC	1.00	0.18	1.01	0.18	1.04	0.19
Post GFC	0.84	0.15	0.86	0.16	0.89	0.16
<b>Sex (ref. male)</b>						
Female	0.54 ***	0.08	0.52 ***	0.08	0.51 ***	0.07
<b>Family @ T1 (ref. both parents)</b>						
One parent	1.60 **	0.27	1.52 *	0.26	1.48 *	0.25
Other	4.66 ***	1.06	4.30 ***	1.00	3.79 ***	0.88
<b>Location @ T1 (ref. regional)</b>						
Metro	0.94	0.15	0.97	0.16	0.89	0.14
<b>SEIFA @ T1 (ref. Q1)</b>						
Quintile 2	0.57 **	0.11	0.63 *	0.13	0.70	0.15
Quintile 3	0.62 *	0.13	0.74	0.16	0.79	0.17
Quintile 4	0.44 ***	0.10	0.60 *	0.14	0.63	0.15
Quintile 5	0.23 ***	0.06	0.36 ***	0.10	0.39 ***	0.11
<b>ABS unemployment rate @ T1 (ref. low)</b>						
Mid	1.23	0.21	1.28	0.22	1.21	0.21
High	1.56 *	0.29	1.64 **	0.32	1.57 *	0.30
<b>Parents' education (ref. &lt;Year12)</b>						
Year 12			0.48 *	0.14		
VET			0.62 *	0.12		
CAE/IT/Uni			0.28 ***	0.06		
Don't know			0.81	0.28		
<b>Parents' occ. prestige (ref. low)</b>						
Mid					0.78	0.17
High					0.32 ***	0.08
Not employed					2.10	0.85
Constant	0.65	0.15	1.03	0.27	0.86	0.23
n=	1202		1202		1202	
Pseudo R-squared	0.0933		0.1201		0.1238	

\*  $p < 0.05$ , \*\*  $p < 0.01$ , \*\*\*  $p < 0.001$ .

### ***The Effect of the GFC on Post-school Outcomes***

Before answering our second research question, we present the percentages of early school leavers and school completers in each of the three cohorts according to employment status, study status and level of engagement at T5. We conducted t-tests to determine whether the differences across the cohorts were statistically significant.

The descriptive statistics presented in table 2 indicate that the percentage of both early school leavers and school completers who were not employed when aged 20/21 years increased across the cohorts.

There were no differences across the cohorts in the percentages of early school leavers or school completers who were engaged in study. Overall, levels of full engagement declined with both early school leavers and school completers in the Post-GFC cohort being less likely than their counterparts in the pre-GFC and GFC cohorts to be fully engaged.

Table 2 - Levels of Engagement in Employment and Study for Each Cohort at T5

	<i>Early School Leaver</i>			<i>School Completer</i>		
	<i>Pre-GFC n=101</i>	<i>GFC n= 118</i>	<i>Post-GFC n=106</i>	<i>Pre-GFC n=251</i>	<i>GFC n=303</i>	<i>Post-GFC n=323</i>
	%	%	%	%	%	%
<b>Employment status T5</b>						
Not employed	26	33	44	11	21	24
Employed part-time	17	16	10	45	40	44
Employed full-time	57	51	45	44	39	32
p-value	0.071			0.001		
<b>Current study T5</b>						
Not studying	77	69	85	46	43	45
Part-time	15	18	9	15	16	15
Full-time	8	13	6	39	42	40
p-value	0.099			0.947		
<b>Level of engagement T5</b>						
Not engaged	24	24	39	2	7	8
Partially engaged	12	14	13	14	11	17
Fully engaged	64	63	48	85	83	74
p-value	0.072			0.001		

To take advantage of the longitudinal nature of these data we construct lagged variables for employment status, study status and level of engagement. Lagged variables allow us to control for the effects of having multiple observations for each respondent. In this case, the lag is the status at T5 compared to the status at T1. Table 3 presents the results of multinomial logistic regression models examining employment status at T5 according to cohort. Model 1 shows that holding employment status at T1, sex and family type constant, being in the GFC cohort or the Post-GFC cohort has a negative effect for both full-time and part-time employment.

Net of the effects of cohort, respondents employed on a part-time basis at T1 were, on average, 2.7 times more likely to be employed part-time relative to being not employed at T5. In other words, combining part-time employment with school at age 16/17 years protects against non-employment at age 20/21 years. Respondents employed on a part-time basis at T1 were, on average, 2.8 times more likely to be employed full-time relative to being not employed at T5. Respondents employed on a full-time basis at T1 were, on average, 4.5 times more likely to be employed full-

time relative to being not employed at T5. Being female has no independent effect on being employed on a part-time basis but has an independent negative effect on being employed on a full-time basis. Not living with both parents when aged 16/17 has an independent negative effect on both part-time and full-time employment.

These results are largely repeated when we add in location, SEIFA, ABS unemployment rate and parents' education into Model 2. Furthermore, when we hold all of the other variables in the model constant, SEIFA quintile for location of residence at age 16/17 has an independent positive effect for part-time employment but no effect for full-time employment. The ABS unemployment rate for location of residence has no independent effect for full-time or part-time employment. Having university-educated parents has an independent positive effect on part-time employment but no independent effect on full-time employment.

Table 3 - Multinomial Regression of the Relative Risk of being Part-time or Full-time Employed Relative to being not Employed at T5

	<i>Model 1</i>		<i>Model 2</i>	
	<i>Part-time employed</i>	<i>Full-time employed</i>	<i>Part-time employed</i>	<i>Full-time employed</i>
	<i>RRR Std. err</i>	<i>RRR Std. err</i>	<i>RRR Std. err</i>	<i>RRR Std. err</i>
<b>Cohort</b> (ref. Pre-GFC)				
GFC	0.61* (0.13)	0.62* (0.13)	0.60* (0.14)	0.54** (0.12)
Post-GFC	0.55** (0.12)	0.43*** (0.09)	0.56** (0.12)	0.39*** (0.09)
<b>Employment status @T1</b> (ref. Not employed)				
Part-time employed	2.72*** (0.48)	2.85*** (0.50)	2.76*** (0.50)	2.80*** (0.50)
Full-time employed	0.81 (0.32)	4.53*** (1.33)	0.91 (0.36)	4.45*** (1.32)
<b>Sex</b> (ref. Male)				
Female	1.08 (0.18)	0.44*** (0.07)	1.13 (0.19)	0.44*** (0.07)
<b>Family</b> (ref. Both parents)				
One parent	0.61** (0.12)	0.67* (0.13)	0.64* (0.13)	0.69 (0.13)
Other	0.21*** (0.06)	0.40*** (0.10)	0.26*** (0.08)	0.41*** (0.11)
<b>Location</b> (ref. Regional)				
Metro			1.41 (0.27)	1.35 (0.25)
<b>SEIFA</b> (ref. Q1)				
Quintile 2			1.54 (0.41)	1.29 (0.31)
Quintile 3			1.73* (0.49)	1.32 (0.35)
Quintile 4			1.94* (0.55)	1.20 (0.32)
Quintile 5			2.07* (0.62)	0.97 (0.28)

Table 3 - Multinomial Regression of the Relative Risk of being Part-time or Full-time Employed Relative to being not Employed at T5 (continued)

	<i>Model 1</i>		<i>Model 2</i>	
	<i>Part-time employed</i>	<i>Full-time employed</i>	<i>Part-time employed</i>	<i>Full-time employed</i>
	<i>RRR</i>	<i>RRR</i>	<i>RRR</i>	<i>RRR</i>
	<i>Std. err</i>	<i>Std. err</i>	<i>Std. err</i>	<i>Std. err</i>
<b>ABS unemployment rate (ref. low)</b>				
Mid			0.92 (0.18)	0.70 (0.14)
High			1.15 (0.28)	0.82 (0.19)
<b>Parents' education &lt;yr12 (ref.)</b>				
Year 12			1.57 (0.56)	1.35 (0.45)
VET			1.58 (0.42)	1.47 (0.36)
CAE/IT/Uni			1.97* (0.54)	1.19 (0.31)
Don't know			0.89 (0.42)	1.00 (0.41)
Constant	1.96*** (0.41)	3.12*** (0.62)	0.58 (0.21)	2.34*** (0.77)
Observations	1202		1202	
Pseudo R-squared	0.0841		0.1062	

\*  $p < 0.05$ , \*\*  $p < 0.01$ , \*\*\*  $p < 0.001$ .

During this transition period, young people may be engaged in post-school study rather than paid employment, therefore, we next examine levels of engagement with post-school study at T5 according to cohort, controlling for sex, family type, location, SEIFA, ABS unemployment rate and parents' education. The results presented in table 4 for Model 1 indicate that holding all other variables in the model constant, cohort had no effect on the likelihood of studying part-time or full-time relative to not studying. Net of the effects of cohort, those in full-time study at T1 were more likely to be studying at T5. Being female has an independent positive effect on studying full-time relative to not studying whereas not living with both parents has an independent negative effect on studying part-time or full-time relative to not studying. These results are largely repeated in Model 2 except that being in the GFC cohort is associated with an increased likelihood of studying full-time relative to not studying. Furthermore, SEIFA quintile and parents' education have independent positive effects and living in a regional or rural area has an independent negative effect on full-time study.

Table 4 - Multinomial Regression of the Relative Risk of Being Engaged in either Part-time or Full-time Study Relative to being not Engaged in Study at T5

	<i>Model 1</i>		<i>Model 2</i>	
	<i>Part-time study</i>	<i>Full-time study</i>	<i>Part-time study</i>	<i>Full-time study</i>
	<i>RRR</i> <i>Std. err</i>	<i>RRR</i> <i>Std. err</i>	<i>RRR</i> <i>Std. err</i>	<i>RRR</i> <i>Std. err</i>
<b>Cohort</b> (ref. Pre-GFC)				
GFC	1.18 (0.25)	1.25 (0.21)	1.28 (0.29)	1.47* (0.28)
Post-GFC	0.89 (0.19)	1.06 (0.18)	0.95 (0.21)	1.15 (0.21)
<b>Study status @T1</b> (ref. Not studying)				
Part-time study	0.99 (0.43)	1.15 (0.46)	0.87 (0.39)	0.92 (0.38)
Full-time study	2.28*** (0.55)	4.25*** (0.95)	2.04** (0.50)	3.13*** (0.73)
<b>Sex</b> (ref. Male)				
Female	0.92 (0.16)	1.36* (0.19)	0.94 (0.16)	1.40* (0.20)
<b>Family</b> (ref. Both parents)				
One parent	1.01 (0.21)	0.63** (0.11)	1.04 (0.22)	0.67* (0.12)
Other	1.17 (0.34)	0.18*** (0.07)	1.24 (0.36)	0.22*** (0.09)
<b>Location</b> (ref. Regional)				
Metro			0.70 (0.14)	0.63** (0.11)
<b>SEIFA</b> (ref. Q1)				
Quintile 2			1.15 (0.31)	2.02** (0.51)
Quintile 3			1.09 (0.31)	2.16** (0.56)
Quintile 4			1.46 (0.43)	2.31** (0.61)
Quintile 5			1.80 (0.56)	3.56*** (0.97)
<b>ABS unemployment rate</b> (ref. low)				
Mid			1.23 (0.26)	1.44* (0.24)
High			1.26 (0.31)	1.27 (0.26)
<b>Parents' education</b> (ref. <yr12)				
Year 12			1.18 (0.44)	2.63** (0.87)
VET			1.14 (0.31)	1.82* (0.49)
CAE/IT/Uni			1.40 (0.40)	3.75*** (1.01)
Don't know			1.00 (0.46)	1.26 (0.58)
Constant	0.15*** (0.04)	0.18*** (0.04)	0.11*** (0.04)	0.04*** (0.02)
Observations	1202		1202	
Pseudo R-squared	0.0545		0.0927	

\*  $p < 0.05$ , \*\*  $p < 0.01$ , \*\*\*  $p < 0.001$ .

Finally, we examine levels of engagement in both paid employment and study. Table 5 presents the results of multinomial logistic regression models examining level of engagement at T5. Model 1 shows that holding level of engagement at T1, sex and family type constant, being in the Post-GFC cohort is negatively associated with being fully engaged relative to being not engaged at T5.

Net of the effects of cohort, respondents who were partially engaged at T1 were, on average, 3.6 times more likely to be partially engaged relative to being not engaged at T5. Respondents who were fully engaged at T1 were, on average, 5.3 times more likely to be partially engaged relative to being not engaged at T5. Respondents who were partially engaged at T1 were, on average, 2.7 times more likely to be fully engaged relative to being not engaged at T5. Respondents who were fully engaged at T1 were, on average, 7.6 times more likely to be fully engaged relative to being not engaged at T5. Being female has no independent effect on level of engagement. Not living with both parents when aged 16/17 has an independent negative effect on level of engagement.

These results are largely repeated when we add in location, SEIFA, ABS unemployment rate and parents' education into Model 2. Furthermore, SEIFA quintile for location of residence at age 16/17 has an independent positive effect on full engagement. The ABS unemployment rate for location of residence has an independent negative effect on being fully engaged. Parents' education has an independent positive effect on being fully engaged at T5.

Table 5 - Multinomial Regression of the Relative Risk of being Partially Engaged or Fully Engaged Relative to being not Engaged at T5

	<i>Model 1</i>		<i>Model 2</i>	
	<i>Partially engaged</i>	<i>Fully engaged</i>	<i>Partially engaged</i>	<i>Fully engaged</i>
	<i>RRR</i>	<i>RRR</i>	<i>RRR</i>	<i>RRR</i>
	<i>Std. err</i>	<i>Std. err</i>	<i>Std. err</i>	<i>Std. err</i>
<b>Cohort</b> (ref. Pre-GFC)				
GFC	0.58 (0.19)	0.67 (0.18)	0.62 (0.21)	0.67 (0.19)
Post-GFC	0.59 (0.18)	0.43*** (0.11)	0.65 (0.21)	0.42*** (0.11)
<b>Level of engagement @T1</b> (ref. not engaged)				
Partially engaged	3.59* (1.84)	2.75** (1.07)	3.36* (1.76)	2.87** (1.17)
Fully engaged	5.34*** (2.16)	7.55*** (2.15)	4.43*** (1.83)	5.92*** (1.77)
<b>Sex</b> (ref. male)				
Female	1.47 (0.36)	0.76 (0.15)	1.49 (0.37)	0.75 (0.15)
<b>Family</b> (ref. both parents)				
One parent	0.60 (0.17)	0.39** (0.09)	0.62 (0.18)	0.43*** (0.10)
Other	0.31*** (0.11)	0.15** (0.04)	0.35** (0.12)	0.18*** (0.05)

Table 5 - Multinomial Regression of the Relative Risk of being Partially Engaged or Fully Engaged Relative to being not Engaged at T5 (continued)

	<i>Model 1</i>		<i>Model 2</i>	
	<i>Partially engaged</i>	<i>Fully engaged</i>	<i>Partially engaged</i>	<i>Fully engaged</i>
	<i>RRR</i> <i>Std. err</i>	<i>RRR</i> <i>Std. err</i>	<i>RRR</i> <i>Std. err</i>	<i>RRR</i> <i>Std. err</i>
<b>Location</b> (ref. regional)				
Metro			1.18 (0.32)	0.80 (0.18)
SEIFA (ref. Q1)				
Quintile 2			1.56 (0.54)	2.05* (0.57)
Quintile 3			1.38 (0.52)	1.79 (0.54)
Quintile 4			2.09 (0.85)	2.45** (0.83)
Quintile 5			2.99* (1.40)	3.60*** (1.45)
<b>ABS unemployment rate</b> (ref. Low)				
Mid			1.02 (0.29)	0.92 (0.22)
High			1.38 (0.47)	0.88 (0.26)
<b>Parents' education</b> (ref. <yr12)				
Year 12			0.98 (0.52)	2.49* (1.02)
VET			1.50 (0.49)	2.19** (0.59)
CAE/IT/Uni			1.55 (0.58)	3.30*** (1.04)
Don't know			0.83 (0.50)	1.49 (0.68)
Constant	0.56 (0.22)	3.49*** (1.20)	0.21** (0.12)	1.23 (0.57)
Observations	1202		1202	
Pseudo R-squared	0.0953		0.1251	

\*  $p < 0.05$ , \*\*  $p < 0.01$ , \*\*\*  $p < 0.001$ .

## 5. Discussion

Although, for the most part, the effects of the GFC were relatively short-lived in Australia, the unemployment and underemployment rates for those aged between 15 and 24 years have yet to recover. Coupled with the transition into a post-industrial economy, these high rates suggest that young people are finding it increasingly difficult to transition from full-time study at school into full-time paid employment. In this paper, we examined the effect of the GFC on levels of engagement in paid employment and/or study to answer two research questions.

In answer to our first research question: Did the GFC encourage young people to complete Year12?, we found that after controlling for sex, family type, parents'

education, parents' occupation, location, SEIFA and ABS unemployment rate, being a member of the GFC or Post-GFC cohort did not affect the likelihood of completing Year 12. Living in an area with a high rate of unemployment was associated with increased odds of leaving school before completing Year 12 suggesting that the decision to leave school early is taken independently of economic conditions. Teese and Polesel (2003) also found that young people located in areas with high rates of unemployment were not deterred from leaving school before completing Year 12 concluding that students do not invest time and effort in their studies unless they believe that they will succeed at school. According to Fitzpatrick and others (2011), the lack of human capital, as certified by the Year 12 certificate, damages the employment prospects of early school leavers. Their study found that around one-quarter had not engaged in any type of paid work during the first eight years after leaving school. This economic precariousness is difficult to overcome in the longer term (Teese and Polesel, 2003).

Turning to our second research question: 'Did the GFC affect post-school outcomes?', the results presented here show that the GFC had a negative effect on both part-time and full-time employment. After controlling for employment status at age 16/17 years, respondents in the GFC and Post-GFC cohorts were less likely to be employed rather than not employed at age 20/21 years. This result is not unexpected given that the youth unemployment rate has yet to recover from the GFC. In February 2014, 28 per cent of labour force participants aged 15 to 24 years were either unemployed or part-time employed and seeking to work more hours. With such a large proportion of young people unable to secure full-time employment, the future employment prospects of this generation may also be affected. As Blossfeld (1990) notes access to apprenticeships is dependent upon the prevailing economic conditions, therefore, a lack of opportunities during the transition years has lifelong economic consequences.

One consequence of this higher rate of unemployment was an increase in the likelihood of undertaking further study. Respondents in the GFC cohort were more likely to be engaged in full-time study at age 20/21 years than those in the Pre-GFC cohort. On the other hand, being a member of the Post-GFC cohort was not associated with a greater likelihood of being engaged in further study. Curtis and McMillan (2008) examined the post-school outcomes of early school leavers finding that around half of those who left school before completing Year 12 returned to education, typically studying low level VET certificates. This may be partly due to the requirement for young people receiving welfare payments to be engaged in study. It may also be a consequence of young people realising that without further investment in their human capital, they have little chance of gaining employment in a highly competitive labour market that is generating highly-skilled rather than low-skilled jobs.

