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Wage Growth Distribution and Decline among Individuals: 2001-2017 ☆

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Abstract

We examine how wage growth is distributed across the Australian population over the period 2001 to 2017. We explore to what extent wage growth is explained by individual characteristics and job characteristics, while controlling for changes in aggregate factors. We also examine the link between low wage growth and financial well-being. The results show that post 2008, and particularly from 2013 onwards, wage growth had significantly slowed down. This result remains, even after controlling for a broad range of individual, household and job characteristics (and for time-invariant unobserved characteristics). Our results also show that the employee's age, education, occupation and industry explain a large share of differences in wage growth. Conversely, the employee's gender and employment contract seem less important. Overall, about half of the wage growth is explained by individual and job characteristics. Finally, we show that wage growth has a significant positive, but small, correlation with financial well-being indicators.

Keywords: individual wage growth, aggregate wage growth, financial well-being

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1. Introduction

In recent years, wage growth has stagnated in several developed countries. This slow-down in wage growth has been observed internationally in the US, Canada, Australia, UK and several European countries (Elsby et al., 2016; Pinheiro and Yang, 2017; Bell and Blanchflower, 2018a; Bishop, 2018). Predicted wage growth has been higher than actual wage growth in the US and Australia (Pinheiro and Yang, 2017; Bishop, 2018). The Reserve Bank of Australia (RBA) has persistently overestimated wage growth by about 1 percentage point, while the annual wage growth has been steadily declining from about 4% in 2011 to less than 2% in 2017. Bishop (2018) notes that since 2012 both the size and frequency of wage increases have reduced, leading to lower overall wage growth. Different measures of labour costs all point to a similar slow-down in earnings growth.

Various macro-oriented explanations have been given to explain the decline in wage growth, including the increase in flexibility of wages to market conditions, decrease in unionisation rates, labour market slack, underemployment, and weak labour productivity growth (Jacobs and Rush, 2015; Brouillette et al., 2017; Bell and Blanchflower, 2018b). However, studies pay less attention to how the decline in wage growth is distributed across the population – for example to what extent it varies among workers with different demographic or job characteristics. Our paper focusses on which worker characteristics explain differences in wage growth, to understand which underlying theoretical mechanisms may be most prevalent. Additional evidence on this topic can inform more effective policy design by determining who are affected and which policy levers may be relevant.

This paper addresses three research questions around low wage growth, where wage growth is defined as the within-individual change in hourly wage. First, how is wage growth distributed across the population? Second, to what extent is wage growth explained by individual characteristics and job characteristics, while also controlling for changes in aggregate factors such as award rates and collective/enterprise agreements that outline minimum pay rates? Whether low wage growth has a social impact depends on whether it makes families vulnerable to financial distress, and/or whether it widens inequality between low and high-income earners. For example, when a mortgage is entered with the expectation that wage growth and inflation will quickly make repayments easier as time goes by, low wage growth may lead to high financial pressure on the family for a longer period of time, particularly if house prices are flat or declining. Therefore, we also aim to answer a third question: is low wage growth linked to financial stress and/or the individual's subjective rating of prosperity?

Differences in hourly wage growth across subgroups of workers can be explained by human capital theory, and/or search and matching theory (Bowlus and Liu, 2013; Lagakos et al., 2018). Based on human capital theory, we expect that the most able workers are provided with the most

opportunities to accumulate human capital and, as a result, experience the highest wage growth over their careers. Based on the literature, we hypothesise that these subgroups are characterised by: (i) lower age, as the incentive to learn and to accumulate human capital reduces with age, and young employees are also the least experienced with the most still to learn; (ii) higher education attainment, as the ability to learn increases with education; and (iii) long-term contracts as opportunities to learn are more likely to be provided by employers to workers on permanent contracts as employers expect these workers to be in their firm for a longer period of time, making investment in these workers more worthwhile.

Aside from skill, ability and experience, differences in job preferences may also affect nominal wage growth. That is, if someone is more selective with regard to the non-financial features of the job that they are willing to work in, e.g. in terms of job location, access to flexible work schedules or working hours, or type of occupation/industry, then a standard job search model suggests that the wage offer curve is less steep due to a slower arrival rate of jobs. This may be more relevant for women than men (Loprest, 1992; Goldin, 2014). Additionally, negative (positive) discrimination may make women (or other groups) less (more) likely to move up to higher paying jobs.

Alternatively, search and matching theory suggests that workers who are more able to move to better paid employment will realise higher wage growth (Burdett, 1978; Burdett et al., 2011). The literature indicates that subgroups of workers who are likely to do better in terms of job-to-job mobility and job matching are younger workers who face low mobility costs, and workers who have higher education as there is high demand for their skills (Manning, 2003). This leads to workers in high demand experiencing more wage growth through increased job-to-job mobility and bargaining power, especially during economic upturns in tight labour markets (Hirsch et al., 2018). In contrast, frictions in the labour market and misallocation have led to poor labour market outcomes for workers, especially for workers who face low labour market demand. The demand side of the labour market has changed due to structural changes in specific economic sectors over the last decades. For example, job polarisation caused by technological change and automation of jobs decreased demand for workers in occupations performing routine tasks relative to workers in occupations performing cognitive tasks. In routine jobs the scope for wage growth is thus likely to be more limited.

To answer our research questions we use the Household Income and Labour Dynamics in Australia (HILDA) 2001-2017, which allows us to follow all employed respondents aged 21 to 64. We use the within-individual year-to-year log change in nominal hourly wage in our descriptive analyses, and the log nominal (and real) wage as the dependent variable in a fixed effects (FE) panel data analysis and in a first differences (FD) panel data analysis. HILDA data are particularly suitable for these analyses, as a rich set of variables is observed on individuals and the households

in which they live, in addition to a range of job characteristics. To answer our third research question, we also need some measure of financial well-being to assess potential consequences of low wage growth. HILDA reports a number of indicators that are suitable for constructing a financial stress index, as well as a subjective prosperity measure. The financial stress index and a poorness index are then used as dependent variables in a generic empirical model with wage growth as one of the explanatory variables.