Our examination of levels of overall engagement showed that being in the Post-GFC cohort had a negative effect on being fully engaged at age 20/21 years, net of the effects of level of engagement at age 16/17 years, sex, family type, location, SEIFA, ABS unemployment rate and parents' education. These results suggests that engaging in paid employment during senior secondary years provides some protection from unemployment at age 20/21 therefore students not intending to pursue post-secondary education may benefit from participation in paid employment whilst at

school. As other researchers have noted (Anlezark and Lim, 2011; Stern and Briggs, 2001), undertaking long hours of employment whilst at secondary school is associated with an increased likelihood of becoming an early school leaver, therefore, students need to carefully balance their school and paid work commitments. Students at risk of being not engaged in either education or employment may benefit from programs that provide actual workplace experience in the fields that interest them. Young people who do not engage in part-time work whilst at school may not see retail or hospitality jobs as having any connection with their post-school plans and may be unsuccessful in their applications for part-time work in their chosen field. The current requirements for school-based apprenticeships may be acting as a deterrent for employers and potential apprentices, therefore, a review of this program is timely given the high rates of both youth unemployment and skilled migration.

## 6. Conclusion

Summing up, the results presented here show that transitions between full-time school and full-time employment were affected by, and continue to be affected by, the GFC. The restructuring of the labour market restricted the availability of low-skilled full-time jobs and the GFC exacerbated this trend. Young people in the Post-GFC cohort, those who finished school after 2009, were less likely than their counterparts in the Pre-GFC cohort to be fully engaged at age 20/21 years, however, the ongoing high rates of unemployment and underemployment do not appear to deter young people from leaving school without a clear plan for the next stage of their life course.

## Appendix

Table A1 - Relevant waves of data for each of the three cohorts: Pre-GFC; GFC; Post-GFC

<i>Cohort</i>	<i>T1</i> [16/17yrs]	<i>T2</i> [17/18yrs]	<i>T3</i> [18/19yrs]	<i>T4</i> [19/20yrs]	<i>T5</i> [20/21yrs]
Pre GFC	2004	2005	2006	2007	2008
GFC	2006	2007	2008	2009	2010
Post GFC	2008	2009	2010	2011	2012

Table A2 - Characteristics of the three cohorts at T1 (respondents aged 16/17 years)

<i>Characteristic</i>	<i>Pre GFC n=352</i>	<i>GFC n= 421</i>	<i>Post GFC n= 429</i>
	<i>%</i>	<i>%</i>	<i>%</i>
Still at school	72	75	74
Early school leaver	19	16	19
Completed Year 12	9	8	8
<b>Sex</b>			
Male	54	51	46
Female	46	49	54
<b>Employment status @ T1</b>			
Not employed	45	52	48
Employed part-time	45	40	42
Employed full-time	11	9	10
<b>Family type @T1</b>			
Both parents	74	69	68
One parent	18	23	22
Other	8	8	10
<b>Parents' education</b>			
<Year12	14	15	12
Year12	7	8	11
VET	33	35	36
Tertiary (CAE/IT/Uni.)	41	39	36
Don't know	6	3	4
<b>Parent occupational prestige</b>			
Low	14	13	7
Mid	46	46	53
High	36	39	37
Not employed	3	3	4
<b>Region @ T1</b>			
Metro	59	57	56
Regional	41	43	44
<b>SEIFA at T1</b>			
Quintile 1	19	19	20
Quintile 2	22	22	20
Quintile 3	20	17	20
Quintile 4	15	23	20
Quintile 5	24	19	20
<b>ABS unemployment rate</b>			
Low (<4%)	22	58	51
Mid (4.1-5%)	49	19	40
High (>5%)	28	23	9

Table A3 - Descriptive Statistics at T1 of Early School Leavers and School Completers (measured at T5)

<i>Characteristic @ T1</i>	<i>Pre GFC</i>		<i>GFC</i>		<i>Post GFC</i>	
	<i>Early school leaver n=101</i>	<i>School completer n=251</i>	<i>Early school leaver n=118</i>	<i>School completer n=303</i>	<i>Early school leaver n=106</i>	<i>School completer n=323</i>
	<i>%</i>	<i>%</i>	<i>%</i>	<i>%</i>	<i>%</i>	<i>%</i>
Male	59	52	62	46	56	42
Female	41	48	38	54	44	58
p-value	0.219		0.004		0.018	
<b>Employment status</b>						
Not employed	37	48	44	55	51	47
Employed p/t	38	48	33	42	20	50
Employed f/t	26	4	23	3	29	3
p-value	<0.0001		<0.0001		<0.0001	
<b>Family type</b>						
Both parents	63	79	59	73	51	73
One parent	20	17	26	22	26	20
Other	17	4	14	5	23	6
p-value	<0.0001		0.001		<0.0001	
<b>Parents' education</b>						
<Year12	22	10	19	13	27	7
Year 12	6	7	8	8	10	11
VET	42	29	45	31	37	36
CAE/IT/Uni.	21	49	23	45	18	42
Don't know	10	4	4	3	8	3
p-value	<0.0001		0.001		<0.0001	
<b>Occupational prestige- Parent</b>						
Low	24	11	19	10	12	5
Mid	47	46	55	43	65	49
High	22	42	21	46	13	45
Not employed	8	1	5	2	9	2
p-value	<0.0001		<0.0001		<0.0001	
<b>Region</b>						
Metro	50	63	50	60	48	59
Regional/Remote	50	37	50	40	52	41
p-value	0.024		0.070		0.047	
<b>SEIFA</b>						
Quintile 1	33	13	28	16	30	16
Quintile 2	23	22	25	21	24	19
Quintile 3	23	19	21	15	18	21
Quintile 4	8	18	18	25	21	20
Quintile 5	14	29	8	22	8	24
p-value	<0.0001		0.001		0.001	
<b>ABS rate of unemployment</b>						
Low	28	20	50	61	43	54
Mid	38	54	17	19	44	39
High	35	26	33	19	12	7
p-value	0.019		0.012		0.114	

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# How Much Do Tradespersons Really Earn?

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## Abstract

*A popular view is that tradespersons' earnings compare favourably with those with university education. This view is not borne out by wage data, but a common rejoinder is that it is the self-employed tradespersons who make the 'big' money (and probably under-report their income). These ideas are examined by analysing household expenditure data in conjunction with income data from the Australian Bureau of Statistics' Household Expenditure Survey and the Survey of Income and Housing. The data also allow us to look at wealth across occupations. Our findings are that neither expenditure data nor wealth data change significantly the relativities between the trades and occupations more associated with higher education. While no doubt there are some very rich tradespersons, on average those with university degrees earn more than those with trade qualifications. And there is little evidence to suggest that on average self-employed tradespeople 'do better' than those who are employees.*

**Keywords:** Wage level and structure, Professional labour markets, Occupational licensing

**JEL classification:** J31, J44

## 1. Introduction

Popular wisdom is that people in the trades do pretty well and in some cases earn more than those with degrees. However, the usual wage comparisons based on employees' earnings do not bear this out and typically there is a handsome premium to university education. The come back to this empirical evidence is that it is the self-employed in the trades who make the real money. But data on the earnings of the self-employed do not confirm the hypothesis that self-employed tradesmen have high earnings. The rejoinder to this is that the earnings of the self-employed are notoriously understated; for example, Hurst *et al.* (2014) estimate that in the US the self-employed understate their incomes by around 25 per cent.

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In this paper, we estimate relative earnings of the employed and self-employed by looking at the household expenditure of both employees and the self-employed, with the idea that household expenditure will better reflect underlying earnings than reported earnings. This approach is similar to that of Hurst *et al.* (2014), who used Engle curves linking income and expenditure of wage and salary earners to infer the earnings of the self-employed from their reported expenditure. The data come from the Australian Bureau of Statistics' Household Expenditure Survey and the Survey of Income and Housing<sup>1</sup>. While somewhat dated (referring to 2003-04) the relationships between earnings and expenditure should remain relatively constant.

A further benefit of these data sets is that some data on household wealth are also collected. Thus we are able to obtain estimates of relativities between employees and the self-employed from income, expenditure and wealth.

While the motivation for the paper was to look at the relative earnings of employees and the self-employed in the trades, the data cover the whole workforce enabling us to cover a wider range of occupational groups. This allows us to examine the trades relative to occupations associated with higher education, and see if the usual comparisons within wage and salary earners are robust when the self-employed are also considered. The surveys also collect data on qualifications and field of study so we can also get the relative earnings by level and field of education. Trade qualifications are typically at the certificate III level. The education data allow us to consider outcomes for trades people who move into other occupations.

Although our starting point is the notion that the self-employed understate their income, it needs to be acknowledged that there is a range of factors that drive self-employment. Therefore a priori there is no compelling reason to assume that the self-employed earn more or less than employees. First, the self-employed choose that state, and Joona and Wadensjo (2013) show that, at least among Swedish-born wage earners, the self-employed come from the most successful (that is, with earnings greater than expected) and the least successful (earnings less than expected). By contrast, Castagnetti and Rosit (2011) find that in the Italian labour market the best graduates become wage and salary earners. Self-employment can also be involuntary in the sense that individuals choose that status because they cannot find a suitable employee position (Kautonen *et al.* 2010; and Lofstrom, 2013) or industrial structures push workers into self-employment (notably in the construction industry – see Harvey and Behling, 2010). Personality traits such as openness to experience, risk tolerance, the importance of locus of control clearly play a role (see for example Caliendo, Fossen and Kritikos, 2014). We also note that earnings is but one attribute of a job and that job satisfaction, for example, may differ between employees and the self-employed (Hangleberger and Merz, 2011). In this regard Millan *et al.* (2013) find that self-employed individuals are more likely to be satisfied with their present jobs in terms of the type of work (but less satisfied in terms of job security), based on the European Community Household Panel. The finding that self-employed persons show substantially higher levels of job satisfaction than employees is consistent across Europe (for example, Blanchflower and Oswald, 1998; Blanchflower, 2000; and Benz

<sup>1</sup> The confidentialised unit record files were accessed through Australian Bureau of Statistics' Remote Access Data Laboratory.

and Frey, 2004 and 2008) and for the USA and Canada (Kawaguchi, 2002; Hundley, 2001; and Benz and Frey, 2004).

The structure of the paper is as follows. We take income, household expenditure and wealth in turn. The paper ends with a discussion bringing together the relativities between the self-employed and employees across our three financial variables.

## 2. Income

The analysis was restricted to persons between the ages of 15 and 64 years. The models were further restricted to full-time workers (35 or more hours per week), with a reported qualification or level of education (thus omitting non-school qualifications of 'certificate not further defined' or 'level not determined'), and with a positive income. An employee was defined by having wages and salary as the primary source of income. If the primary source of income was 'own incorporated business' the person was classified as self-employed. If the primary source of income was 'other income (including government pensions and allowances)' the person was classified as a non-worker. Table 1 provides the sample numbers in each category.

Table 1 - Sample Size by Primary Source of Income and Type of Employment, Full-time Workers

<i>Primary source of income</i>	<i>Total</i>
Zero or negative income	47
Wage and salary	4,987
Own unincorporated business income	529
Other income (incl. govt. pensions and allowances)	107
Total	5,670

We have constructed an occupational classification that straddles one and two digit ASCO (Australian Standard Classification of Occupations), which we label as 'ASCO 1.5'. Essentially this covers the major ASCO groups but with more detail for the trades where the sample permitted. Note that the food trades ASCO 45 have been combined with ASCO 49 'other tradespersons' because there were no self-employed food tradespersons in the sample. Similarly, ASCO 5 (advanced clerical, sales and service workers) and ASCO 6 (intermediate clerical, sales and service workers) have been combined because of very small numbers of self-employed persons in ASCO 5. Table 2 gives the final occupational categories with sample sizes.

We see that construction tradespersons have the greatest proportion of self-employed by a long margin, no doubt reflecting the structure of that industry with its emphasis on contractors. There is also a substantial proportion of self-employed among skilled agricultural and horticultural workers (25 per cent) and electrical and electronic tradespersons (15 per cent).

Table 2 - Sample Size by Occupation and Type of Employment,  
Full-time Workers

<i>ASCO</i>	<i>Description</i>	<i>Employees</i>	<i>Self- employed</i>	<i>Per cent Self- employed</i>	<i>Total<sup>1</sup></i>
1	Managers and Administrators	481	76	13.6	557
2	Professionals	1,130	87	7.1	1,217
3	Associate Professionals	756	95	11.2	851
41	Mechanical and Fabrication Engineering Tradespersons	157	10	6.0	167
42	Automotive Tradespersons	78	11	12.4	89
43	Electrical and Electronic Tradespersons	108	18	14.3	126
44	Construction Tradespersons	118	103	46.6	221
46	Skilled Agricultural and Horticultural Workers	36	12	25.0	48
45/49	Other Tradespersons (inc. food) and Related Workers	173	22	11.3	195.0
5/6	Clerical and Service Workers	925	34	3.5	959
7	Intermediate Production and Transport Workers	450	67	13.0	517
8	Elementary Clerical Sales and Service Workers	253	15	5.6	268
9	Labourers and Related Workers	312	32	9.3	344
Total		4,977	582	10.5	5,559

<sup>1</sup> There were 111 persons with a response of 'Not applicable' not included in this table.

For the level of education analysis we have six categories (excluding level not defined), ranging from Year 10 and below up to diploma and above (table 3). Certificate III/IV is the group with the highest proportion of self-employed, the majority of whom will be in the trades. Interestingly, the categories year 11, and year 10 and below have relatively high proportions of self-employed. The smallest group of self-employed are the most highly educated, suggesting that perhaps self-employment is not always a desired state, or that the returns to schooling differ between employees and the self-employed (Iversen *et al.* (2010) find very low returns for most educational levels in self-employment).

Table 3 - Sample Size by Level of Education and Type of Employment,  
Full-Time Workers

<i>Qualification</i>	<i>Employees</i>	<i>Self- employed</i>	<i>Per cent Self- employed</i>	<i>Total</i>
Not defined	165	9	5.2	174
Year 10 and below	830	128	13.4	958
Year 11	279	49	14.9	328
Year 12	689	55	7.4	744
Certificate I/II	315	34	9.7	349
Certificate III/IV	983	189	16.1	1,172
Diploma and above	1,816	129	6.6	1,945
Total	5,077	593	10.5	5,670

Level of education is a rather coarse filter given the very different types of jobs that are held by people with different fields of education. Thus we combine level of education with field of education to give a somewhat different view of the workforce to occupation. The main motivation for this is it may be the case that tradespeople who start their own business may report their occupation as ‘manager’ if the business is of any size. Classifying by level and field of education will get over this occupational labelling effect. Unfortunately the relatively small number of self-employed persons severely constrains the level of possible disaggregation. Table 4 shows the disaggregation we have adopted, noting that the sample sizes are really too small to provide much confidence in our estimates in many of the cells.

Table 4 - Sample Size by Qualification and Field of Education for Full-time Workers

<i>Highest Level of Qualification</i>	<i>Area of Qualification</i>	<i>Employees</i>	<i>Self-employed</i>	<i>Per cent Self-employed</i>	<i>Total</i>
Cert I/II	Natural Sci./Physical Sci./Agriculture	20	7	25.9	27
Cert III/IV	Natural Sci./Physical Sci./Agriculture	22	3	12.0	25
Dipl. or higher	Natural Sci./Physical Sci./Agriculture	198	8	3.9	206
Cert I/II	Information Technology/Engineering	72	8	10.0	80
Cert III/IV	Information Technology/Engineering	551	78	12.4	629
Dipl. or higher	Information Technology/Engineering	297	18	5.7	315
Cert I/II	Architecture/Building	11	3	21.4	14
Cert III/IV	Architecture/Building	112	84	42.9	196
Dipl. or higher	Architecture/Building	29	6	17.1	35
Cert I/II	Health/Education	14	1	6.7	15
Cert III/IV	Health/Education	32	3	8.6	35
Dipl. or higher	Health/Education	445	30	6.3	475
Cert I/II	Management/Commerce	156	6	3.7	162
Cert III/IV	Management/Commerce	132	6	4.3	138
Dipl. or higher	Management/Commerce	393	19	4.6	412
Cert I/II	Society/Culture/Creative Arts/Food/ Hospitality/ Personal Services	41	9	18.0	50
Cert III/IV	Society/Culture/Creative Arts/Food/ Hospitality/ Personal Services	129	14	9.8	143
Dipl. or higher	Society/Culture/Creative Arts/Food/ Hospitality/ Personal Services	428	46	9.7	474
Total		3,114	352	10.2	3,466

Notes: ‘Certificate not defined’ not included in this analysis.

The group we are most interested in is certificate III/IV in architecture/building, the qualification linked to the construction trades. As expected, this is the group with the highest proportion of self-employed (42.9 per cent).

### 3. The Income Model

We use a simple Mincer style model for income with log income a function of sex interacted with age and age-squared (to proxy experience) within each category. The categories are those we described above, being occupation, level of education and level of education classified by field of education. The differential between employees and self-employed is a single dummy variable within each category (that is we are assuming that the impact of age and sex is the same for employees and the self-employed). The reason for this assumption is one of parsimony – the sample size for the self-employed is quite constrained.

The results are tabulated in table 5. The coefficient on the employment status dummy translates to the premium that employees get relative to the self-employed. For example, a coefficient of 0.35 equates to the ratio of employee income to self-employed income of 1.4.<sup>2</sup>

Table 5 - Income Model for Occupations

<i>ASCO</i>		<i>N</i>	<i>Coef on 'employee'</i>	<i>SE</i>	<i>t</i>	<i>Employee income relative to self- employed</i>	<i>Employee income (\$s per week)</i>	<i>Self- employed income (\$s per week)</i>
1	Managers/administrators	172	-0.1855	0.149	-1.24	0.8	948.78	1142.13
2	Professionals	1209	0.3537	0.07	5.1	1.4	1271.66	892.83
3	Associate professional	845	0.8294	0.067	12.4	2.3	1059.28	462.18
41	Mechanical and fabrication trades	165	0.6255	0.214	2.91	1.9	994.19	531.87
42	Automotive	89	0.5106	0.132	3.88	1.7	957.27	574.51
43	Electrical and electronic trades	123	-0.01418	0.123	0.12	1.0	996.14	1010.36
44	Construction trades	215	0.287	0.091	3.16	1.3	955.91	717.46
46	Ag and horticultural trades	47	0.1252	0.141	0.89	1.1	777	685.54
49	Other trades including food	194	0.4202	0.099	4.25	1.5	969.3	636.77
5&6	Clerical and service	955	0.8453	0.083	10.2	2.3	826.59	354.98
7	Production and transport	512	0.6701	0.057	11.7	2.0	917.41	469.42
8	Elementary clerical sales and service	266	0.755	0.177	4.26	2.1	786.45	369.64
9	Labourers	341	0.1809	0.108	1.68	1.2	754.96	630.06

*Note:* Income for a male aged 39 years.

We see that on the whole employees have higher incomes than the self-employed, with a couple of exceptions. One of these is in the trades - electrical and electronic tradespersons- while the other is managers and administrators, although in both cases the null hypothesis of no difference in income between employees and the self-employed is accepted. For the other trades the ratio of employee to self-employed income ranges

<sup>2</sup>  $\text{Exp}(0.35)=1.4$ .

from a low of 1.1 in the agricultural and horticultural trades (a low paying occupational group) to 1.9 for the mechanical and fabrication trades. For the construction trades – the group with the highest proportion of self-employed persons – the ratio of employee income to self-employed is 1.3. The higher incomes of employees were expected, which leads us to the nub of the paper which is whether analysis of household expenditure changes our finding that employees are generally ‘doing better’ than the self-employed.

Before doing this, however, we report the results of the income models based upon the other classifications. First, we present the results by education level.

Table 6- Income Model for Education Levels, Full-time Workers

<i>Highest qualification level</i>	<i>N</i>	<i>Coef on 'employee'</i>	<i>SE</i>	<i>t</i>	<i>Employee self-employed income</i>	<i>Employee income (\$A/wk)</i>	<i>Self-employed income (\$A/wk)</i>
Year 10 or below	948	0.5766	0.0592	9.75	1.8	861.06	483.57
Year 11	324	0.4423	0.029	5.34	1.6	878.89	564.75
Year 12	743	0.466	0.0675	6.9	1.6	1039.94	652.78
Cert I/II	345	0.6237	0.0967	6.45	1.9	914.32	490.04
Cert III/IV	1158	0.4842	0.044	10.99	1.6	959.77	591.4
Dipl. and above	1933	0.6036	0.0624	9.66	1.8	1254.85	686.17

We see that the results are very consistent by level of education. The groups with the lowest penalty to being self-employed are those with year 11 or year 12 and those with a certificate III/IV.

Table 7 - Income Models for Qualification by Field of Study, Full-time Workers

<i>Area of Qualification</i>	<i>Qualification level</i>	<i>N</i>	<i>Coef on 'employee'</i>	<i>SE</i>	<i>t</i>	<i>Employee to self-employed income</i>	<i>Employee income</i>	<i>Self-employed income</i>
Natural/Physical Sci./Ag	Cert I/II	27	0.232	0.306	0.76	1.3	1043.75	827.48
	Cert III/IV	25	0.7069	0.389	1.82	2.0	862.96	425.56
	Dipl. and above	204	2.4118	0.25	9.64	11.2	1108.05	99.34
IT/Engineering	Cert I/II	78	0.3985	0.191	2.08	1.5	831.52	558.24
	Cert III/IV	621	0.4984	0.064	7.85	1.6	990.64	601.83
	Dipl. and above	314	1.0826	0.152	7.11	3.0	1354.23	458.69
Architecture/Building	Cert I/II	14	0.3878	0.264	1.47	1.5	887.97	602.51
	Cert III/IV	191	0.4307	0.108	4.01	1.5	897.79	583.63
	Dipl. and above	34	0.0394	0.7058	0.06	1.0	908.02	872.94
Health and Education <sup>1</sup>	Cert III/IV	35	-0.0506	0.254	-0.2	1.0	1018.32	1071.18
	Dipl. and above	474	0.4404	0.109	4.05	1.6	1198.92	771.86
Management/ Commerce	Cert I/II	161	1.2804	0.212	6.03	3.6	923.28	256.61
	Cert III/IV	137	0.9601	0.156	6.14	2.6	917.36	351.22
	Dipl. and above	409	0.729	0.173	4.21	2.1	1349.77	651.1
Society/Culture/Arts/ Food & Hospitality	Cert I/II	50	0.5906	0.231	2.56	1.8	895.19	495.96
	Cert III/IV	143	0.7438	0.132	5.65	2.1	937.96	445.84
	Dipl. and above	470	0.1964	0.098	2.01	1.2	1210.12	994.36

Our particular interest is the trades, with trade qualifications equating to certificate III/IV. The two fields with the greatest proportion of self-employed are IT and engineering, and architecture and building. In these two areas we see still a very substantial premium to being an employee, with the ratio of employee to self-employed income being 1.6 and 1.5 respectively. This compares to 1.0 for electrical and electronic trades and 1.3 for the construction trades. Thus, this broader view of workforce destinations does not change our finding that on average trade employees have higher incomes than trade self-employed. Given that this way of looking at the workforce does not change our conclusion regarding the income of trade employees and self-employed we do not pursue this alternative classification further in the paper.

#### 4. Household Expenditure

The immediate issue we have is that the Australian Bureau of Statistics collects expenditure data for households, not for individuals. Thus the analysis is considerably more complicated.

Our approach is to build up household expenditure by taking a linear combination of the incomes of the members of a household and then multiplying this by a factor which reflects the demographics of the household. The incomes of the members of the household are partitioned into the income of employees, the income of own account workers and the incomes of non-workers. We can further partition the workers into employee managers and administrators, self-employed managers and administrators and so on. The coefficients on these income variables tell us how income translates into expenditure for a given group, abstracting from the demographics of the household. If the self-employed are understating their income we would expect that a given level of income translates to a higher level of expenditure.

More formally, the base model is defined as:

$$x = (b_1y_1 + b_2y_2 + b_3y_3) * (1 + c_1f_1 + c_2f_2 + c_3f_3 + c_4f_4 + c_5f_5 + c_6f_6 + c_7f_7 + c_8f_8 + c_9f_9)$$

where

$x$  = household expenditure (\$A/week)

and

$y_1$  = income of employees (\$A/week)

$y_2$  = income of own account workers (\$A/week)

$y_3$  = income of non-workers (\$A/week)

and

$f$  is a vector of family characteristics the elements comprising:

$f_1$  = number of dependent children in the household aged 0-4

$f_2$  = number of dependent children in the household aged 5-14

$f_3$  = number of dependent children in the household aged above 15

$f_4$  = number of adults in the household aged below 25

$f_5$  = number of adults in the household aged 25-34

$f_6$  = number of adults in the household aged 35-44

$f_7$  = number of adults in the household aged 45-54

$f_8$  = number of adults in the household aged 55-64

$f_9$  = number of adults in the household aged 65+

$b_1$ ,  $b_2$  and  $b_3$  are the coefficients for  $y_1$ ,  $y_2$  and  $y_3$ , respectively and  $c_1..c_9$  are the coefficients for  $f_1$  to  $f_9$ .

The main point of presenting the results for this simple model is to demonstrate its structure. While our interest is in the coefficients of  $y_1$  and  $y_2$  in particular, we show all the coefficients for completeness.

Table 8 - Results of simple expenditure model

<i>Variable</i>	<i>Coef</i>	<i>SE</i>
Employee income	1.05	0.03
Self-employed income	0.91	0.03
Other income	1.21	0.05
No. of children 0-4	0.06	0.01
No. of children 5-14	0.04	0.01
No. of children 15+	0.08	0.02
No. of adults <25	-0.01	0.01
No. of adults 25-34	-0.04	0.01
No. of adults 35-44	-0.04	0.01
No. of adults 45-54	-0.03	0.01
No. of adults 55-64	-0.06	0.01
No. of adults <65+	-0.05	0.02
No. of observations	6,845	
Adjusted R squared	0.478	

The interest in the income coefficients is their deviation from one. A value of one indicates that income translates to expenditure on a one to one basis (for a neutral demographic mix). A value greater than one indicates that expenditure is higher than income, while a value less than one the opposite. Not surprisingly, the coefficient on 'other income' is greater than one indicating that those depending on 'other income' are drawing on their savings. Our main interest, however, is in the difference between the coefficients on employee and self-employed income. Our presupposition is that the coefficient for self-employed income would be greater than one, indicating that the self-employed were possibly understating their income. However, the results are in the opposite direction indicating that the self-employed in general are spending less than their reported incomes. We return to this when we partition the income by occupation.

We have included the demographic characteristics to give an understanding of how the model works. The neutral value for a demographic coefficient is zero. Thus we see that in general households with children spend more than other households (and by implication more than their income) while households consisting of adults spend less of their income. Adults under 25 years are the group that are closest to neutral, with income translating very closely to expenditure.

If we evaluate the demographic variables at their average we can calculate 'main effects' as in table 9 (that is, the income coefficient multiplied by the demographic factor for the average household).

Table 9 - Main Effects for Base Expenditure Model

<i>Term</i>	<i>Description</i>	<i>Average Main Effect (per A\$ income)</i>
y1	Total income from employees in household	1.0137
y2	Total income from self-employed in household	0.8781
y3	Total other income in household	1.1701

*Note:* Coefficients on y1, y2 and y3 are statistically different from each other at the one per cent level.

Comparing this with the earlier table we see that on average the demographic factor is a little less than one.

The model above is simplistic and so in the next table we compare the main effects for the occupational classification we introduced earlier. Our particular interest is in the two trades with the greatest proportion of self-employed: the construction trades and the skilled agricultural and horticultural groups (although the automotive, electrical and electronic and 'other' trades also have reasonable numbers of self-employed).

The earlier model is expanded by partitioning  $y_1$  and  $y_2$  defined above into  $y_{1j}$  and  $y_{2j}$  where  $j$  is one of the 13 areas of occupation defined using the ASCO 1.5 classification defined earlier. The variable  $y_3$  (income from non-workers) and the demographic variables remain as before.

Table 10 - Main Effects for Expenditure

<i>Occupation</i>	<i>Average main employee effect (per A\$ income)</i>	<i>Average main self-employed effect (per A\$ income)</i>	<i>Significance of the difference between employee and self-employed main effects **** (one per cent) *** (five per cent) ** (10 per cent) * (20 per cent)</i>
Managers and administrators	1.0442	0.6667	****
Professional	1.021	0.7952	****
Associate Professional	0.9898	1.1305	*
Mechanical and Fabrication Engineering Tradespersons	0.9899	0.871	
Automotive Tradespersons	0.9564	0.7088	
Electrical and Electronic Tradespersons	0.97	0.9361	
Construction Tradespersons	0.9806	1.0814	
Skilled Agricultural and Production	0.923	1.2087	
Other Tradespersons (Incl. Food)	0.9728	1.3567	*
Clerical and Service	1.1333	0.7648	****
Intermediate and Production Transport	0.904	1.1585	**
Employee Elementary Clerical and Service	1.0714	1.0105	
Labourers and Related	0.8963	1.0674	

*Note:* The main effect for 'other income' is 1.1798.

We see that this more detailed partitioning provides quite a varied picture. We find three of the trades, all with higher than average proportions of self-employed, with main effects that exceed unity: construction, skilled agricultural and horticultural, and other trades with main effects of 1.08, 1.21 and 1.36 respectively (compared to main effects for employees of 0.99, 0.92 and 0.97, respectively). This provides some evidence of these trades under reporting their income, although the differences are not statistically different at conventional levels. However, there are two trades with reasonable proportions of self-employed – automotive and electrical and electronic trades – which have main effects less than unity (0.71 and 0.94, respectively), although it is acknowledged that the sample sizes are quite small (the two trades in question had self-employed samples of 11 and 18 respectively) and therefore the statistical power of the analysis is weak.

If we accept that the differences in the proportion of income that translates to expenditure reflects under reporting of the income of self-employed, we can combine the above results and the earlier income estimates to get an ‘adjusted’ income estimate for the self-employed. We simply take the earlier income ratio and multiply by the ratio of the main effects for the employees to self-employed to give an ‘adjusted ratio’. The results of this exercise are shown for selected trades in the table below.

Table 11 - Income and Income Adjusted for Expenditure Relationship for Selected Trades

<i>ASCO</i>		<i>Employee income relative to self-employed</i>	<i>Employee 'adjusted' income relative to self-employed</i>
44	Construction trades	1.33	1.21
46	Ag and horticultural trades	1.13	0.87
49	Other trades including food	1.52	1.09

While this adjustment does affect the relativities, the conclusion remains that for construction trades and other trades (including food) the employees have higher incomes than the self-employed. Only for the agricultural and horticultural trades is the relativity reversed, and it is worth keeping in mind that this trade is the worst paid of all the trades.

While our initial interpretation of how self-employed income translates into expenditure relates to the extent to which income is understated there is an alternative explanation. The alternative would be to argue that the self-employed are in a position to confound household and business expenditure. For example, it could be the case that the household car is also a business vehicle and thus the household may not fully report automotive expenditure. Of course, there is also the possibility that there is a degree of misreporting of household expenditure – perhaps the self-employed are suspicious of the Australian Bureau of Statistics on the expenditure side as well as on the income side. It is also possible that the self-employed save at different rates to employees and this drives the differences in the relationship between reported income and expenditure.

## 5. Household Wealth

Our final approach to seeing if the self-employed 'do better' than employees is to consider the differences in household wealth between the two groups. As for the expenditure data we observe household wealth rather than individual wealth, and we adopt a similar approach to mapping individuals to households. We also acknowledge that the data refer to a point in time and we have not observed the accumulation process (for example a self-employed person at one point in time may have been an employee in the past or *vice versa*). Thus at the outset we acknowledge that the analysis is simplistic. Nevertheless, we can look at the wealth of those who are at the time of the survey are employees or self-employed.

In the Household Expenditure Survey household wealth is defined as the net worth of the household at the time of the survey i.e. the value of the household assets (financial and non-financial) minus its liabilities.

Household wealth is modelled against counts of persons in each household in each employment category (employees, self-employed income, and those who primarily rely on income from non-employment sources), adjusted for the demographic composition of the household. Thus we are assuming that the demographic factors impact on the three employment status groups in the same way.

That is

$$w = (b_1n_1 + b_2n_2 + b_3n_3) * (1 + c_1f_1 + c_2f_2 + c_3f_3 + c_4f_4 + c_5f_5 + c_6f_6 + c_7f_7 + c_8f_8 + c_9f_9)$$

where  $w$  is the wealth for the household,

$n_1$  is the number of persons in the household that are employees,

$n_2$  is the number of persons in the household that are self-employed,

$n_3$  is number of persons in the household that have other sources of income,

$f_1..f_9$  are as defined in the expenditure analysis (age categories for the number of dependent children and number of adults 15+ in the household),

$b_1..b_3$  and  $c_1..c_9$  are the parameters to be estimated.

The coefficients for this simple model are shown in table 12.

Table 12 - Simple Wealth Model

	Coef	SE
Number of employees	304,612	15,939
Number of self-employed	409,384	26,053
Number who rely on other income	162,034	10,537
No. of children 0-4	0.091	0.033
No. of children 5-14	0.025	0.021
No. of children 15+	0.098	0.026
No. of adults <25	-0.273	0.018
No. of adults 25-34	-0.328	0.019
No. of adults 35-44	-0.136	0.025
No. of adults 45-54	0.053	0.029
No. of adults 55-64	0.307	0.041
No. of adults <65+	0.389	0.054
No. of observations	6,845	
Adjusted R squared	0.128	

Table 13 - Main Effects for Wealth of Employees and Employed Persons

<i>Description</i>	<i>Average main effect for employees (A\$ per person)</i>	<i>Average main effect for self-employed (A\$ per person)</i>	<i>Ratio of main self-employee to self-employed wealth</i>	<i>Significance of the difference between employee and self-employed main effects *** (five per cent) ** (10 per cent) * (20 per cent)</i>
# of Managers and Administrators in household	785,064	684,848	1.15	***
# of Professionals in household	376,236	472,172	0.80	**
# of Associate Professionals in household	384,946	417,534	0.92	
# of Mechanical and Fabrication Engineering Tradespersons in household	89,496	43,239	2.07	
# of Automotive Tradespersons in household	163,240	219,972	0.74	
# of Electrical and Electronic Tradespersons in household	237,459	224,879	1.06	
# of Construction Tradespersons in household	182,363	137,596	1.33	
# of Skilled Agricultural and Production workers in household	152,852	119,829	1.28	
# of Other Tradespersons (incl. Food) in household	268,780	207,833	1.29	
# of Clerical and Service workers in household	245,157	300,289	0.82	
# of Intermediate and Production Transport workers in household	117,448	126,419	0.93	
# of Elementary Clerical and Service workers in household	150,129	290,645	0.52	*
# of Labourers and Related workers in household	62,474	207,292	0.30	**

*Note:* The main effect for other income earners in the household is \$168,749.

Thus, for a 'demographically neutral' household, each employee contributes \$304,612 to household wealth, each self-employed person \$409,385 and each person relying on other income \$162,034. In terms of the demographics, households with children are somewhat wealthier than other households (for example, 9.1 per cent wealthier if the household has one child 0-4 years relative to a demographically neutral household) but not as wealthy as households with adults over the age of 55 years. Households made up of younger adults tend to be poorer. These results, of course, reflect household and wealth formation over the life cycle.

However, the most interesting figure to emerge from the point of view of this paper is that the self-employed tend to be considerably wealthier than employees, although there may well be an interaction with age that is influencing this finding.

As in the expenditure model we now partition the first part of the above model by occupation. That is, separate variables are entered for the number of employees (and self-employed) within each occupation.

In order to abstract from the demographics we present the results of this model evaluated for 'an average' household in respect of the demographics (table 13).

We see quite a deal of variation in the average wealth of employees and self-employed across occupational groups. The self-employed are wealthier among labourers, clerical and service workers, professionals and associate professionals (and these differences are statistically significant). Our main interest, though, is the trades and in this occupational group it is employees who are wealthier than the self-employed except for those in automotive. However, the sample sizes are such that the differences are not statistically significant at conventional levels, so not much can be concluded from this. We also see that the levels of wealth on average of those in the trade are modest compared to those of most other occupational groups. In particular, those employed as managers and administrators, professionals and associate professionals have accumulated considerably higher levels of wealth than those in the trades.

## 6. Concluding Comments

The motivation behind this paper was to examine the idea that incomes of employees in the trades give a false picture of the rewards from undertaking a trade compared in particular with those undertaking higher education. We did this by looking at the relationship between income, household expenditure and household wealth for both those who are employees and those who are self-employed. We acknowledge that there are limitations to the analysis in terms of sample sizes (self-employment is quite unusual in most occupations) and the relationship between demographics and expenditure or wealth and whether an individual is self-employed or an employee. We have treated employee/self-employed status as an exogenous variable; modelling why people are self-employed is beyond this paper and the data sets which it uses.

Nevertheless, there is no evidence to suggest that a comparison of employee income of those in the trades with, say, those in professional or associate professional occupations, gives a false impression of rewards associated with the trades. Adjusting the reported income of those who are self-employed in the trades by considering their expenditure makes little difference, and looking at levels of wealth does not change the picture either.

In drawing this conclusion, we note that self-employment is not very common (10 per cent overall among full-time workers) except in a couple of trades, notably construction (47 per cent of full-time workers in the sample) and agriculture and horticulture (25 per cent). In the former, employees earn more than the self-employed, have higher levels of expenditure, and have greater levels of wealth. In the latter, employees earn more than the self-employed and greater levels of wealth but lower levels of expenditure. However, the trades in agriculture and horticulture are among the most poorly paid trades, and the sample size is not large.