An earlier study by Treasury (2017) also examines the distribution of wage growth over individuals and businesses with different characteristics using HILDA 2001-2015 data. However, this is a more descriptive study using univariate analyses that does not allow for holding other – individual or aggregate – attributes constant. A multivariate analysis for New Zealand by Hyslop and Rice (2019) focusses on decomposing overall individual wage growth in the period 1997-2015 into a within-group component and a change in employment composition through workers entering and exiting. Similar to Australia, real wage growth was lower than usual in the post Global Financial Crisis recovery period. They find that compositional changes are only a minor component of real wage growth.

Results from different specifications in our paper consistently show that the employee's age, education, occupation and industry explain a large share of differences in wage growth, while the employee's gender and employment contract appear less important. Furthermore, the results show that post 2008, and particularly from 2013 onwards, nominal and real wage growth was significantly lower than in 2007, even after controlling for a broad range of individual, household and job characteristics (and for time-invariant unobserved characteristics). Overall, about half of the individual's wage growth is explained by individual and job characteristics. Nominal wage growth has been stable in the last few years, while real wage growth has been more volatile in the post-2008 period (due to fluctuations in inflation), but still seems to be in a downward trend. The analyses also show that wage growth is positively and significantly correlated with financial well-being indicators, although the correlation is small.

The next section describes the data used and our sample selections. Section 3 provides a descriptive analysis of wage growth over 17 years of pooled data. The approach used in the multivariate analysis is outlined in Section 4. Results are then reported in Section 5, before concluding in Section 6.

2. Data

We use all 17 waves over the period 2001-2017 of the HILDA that are currently available, following individuals aged 21 to 64 in the sample who are wage and salary workers. The HILDA survey is based on a representative sample of Australian households (excluding those living in

very remote areas). All individuals over 15 years of age living in these households are interviewed face to face at annual intervals.

2.1. Dependent Variables

We use the logarithm of nominal hourly wage as the dependent variable in our FE empirical analysis. The hourly wage is constructed by taking the usual weekly earnings divided by the usual weekly hours worked. We also construct a within-individual year-to-year change in nominal hourly wage for our descriptive analysis and FD empirical analysis. The respondent needs to be observed in at least two consecutive waves to compute this wage growth variable.

We allow for comparisons of the wage growth variable to the measures typically used in the existing literature by using macro-level industry-specific data on the Wage Price Index (WPI), Average Weekly Ordinary-Time Earnings (AWOTE) and Average Annualised Wage Increase (AAWI).[1] We include all three indexes as each of them measures a related but different aspect of labour costs. The WPI captures changes in wage rates excluding bonuses, while controlling for changes in the composition of the workforce. The AWOTE captures changes in total earnings by individuals, which includes bonuses and depends on changes in the workforce. The AAWI captures changes based on federal enterprise wage agreements in all economic sectors. We use these three indexes to provide a clear picture of aggregate changes in earnings, which allows us to analyse the importance of worker characteristics for individual wage growth while taking into account changes at the aggregate level.

We use two variables to assess the potential consequences of low wage growth for the worker's financial well-being. We use information collected on financial difficulties to construct a measure of financial stress. HILDA reports several indicators that are suitable for constructing a financial stress measure. These indicators are subjective measures but they are based on individuals' responses to concrete questions regarding financial difficulties. They include the following seven concrete (and severe) financial hardships: unable to heat the home; unable to pay bills; unable to pay mortgage or rent on time; pawned or sold something; went without meals; asked for financial help from friends or family; and asked for help from welfare/community organisations. In addition, we use information on the respondent's self-reported prosperity given current needs and financial responsibilities. The respondent's self-reported prosperity is collected as an ordinal variable with six categories, ranging from prosperous to very poor.

[1] The following data on these macro-economic measures are used. For the WPI, we use the Ordinary Hourly Rates of Pay Excluding Bonuses in June of each year (Australian Bureau of Statistics, 2018b). For the AWOTE, we use the Average Weekly Earnings in May of each year (Australian Bureau of Statistics, 2018a). For the AAWI, we use the Trends Historical Table in June of each year (Australian Government Department of Jobs and Small Business, 2018). WPI and AWOTE numbers are not available for the Agriculture, Forestry and Fishing industry. For inflation, we use data based on June of each year.

2.2. Covariates and Sample Selections

Our analyses include a rich set of variables with information on individuals and the households in which they live, including gender, age, education attained, current education/training enrolment, number of household members, number and age of children, Indigenous status, country of birth, marital status, individual's annual personal income (categorised in year-specific quintiles), long-term health condition and location of residency at the SA3 level; as well as information on job characteristics such as type of contract (permanent/fixed-term/casual), occupation, industry and type of job (public/private). Job-to-job turnover is represented by an indicator variable that equals one if the tenure in the job is less than one year and zero otherwise. A transition in occupation is represented by an indicator variable that equals one if the current occupation differs from the occupation in the previous year. A transition in industry is represented by an indicator variable that equals one if current industry differs from industry in the previous year.

Our sample of analysis is determined by the following sample selections. We only keep full-time employed individuals, i.e. individuals working more than 35 hours in their main jobs. This is an important selection as it eliminates the confounding effects of underemployment, and of transitions from part-time to full-time work on wage growth. For example, wage growth varies considerably following transitions between unemployment, part-time employment and full-time employment (Moscarini and Postel-Vinay, 2016, 2017; Daly and Hobijn, 2017; Moscarini and Postel-Vinay, 2018). Moreover, a focus on full-time workers limits selectivity into promotions and other opportunities based on having a full-time job versus a part-time job. Also, full-time workers tend to have a stronger attachment to the labour market than part-time workers, which lowers the incidence of job-to-unemployment (or job-to-non-employment) transitions, limiting the confounding effects of signalling. By restricting our analysis to full-time workers, we focus on the within-group wage growth of full-time workers while taking out between-group composition effects.[2]

We further restrict the sample by excluding several employee-year observations. Employee-year observations involving employees working more than 80 hours in their main job are excluded. Employee-year observations involving workers earning more than 10,000 AUD a week in their main job, as well as observations with an hourly wage of less than 8 AUD, are excluded. We also remove the bottom 1 percentile and top 1 percentile (on an annual basis) of hourly wage and percentage growth in hourly wage. These selections limit the incidence and problems associated with outliers, and the volatility of wages and working hours.