If we accept this analysis then how do we rationalise the common perception that there are a lot of wealthy tradespersons, particularly in the construction industry? There are a couple of possible explanations. First, no doubt there are some very successful and wealthy tradespersons but perhaps these represent a long tail in the distribution, and that the average self-employed tradesperson is a long way from these outliers. It is also possible that tradespersons display their material wealth in a way that catches the eye compared to other groups.

Is our conclusion surprising? Not really. It seems to be the case that for many people self-employment is an outcome rather than a choice. If the self-employed person could get an appropriate employee job then they may well do so. Certainly, Buchanan and Allan (2000) examined the expansion in contractors in the construction industry and pointed to 'dependent contractors' as being the major source of growth and argued that the growth has been driven by taxation arrangements to a large extent. They also point out that there is an imprecise distinction between employee and contractor forms of employment. In respect of our analysis, there is a possible implication that the self-employed would do a little better compared to employees if we considered taxation arrangements as well as reported income. On the other hand, our modelling of the relationship between expenditure and income must account for this to some extent.

In conclusion, no doubt some in the trades have very remunerative careers, but it does seem to be the case that on average those who get into a professional or associate professional occupation have higher financial rewards. This conclusion is very apparent from employee income data, but our examination of the self-employed in the trades does not alter that conclusion.

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# Modelling the Relationships Between the Use of STEM\* Skills, Collaboration, R&D, and Innovation among Australian Businesses

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## Abstract

*This paper investigates the relationship between the use of STEM/Non-STEM skills, collaboration, R&D and innovation, including novelty of innovation, among Australian businesses. The analysis employs standard probit modelling using the 2010-11 and 2011-12 ABS Business Characteristics Survey data. Results show that the use of STEM skills and collaboration in R&D are very strongly associated with an increase in the likelihood of innovating. The combined impact of collaboration in R&D, expenditure in R&D, and the use of STEM skills on the probability of having a 'new to the world' type of innovation is also found to be strong.*

Keywords: Skills, Collaboration, R&D, Innovation, Australia.

JEL Classification: O32, O31, J24, D29

## 1. Introduction

There is growing recognition of the importance of human capital in shaping Australia's future prosperity. A recent report for the Australian Council of Learned Academies argued that building capacity particularly in the fields of science, technology, engineering and mathematics (STEM) is pivotal to competitiveness in the global economy (Marginson, *et al.* 2013). Another study showed that an increase in the proportion of workers in skilled occupations is followed by an increase in labour

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productivity, and organisation of human capital was important in determining labour productivity (Connolly, *et al.* 2012).

A firm's competitiveness is attributed to R&D, innovation and collaborative efforts between firms. In Australia, however, not many studies have looked into the relationship between these and STEM employment. But in the U.S., Lieponen (2005) examined the complementarity between employees' skills and firms' innovation activities and found that high technical skills are complementary with R&D collaboration and product or process innovation and that human capital are seen as an enabling factor in profitable innovation. The study however did not specifically separate STEM skills.

The ABS has investigated several related topics in the past, such as skills shortages, information and communication technology (ICT), flexible working arrangements, government assistance, innovation and productivity, but none of these specifically looked at the effects of STEM skills and STEM employment (see, Wong, *et al.* 2007; Brunker and O-Fischer, 2008; ABS, 2008; Todhunter and Abello, 2011; Rotaru, Dzhumasheva and Soriano, 2013; and Rotaru, 2013).

This paper investigates the relationship between the use of STEM/Non-STEM skills, collaboration, R&D and innovation, including novelty of innovation, among Australian businesses. Specifically, it examines the association of the following factors: business size, industry, collaboration on R&D, foreign ownership, market competition, skills shortage, working arrangement, government assistance and ICT intensity, on the likelihood of the business innovating if it is using STEM or Non-STEM skills. The impact of having R&D and collaboration on the probability of achieving a specified highest degree of novelty between businesses using STEM or Non-STEM skills is also assessed.

Firm level data from the Australian Bureau of Statistics' annual Business Characteristics Survey (BCS) are used in the analysis. The study applies probit regression modelling on the 2010-11 to 2011-12 waves of the BCS.

### ***Conceptual Framework and Definitions***

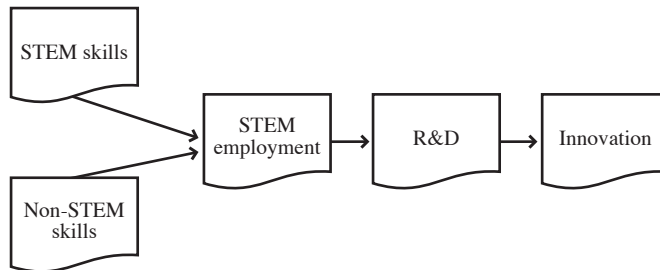
Innovation is a primary driver of a nation's economic growth. As Australia continues to compete in the global economy, Australian businesses need to be innovative to increase performance (DIISR, 2009). The association between innovation and economic growth is particularly important in an economy which is subject to binding constraints on the rate of growth of its primary inputs. In the current economic environment, Australia is experiencing an increasing incidence of such constraints particularly in relation to skilled labour markets (ABS, 2008).

An educated and skilled workforce is essential for successful innovation. Under normal circumstances, innovation increases productivity and creates prosperity. However, in reality in many cases, the link between innovation and productivity is convoluted and it may take many years for innovations to increase productivity. The relationship between skills and innovation in the long term, cycles. The skills of the workforce and management determine the innovation that takes place, which then help determine the demand for skills in a business, which then influence the innovation and so on (Tether, *et al.* 2005).

Research and experimental development work leads to innovation. Van Zon's (2001) model had demonstrated the link between skills and innovation through R&D. People with STEM capabilities (skills, knowledge and ways of thinking) are employed to drive R&D work. STEM capabilities come primarily from those with formal STEM qualifications, although some people employed in occupations requiring STEM skills may have non-STEM fields as their qualification. The literature review of Stanwick (2011) discussed the kind of skills which contribute to innovation. The latter also concluded that a good educational foundation is the key to promoting successful innovative practice.

Figure 1 below illustrates the relationships between the use of skilled workers, R&D and innovation.

Figure 1 - Conceptual framework for the analysis of STEM, R&D, and Innovation



Skills are typically acquired from formal education, general life experience and learning on the job. However, when policy makers talk about 'skills' they generally are referring to the skills obtained from formal education. Often qualifications and education levels are used as proxy for skills, for the simple reason that they can be quantified (Karmel, 2012).

**STEM** qualifications are defined according to the *Australian Standard Classification of Education, 2001*, as those of Postgraduate degree level, Master degree level, Graduate diploma and Graduate certificate level, Bachelor degree level, Advanced diploma level, and Certificates II and IV levels – in any of the fields below:

- Natural and Physical Sciences (NPS) (including Mathematical Sciences)
- Information Technology (IT)
- Engineering and Related Technologies (ERT)
- Agricultural, Environmental and Related Studies (AERS)

However, for this study, **STEM** skills variables have been constructed based on the type of skills used by a business as reported in the BCS. A business is considered to have used STEM skills if it reported using any of the following skills: Engineering, Scientific and Research, IT professionals, and IT support technicians. These are based on subjective responses by businesses to the BCS question about the types of skills used in undertaking core business activities.

**Research and experimental development (R&D)** comprises creative work undertaken on a systematic basis in order to increase the stock of knowledge, including knowledge of people, culture and society, and the use of this stock of knowledge to devise new applications. R&D contains an appreciable element of novelty and scientific or technological uncertainty, or risk, to overcome.

The R&D performed by business is investigative work that has actual or potential use in the development of new or enhanced materials, products, devices, processes, systems or services (see OECD, 2002, pp. 30-48 for the complete definition and convention of R&D).

In the current investigation, two R&D variables have been constructed and used in the modelling. The first one is business involvement in co-operative arrangements in joint research and development (i.e., collaboration in R&D). To collaborate is to participate in joint projects with other businesses or organisations (including wider parts of the business' enterprise group). The second R&D variable (i.e., expenditure on R&D) is used in the modelling of innovation novelty. This variable indicates whether or not innovating businesses have invested in research and experimental development.

The definition of **innovation** follows the Oslo Manual as '*...the implementation of a new and significantly improved product (good or service); or process, a new marketing method, or a new organisational method in business practices, workplace organisation or external relations.*' (OECD, 2005, p.46)

A business is called 'innovation-active' if it engaged in any innovation activities that were implemented, ongoing or abandoned during a period. A business is called an 'innovator' if it successfully developed and implemented an innovation, which may have taken many years to complete. The current investigation is conducted for 'innovation-active' businesses.

Four types of innovation are covered in the analysis: product innovation, process innovation, organisational or managerial innovation, and marketing innovation (see OECD, 2005, pp. 48-53 for the full description of the different types of innovation). Note that a business could do more than one type of innovation.

It is important to note that many of the key variables used in this study are 'self-reported' rather than objectively measured. That is, a degree of subjective judgement on the part of the business respondent is inherent in the BCS data; for example, questions relating to the highest degree of innovation novelty (new to the world, new to Australia, new to the industry or new to the business). In such cases, the modelled outcomes should be properly interpreted as relating to the predicted likelihood of certain outcomes.

Appendix A1 gives more definitions, including those of the variables used in the models.

## 2. Data

The analysis used data from the ABS Business Characteristics Survey which has detailed information on the types of skills used in the business, business demographics, innovation activity, ICT usage, R&D expenditure, innovation novelty, and many other variables relevant to the analysis. The study utilised firm level data for Australian businesses covered by the 2010-11 to 2011-12 waves of the BCS. The data is based

on the ANZSIC 2006 classification of industry. For each wave of the BCS, a unique sample was constructed from the responses of the small, medium-sized, large and complex businesses. (See ABS (2013b) for more information about the survey.)

### 3. Methodology

The analysis used standard probit modelling (see Wooldridge, 2010) to help answer the research questions above. A number of models have been estimated—three were binary probit models and three were ordered probit models. A model was run to establish the relationship between the use of STEM/Non-STEM skills, R&D and the degree of novelty of innovation among Australian innovating businesses. Weights were not used in the modelling as the variables used in the sample stratification design (i.e., industry and employment-based size) were already included as explanatory variables.

The study also examined the impact of the use of STEM/Non-STEM skills on business innovation and on the probability of achieving a specified highest degree of novelty. The marginal effects (or predicted probabilities) were also computed.

All modelling procedures were executed using SAS and STATA 12. Appendix A2 shows the details of the regression models.

### 4. Results

#### *Cross-tabulations*

The BCS covers four broad types of innovation (goods or services, operational processes, organisational/managerial processes, and marketing methods) across three innovation statuses (introduced, still in development, and abandoned). Businesses were asked to indicate if they had introduced any new or significantly improved type of innovation during the reference period (i.e., year ending 30 June 2011 for 2010-11 and year ending 30 June 2012 for 2011-12). Businesses could report multiple types of innovation and/or multiple innovation statuses. In the BCS, all businesses were also asked to report the types of skills used in undertaking their core business activities during the reference period. Again, businesses could report multiple types of skills used.

Table 1 presents the proportion of Australian businesses that engaged in any innovation activities by skills used in the two reference years. The table also shows the estimated proportion for innovation active businesses, i.e., those that undertook any innovative activity irrespective of whether the innovation was introduced, still in development or abandoned. Readers may again refer to appendix A1 for the full description of the five categories of skills used in the table.

Table 1 - Proportion of Innovating and Non-Innovating Businesses using STEM and Other Skills, 2010-11 and 2011-12

Skills used	Estimated number of businesses '000 (A)	Businesses that introduced any new or significantly improved goods or services (B)		Businesses that introduced any new or significantly improved organisational/managerial processes (C)		Businesses that introduced any new or significantly improved marketing methods (D)		Businesses with innovative activity which was abandoned or still in development (F)		Businesses with any innovative activity (innovation-active businesses) (G)		Businesses that did not have any innovative activity (non-innovation-active businesses) (H)	
		%	%	%	%	%	%	%	%	%	%	%	%
2011-12													
STEM and Non-STEM skills	224	29.1	31.9	37.4	31.8	44.9	66.7	33.3					
STEM skills only	44	26.7	21.0	23.9	22.2	32.8	52.3	47.7					
Other Non-STEM skills only	387	16.9	13.6	17.2	14.6	19.0	37.5	62.5					
Trades and other Non-STEM skills	47	17.7	18.6	21.5	21.4	30.0	49.4	50.6					
Trade skills only	74	10.6	8.5	10.9	9.4	12.1	28.3	71.7					
TOTAL	776	20.4	19.1	23.0	19.9	27.3	46.6	53.4					
2010-11													
STEM and Non-STEM skills	202	28.0	28.7	33.0	28.1	36.6	60.0	40.1					
STEM skills only	50	23.4	19.2	20.0	15.8	24.9	45.5	54.5					
Other Non-STEM skills only	397	12.9	11.0	12.5	12.6	15.6	29.8	70.2					
Trades and other Non-STEM skills	50	11.1	13.1	17.3	12.2	23.6	35.8	64.2					
Trade skills only	65	10.4	11.4	14.2	11.6	9.6	28.8	71.2					
TOTAL	764	17.3	16.4	18.9	16.8	21.8	39.1	61.0					

Note: Column A contains the estimated number of Australian businesses by skills used, and is the denominator used in calculating the proportions in columns B to H. Columns B to E contain the proportion of businesses that introduced a particular type of innovation by skills used. Column F contains the proportion of businesses with any innovative activity which was abandoned or still in development by skills used. Columns G and H contain the percentage frequency distributions for innovation-active and non-innovation-active businesses in each skills used category. Column G plus column H equals 100%.

### ***Skills used and innovation-active businesses***

From table 1, we observed that the proportion of businesses that were innovation-active in 2011-12 was 66.7 per cent, a significant increase of 6.7 percentage points from the previous year. For businesses that indicated using Trade skills only, and Other non-STEM skills only, the estimated proportion of non-innovation-active businesses was significantly higher than the proportion of innovation-active businesses (in both years).

### ***Skills used and different types of innovation***

Businesses that used a combination of STEM and Non-STEM skills were significantly more likely to engage in any one of the three broad types of innovation than other businesses. There was no significant difference between businesses using STEM skills only and STEM and Non-STEM skills in terms of the proportion engaged in goods and services innovation in 2011-12. In addition, businesses using the said skills categories were significantly more likely to engage in this type of innovation than other businesses. Businesses that reported using STEM and Non-STEM skills were significantly more likely than other businesses to have abandoned or still be in the development process of innovation activities.

### ***Modelling and Impact Analysis***

Below are the selected key findings coming from the different models. The regression modelling outputs are in appendix A3.

For the purpose of this paper, all calculated marginal effects are with reference to a firm that is small in size, has moderate ICT intensity, no skill shortage within business, no skill shortage within labour market, no effective competition, 100 per cent Australian owned, no flexible working arrangements, and received no government assistance.

### ***STEM skills and innovation***

The use of STEM skills is strongly associated with the likelihood of innovation. The predicted probability of being an innovator rises from 24.1 per cent for a non-STEM skills user to 38.3 per cent for a STEM skills user in 2011-12.

### ***Other factors associated with innovating businesses***

Also positively and significantly associated with innovation are higher ICT intensity, having minimal to strong degree of market competition, having flexible working arrangements, having >0 per cent to 50 per cent foreign ownership, lacking skilled staff, and receiving government financial assistance.

### ***Cooperative arrangements or collaboration in R&D***

Having cooperative arrangements or collaboration in R&D is also found to be strongly associated with innovation. The combined impact of collaboration in R&D and use of STEM skills on the likelihood of innovation is very strong. Collaborating businesses which use STEM skills have a 48.3 per cent (in 2010-11) and 53.0 per cent (in 2011-12) chances of innovating. A business which does not engage in any cooperative

arrangement in R&D as well as not using any STEM skills has lower chances of innovating (i.e., 19.2 per cent in 2010-11 and 22.9 per cent in 2011-12).

### ***Business size***

Where results are significant, business size is strongly associated with an increase in the predicted probability of innovation if the business uses STEM skills. In addition, generally for all business sizes, the model predicts that a reference firm in the Manufacturing industry that collaborates has more chances of innovating than a firm that does not engage in collaboration. Specifically, for 2011-12, the model predicts that a micro (1-4 employees) business has a 56.8 per cent chance of innovating if it uses STEM skills, compared with 60.5 per cent for small (5-19 employees), 57.9 per cent for medium (20-199 employees), and 52.7 for large (200+ employees) businesses.

### ***Use of STEM skills across industries***

The probability of innovation is relatively higher for a business that uses STEM skills compared with a business that does not use STEM skills, in all of the industries. Relative to the manufacturing industry, financial and insurance services (in 2010-11 only), businesses in retail trade and wholesale trade industries have relatively higher likelihood of innovation.

### ***Types of innovation***

The use of STEM skills and collaboration in R&D are strongly associated with higher likelihood of innovating in all types of innovation. In 2011-12, for goods and services innovation, collaborating businesses which use STEM skills have 32.1 per cent probability of innovating compared with 22.3 per cent for businesses that do not use STEM skills. For operational processes innovation, collaborating businesses which use STEM skills have 25.9 per cent likelihood of innovating compared with 15.8 per cent for businesses that do not use STEM skills. For organisational/managerial processes innovation, collaborating businesses that use STEM skills have 31.8 per cent likelihood of innovation compared with 20.4 per cent for businesses not using STEM skills. For marketing methods innovation, collaborating businesses that use STEM skills have a 15.6 per cent likelihood of innovation compared with 9.5 per cent for businesses not using STEM skills. The results were similar for 2010-11.

### ***Degree of novelty in innovation***

Innovating businesses that use STEM skills are significantly more likely to achieve a higher degree of novelty of innovation than innovating businesses that do not use STEM skills. On average, a small non-collaborating Australian-owned innovating business in manufacturing that is not engaged in R&D, but is using STEM skills, is 63.6 per cent more likely to achieve a highest degree of novelty of 'new to the world' than a firm not using STEM skills; or 39.5 per cent more likely to achieve a highest degree of novelty of 'new to Australia' than a firm not using STEM skills.

Having expenditure in R&D is significantly associated with an increase in the predicted probability of achieving a 'new to the world' innovation. The model

predicts that a small non-collaborating Australian owned innovating business in the Manufacturing industry that is investing in R&D has an 11.2 per cent probability of having a 'new to the world' innovation, compared with 3.6 per cent for a similar business that is not engaged in R&D.

Having cooperative arrangements in R&D is associated with statistically significant but relatively modest increases in the probability of higher degrees of innovation novelty among innovating businesses. This probability is higher if the business uses STEM skills. Innovating businesses having collaboration in R&D, expenditure in R&D, and using STEM skills are 15 per cent more likely to achieve 'new to the world' innovation, compared with 10.7 per cent for similar businesses that do not use STEM skills.