[2]Lass and Wooden (2019) consider all workers as they are interested in wage growth for part-time versus full-time workers, and casual or fixed-term workers versus workers with a permanent contract.

3. Descriptive Analysis

The first research question is addressed using descriptive analysis. We present summary statistics for our key variables in Table 1. Table 1 reveals the range of the values that the nominal wage of workers takes. To limit the impact of "outliers" on our results, we follow the literature in using the log hourly wage and the change in log hourly wage as the dependent variables in our multivariate analyses. We use information from the pooled years 2001/02 to 2017.[3] Applying the sample selections described in the previous section, we have observations for 11,240 and 10,671 unique persons who are observed in full-time employment in at least two waves and at least two consecutive waves, respectively.

Individual-level wage growth is at least partly due to the fact that many employees receive regular annual increases as a result of the presence of annual increments within a pay scale. These annual increments are often set within award rates, which are generally higher than the national minimum wage and depend on the industry, occupation and location of a worker. The award wages cause, from an international perspective, the relatively high minimum wages and high wage growth in Australia. The aggregate wage indexes are based on industry-specific changes in wages using data on the entire population of Australian workers. We pay attention to differently defined macro-level wage growth by comparing the WPI, AWOTE, and AAWI with the average individual wage growth observed in our sample of the HILDA data. We link inflation, WPI, AWOTE and AAWI to individuals in the HILDA sample on the basis of year of observation and industry of the individual.

It is clear from Table 1 that average hourly individual wage growth observed in our sample is much higher than any of the aggregate wage indexes indicate. The difference between the hourly wage growth and the wage indexes can be explained by our sample selections. For example, individuals who churn in and out of employment are less likely to be included in our analysis, since the individuals in our sample of analysis need to be in full-time employment for at least two consecutive waves to be included. Moreover, workers who churn in and out of employment are more likely to be affected by structural changes in labour demand such as automation (Gregory et al., 2019). More generally, disadvantaged individuals are less likely to be represented in our analysis (especially post-Global Financial Crisis (GFC)), as they are more likely to be displaced and remain non-employed, or only gain part-time employment.

[3]For several variables, e.g. change in hourly wage, we focus on the change from $t-1$ to t. Hence, in all graphs and tables related to these variables, e.g. the FD analysis, data are included over the period 2002 to 2017. We exclude $t = 2001$, as we need information from the previous year to construct these variables.

Table 1
Individual summary statistics.

	N	Mean	Median	Min.	Max.
Hourly wage (AUD)	75,108	29.24	26	5.600	108.3
Log hourly wage	75,108	3.283	3.258	1.723	4.685
Wage main job (AUD, weekly)	75,108	1,274	1,100	200	7,135
Log wage main job (AUD)	75,108	7.043	7.003	5.298	8.873
Working hours main job (weekly hrs)	75,108	43.50	40	35	80
WPI (%)	73,898	3.322	3.300	1.000	6.000
AWOTE (%)	73,898	3.683	3.756	-8.643	16.66
AAWI (%)	75,108	3.750	3.748	2.335	5.127
Inflation (%)	75,108	2.611	2.500	1.000	6.100
Growth hourly wage (%)	57,114	7.698	4.550	-58.00	158.2
Log change hourly wage	57,114	0.052	0.045	-0.867	0.948
Growth wage main job (%)	57,114	7.560	4.265	-72.00	280.5
Log change wage main job	57,114	0.053	0.042	-1.273	1.336
Financial stress index	57,114	0.285	0	0	7
Poorness index	51,707	3.093	3	1	6

Notes: The time period under observation is from 2001 to December 2017. The number of individuals equals 11,240 for the level variables and 10,671 for the growth variables. The number of observations, sample mean, median, minimum and maximum are provided. The number of observations for WPI and AWOTE is lower as there is no information available for the economic sector "Agriculture, forestry and fishing".

Figure 1 shows mean and median nominal wage development over the 2001-2017 period. In seventeen years time the mean and median value nearly doubled. However, the growth in mean and median nominal wage slowed down since 2007. Figure 2 shows that average wage growth over the 2002-2017 period varied substantially (between around 6 to 11%), and both mean and median wage growth are at their lowest level in 2017. The patterns of wage growth reflect the patterns observed for the aggregate wage indexes, but the wage growth based on our sample is always at a higher level. These descriptive findings are consistent with reports by the RBA on declining wage growth in Australia (Jacobs and Rush, 2015; Bishop, 2018), and it is important to note that even full-time workers, who are among the least disadvantaged individuals in the population, have experienced lower wage growth in recent years.