## 5. Conclusion

This paper investigated the relationship between the use of STEM/Non-STEM skills, collaboration, R&D and innovation among Australian businesses. It explored the association between use of skills and innovation for each type of innovation (i.e., goods and services, operational processes, organisational/managerial processes, marketing methods). It also examined the relationship between the degree of novelty of innovation achieved by innovating Australian businesses, whether they are using STEM skills or not. Other relevant business characteristics such as business size, industry of operation, skill shortages, degree of market competition, degree of foreign ownership, ICT intensity, flexible working arrangements, and government financial assistance were also taken into account alongside collaboration and R&D.

The data available from the ABS BCS have proven to be adequate to model the above relationships using standard probit modelling procedures.

The probit regression models found that the use of STEM skills and collaboration in R&D are very strongly associated with an increase in the likelihood of being an innovating business. In most cases, the following variables: ICT intensity, market competition, lacking skilled staff, flexible working arrangements and government financial assistance are found to be significantly associated with a higher likelihood of being an innovator. The predicted probability for achieving a highest degree of innovation novelty is higher for an innovating business which is using STEM skills and has invested in R&D than for an innovating business not using STEM skills and has not invested in R&D.

Possible future work that would further enhance the current investigation is to consider labour productivity and link it with innovation and use of STEM/Non-STEM skills. The Australian Bureau of Statistics is currently in the process of creating an 'Expanded Analytical Business Longitudinal Database (EABLD)' that could provide a rich data source for micro level labour productivity analysis and panel data modelling.

## Appendices

### ***A1 Definitions of Variables***

This section describes the compilation of the variables used in the analysis.

#### ***Innovation***

The scope of innovative activity, as measured by the BCS, follows the Oslo Manual (OECD, 2005) and covers four broad types of innovation:

- *Goods or services* – Any good or service or combination of these which is new to a business (or significantly improved). Its characteristics or intended uses differ significantly from those previously produced/offered.
- *Operational processes* – New or significantly improved methods of producing or delivering goods or services of a business (including significant change in techniques, equipment and/or software).
- *Organisational/managerial processes* – New or significantly improved strategies, structures or routines of a business which aim to improve performance.
- *Marketing methods* – New or significantly improved design, packaging or sales methods aimed to increase the appeal of goods or services of a business or to enter new markets.

There are three statuses of innovation, namely:

- *Introduced or implemented* – the business successfully introduced or implemented an innovation during the reference period (although the innovation does not need to have been commercially successful);
- *Still in development* – the business was in the process of developing, introducing or implementing an innovation during the reference period but work on the innovation was still in progress at the end of the period; and,
- *Abandoned* – the business abandoned the development and/or introduction of an innovation during the reference period (i.e., work on the innovation ceased without full introduction occurring).

A business is called 'innovation-active' if it engaged in any innovation activities that were implemented, still in development or abandoned during the period. Note that in the BCS, businesses could report more than one type of innovation.

The BCS also asked the degree of novelty of innovation achieved by innovating Australian businesses. The degree of novelty are categorised as:

- Innovation is new to the world;
- Innovation is new to Australia but not new to the world;
- Innovation is new to the industry within Australia but not new to the world or Australia; and,
- Innovation is new to the business only. The table below describes the different innovation (dependent) variables used for modelling.

<i>Description</i>	<i>Range of Values</i>
Innovation (binary) Firm engaged/not engaged in any types of innovation (i.e., overall measure of innovation)	0/1 dummy
Innovation (binary) – for particular type of innovation Firm engaged/not engaged in this type of innovation, say <ul style="list-style-type: none"> <li>• Goods and services</li> <li>• Operational processes</li> <li>• Organisational/Managerial processes</li> <li>• Marketing methods</li> </ul>	0/1 dummy
Innovation Diversity (categorical) <ul style="list-style-type: none"> <li>• No innovation activity at all</li> <li>• Exactly 1 type of innovation</li> <li>• Exactly 2 types of innovation</li> <li>• Exactly 3 types of innovation</li> <li>• Exactly 4 types of innovation</li> </ul>	0 to 4
Innovation Novelty (categorical) <ul style="list-style-type: none"> <li>• Innovation is new to the world</li> <li>• Innovation is new to Australia but not new to the world</li> <li>• Innovation is new to the industry within Australia but not new to the world or Australia</li> <li>• Innovation is new to the business only</li> </ul>	3 to 0

### ***STEM Skills***

Two forms of STEM/Non-STEM skills variables have been constructed, a binary and a categorical. The categorical variable was designed to refine and capture the association of the use the different types of skills (e.g., STEM; Non-STEM; Trade; and Other Non-STEM) on business innovation.

<i>Description</i>	<i>Range of Values</i>
STEM Skills (binary) Firm used/not used any of the following types of STEM skills <ul style="list-style-type: none"> <li>• Engineering</li> <li>• Scientific and Research</li> <li>• IT professionals</li> <li>• IT support technicians</li> </ul>	0/1 dummy
STEM/Non-STEM Skills (categorical) <ul style="list-style-type: none"> <li>• Firm did use any STEM skills and Non-STEM skills (i.e., Trade or Other Non-STEM – Transport, plant and machinery operation; Marketing; Project management; Business management; and Financial)</li> <li>• Firm did use STEM skills only</li> <li>• Firm did use Trade skills only</li> <li>• Firm did use Trade and Other Non-STEM skills only</li> <li>• Firm did use Other Non-STEM skills only</li> </ul>	0/1 dummy (each category)

***Collaboration and R&D***

The following collaboration and R&D indicators were also compiled.

<i>Description</i>	<i>Range of Values</i>
Collaboration in R&D (binary) Business was involved in co-operative arrangement for joint research and development (R&D)	0/1 dummy
Expenditure on R&D (binary) Business reported having expenditure on research and experimental development either acquired from other firms or performed by the businesses itself, for innovation	0/1 dummy

***Selected key business characteristics***

The other key business characteristics employed in the modelling are described below. The selection of the key business characteristics has been mainly based on the two recent research publications of ABS on innovation. See Rotaru (2013); and Rotaru, *et al.* (2013) for more information about the justification for their selection. Skill shortage indicators have been added following the ABS (2008) paper submission to the Innovation Review.

<i>Description</i>	<i>Range of Values</i>
Number of employees (business size) • 1-4 Employees • 5-19 Employees • 20-199 Employees • 200+ Employees	0/1 dummy (each category)
Degree of competition in the market • No effective competition (0 competitor) • Minimal (1-2 competitors) • Moderate to strong (3 or more competitors)	0/1 dummy (each category)
Degree of foreign ownership • 100 per cent Australian owned • > 0 per cent to 50 per cent foreign owned • > 50 per cent foreign owned	0/1 dummy (each category)
Industry division (ANZSIC2006) • Agriculture, Forestry and Fishing • Mining • Manufacturing • Electricity, water, gas and waste services • Construction • Wholesale • Retail Trade • Accommodation and food service • Transport, postal and warehousing • Information, media and telecommunications • Financial and insurance services • Rental, hiring and real estate services • Professional, scientific and technical services • Administrative and support services	0/1 dummy (each category)

<i>Description</i>	<i>Range of Values</i>
<ul style="list-style-type: none"> <li>• Health care and social assistance</li> <li>• Arts and recreation services</li> <li>• Other services</li> </ul>	
ICT intensity <ul style="list-style-type: none"> <li>• Most intense <i>Business had broadband connection, web presence, and places or receives orders via the internet or web</i></li> <li>• High <i>Business had broadband connection, web presence, but does not receive orders via the internet or web</i></li> <li>• Moderate <i>Business had broadband connection, but has no web presence</i></li> <li>• Low <i>Business does not use broadband connection</i></li> </ul>	0/1 dummy (each category)
Flexible Working Arrangement (binary) Firm offered the following working arrangements to their employees: <ul style="list-style-type: none"> <li>• Flexible working hours</li> <li>• Flexible leave</li> <li>• Job sharing</li> <li>• Working from home</li> </ul>	0/1 dummy
Government financial assistance (binary) Firm received/not received any form of assistance (i.e., grants, on-going funding; tax concession; subsidies; rebates; and other government financial assistance)	0/1 dummy
Skills shortage (binary) <ul style="list-style-type: none"> <li>• Firm reported that lack of skilled persons within the business significantly hampers their innovation</li> <li>• Firm reported that lack of skilled persons within the labour market significantly hampers their innovation</li> </ul>	0/1 dummy (each)

## **A2 Methodology**

The following methodological approaches have been used to answer the research questions.

### ***Probit regression***

To address the research question:

- *What is the relationship between the use of STEM/Non-STEM skills, collaboration in R&D and innovation among Australian businesses?*

Five models (i.e., Models 1-5) have been specified and estimated using the standard probit modelling procedure.

### ***Model 1. Binary probit with binary STEM skill***

The first model is given by

*Innovation = Binary Probit (STEM skills,  $X_2$ )*

where:

*Innovation* – Binary variable taking the value 1 if the business was innovative and 0 otherwise

*STEM skills* – Binary

$X_2$  stands for the vector of other variables included in the model. These variables included the following:

- Business size
- Industry of operation
- Cooperative R&D
- Market Competition
- Foreign Ownership
- Flexible Working Arrangement
- Government Financial Assistance
- ICT intensity
- Skill shortage.

Note that in order to specify the binary probit model we can follow the traditional approach of using the latent variable  $y_i^*$  to determine the binary variable,  $y_i$ , a binary variable indicating whether a firm innovated (i.e.,  $y_i = 1$ ) or not (i.e.,  $y_i = 0$ ) the latent variable is given by

$$y_i^* = X_{1,i} \beta + \varepsilon_i \quad \forall i = 1, \dots, N$$

where  $\varepsilon_i$  is the random error term (which is assumed to have a standard normal distribution),  $N$  stands for total number of businesses,  $X_{1,i}$  is a  $(1 \times k)$  vector of conditioning variables for business  $i$  (i.e.  $X_2$  including the STEM skills), and  $\beta$  is a vector of parameters corresponding to the  $k$  conditioning variables. However, as  $y_i^*$  is unobserved in practice, we used the observed dichotomous variable  $y_i$  which indicates the sign of the latent variable,  $y_i^*$ . Note that  $y_i$  is given by

$$y_i = \begin{cases} 1, & \text{if } y_i^* > 0 \\ 0, & \text{otherwise.} \end{cases}$$

Following this approach, the binary probit model is specified by

$$P(y_i = 1 | X_i) = P(y_i^* > 0 | X_i) = \Phi(X_i \beta)$$

where  $\Phi(\cdot)$  is the standard normal cumulative distribution function. Note that the values of the parameter vector  $\beta$  were estimated using maximum likelihood estimation (MLE).

### ***Model 2. Binary probit with categorical STEM/Non-STEM skills***

The second model is the same as the first model but with categorical skills variable. The categorical variable is designed to capture the association of the use the other types of skills (i.e. Trade and Non-STEM) on innovation. The skills variable is defined as follows:

- Firm did use any STEM skills and Non-STEM skills (i.e., Trade or Other Non-STEM – Transport, plant and machinery operation; Marketing; Project management; Business management; and Financial)
- Firm did use STEM skills only
- Firm did use Trade skill only
- Firm did use Other Non-STEM skills only
- Firm did use Trade and Other Non-STEM skills only

**Model 3. Binary probit for a particular type of innovation**

The third model is a variation of models 1 and 2 with the dependent variable (i.e., innovation) taking a value of 1 if the firm performed a particular type of innovation (e.g., goods and services) and 0 otherwise. This model is run for each of the four types of innovation with either a binary STEM skills or categorical skills variables.

**Model 4. Ordered probit with binary STEM skills**

The fourth model is an ordered probit given by:

*Innovation = Ordered Probit (STEM skills,  $X_2$ ).*

In this case, all covariates are the same as in Model 1 but Innovation is categorical (or polychotomous) having the following subcategories: no innovation, exactly 1 type of innovation, exactly 2 types of innovation, exactly 3 types of innovation, and exactly four types of innovation.

The derivation of this model is not too different from the previous binary probit model derivation. The difference now consists in the fact that the innovation variable  $y_i$  has five values, 0 if there is no innovation, 1 if the business engaged in exactly one type of innovation, 2 if the business engaged in exactly two types of innovation, 3 if the business engaged in exactly three types of innovation, and 4 if the business engaged in exactly four types of innovation.

By considering the latent variable  $y_i^*$  and the threshold parameters ( $\gamma_1, \gamma_2, \dots, \gamma_4$ ),  $y_i$  can be determined as

$$y_i = \begin{cases} 0, & \text{if } y_i^* \leq \gamma_1 \\ 1, & \text{if } \gamma_1 < y_i^* \leq \gamma_2 \\ 2, & \text{if } \gamma_2 < y_i^* \leq \gamma_3 \\ 3, & \text{if } \gamma_3 < y_i^* \leq \gamma_4 \\ 4, & \text{if } y_i^* > \gamma_4 \end{cases}$$

The model is then specified by:

$$P(y_i = 0|X_1) = P(y_i^* \leq \gamma_1 | X_1) = 1 - \Phi(X_{1,i} \beta - \gamma_1)$$

$$P(y_i = 1|X_1) = P(\gamma_1 < y_i^* \leq \gamma_2 | X_1) = \Phi(X_{1,i} \beta - \gamma_1) - \Phi(X_{1,i} \beta - \gamma_2)$$

$$P(y_i = 2|X_1) = P(\gamma_2 < y_i^* \leq \gamma_3 | X_1) = \Phi(X_{1,i} \beta - \gamma_2) - \Phi(X_{1,i} \beta - \gamma_3)$$

$$P(y_i = 3|X_1) = P(\gamma_3 < y_i^* \leq \gamma_4 | X_1) = \Phi(X_{1,i} \beta - \gamma_3) - \Phi(X_{1,i} \beta - \gamma_4)$$

$$P(y_i = 4|X_1) = P(y_i^* > \gamma_4 | X_1) = \Phi(X_{1,i} \beta - \gamma_4)$$

where, as before,  $\Phi(\cdot)$  stands for the standard normal cumulative distribution function. Once again the parameters were estimated using MLE.

**Model 5. Ordered probit with categorical STEM/Non-STEM skills**

The fifth innovation model is the same as the fourth model but with a categorical skills variable. In this case, all covariates are the same as in Model 2. To address the research question:

- *What is the relationship between the use of STEM/Non-STEM skills, collaboration in R&D, R&D expenditure and the degree of novelty of innovation among Australian innovating businesses?*

another model has been specified and estimated again using the standard probit modelling procedure. The model is run for a sample of innovating firms only.

**Model 6. Ordered probit on innovation novelty with binary collaboration**

The sixth innovation model is an ordered probit given by:

*Degree of Innovation Novelty = Ordered Probit (Skills, Collaboration in R&D, Expenditure on R&D,  $X_3$ ).*

where:

Degree of Innovation Novelty is categorical (or polychotomous) having the following subcategories:

- Innovation is new to the business only
- Innovation is new to the industry within Australia but not new to the world or Australia
- Innovation is new to Australia but not new to the world
- Innovation is new to the world

Skills – Either a binary STEM skills or categorical skills variables

$X_3$  stands for the vector of other covariates included in the model. These are:

- Business size
- Industry of operation
- Foreign Ownership.

The estimation procedure for the above model follows that of Model 4.

**Impact Analysis**

The modelling conducted here are all cross-sectional in nature and as such it is not possible to establish the existence or direction of ‘causality’ between the various conditioning (business characteristics) variables and innovation. While there may be broadly or particularly prior views in relation to causality, the current analysis can establish only statistical association between the conditioning variables and innovation.

However, the impact of using STEM/Non-STEM skills on the likelihood of business innovating can be investigated. Also, the impact of using STEM/Non-STEM skills on the probability of engaging in a particular type of innovation can also be measured. Hence, to complement the interpretation of the regression results, the all-else-equal incremental impacts of selected conditioning variables are also calculated. These are referred to as ‘marginal’ effects even though the conditioning variables were in almost all cases discrete. For binary variables (e.g., use of STEM skill vs. not use of STEM skill), the ‘marginal’ effect was the increment to the probability arising

from varying the variable from 0 to 1. While for categorical variables, the effect was the increment to the probability from moving from the reference value to the value in question.

The DITR (2006, pp. 32-34; and 2007, p. 40-41) studies provide an illustration of the methodology behind the estimation of this ‘marginal’ effect (i.e. impact on probability).

### A3 Selected Regression Results

Table A1 - Results of the Probit (binary) Model for Innovation with STEM Skills as Binary

<i>Variable</i>	<i>2010-11</i>	<i>2011-12</i>
Intercept	-0.548 ***	-0.081
STEM skills		
<i>Not used STEM skills</i>		
Used STEM skills	0.440 ***	0.405 ***
Skills shortage within business hampering innovation		
<i>No skills shortage</i>		
Have skills shortage	0.316 ***	0.368 ***
Skills shortage within labour market hampering innovation		
<i>No skills shortage</i>		
Have skills shortage	0.147 ***	0.296 ***
ICT Intensity		
<i>ICT_intensity=1 (Most intense)</i>		
ICT_intensity=2 (High)	-0.318 ***	-0.372 ***
ICT_intensity=3 (Moderate)	-0.666 ***	-0.741 ***
ICT_intensity=4 (Low)	-0.824 ***	-1.055 ***
Number of employees		
1-4 employees	-0.101 **	-0.095
5-19 employees		
20-199 employees	-0.010	-0.067
200+ employees	-0.122 **	-0.197 ***
Market competition		
<i>No effective competition</i>		
Minimal	0.333 ***	0.310 ***
Moderate to strong	0.367 ***	0.281 ***
Foreign ownership		
100% Australian owned		
Foreign ownership > 0% to 50%	0.226 **	0.236 **
Foreign ownership > 50%	0.056	0.047
Collaboration in R&D		
Joint R&D (co-operative) agreement	0.387 ***	0.413 ***
<i>No joint R&amp;D (co-operative) agreement</i>		
Flexible Working Arrangement		
Have flexible working arrangements	0.378 ***	0.296 ***
<i>No flexible working arrangement</i>		
Government financial assistance		
Received government assistance	0.152 ***	0.189 ***
<i>Not received government assistance</i>		
Industry		
<i>Manufacturing</i>		
Accommodation and food services	-0.067	-0.205 **
Administrative and support services	-0.105	-0.103
Agriculture, forestry and fishing	-0.048	-0.212 *

Table A1 - Results of the Probit (binary) Model for Innovation with STEM Skills as Binary (continued)

<i>Variable</i>	<i>2010-11</i>	<i>2011-12</i>
Arts and recreation services	-0.042	-0.020
Construction	-0.181 **	-0.267 ***
Electricity, water, gas and waste services	0.051	-0.152
Financial and insurance services	0.167 *	-0.140
Health care and social assistance	-0.023	-0.079
Information, media and telecommunications	0.035	-0.079
Mining	-0.471 ***	-0.408 ***
Other services	0.028	-0.141
Professional, scientific and technical services	-0.087	-0.234 ***
Rental, hiring and real estate services	-0.183 **	-0.185
Retail Trade	0.192 **	0.062
Transport, postal and warehousing	-0.229 ***	-0.216 **
Wholesale trade	0.106	0.010
Number of observations (n)	7548	5554
AIC	8765.5	6219.3
Log Likelihood	-4349.7	-3076.6

*Note:* \*\*\*, \*\* and \* denote significance at the 1%, 5% and 10% levels, respectively.