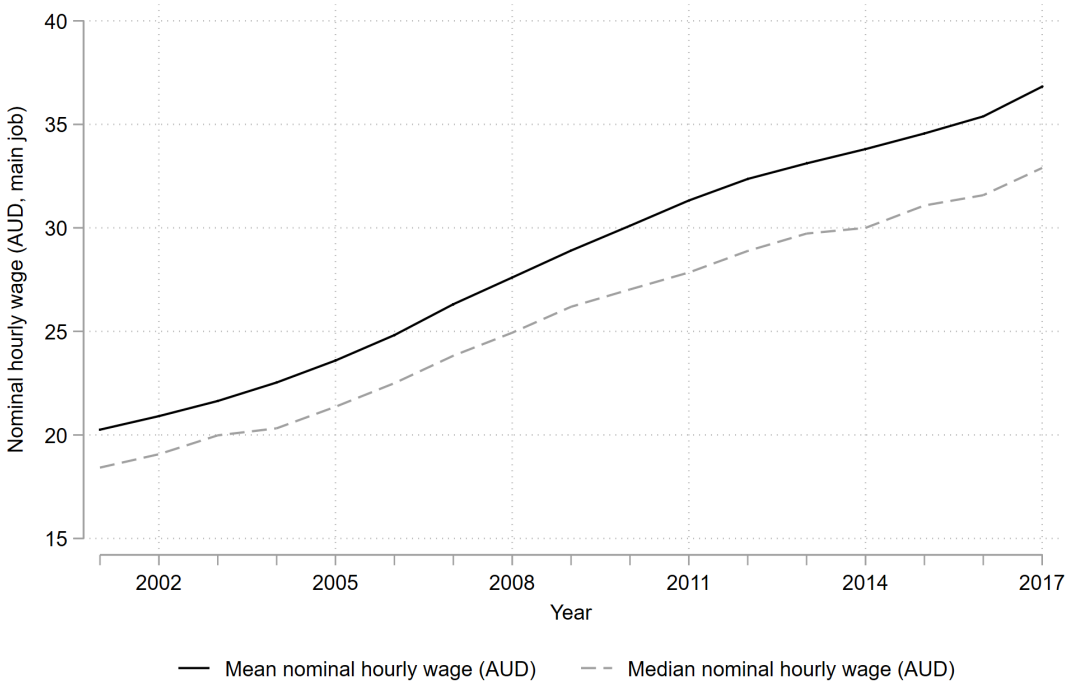


Fig. 1. Mean and median hourly wages over time (main job) (N=75,108).

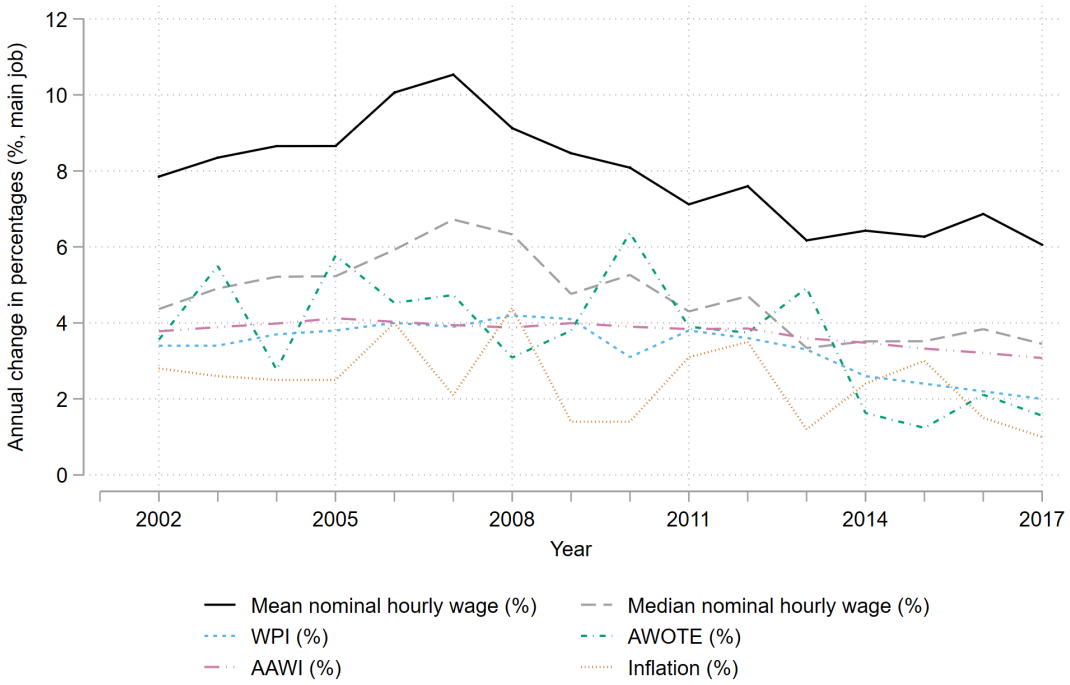


Fig. 2. Changes in mean and median nominal hourly wage and the wage indexes over time (N=57,114).

Examining the distribution of the change in log wage, Figure 3 displays a distribution ranging from negative to positive values, which is slightly skewed towards positive values. This distribution is plotted for four different years. This shows that 2007 is the most different, with a clear shift to the right, indicating higher positive wage changes. Since 2007, both the size and frequency of wage increases have reduced. The years 2012 and 2017 have slightly shifted to the left (indicating lower wage growth) compared to 2002.

Figure 3 is consistent with several findings in the literature (Elsby et al., 2016). First, there is evidence of a nominal wage stickiness (visible in the large peak at zero change) and a resistance to nominal wage cuts (visible from the relatively low share of workers who experience negative year-to-year wage changes). This is more easily observed in Figure B1 of Appendix B, which shows a graph of the year-specific density plots of percentage change in nominal hourly wages. Second, wage increases are pro-cyclical, as evidenced by the higher share of positive year-to-year log changes in 2007. This finding could be explained by higher job-to-job mobility and increased bargaining power during economic upturns.

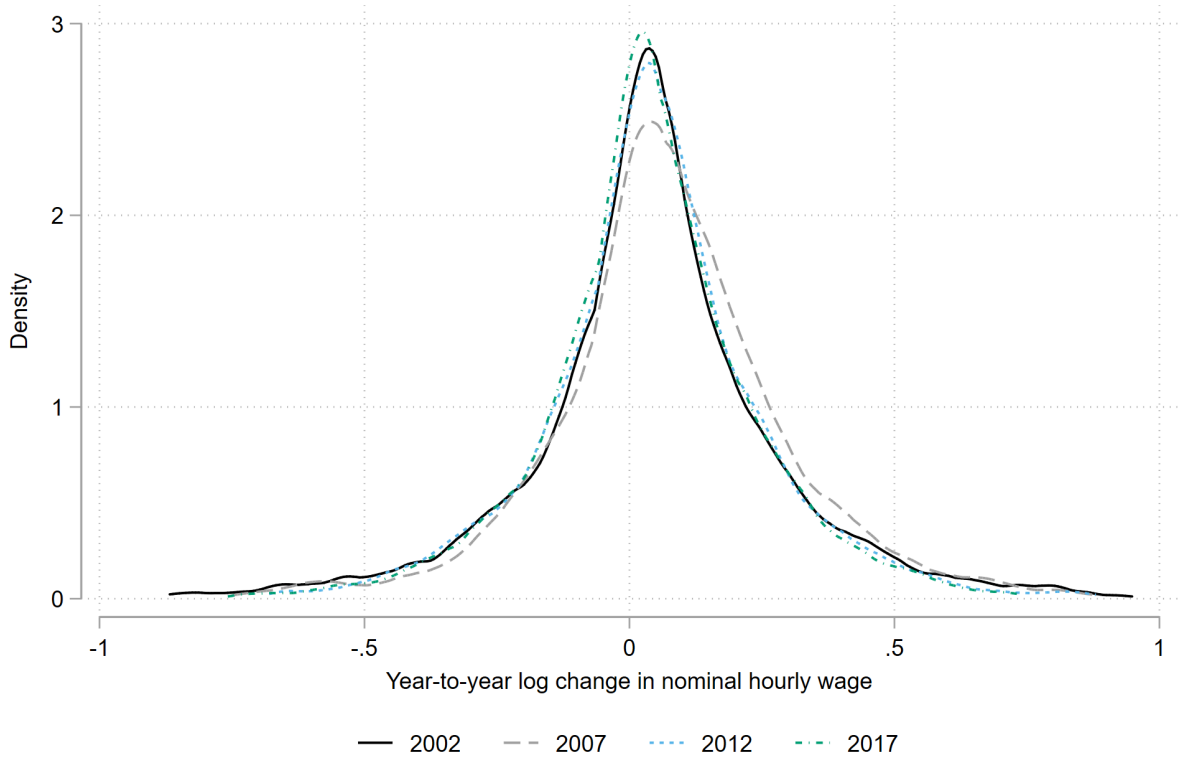


Fig. 3. Year-specific density plot of log change in nominal hourly wages (main job) (N=57,114).

Tables 2 and 3 both present average wage growth by subgroups for the 2002-2008 versus the 2009-2017 period (roughly pre- and post-GFC). We repeat wage growth comparisons over time

for a number of subgroups of interest: men versus women, by age, by education level, by income group, by type of contract, by occupation and by industry. We assess whether the role of individual characteristics and job characteristics in wage growth depends on the overall level of wage growth in the population (high versus low), by comparing this role in the period pre- and post-GFC.

Table 2 focusses on the individuals' characteristics, showing lower percentage wage growth in the post-GFC period than in the pre-GFC period for all groups. However, there are some differences between groups in terms of wage growth. For example, comparing wage growth for men and women over time, Table 2 shows that wage growth, although similar for the two groups, is slightly higher for men pre-GFC and slightly higher for women post-GFC, with women seemingly suffering less from the downturn in 2008.[4]

Younger employees have higher wage growth than older employees. This difference is reduced after the GFC, but younger employees remain with a higher average wage growth than older employees. This is to be expected as employees tend to start at the bottom of a pay scale and are more likely to receive increments for the first few years of employment. Older employees are more likely to have reached the top of their pay scale. Younger employees are also more likely to experience promotions than older employees. More highly educated employees at higher incomes without long-term health conditions receive higher wage increases than their counterparts, which again decrease post-GFC without changing the pattern of who receives the highest wage growth.

Table 3 focusses on the employment characteristics in our sample, and again we observe that wage growth decreases across the board between the pre- and post-GFC period. Employees on a casual contract receive the highest wage increases, followed by employees on a permanent contract and a fixed-term contract. In Australia, casual workers are entitled to a premium on the hourly pay rate. This casual wage premium compensates for the lack of paid leave and job protection, and changes in this wage premium may explain why wage growth for casual workers is relatively high. Again relativities remain the same pre- and post-GFC.

Relativities in pre- and post-GFC mean wage growth are not maintained for occupations and industries, where we observe (sometimes large) changes in rankings based on wage growth. Consistent with job search and matching theory, changes in labour demand across occupations and industries explain some of the changes in wage growth. E.g., the Australian mining industry almost doubled in dollar value over the period 2005 to 2012, which was accompanied by an increased demand for workers in the mining industry. Indeed, mining remained amongst the industries with the highest wage growth. However, occupations and industries characterised by increased labour demand could also provide more scope for learning, suggesting potential spillover effects between human capital accumulation and job search as discussed by Bowlus and Liu (2013).

[4] Also see Figure B2 of Appendix B for wage growth over time by gender.

Table 2
Mean percentage year-to-year growth in nominal hourly wages (main job) by observables.

	Time period			
	2002-2008		2009-2017	
	N	Mean wage growth (%)	N	Mean wage growth (%)
Gender:				
Female (=1)	7,749	8.713	13,313	7.016
Male (=1)	13,749	9.178	22,303	6.840
Age:				
$21 \leq age < 25$ years (=1)	1,507	14.57	2,367	11.01
$25 \leq age < 30$ years (=1)	2,900	11.64	5,563	8.650
$30 \leq age < 35$ years (=1)	3,049	9.560	4,806	7.886
$35 \leq age < 40$ years (=1)	2,941	9.035	4,194	6.958
$40 \leq age < 45$ years (=1)	3,234	7.646	4,443	5.983
$45 \leq age < 50$ years (=1)	3,210	7.389	4,542	5.916
$50 \leq age < 55$ years (=1)	2,541	7.561	4,533	5.009
$55 \leq age < 60$ years (=1)	1,554	6.743	3,507	5.422
$60 \leq age < 65$ years (=1)	562	7.330	1,661	5.728
Education:				
Year 11 (=1)	4,318	7.630	5,183	5.881
Year 12 (=1)	2,930	9.448	4,876	7.364
Cert III and IV (=1)	5,285	9.010	9,349	6.347
Diploma and adv. diploma (=1)	2,240	8.414	3,923	6.985
Bachelor, grad and postgrad (=1)	6,725	9.904	12,285	7.556
Household situation:				
Partner (=1)	15,306	8.848	26,211	6.784
No partner (=1)	6,192	9.411	9,405	7.243
Own resident children (=1)	9,745	8.439	16,117	6.204
No own resident children (=1)	11,753	9.484	19,499	7.486
Background:				
Indigenous origin (=1)	286	10.58	605	6.819
Not of Indigenous origin (=1)	21,212	8.989	35,011	6.907
Born abroad (=1)	4,505	9.011	7,118	6.738
Not born abroad (=1)	16,993	9.010	28,498	6.947
Individual's income:				
First quintile (=1)	3,079	8.429	5,354	5.717
Second quintile (=1)	4,338	8.607	7,270	6.549
Third quintile (=1)	4,602	9.089	7,543	7.065
Fourth quintile (=1)	4,796	9.044	7,824	7.167
Fifth quintile (=1)	4,683	9.652	7,625	7.654
Health status:				
Long-term health condition (=1)	2,908	8.349	5,188	5.491
No long-term health condition (=1)	18,590	9.113	30,428	7.147

Notes: The number of observations and mean wage growth are provided at the individual-year level. The time period under observation is from 2002 to 2017. Note that the individual's income quintiles are based on the sample of 75,108 observations. N=57,114

Table 3
Mean percentage year-to-year growth in nominal hourly wages (main job) by job characteristics.