Table A2 - Results of the Probit (binary) Model for Innovation with STEM/ Non-STEM Skills as Categorical

<i>Variable</i>	<i>2010-11</i>	<i>2011-12</i>
Intercept	-0.558 ***	-0.074
STEM skills		
<i>Other Non-STEM skills only</i>		
STEM and Non-STEM skills	0.470 ***	0.430 ***
STEM skills only	0.354 ***	0.229 **
Trade skills only	0.030	-0.123
Trade and other Non-STEM skills only	0.105	0.129
Skills shortage within business hampering innovation		
<i>No skills shortage</i>		
Have skills shortage	0.314 ***	0.366 ***
Skills shortage within labour market hampering innovation		
<i>No skills shortage</i>		
Have skills shortage	0.141 ***	0.293 ***
ICT Intensity		
<i>ICT_intensity=1 (Most intense)</i>		
ICT_intensity=2 (High)	-0.316 ***	-0.367 ***
ICT_intensity=3 (Moderate)	-0.666 ***	-0.733 ***
ICT_intensity=4 (Low)	-0.822 ***	-1.051 ***
Number of employees		
1-4 employees	-0.099 **	-0.095
5-19 employees		
20-199 employees	-0.013	-0.073
200+ employees	-0.131 **	-0.212 ***
Market competition		
<i>No effective competition</i>		
Minimal	0.331 ***	0.304 ***
Moderate to strong	0.363 ***	0.276 ***

Table A2 - Results of the Probit (binary) Model for Innovation with STEM/  
Non-STEM Skills as Categorical (continued)

<i>Variable</i>	<i>2010-11</i>	<i>2011-12</i>
Foreign ownership		
<i>100% Australian owned</i>		
Foreign ownership > 0% to 50%	0.227 **	0.238 **
Foreign ownership > 50%	0.058	0.045
Collaboration in R&D		
Joint R&D (co-operative) agreement	0.385 ***	0.409 ***
<i>No joint R&amp;D (co-operative) agreement</i>		
Flexible Working Arrangement		
Have flexible working arrangements	0.373 ***	0.292 ***
<i>No flexible working arrangement</i>		
Government financial assistance		
Received government assistance	0.147 ***	0.186 ***
<i>Not received government assistance</i>		
Industry		
<i>Manufacturing</i>		
Accommodation and food services	-0.062	-0.205 **
Administrative and support services	-0.095	-0.099
Agriculture, forestry and fishing	-0.050	-0.230 *
Arts and recreation services	-0.033	-0.023
Construction	-0.191 **	-0.265 ***
Electricity, water, gas and waste services	0.049	-0.159
Financial and insurance services	0.173 *	-0.143
Health care and social assistance	-0.006	-0.072
Information, media and telecommunications	0.048	-0.062
Mining	-0.472 ***	-0.414 ***
Other services	0.026	-0.127
Professional, scientific and technical services	-0.072	-0.221 **
Rental, hiring and real estate services	-0.177 **	-0.189
Retail Trade	0.199 **	0.058
Transport, postal and warehousing	-0.227 ***	-0.224 **
Wholesale trade	0.112	0.007
Number of observations (n)	7548	5554
AIC	8767.1	6216.8
Log Likelihood	-4347.6	-3072.4

Note: \*\*\*, \*\* and \* denote significance at the 1%, 5% and 10% levels, respectively.

Table A3 - Results of the Probit (binary) Model for the Different Types of Innovation with STEM Skills as Binary

Variable	Goods and Services			Operational Processes			Organisational/Managerial			Marketing Methods		
	2010-11	2011-12	2010-11	2011-12	2010-11	2011-12	2010-11	2011-12	2010-11	2011-12	2010-11	2011-12
Intercept	-0.976 ***	-0.714 ***	-1.008 ***	-0.571 ***	-1.210 ***	-0.816 ***	-1.325 ***	-0.923 ***				
STEM skills												
<i>Not used STEM skills</i>												
Used STEM skills	0.379 ***	0.296 ***	0.383 ***	0.355 ***	0.361 ***	0.354 ***	0.295 ***	0.298 ***				
Skills shortage within business hampering innovation												
<i>No skills shortage</i>												
Have skills shortage	0.202 ***	0.307 ***	0.285 ***	0.300 ***	0.349 ***	0.394 ***	0.287 ***	0.237 ***				
Skills shortage within labour market hampering innovation												
<i>No skills shortage</i>												
Have skills shortage	0.132 ***	0.146 **	0.149 ***	0.239 ***	0.202 ***	0.220 ***	0.140 ***	0.160 **				
ICT Intensity												
<i>ICT_intensity=1 (Most intense)</i>												
ICT_intensity=2 (High)	-0.257 ***	-0.253 ***	-0.272 ***	-0.324 ***	-0.211 ***	-0.247 ***	-0.199 ***	-0.356 ***				
ICT_intensity=3 (Moderate)	-0.465 ***	-0.540 ***	-0.475 ***	-0.536 ***	-0.431 ***	-0.510 ***	-0.766 ***	-0.843 ***				
ICT_intensity=4 (Low)	-0.456 ***	-0.640 ***	-0.634 ***	-0.965 ***	-0.678 ***	-0.874 ***	-0.852 ***	-1.033 ***				
Number of employees												
1-4 employees	-0.032	0.055	-0.080	-0.187 ***	-0.135 ***	-0.220 ***	0.095 *	0.027				
5-19 employees												
20-199 employees	-0.133 **	-0.142 *	0.115 **	-0.040	0.101 **	-0.044	-0.059	-0.214 ***				
200+ employees	-0.232 ***	-0.249 ***	0.123 **	0.073	0.041	-0.017	-0.293 ***	-0.345 ***				
Market competition												
<i>No effective competition</i>												
Minimal	0.342 ***	0.503 ***	0.182 **	0.169 **	0.176 **	0.184 **	0.403 ***	0.229 **				
Moderate to strong	0.309 ***	0.422 ***	0.187 ***	0.159 **	0.220 ***	0.177 ***	0.470 ***	0.391 ***				
Foreign ownership												
<i>100% Australian owned</i>												
Foreign ownership > 0% to 50%	0.244 ***	0.117	0.102	0.079	0.110	0.241 ***	0.167 *	0.173 *				
Foreign ownership > 50%	0.142 **	0.193 ***	0.059	-0.027	0.097 *	0.011	-0.005	-0.002				

Table A3 - Results of the Probit (binary) Model for the Different Types of Innovation with STEM Skills as Binary (continued)

Variable	Goods and Services			Operational Processes			Organisational/Managerial			Marketing Methods		
	2010-11	2011-12	2010-11	2011-12	2010-11	2011-12	2010-11	2011-12	2010-11	2011-12	2010-11	2011-12
Collaboration in R&D												
Joint R&D (co-operative) agreement	0.401 ***	0.330 ***	0.354 ***	0.329 ***	0.387 ***	0.399 ***	0.259 ***	0.245 ***				
<i>No joint R&amp;D (co-operative) agreement</i>												
Flexible Working Arrangement	0.299 ***	0.187 ***	0.303 ***	0.246 ***	0.370 ***	0.370 ***	0.323 ***	0.224 ***				
<i>No flexible working arrangement</i>												
Government financial assistance	0.146 ***	0.118 ***	0.140 ***	0.111 **	0.165 ***	0.128 ***	0.159 ***	0.072				
<i>Not received government assistance</i>												
Industry												
<i>Manufacturing</i>												
Accommodation and food services	-0.171 **	-0.249 ***	-0.219 ***	-0.455 ***	-0.005	-0.272 ***	0.290 ***	0.305 ***				
Administrative and support services	-0.368 ***	-0.424 ***	-0.082	-0.265 **	0.110	0.045	0.105	0.158 *				
Agriculture, forestry and fishing	-0.430 ***	-0.831 ***	0.017	-0.144	-0.034	0.039	0.011	-0.029				
Arts and recreation services	-0.208 ***	-0.322 ***	-0.189 **	-0.311 ***	0.009	-0.268 **	0.316 ***	0.414 ***				
Construction	-0.560 ***	-0.723 ***	-0.195 **	-0.275 ***	0.089	0.037	-0.302 ***	-0.179 **				
Electricity, water, gas and waste services	-0.475 ***	-0.718 ***	0.143	-0.092	0.106	-0.121	-0.144	-0.173				
Financial and insurance services	-0.080	-0.305 **	0.273 ***	-0.079	0.279 ***	0.057 *	0.245 **	0.099				
Health care and social assistance	-0.274 ***	-0.319 ***	-0.112	-0.240 ***	0.085	0.137 *	0.024	0.167 **				
Information, media and telecommunications	0.142 *	-0.065	-0.058	-0.249 **	-0.097	-0.161	0.183 **	0.098				
Mining	-0.903 ***	-1.088 ***	-0.272 ***	-0.349 ***	-0.231 ***	-0.228 **	-0.793 ***	-0.738 ***				
Other services	-0.204 **	-0.368 ***	-0.125	-0.361 ***	-0.023	0.041	0.241 ***	-0.020				
Professional, scientific and technical services	-0.281 ***	-0.399 ***	-0.118	-0.332 ***	0.099	-0.060	-0.010	-0.075				
Rental, hiring and real estate services	-0.416 ***	-0.579 ***	-0.141	-0.225 *	0.124	0.108	0.108	0.235 **				
Retail Trade	0.083	-0.087	-0.036	-0.208 **	0.125	-0.133	0.387 ***	0.398 ***				
Transport, postal and warehousing	-0.540 ***	-0.513 ***	0.006	-0.098	0.087	-0.071	-0.235 ***	-0.113				
Wholesale trade	0.120	-0.071	-0.009	-0.123	0.112	-0.024	0.247 ***	0.280 ***				
Number of observations (n)	7548	5554	7548	5554	7548	5554	7548	5554				
AIC	7989.8	6240.7	8490.3	6438.4	8486.9	6483.7	7946.7	6220.6				
Log Likelihood	-3961.9	-3087.3	-4212.2	-3186.2	-4210.4	-3208.9	-3940.3	-3077.3				

Note: \*\*\*, \*\* and \* denote significance at the 1%, 5% and 10% levels, respectively.



Table A4 - Results of the Probit (binary) Model for the Different Types of Innovation with STEM/Non-STEM Skills as Categorical (continued)

Variable	Goods and Services			Operational Processes			Organisational/Managerial			Marketing Methods		
	2010-11	2011-12	2010-11	2011-12	2010-11	2011-12	2010-11	2011-12	2010-11	2011-12	2010-11	2011-12
Collaboration in R&D												
Joint R&D (co-operative) agreement	0.398 ***	0.331 ***	0.350 ***	0.327 ***	0.381 ***	0.396 ***	0.252 ***	0.242 ***				
No joint R&D (co-operative) agreement												
Flexible Working Arrangement	0.295 ***	0.184 ***	0.299 ***	0.241 ***	0.366 ***	0.367 ***	0.318 ***	0.219 ***				
Have flexible working arrangements												
No flexible working arrangement												
Government financial assistance	0.145 **	0.120 **	0.135 ***	0.111 **	0.154 ***	0.127 ***	0.148 ***	0.069				
Received government assistance												
Not received government assistance												
Industry												
Manufacturing												
Accommodation and food services	-0.178 **	-0.260 ***	-0.217 ***	-0.462 ***	0.005	-0.276 ***	0.299 ***	0.307 ***				
Administrative and support services	-0.373 ***	-0.429 ***	-0.075	-0.264 ***	0.131 *	0.048	0.125	0.162 *				
Agriculture, forestry and fishing	-0.447 ***	-0.847 ***	0.009	-0.166	-0.038	0.023	0.009	-0.042				
Arts and recreation services	-0.220 **	-0.334 ***	-0.188 **	-0.323 ***	0.021	-0.276 **	0.330 ***	0.412 ***				
Construction	-0.564 ***	-0.700 ***	-0.201 **	-0.260 ***	0.074	0.047	-0.318 ***	-0.182 **				
Electricity, water, gas and waste services	-0.492 ***	-0.726 ***	0.134	-0.101	0.100	-0.127	-0.150	-0.177				
Financial and insurance services	-0.088	-0.317 ***	0.274 ***	-0.089	0.289 ***	0.052	0.255 ***	0.100 *				
Health care and social assistance	-0.276 **	-0.329 ***	-0.100	-0.242 **	0.116	0.140 *	0.054	0.175 **				
Information, media and telecommunications	0.140	-0.068	-0.049	-0.233 **	-0.073	-0.142	0.208 **	0.114				
Mining	-0.917 ***	-1.093 ***	-0.278 ***	-0.356 ***	-0.234 ***	-0.252 **	-0.794 ***	-0.745 ***				
Other services	-0.192 **	-0.335 ***	-0.121	-0.336 ***	-0.025	0.062	0.238 **	-0.013				
Professional, scientific and technical services	-0.280 ***	-0.401 ***	-0.103	-0.319 ***	0.131 *	-0.044	0.021	-0.063				
Rental, hiring and real estate services	-0.427 ***	-0.590 ***	-0.142	-0.235 **	0.134	0.101	0.119	0.234 **				
Retail Trade	0.078	-0.096	-0.032	-0.215 **	0.138 *	-0.136	0.401 ***	0.397 ***				
Transport, postal and warehousing	-0.553 ***	-0.525 ***	0.002	-0.113	0.089	-0.079	-0.231 **	-0.116				
Wholesale trade	0.112	-0.073	-0.007	-0.124	0.123	-0.024	0.258 ***	0.280 ***				
Number of observations (n)	7548	5554	7548	5554	7548	5554	7548	5554				
AIC	7987.8	6241.1	8489.7	6432.3	8473.8	6481.3	7935.5	6220.4				
Log Likelihood	-3957.9	-3084.6	-4208.9	-3180.1	-4200.9	-3204.6	-3931.7	-3074.2				

Note: \*\*\*, \*\* and \* denote significance at the 1%, 5% and 10% levels, respectively.

Table A5 - Results of the Ordered Probit Model for Innovation with STEM Skills as Binary

<i>Variable</i>	<i>2010-11</i>	<i>2011-12</i>
Intercept		
1 type of innovation	-0.533 ***	-0.050
2 types of innovation	-0.997 ***	-0.587 ***
3 types of innovation	-1.508 ***	-1.129 ***
4 types of innovation	-2.056 ***	-1.694 ***
STEM skills		
<i>Not used STEM skills</i>		
Used STEM skills	0.414 ***	0.382 ***
Skills shortage within business hampering innovation		
<i>No skills shortage</i>		
Have skills shortage	0.312 ***	0.350 ***
Skills shortage within labour market hampering innovation		
<i>No skills shortage</i>		
Have skills shortage	0.174 ***	0.214 ***
ICT Intensity		
<i>ICT_intensity=1 (Most intense)</i>		
ICT_intensity=2 (High)	-0.274 ***	-0.345 ***
ICT_intensity=3 (Moderate)	-0.619 ***	-0.708 ***
ICT_intensity=4 (Low)	-0.762 ***	-1.019 ***
Number of employees		
1-4 employees	-0.064	-0.103 **
5-19 employees		
20-199 employees	0.006	-0.118 *
200+ employees	-0.107 **	-0.163 ***
Market competition		
<i>No effective competition</i>		
Minimal	0.304 ***	0.298 ***
Moderate to strong	0.329 ***	0.317 ***
Foreign ownership		
<i>100% Australian owned</i>		
Foreign ownership > 0% to 50%	0.177 **	0.176 **
Foreign ownership > 50%	0.075 *	0.054
Collaboration in R&D		
Joint R&D (co-operative) agreement	0.380 ***	0.366 ***
<i>No joint R&amp;D (co-operative) agreement</i>		
Flexible Working Arrangement		
Have flexible working arrangements	0.369 ***	0.290 ***
<i>No flexible working arrangement</i>		
Government financial assistance		
Received government assistance	0.165 ***	0.137 ***
<i>Not received government assistance</i>		
Industry		
<i>Manufacturing</i>		
Accommodation and food services	-0.038	-0.188 **
Administrative and support services	-0.083	-0.134 *
Agriculture, forestry and fishing	-0.112	-0.273 ***
Arts and recreation services	-0.022	-0.115
Construction	-0.251 ***	-0.321 ***
Electricity, water, gas and waste services	-0.075	-0.288 ***
Financial and insurance services	0.188 **	-0.071
Health care and social assistance	-0.075	-0.068
Information, media and telecommunications	0.047	-0.104
Mining	-0.564 ***	-0.603 ***

Table A5 - Results of the Ordered Probit Model for Innovation with STEM Skills as Binary (continued)

<i>Variable</i>	<i>2010-11</i>	<i>2011-12</i>
Other services	-0.020	-0.191 *
Professional, scientific and technical services	-0.095	-0.250 ***
Rental, hiring and real estate services	-0.113	-0.146
Retail Trade	0.160 **	0.000
Transport, postal and warehousing	-0.199 ***	-0.226 ***
Wholesale trade	0.141 **	0.019
Number of observations (n)	7548	5554
AIC	19589.8	15250.6
Log Likelihood	-9758.9	-7589.3

Note: \*\*\*, \*\* and \* denote significance at the 1%, 5% and 10% levels, respectively.

Table A6 - Results of the Ordered Probit Model for Innovation with STEM/ Non-STEM Skills as Categorical

<i>Variable</i>	<i>2010-11</i>	<i>2011-12</i>
Intercept		
1 type of innovation	-0.540 ***	-0.035
2 types of innovation	-1.005 ***	-0.572 ***
3 types of innovation	-1.517 ***	-1.115 ***
4 types of innovation	-2.067 ***	-1.680 ***
STEM skills		
<i>Other Non-STEM skills only</i>		
STEM and Non-STEM skills	0.457 ***	0.396 ***
STEM skills only	0.245 ***	0.194 **
Trade skills only	-0.007	-0.197 **
Trade and other Non-STEM skills only	0.143 **	0.094
Skills shortage within business hampering innovation		
<i>No skills shortage</i>		
Have skills shortage	0.310 ***	0.348 ***
Skills shortage within labour market hampering innovation		
<i>No skills shortage</i>		
Have skills shortage	0.169 ***	0.216 ***
ICT Intensity		
<i>ICT_intensity=1 (Most intense)</i>		
ICT_intensity=2 (High)	-0.271 ***	-0.340 ***
ICT_intensity=3 (Moderate)	-0.617 ***	-0.700 ***
ICT_intensity=4 (Low)	-0.760 ***	-1.014 ***
Number of employees		
1-4 employees	-0.062	-0.103 **
5-19 employees		
20-199 employees	0.0005	-0.125 **
200+ employees	-0.122 ***	-0.177 ***
Market competition		
<i>No effective competition</i>		
Minimal	0.301 ***	0.294 ***
Moderate to strong	0.325 ***	0.314 ***
Foreign ownership		
<i>100% Australian owned</i>		
Foreign ownership > 0% to 50%	0.175 **	0.177 **
Foreign ownership > 50%	0.077 *	0.051

Table A6 - Results of the Ordered Probit Model for Innovation with STEM/  
Non-STEM Skills as Categorical (continued)

<i>Variable</i>	<i>2010-11</i>	<i>2011-12</i>
Collaboration in R&D		
Joint R&D (co-operative) agreement	0.376 ***	0.365 ***
<i>No joint R&amp;D (co-operative) agreement</i>		
Flexible Working Arrangement		
Have flexible working arrangements	0.363 ***	0.286 ***
<i>No flexible working arrangement</i>		
Government financial assistance		
Received government assistance	0.158 ***	0.135 ***
<i>Not received government assistance</i>		
Industry		
Manufacturing		
Accommodation and food services	-0.032	-0.192 **
Administrative and support services	-0.071	-0.132 *
Agriculture, forestry and fishing	-0.117	-0.291 ***
Arts and recreation services	-0.015	-0.121
Construction	-0.262 ***	-0.309 ***
Electricity, water, gas and waste services	-0.083	-0.295 ***
Financial and insurance services	0.193 **	-0.077
Health care and social assistance	-0.055	-0.065
Information, media and telecommunications	0.064	-0.087
Mining	-0.570 ***	-0.610 ***
Other services	-0.017	-0.168 *
Professional, scientific and technical services	-0.074	-0.237 ***
Rental, hiring and real estate services	-0.108	-0.152 *
Retail Trade	0.168 **	-0.005
Transport, postal and warehousing	-0.200 ***	-0.235 ***
Wholesale trade	0.147 **	0.020
Number of observations (n)	7548	5554
AIC	19579.9	15242.5
Log Likelihood	-9750.9	-7582.2

Note: \*\*\*, \*\* and \* denote significance at the 1%, 5% and 10% levels, respectively.