	Time period			
	2002-2008		2009-2017	
	N	Mean wage growth (%)	N	Mean wage growth (%)
Type of contract:				
Permanent contract (=1)	5,285	9.010	9,349	6.347
Fixed-term contract (=1)	4,318	7.630	5,183	5.881
Casual contract(=1)	2,930	9.448	4,876	7.364
Occupation:				
Managers (=1)	3,127	9.112	6,012	7.324
Professionals (=1)	5,863	10.04	9,872	7.834
Technicians and trades (=1)	3,263	9.939	5,355	7.587
Community and personal service (=1)	1,421	8.424	2,469	6.567
Clerical and admin (=1)	3,558	7.182	5,367	5.940
Sales (=1)	1,074	9.640	1,628	5.454
Machinery operators and drivers (=1)	1,825	8.274	2,856	5.283
Labourers (=1)	1,367	8.015	2,057	5.780
Job industry:				
Agriculture, forestry and fishing (=1)	395	7.724	434	5.961
Mining (=1)	535	12.07	1,019	9.917
Manufacturing (=1)	3,133	8.898	3,899	5.807
Electricity, gas and water service (=1)	325	10.32	639	7.755
Construction (=1)	1,280	10.83	2,809	7.514
Wholesale trade (=1)	950	7.774	1,563	5.212
Retail trade (=1)	1,374	8.295	2,246	5.856
Accommodation and food service (=1)	564	8.426	893	5.190
Transportation and storage (=1)	1,132	8.658	1,972	6.602
Information and communication (=1)	720	8.899	837	7.862
Financial and insurance (=1)	1,000	8.889	1,784	8.425
Rental, hiring and real estate (=1)	263	13.80	527	6.394
Professional, scientific and technical (=1)	1,526	10.96	2,783	7.211
Administrative and support service (=1)	392	9.997	809	7.465
Public administration and safety (=1)	2,558	8.669	3,964	7.493
Education and training (=1)	2,344	8.117	3,822	6.956
Human health and social work (=1)	2,040	8.064	4,058	6.898
Arts and recreation service (=1)	314	8.838	480	5.954
Other service activities (=1)	653	8.827	1,078	6.841

Notes: The number of observations and mean wage growth are provided at the individual-year level. The time period under observation is from 2002 to 2017. *N*=57,114

4. Methodology – Empirical Models

4.1. Wage Level and Wage Growth

Research questions 2 and 3 are addressed by multivariate panel analyses. In the multivariate analyses we explore the worker characteristics that explain differences in wage growth, while including a large set of covariates and controlling for various aggregate factors. To achieve this we first estimate a fixed-effects wage level model using all available waves of data.

We specify the following empirical model to estimate the effect of various individual characteristics and job characteristics on log hourly wage:

$$log(w_{irt}) = \beta' X_{irt} + \alpha_i + A_r + D_t + \varepsilon_{irt} \tag{1}$$

$i \in 1, 2, ..., N$; $r \in 1, 2, ..., R$; $t \in 2001, 2002, ..., 2017$

where subscripts i, r and t denote the worker, regional residence SA3 and year, respectively. The worker's characteristics, including demographics, occupation and industry, are represented by X_{irt}. The parameter estimates on the employees' observables are denoted by β, which allows us to examine the main individual and job characteristics that influence wage levels.[5] Individual-specific fixed effects are denoted by α_i, which are included to control for time-constant unobserved heterogeneity such as worker's motivation and ability. The fixed effects specification allows us to focus on the impact of local macro-economic circumstances and individual characteristics that change over time. A_r refers to residential area fixed effects that control for local labour market conditions at the SA3 level. We include calendar year fixed effects, D_t, to estimate the year-to-year growth in wages including business cycle effects and inflation. ε_{irt} refers to the idiosyncratic error term.

We estimate (1) using nominal hourly wages. We also estimate (1) based on real hourly wages deflated by CPI, to control directly for changes in inflation over time. This results in the same estimated coefficients, except for the calendar year fixed effects, D_t, which no longer include inflation. Yearly wage growth (holding individual worker characteristics constant) can be computed using $D_t - D_{t-1}$.

Equation (1) does not allow for different wage growth patterns over time for workers with different characteristics. Equation (2) extends the model specified in equation (1) by interacting worker characteristics with the calendar year of the wage observation:

$$log(w_{irt}) = \beta' X_{irt} + \alpha_i + A_r + D_t + \eta_t' X_{irt} + \varepsilon_{irt} \tag{2}$$

[5] When sufficiently small, β can be interpreted as the approximate percentage increase in wage as a result of a one-unit increase in X_{irt}. The precise percentage change is $exp(\beta) - 1$.

The additional parameter of interest is denoted by η_t, which represents the difference in wage growth between specific groups of interest versus the reference groups (e.g. women versus men) in year t relative to reference year 2001. Wage growth of a specific group relative to a reference group in year t is then $\eta_t - \eta_{t-1}$.[6]

When estimating wage levels (as specified in equation (1)), and using the estimated coefficients to compute wage growth, impacts from compositional changes of the sample are included in our wage growth numbers as individuals do not need to have consecutive year observations to be included in the estimation. As a result the individuals (and thus the characteristics of the sample of analysis) on which the year effects are based may vary (slightly) from year to year. Hyslop and Rice (2019) allow for this by distinguishing three groups of salary earners in their analysis: continuing workers, entering workers and exiting workers. In our analysis we re-estimate equation (1) in a FD specification, which means that only observations with two consecutive observation years are included (i.e. the continuing workers).[7]

$$log(w_{irt}) - log(w_{ir',t-1}) = \beta'(X_{irt} - X_{ir,t-1}) + A_r - A_{r'} + D_t - D_{t-1} + \varepsilon_{irt} - \varepsilon_{ir',t-1} \tag{3}$$

$i \in 1, 2, ..., N$; $r, r' \in 1, 2, ..., R$; $t \in 2002, 2003, ..., 2017$

We compare the results based on equations (1) and (3) to assess whether a more restricted sample of analysis affects the estimated coefficients, in particular the calendar year fixed effects.