Table A7 - Results of the Ordered Probit Model for Innovation Novelty with  
STEM Skills as Binary, 2010-11

<i>Variable</i>	<i>2010-11</i>
Intercept	
New to the industry	-1.107 ***
New to Australia	-1.495 ***
New to the world	-1.991 ***
STEM skills	
<i>Not used STEM skills</i>	
Used STEM skills	0.208 ***
Number of employees	
1-4 employees	0.018
5-19 employees	
20-199 employees	-0.100
200+ employees	-0.170 **
Foreign ownership	
100% Australian owned	
Foreign ownership > 0% to 50%	0.133
Foreign ownership > 50%	0.310 ***
Collaboration in R&D	
Joint R&D (co-operative) agreement	0.181 ***
<i>No joint R&amp;D (co-operative) agreement</i>	
Expenditure on R&D	
Have expenditure on R&D	0.586 ***
<i>No expenditure on R&amp;D</i>	
Industry	
<i>Manufacturing</i>	
Accommodation and food services	-0.356 ***
Administrative and support services	-0.411 ***
Agriculture, forestry and fishing	-0.337 **
Arts and recreation services	-0.152
Construction	-0.459 ***
Electricity, water, gas and waste services	-0.254
Financial and insurance services	-0.287 **
Health care and social assistance	-0.280 **
Information, media and telecommunications	0.078
Mining	-0.679 ***
Other services	-0.264 *
Professional, scientific and technical services	-0.174
Rental, hiring and real estate services	-0.240
Retail Trade	-0.151
Transport, postal and warehousing	-0.266 **
Wholesale trade	-0.006
Number of observations (n)	3554
AIC	4189.5
Log Likelihood	-2067.7

Note: \*\*\*, \*\* and \* denote significance at the 1%, 5% and 10% levels, respectively.

Table A8 - Results of the Ordered Probit Model for Innovation Novelty with STEM/Non-STEM Skills as Categorical, 2010-11

<i>Variable</i>	<i>2010-11</i>
Intercept	
New to the industry	-1.048 ***
New to Australia	-1.437 ***
New to the world	-1.934 ***
STEM skills	
<i>Other Non-STEM skills only</i>	
STEM and Non-STEM skills	0.168 **
STEM skills only	0.204 *
Trade skills only	-0.584 **
Trade and other Non-STEM skills only	0.007
Number of employees	
1-4 employees	0.013
5-19 employees	
20-199 employees	-0.105
200+ employees	-0.173 **
Foreign ownership	
100% Australian owned	
Foreign ownership > 0% to 50%	0.134
Foreign ownership > 50%	0.305 ***
Collaboration in R&D	
Joint R&D (co-operative) agreement	0.179 ***
No joint R&D (co-operative) agreement	
Expenditure on R&D	
Have expenditure on R&D	0.583 ***
No expenditure on R&D	
Industry	
Manufacturing	
Accommodation and food services	-0.373 ***
Administrative and support services	-0.434 ***
Agriculture, forestry and fishing	-0.358 **
Arts and recreation services	-0.179
Construction	-0.450 ***
Electricity, water, gas and waste services	-0.275
Financial and insurance services	-0.308 **
Health care and social assistance	-0.302 **
Information, media and telecommunications	0.054
Mining	-0.699 ***
Other services	-0.235
Professional, scientific and technical services	-0.193 *
Rental, hiring and real estate services	-0.267 *
Retail Trade	-0.172
Transport, postal and warehousing	-0.288 **
Wholesale trade	-0.024
Number of observations (n)	3554
AIC	4188.258
Log Likelihood	-2064.1289

Note: \*\*\*, \*\* and \* denote significance at the 1%, 5% and 10% levels, respectively.

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# Exploratory Research into Government Regulation's Impact on Business-level Employment Growth

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## Abstract

*Recent structural reforms of the Australian economy have included a determination to reduce any excessive regulatory burden on businesses. Previous research has shown that the regulatory burden may adversely impact employment growth; however little empirical research has been conducted on the Australian context. This research, using the Australian Bureau of Statistics Business Longitudinal Database, finds mixed evidence for the impact of government regulation on employment. While no significant impact is found for job creation, this paper finds that government regulation has a disproportionate effect on job destruction for firms aged five years or less. For firms that report government regulation as a barrier to performance, the odds of a younger firm reporting job destruction are more than two times greater than for other firms. Given the dataset used, these findings mainly refer to small and medium sized businesses.*

Keywords: Government regulation, Employment growth, Job creation, Job destruction, Australia, Small business

JEL classification: L5, L51, B52

## 1. Introduction

Below trend economic growth has increased interest in structural reforms to boost productivity, increase employment and competitiveness. One aspect of structural reform is regulatory reform that includes ensuring regulation is effective in achieving its intended outcomes and at a minimum cost (for example, lower compliance costs or reduced time interacting with a regulator). In particular, there has been renewed

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effort to reduce the overall impact of government regulation on business performance.<sup>1</sup> The drive to reduce the impact of government regulation on business has spread to many regions in the world, including Europe and North America (see, Wegrich, 2009; Greenstone, 2013; Canadian Government, 2012; and Chittenden, Kauser and Poutziouris, 2002).

There is anecdotal evidence in Australia of the cost of government regulation, however, there is limited empirical literature on the impact that government regulation has on business performance, and specifically employment. Examples of anecdotal evidence are given in various media reports on the issue (see, Lahey, 2005; Mazzarol, 2012; and Mitchell, 2014). This paper aims to address this gap in our knowledge by using an Australian Bureau of Statistics business longitudinal dataset. In particular, the paper estimates the firm level effect of regulation on job creation and job destruction. This is only one potential impact of regulation and needs to be compared with the benefits of a particular regulation, which are typically reviewed on a case by case basis.

The rest of this paper is broken down into four sections. A literature review reports how government regulation has been associated with business performance and specifically employment. The paper continues by examining through descriptive statistics how government regulation is associated with employment growth in Australia. The fourth section of the paper examines through an econometric analysis the impact of government regulation on employment growth. Finally, a conclusion summarises the main results and outlines possible next steps in research.

## 2. Literature Review and Theory

An institutional framework is the formal and informal rules within a country and an important part of this framework is regulation. New institutional economics illustrates how the long term prosperity of nations is influenced by this institutional framework (North, 1990). The institutional framework forms the incentive structure of countries, helping shape the growth trajectory of an economy. For example, empirical research has found that countries with less onerous regulation tend to grow faster (see, Loayza, Oviedo and Servén, 2004; and Djankov, McLiesh and Ramalho, 2006). Other research indicates that regulation thresholds, where firms have a large change in regulatory compliance for a particular firm size, can also create strong disincentives for firm growth (Garicano, Lelarge and Van Reenen, 2013).

Regulation can achieve desirable outcomes. This typically occurs when on balance the total benefits outweigh the total costs of regulation. Importantly, the benefits and costs of regulation may be distributed unevenly. For example, in some instances the cost of regulation may fall largely on businesses while benefits accrue to individuals. When discussing the effect of regulation on employment it is important to balance this specific effect with other potential impacts (such as improved health or environmental outcomes).

As Australian firms face continuing pressure from globalisation and structural change, excessive barriers on their capacity to act quickly and compete can cause important inefficiencies and increase their costs of doing business. In addition, any

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<sup>1</sup> Government regulation here is synonymous with regulation and compliance costs.

changes to new or existing regulation may cause uncertainty amongst the business community. An increase in the cost of doing business as well as rising uncertainty may in turn cause firms to hire less people, lowering the overall level of employment. From a dynamic point of view, regulation may effect economic growth and employment through such areas as international competitiveness, entrepreneurship, the ability to develop and market new products, or productivity growth (Hall, 2013).

In the Australian context government regulation has been raised as a significant issue by business. For example, the Australian Chamber of Commerce and Industry found that 42.2 per cent of surveyed businesses estimate they spent more than \$10,000 complying with government regulations in the last year (ACCI, 2012). This is a significant amount of money especially for small or medium sized enterprises.

A crude measure of the burden of regulation on business, cited in a Productivity Commission (2007) report, looks at the increase in the volume of regulation over time. For example, between 2000 and 2004 as many pages of Commonwealth Government legislation was passed as during the period 1901 to 1969. International estimates of the cost of the administrative burden on business from government regulation are generally around two per cent of GDP, with the exception of the Netherlands (Productivity Commission, 2006).

Research typically finds that small to medium sized businesses are the most adversely affected by government regulation (Kitching, 2006). Australian taxation-focused research conducted by ATAX (1995) and Walpole *et al.* (1999) has shown that small businesses are significantly burdened with compliance costs, particularly in terms of the total number of hours taken up with compliance. The research found that 90 per cent of compliance costs are borne by small firms. More recent research demonstrates that smaller businesses' compliance costs as a percentage of sales are relatively higher than that of their larger counterparts, with more frequent reported difficulties in record keeping for taxation purposes and complying with Occupational Health and Safety laws (Lewis, Richardson and Corliss, 2015).

Lattimore *et al.* (1998) estimated the 'paperwork' compliance costs for Australian businesses to be approximately \$11 billion in 1994-95 (or 2.3 per cent of GDP) drawing on the results from a 1996 Small Business Deregulation Taskforce survey and Evans *et al.* (1997). Compliance costs were defined to include the costs of managers and staff time, costs of external advisers and incidental costs such as specific travel, stationary, postage and computer use. As part of an international study, the OECD (2001) estimated Australian compliance costs for small and medium enterprises (SMEs) – covering tax, employment and environmental regulation – to be approximately \$17 billion (2.9 per cent of GDP) in 1998. Lewis, Richardson and Corliss (2015) also estimated that the total cost to the Australian economy of regulation on small business is over \$10 billion. The authors defined compliance costs as the costs of becoming aware of, abiding by, and demonstrating compliance with, regulations.

Research indicates that the existing stock of regulation has a positive association with compliance costs (de Jong and Kloeze, 2013). The average firm in the authors' study faces compliance costs of approximately USD \$380,000 per year. Note that this sample includes Australian firms. Other important findings of this research include that a higher quality of regulation design reduces the companys costs

of regulatory compliance. Also the greater the predictability of regulatory application the lower the compliance costs.

Research has found that the impact of regulation on employment is typically small and has an ambiguous association (see, Coglianesi, 2013; and Coglianesi and Carrigan, 2014). Berman and Bui (2001) analysed the impact on manufacturing jobs of local air pollution regulations adopted in Southern California. The study found no substantive or statistically significant effects of local air pollution regulations on employment. Morgenstern, Pizer, and Shih (2002) evaluated whether reported spending by firms on environmental regulatory compliance correlated with changes in employment levels across four different industries. Two of the four sectors actually showed small, statistically significant increases in jobs in the face of increased regulatory compliance spending.

Walker (2011) found that overall employment in the more regulated sectors fell by about 15 per cent (relative to areas with less regulation) following the imposition of new clean air designations. Using other data and a different study design, Greenstone (2002) found a decrease on average of about 40,000 jobs per year in facilities located in non-attainment areas. Non-attainment areas are parts of the country declared to have 'dirty' air and therefore subject to more stringent air pollution requirements under the clean air act.

Regulation may impose a cost on job creation through reduced business entry. Job creation is mainly driven by small, young firms. If new business entry is slowed then job creation will be slowed (Haltiwanger, Jarmin and Miranda, 2010). For example, the average number of procedural steps needed to start a business in the sample by Djankov *et al.* (2002) was 10.48, taking at least 47.4 business days. These costs of regulation have been found to reduce the rate of new business entry (Ciccone and Papaioannou, 2007).

Research indicates, using data from 74 industrial and transition countries for the years 2000-2003, that anticompetitive business regulations affect the performance of the labour market. According to the regression results, they appear to increase unemployment rates and lower employment rates (Feldmann, 2008). For example, if Indonesia had the same flexibility in business regulation as Finland, its unemployment rate might have been 2.1 percentage points lower among the total labour force.

### **Theory**

The impact of regulation on employment is ambiguous, however, in most explanations it is viewed as having a negative effect on employment (Mankiw, 2012). Regulation increases costs for the business and this leads to an increase in prices that the business charges to customers. In general, an increase in price will lead to a decrease in demand for the business goods and services. This leads to decreased revenue and lower production, and this leads to lower employment. Costs also take the form of allocative inefficiencies, where as a result of regulation, businesses change their behaviours and organise their factors of production to reduce costs while maintaining low prices for their goods and services (Lewis, Richardson and Corliss, 2015).

Regulation under particular circumstances may have a neutral or positive effect on employment (Morgenstern, 2000). If the regulation is employment intensive

and regular production is relatively less labour intensive, this may contribute to a net increase in employment. This in combination with a relatively inelastic demand for business goods and services may also contribute to positive gains in net employment.

Even when in some special circumstances regulation may lead to increased employment there are other potential economic losses to regulation (Hall, 2013). For example, there is a deadweight loss associated with the regulation's effect on production. There is also a deadweight loss associated with increased employment from regulation (related to compliance). However, regulation may still lead to a net benefit to society if the improved outcomes from regulation are greater than the aforementioned deadweight losses.

### 3. Descriptive Statistics

This research uses the Australian Bureau of Statistics Business Longitudinal Database (BLD) to analyse how Government regulation may effect employment for Australian businesses. The BLD was constructed from the ABS's yearly Business Characteristics Survey and is a longitudinal dataset that mainly refers to small to medium businesses. The BLD is split into three panels with the first starting in the financial year 2004-05 and ending in 2008-09; the second panel starting in 2005-06 and ending in 2009-10 and the third panel starting in 2006-07 and ending in 2010-11. The survey covers all major industries except Electricity, Gas, Water and Waste Services; Finance and Insurance Services; Public Administration and Safety; Education and Training; Health Care and Social Assistance and some Other Services.

Given this analysis focuses on small and medium enterprises, who are disproportionately affected by regulation, the hypothesis is that businesses that report an issue with Government regulation will be less likely to report job creation (and more likely to report job destruction).

The relevant question in relation to government regulation that is asked in the BLD is:

- Did any of the following factors significantly hamper other business activities or performance (Tick all that apply):
  - government regulation or compliance

The relevant question in relation to employment that is asked in the BLD is:

- Compared to the previous year, did any of the following decrease, stay the same or increase:
  - Total number of jobs or positions

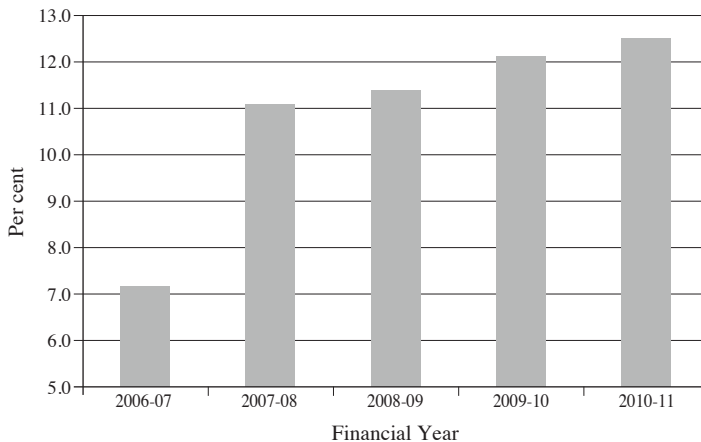
The employment variable of interest was only asked more than once in the second and third panel. The government regulation variable was asked in all waves. The questions were asked of a senior manager in the business. While these questions were asked in both panels, the two panels analysed are structurally different. The panels were stratified differently, with panel two stratified based on ANZSIC 1993 and panel three stratified based on ANZSIC 2006. This led to two more strata in panel three compared to panel two. The job destruction category of the panel two

employment question was only asked for the financial years of 2008-09 and 2009-10. This means that only two waves of panel two can be used in the job destruction analysis. Further, panel two was missing some valid controls required to isolate the effect of regulation, such as the age of firms, while also showing some inconsistent results in one of the waves, suggesting an inconsistency in data measurement. As a result, this paper will focus on panel 3.

Subjective measures of business performance are widely used in research and typically are interpreted as equivalent to objective measures. Research indicates that there is convergent validity, that the subjective measures are associated with corresponding objective measures (see, Wall *et al.* 2004; and Bommer *et al.* 1995). Discriminant validity and construct validity were also found to hold between subjective and objective measures of business performance.<sup>2</sup> This would suggest that it is valid to use subjective measures of employment change, even if this is not ideal.

As shown in figure 1, government regulation has become an increasing problem for business performance over time. For example, 7.1 per cent of businesses reported government regulation as hampering their performance in the 2006-07 financial year. This has increased to 12.5 per cent in 2010-11.

Figure 1 - Per cent of Businesses that Report Government Regulation as Negatively Impacting on Business Performance



Note: Normal units and non-respondents removed. Figures are weighted.

<sup>2</sup> Discriminant validity: for example, the relationship between subjective and objective measures of productivity, and between subjective and objective measures of profit, should be stronger than the relationships between subjective measures of productivity and profit or between objective measures of productivity and profit. Construct validity: the relationships of subjective and objective company performance measures with a range of independent variables were equivalent.

Table 1 shows business that report an issue with government regulation are more likely to report job destruction. For example, in the 2009-10 financial year 28.1 per cent of businesses that report an issue with government regulation also report job destruction. This compares with only 15 per cent of businesses with no government regulation issues.