4.2. Financial Well-being

A similar panel FE model to that in equation (1) is specified to estimate the role of wage growth in financial well-being. Equation (4) is a generic empirical model in which y in turn stands for the financial stress index and the poorness index:

$$y_{irt} = \delta_y \Delta w_{irt} + \beta_y' X_{irt} + \alpha_{yi} + A_{yr} + D_{yt} + \varepsilon_{y,irt} \tag{4}$$

where the main parameter of interest is δ_y, which measures the impact of percentage hourly wage growth, Δw_{irt}, on y. Individual-specific fixed effects, residential area fixed effects and calendar year fixed effects are denoted by α_{yi}, A_{yr} and D_{yt}, respectively. Equation (4) is estimated using pooled ordinary least squares (OLS) (i.e. without the individual-specific fixed effects term α_{yi}) and

[6]The differences in average wage level between specific groups of interest versus the reference groups in year t are measured by $\beta + \eta_t$.

[7]Note that the restriction of consecutive observation years leads to a sample of more advantaged employees with more stable employment. The statistics reported in Table 2 are consistent with this observation, as these illustrate that by selecting consecutive observation years, individuals from the lowest income quintile are removed disproportionally from the sample.

a FE panel model. The FE analysis of financial stress allows us to determine the impact of variations in within-individual wage growth on financial stress while controlling for individual-specific differences. This enables us to determine whether low wage growth for individuals is correlated with financial difficulties.

5. Empirical Analysis

5.1. Wage Growth

5.1.1. Main Results FE model

We examine which worker characteristics explain differences in wage growth.[8] First, we estimate a basic FE wage level model (as specified in equation (1)), in turn using nominal and real wages, which controls for a broad range of individual and job characteristics. The implied year-to-year wage growth is graphically presented in Figure 4 (with more detailed results reported in column 5 in Table A1 in Appendix A). With all controls (and individual- and region-specific effects) included, the relative pattern of wage growth is still similar to that in Figure 2, but at a lower level. As expected, the real wage growth is always lower than nominal wage growth, with 2013 and 2014 revealing less than 1 percent wage growth on average. See Figure B3 in Appendix B for a graph with the cumulative relative wage growth. The strong negative effects from 2013 onwards illustrated in Figure 4 are striking, especially considering that the composition of the employee population may have changed over time, with more disadvantaged employees leaving employment post-GFC.

Columns 1 to 4 in Table A1 in Appendix A also show how adding the different groups of covariates affect the estimated impacts on wage levels. It shows that the impact of education reduces once occupation and industry are included, indicating that the impact of education to some extent (but not completely) works through these two job characteristics. Conversely, the impact of having a casual contract is reinforced when including occupation and industry, possibly due to casual contracts being more prevalent among lower-skill jobs resulting in a downward bias on the estimated impact of having a casual contract on wage level when excluding occupation. Overall, about half of the employees' wage growth observed in Figure 2 is explained by individual and job characteristics.

[8] Due to the fixed effects and several interaction effects that are estimated in our models, our results include a large number of estimated coefficients which are difficult to digest. Therefore we present our key results through graphs, with some additional results reported in a table included in the Appendix. Full results are available from the authors upon request.