Table 1 - Percentage of Businesses That Report Job Destruction by Government Regulation's Impact on Business Performance

<i>Financial year</i>	<i>No government regulation issue</i>	<i>Government regulation is an issue</i>
2008-09	15.5	22.9
2009-10	15.0	28.1
2010-11	18.3	25.0

*Note:* Normal units. Removed non-respondents. Figures are weighted.

Notably, as shown in table 2, an association is found when comparing government regulation to job creation. Firms reporting an issue with regulation are more likely to report job creation. For example, 8.4 per cent of businesses reporting job creation in the 2008-09 financial year reported no government regulation issue. This compares with 11.6 per cent of businesses reporting job creation and an issue with government regulation.

Table 2 - Percentage of Businesses That Report Job Creation by Government Regulation's Impact on Business Performance

<i>Financial year</i>	<i>No government regulation issue</i>	<i>Government regulation is an issue</i>
2008-09	8.4	11.6
2009-10	12.2	19.6
2010-11	7.8	12.8

*Note:* Normal units. Removed non-respondents. Figures are weighted.

A longitudinal analysis is important as it may show how a change in circumstances in relation to government regulation can affect firm performance. This analysis uses a comparison between two different situations:

- The first situation looks at businesses that report no government regulation issues in two consecutive financial years.
- The second situation is represented by businesses initially reporting no government regulation issues and then in the following financial year reporting an issue with government regulation.

Table 3 shows how government regulation as an issue across financial years interacts with the likelihood of reporting job creation compared to the previous year. Taking the initial year as 2007-08, when government regulation is not hampering business performance in both financial years, 13.7 per cent of businesses report job

creation. This compares with 14 per cent of businesses reporting job creation when government regulation moves from a non-issue in period one to becoming an issue in period two. Looking at this result along with the two other comparisons, we can see that the effects are ambiguous and negligible.

Table 3 - Percentage of Firms that Report Job Creation Compared to the Previous Year when Government Regulation becomes an Issue and when Government Regulation is Never an Issue

<i>Financial years</i>	<i>Government regulation not hampering in both periods</i>	<i>No problem in period 1, government regulation hampering in period 2</i>
2007-08 to 2008-09	13.7	14.0
2008-09 to 2009-10	16.2	17.2
2009-10 to 2010-11	13.5	13.2

*Note:* All units. Removed non-respondents. Figures are unweighted.

Table 4 shows how government regulation as an issue across financial years increases the likelihood of reporting job destruction compared to the previous year. Taking 2007-08 as the initial year, when government regulation is not hampering business performance in both financial years, 20 per cent of businesses report job destruction. This compares with 28 per cent of businesses reporting job destruction when government regulation moves from a non-issue in period 1 to becoming an issue in period 2. A similar association is apparent across the two other comparisons.

Table 4 - Percentage of Firms that Report Job Destruction compared to the Previous Year when Government Regulation becomes an Issue and when Government Regulation is Never an Issue

<i>Financial years</i>	<i>Government regulation not hampering in both periods</i>	<i>No problem in period 1, government regulation hampering in period 2</i>
2007-08 to 2008-09	20.0	28.0
2008-09 to 2009-10	19.0	20.9
2009-10 to 2010-11	18.5	24.6

*Note:* All units. Removed non-respondents. For panel 2 and panel 3 of the BLD. Figures are unweighted.

#### 4. Regression Analysis

The regression analysis used two binary logit models, one for job creation and another for job destruction. Binary logit models are used because different processes are driving job creation versus job destruction within businesses. Following the Baum, Calabrese and Silverman (2000) approach, this study used Heckman's (1979) procedure to generate an inverse Mill's ratio that was then included in each regression model to control for attrition.

### **Variables**

The dependent variable measuring employment change for the two binary logit regression models is as follows:

- 0 if the total number of jobs or positions has stayed the same compared to the previous year or
- 1 if the total number of jobs or positions has increased/declined compared to the previous year (for job creation and job destruction respectively).

The independent variable of interest is the same variable that was used for the descriptive analysis:

- Did any of the following factors significantly hamper other business activities or performance (Tick all that apply):
  - government regulation or compliance.

This is a binary variable, equal to 1 if a business perceived government regulation or compliance as significantly hampering other business activities or performance, and equal to zero otherwise.

Consistent with employment change analysis, whereby smaller businesses are expected to grow more quickly relative to larger businesses, it is necessary to include a lagged control variable for the size of the business at the beginning of the panel (see, Lewis, Richardson, and Corliss, 2015; and Davidsson *et al.* 2002). It is also likely that larger firms will experience more employee turnover, meaning that the employment changes for large firms may be arbitrary. Three binary control variables for business size at the beginning of the panels will be included – those with no employed workers; those with one to four workers; and those with five to 19 workers. Those businesses employing more than 19 workers will act as the reference group. Relative to the reference group, we would expect to see an increased likelihood of job creation in smaller firms and an increased likelihood of job destruction in larger firms.

Lewis, Richardson, and Corliss (2015) identified that smaller businesses are disproportionately affected by regulation due to a lowered capacity to comply and lower efficiencies in dealing with regulation. As such, an interaction term will be included between the regulation variable and each of the firm size variables. We would expect these interactions to show that smaller firms have a decreased likelihood of experiencing job creation as a result of regulation relative to larger firms. We would also expect that smaller firms have an increased likelihood of experiencing job destruction as a result of regulation relative to larger firms.

As indicated by Davidsson *et al.* (2002), the age of a business is a required control as older businesses are expected to grow more slowly. Further, older businesses are likely to have more experience in dealing with compliance to regulation and be less affected by regulation (de Jong and Kloeze, 2013). This analysis will therefore include controls for the age of a business, namely binary control variables for, those firms aged five years or less; those aged six years to 10 years; and those aged 11 years to 15 years. Those aged greater than 15 years will act as the reference group.

To analyse the differing effects of regulation between firms of different ages, an interaction term will be included between the regulation variable and each of the age variables. If regulation does disproportionately impact younger businesses,

we would expect to see, relative to the reference group, those younger businesses, on average, experiencing a decreased likelihood of job creation and an increased likelihood of job destruction.

Following regression analysis by de Jong and Kloeze (2013) and others, industry is added as a control variable. Regulation differs between industries and the relative magnitude of regulation may be considered greater in some industries. Employment conditions may also be different between industries and job creation and job destructions effects are likely to not be homogenous. Table 5 includes a full list of the industry controls used in the regression.

Table 5 - Industry Variables included in Regression

<i>Industries</i>
Agriculture, Forestry and Fishing
Mining
Manufacturing
Construction
Wholesale Trade
Retail Trade
Accommodation and Food Services
Transport, Postal and Warehousing
Information Media and Telecommunications
Rental, Hiring and Real Estate Services
Professional, Scientific and Technical Services
Administrative and Support Services
Arts and Recreation Services
Other Services (Reference group)

In line with other research, an innovation variable is included as innovative activities are likely to impact job creation and destruction within firms (Soames, Brunner and Talgaswatta, 2011). This variable indicates if firms have introduced any new or substantially improved goods or services within a given year. It has been lagged by one period as innovation generally positively impacts business performance with some delay (see, Soames, Brunner and Talgaswatta, 2011; Gronum, Verreyne and Kastle, 2012). To mitigate any omitted variable bias in the regulation variable of interest, it is necessary to control for other factors that may impact the number of jobs or positions. General business performance is likely to drive a business' demand for labour and as such, reported level of sales has been included, in its logarithmic transformation, as a control.

Australian businesses have identified a range of perceived barriers to business performance, including regulation (Australian Bureau of Statistics, 2013). In order to mitigate any other biases, these other barriers to business performance should be controlled for in the regression. As is the case for the variable of interest, these barriers were identified in the BLD through the same question:

- Did any of the following factors significantly hamper other business activities or performance (Tick all that apply).

<sup>3</sup> Normal units do not include businesses that are dying or have died. It also omits those businesses that are out of scope or become out of scope.

These control variables include, a lack of customer demand for goods and services; and lowering of profit margins to remain competitive. These are both binary variables, equal to 1 if a business perceived that barrier as significantly hampering other business activities or performance, and equal to zero otherwise.

There were a number of tests undertaken to ensure the robustness of the results:

- All datasets under analysis are limited to normal units.<sup>3</sup> Furthermore, the dataset has been cleaned to eliminate firms for non-response in either the dependent or independent variables.
- The log-likelihood chi square is used to test to see if the model as a whole is statistically significant. All models presented were found to be statistically significant.
- No evidence of multicollinearity is found for our independent variables for all regressions presented.

## **Results**

Odds ratios are reported in table 6 in relation to job creation and job destruction. The main variable of interest does not show any significant effects within either regression. Taken alone, this indicates that regulation does not influence the employment growth of a firm. This is contrary to much of the existing theory and research presented in this paper, which shows that regulation negatively impacts employment. However, there is also the position that some regulation might be more labour intensive than other types of regulation and therefore result in positive employment effects (Morgenstern, 2000). As we have not differentiated between types of regulation, this might be affecting our results.

The secondary variables of interest include the interaction terms between firms' age and the regulation variable. An interesting result is that, when interacted with regulation, firms aged five years or less are significantly more likely to experience job destruction. This odds ratio is showing, all else equal, the increased likelihood of job destruction for those firms who are five years or less in age and who have indicated government regulation is a barrier to business performance, relative to all other firms.

Table 7 includes the two different effects that exist within the age and regulation interaction for job destruction. For those firms that report government regulation as a barrier to business performance, firms aged five years or younger are 3.2 times more likely to report job destruction than firms of all other ages. This effect is significant at the 1 per cent level. For those firms that are aged five years or less, firms that report government regulation as a barrier to business performance are 2.3 times more likely to experience job destruction relative to those firms that do not report government regulation as a barrier. This is significant at the five per cent level. This result is in line with research presented in this paper, whereby younger firms are disproportionately affected by regulation, due to less experience with the required compliance (de Jong and Kloeze, 2013).

The other regulation interactions of interest, those with other ages of firms and sizes of firms, reveal no significant effects. Despite research finding that smaller firms are increasingly burdened by regulation, this effect is not present here, which is most likely due to the dataset being comprised of small and medium sized firms. Additionally, inclusion of the inverse Mill's ratio ( $\lambda$ ) is insignificant in both

regressions, meaning that attrition was not related to the likelihood of reporting job creation or job destruction.

A number of control variables significantly predict both job creation and job destruction, which is in line with what was expected. Firstly, the size of a firm significantly predicts if a business will experience job destruction, with bigger effects for larger firms. Secondly, the age of a firm shows that small to medium size firms are associated with increased odds of experiencing job creation. Firm performance, as measured through level of sales, is also a significant predictor of both job creation and job destruction, with the direction of the effects in line with expectations. Further, the lagged innovation variable is the biggest predictor in the probability of reporting job creation, showing positive effects on job creation. Finally, the barrier control variables also show results as expected, with decreased odds associated with job creation and increased odds associated with job destruction.

Not reported in table 6, the industry control variables showed that the retail and agriculture, forestry and fishing industries were significant at the one per cent level, and were associated with a decrease in odds of job creation and job destruction respectively.

Table 6 - Odds Ratios of Binary Logits of Job Creation and Job Destruction by Firm Characteristics

Variable	Job creation		Job destruction	
	Odds Ratio	Robust Standard Error	Odds Ratio	Robust Standard Error
Non-employing businesses (at time of first observation)	1.530	0.418	2.151 ***	0.485
1 to 4 workers (at time of first observation)	1.533	0.514	3.789 ***	1.022
5 to 19 workers (at time of first observation)	1.840	0.705	6.789 ***	2.071
Non-employing businesses x Government regulation	0.917	0.557	0.749	0.338
1 to 4 workers x Government regulation	1.112	0.650	0.889	0.407
5 to 19 workers x Government regulation	0.912	0.556	0.791	0.362
Age 5 years or less	1.752 ***	0.317	1.000	0.167
Age 6 years to 10 years	1.575 ***	0.261	1.249	0.185
Age 11 years to 15 years	1.104	0.237	1.191	0.200
Age 5 years or less x Government regulation	1.261	0.628	2.285 **	0.808
Age 6 years to 10 years x Government regulation	1.759	0.628	1.216	0.399
Age 11 years to 15 years x Government regulation	0.741	0.401	1.143	0.400
Exporter	1.335 *	0.211	1.223	0.170
Foreign ownership	0.837	0.231	1.299	0.302
Log sales	1.588 ***	0.084	0.922 **	0.035
New goods or services (lag)	1.814 ***	0.223	1.217 *	0.143
Government regulation	1.095	0.625	1.414	0.627
Lack of customer demand for goods and services	0.639 ***	0.102	2.044 ***	0.226
Lower profit margins to remain competitive	1.024	0.129	1.596 ***	0.165
Lambda (inverse Mills ratio)	0.849	0.697	1.535	0.987
N		3170		3410
Log likelihood		-1267.0217		-1673.0013

\* 10% significance level; \*\* 5% significance level; \*\*\* 1% significance level. Year dummies are included in the concatenated regression. In the concatenated regression errors are clustered around the ABSID. For the full list of regression results please email authors. All results are rounded to the third decimal place. Run in STATA.

Table 7 - Differentiation of Effects within the 'age 5 years or less' and 'Government Regulation' Interaction

	<i>Odds Ratio</i>	<i>Robust Standard Error</i>
Difference between those aged 5 years or less and all other businesses (when 'government regulation' = 1)	<b>3.171***</b>	1.379
Difference between those who reported government regulation as a barrier and those who did not (when 'aged 5 years or less' = 1)	<b>2.256**</b>	0.730

### **Panel Data Models**

A significant advantage of using panel data is the ability to, at least in part, control for unobserved heterogeneity. Research on firm performance using panel data has utilised both random effects and fixed effects methods to control for unobserved factors (Pendell and Boland 2005; Hawawini *et al.* 2001).

In all cases when a hausman test was run for both a fixed effects model and a random effects model, the test found that the unique errors were correlated with the regressors, which suggests the fixed effects model should be examined. However, in all of the fixed effects models there were almost no statistically significant variables. A key reason is that the fixed effects models dropped a significant amount of observations and resulted in small sample sizes (690). Furthermore, as the regression model's dependent variables are specified as a discrete change on the previous year, this reduces the likelihood of finding a significant association through a fixed effects model. The available data was restricted by groupings, and as such, a discrete modelling technique needed to be used.

While caution must be observed when interpreting the previous results that do not control for unobserved factors, if data on employment change would be available as a continuous variable, it would allow for different modelling techniques. Indeed, the exploratory research in this paper suggests that modelling using these panel techniques on a continuous dependent variable is an area of possible future research.

## **5. Discussion and Conclusion**

In regards to the hypothesis made earlier, this paper finds that, for many businesses, government regulation tends to have no observable impact on the job creation and job destruction rates of firms. The paper, however, does find a concentrated effect on job destruction for firms that are aged five years or less. Of those firms that report an issue with government regulation, firms aged five years or less are 3.2 times more likely to experience job destruction than those older firms. Further, of those firms that are aged five years or less, firms that report government regulation as a barrier are 2.3 times more likely to experience job destruction relative to those firms that don't report regulation as a barrier. This result is consistent with other research that shows younger firms are disproportionately burdened by government regulation, relative to older firms (Lewis, Richardson and Corliss, 2015).

The impact of regulation on employment also potentially varies according to the business cycle or sales growth in the industry. Indeed, lack of customer demand

remains central to the probability of firm-level job creation and job destruction. Due to data limitations in this analysis, this level of analysis could not be included.

Simple random effects and fixed effects logistic models were run in an attempt to control for individual heterogeneity. While the panel data analysis preferred the fixed effects model, given the drop in sample size, virtually none of the independent variables were statistically significant. Models that use a different measure of employment, not publicly available in the data set used, are a possible area of future research.

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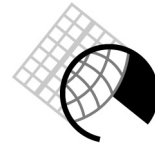
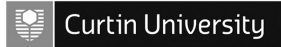
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URL: <http://www.business.curtin.edu.au/research/publications/journals/ajle/index.cfm>



# Bankwest Curtin Economics Centre

## The Australian Society of Labour Economists (ASLE)

The Australian Society of Labour Economists encourages the study of labour economics and labour relations. The Society promotes informed public debate of issues relating to labour economics, labour markets and labour relations through seminars, workshops, conferences and publications. All members of the Society will be eligible to receive The Australian Journal of Labour Economics [ISSN 1328-1143], a publication of the Centre for Labour Market Research. The Journal is published three times a year.

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I would like to renew/become a member of the Australian Society of Labour Economists for:

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## Notes to Authors

The Australian Journal of Labour Economics (AJLE) is a forum for the analysis of labour economics and labour relations. It is particularly focused on theoretical and policy developments in respect of Australian labour markets. Interdisciplinary approaches are particularly encouraged. The AJLE invites submissions of articles in the following areas:

- Time allocation, work behaviour, and employment determination
- Wages, compensation, and labour costs
- Labour-management relations, trade unions, and collective bargaining
- Work organisation and the sociology of work
- Productivity
- Income and wealth distribution
- Mobility, unemployment, labour force participation and vacancies
- Gender, ethnicity, labour market segmentation and discrimination
- Population and demography in respect of the labour market

While contributors to the AJLE are expected to demonstrate theoretical or empirical originality – and preferably both – they should make their work accessible to readers from a non-technical background. Survey articles are also encouraged. Further, as a means of strengthening the integration of theory and practice the AJLE welcomes reflective contributions from practitioners. The AJLE recognises that the areas of labour economics and labour relations are subject to controversy and aims to provide an arena for debate.

## Submission of Papers

Contributors should submit manuscripts via the email in Microsoft Word to:

patricia.madden@cbs.curtin.edu.au  
Pat Madden  
Editorial Assistant  
Australian Journal of Labour Economics  
C/o Bankwest Curtin Economics Centre  
Curtin Business School  
Curtin University  
GPO Box U1987 Perth WA 6845

Manuscripts should not normally exceed 8000 words and should contain an abstract of approximately 150 words. They should be double-spaced and should include a separate title sheet which contains the author's name and affiliation, contact details, followed by the abstract, along with at least three Econlit subject descriptors. The next page will start with the Introduction. Text should be in Times 12pt with first level headings numbered using Century Gothic lower case, secondary headings italics bold (no numbering). Notes should be numbered in sequence and placed at the bottom of each relevant page.

References in Harvard style. A detailed style guide for preparation of final drafts will be sent to authors should the manuscript be accepted for publication and is also accessible through the Centre's web site at <http://business.curtin.edu.au/research/publications/journals/ajle/index.cfm>

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## Refereeing Procedure

It is the policy of the editors to send submitted papers to two referees. The names of authors are not disclosed to referees.



*the* **CENTRE** *for*  
**LABOUR MARKET RESEARCH**

The Centre is a consortium of Curtin University, Murdoch University, the University of Canberra and the University of Western Australia.

The objectives of the Centre are to further the understanding of labour market and related issues through research, with special reference to Australian labour markets. The Centre promotes the exchange of knowledge and expertise on labour economics and labour relations between the academic community, governments, business and trade unions.