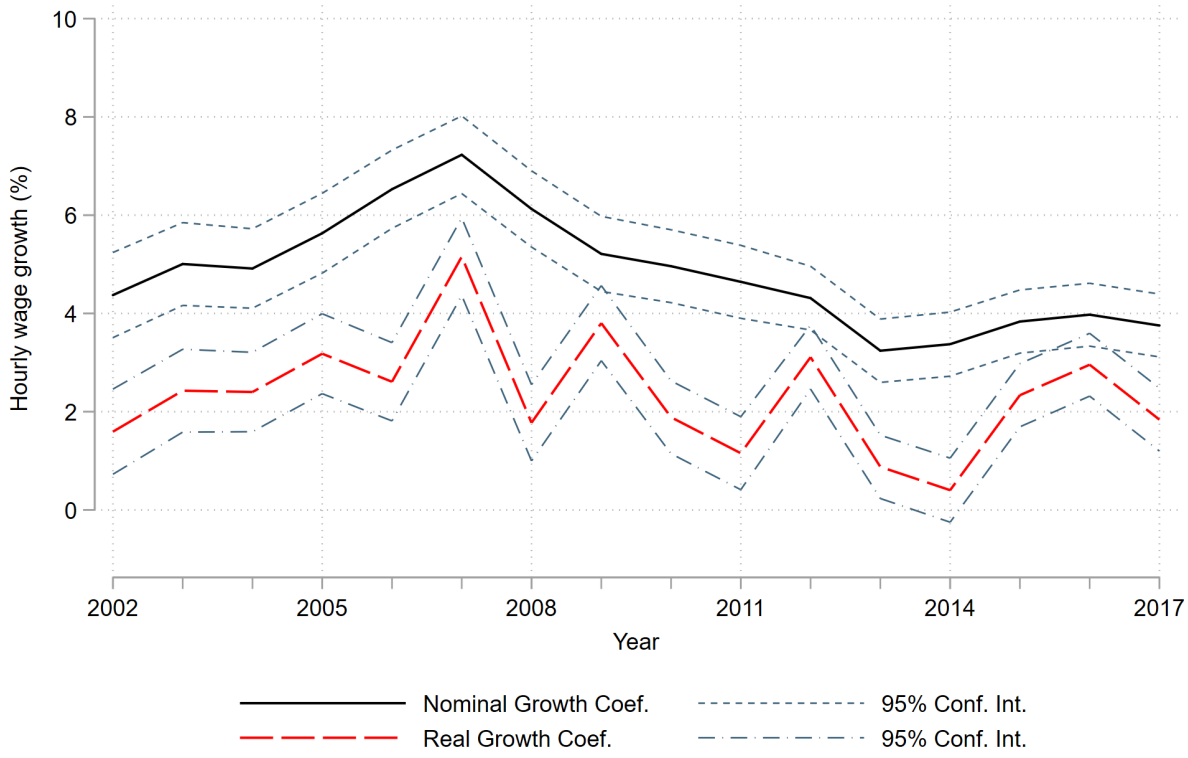


Fig. 4. Year-to-year wage growth (Eq. (1)).
Notes: The nominal and real wage coefficients are based on two sets of FE regressions (see column 5 in Table A1 for the set based on nominal wages). The 95% confidence intervals are computed using clustered standard errors by individual. The regressions include zero-one indicator variables for age (8), education (4), number of household members (3), marital status (5), number of own resident children (3), type of contract (2), job occupation (7), job industry (18), private sector, the SA3 regional location of the household (320) and calendar year (16). The sample of analysis includes 75,108 individual-year observations and 11,240 unique individuals. R^2 equals 0.51 and 0.23 for the nominal and real wage growth model, respectively.

Second, we estimate an extended FE nominal wage level model (as specified in equation (3)), controlling for the same broad range of individual and job characteristics as before, and for all these characteristics interacted with year of observation.[9] Again we report the results graphically. Figure 5 shows relative year-to-year wage growth for a number of subgroups relative to a reference group. We have selected some of the more interesting characteristics. In addition, for characteristics with many categories we have made a further selection of the categories to be included to keep the graphs legible. For the same reason, we have also excluded confidence bounds from the graphs,

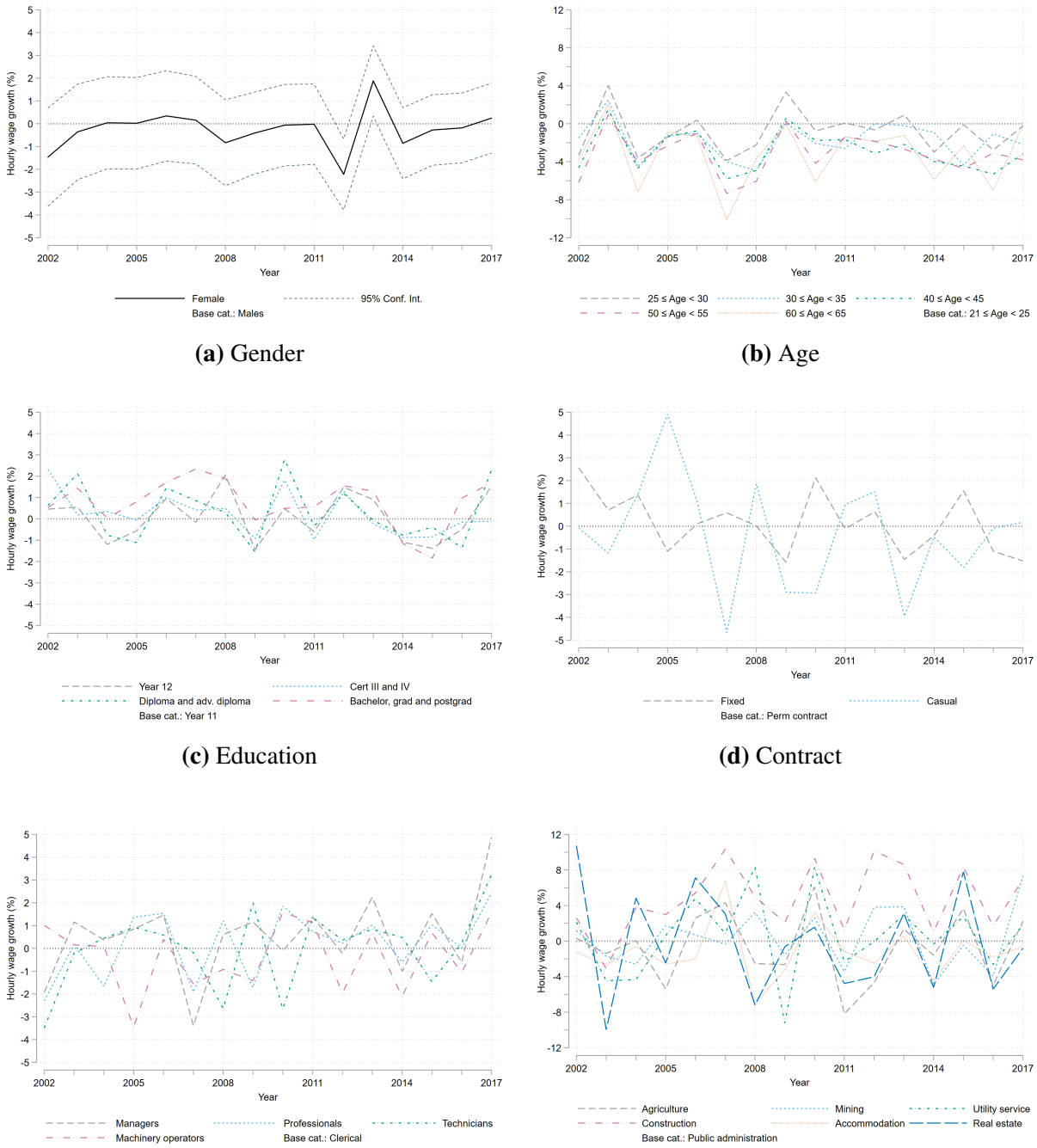
[9]Note that using real hourly wages instead of nominal wages does not change the results of this specification, as inflation is captured by the main year effects and we are interested in the interaction effects between year and various observables.

except in Figure 5a. Figure 6 displays the corresponding cumulative wage growth effects over time, showing the long-term differences in wage growth among various subgroups.

Figure 5a shows that differences in wage growth by gender are never significantly different from zero. It shows that women and men are similar in terms of wage growth, which is also visible in the cumulative wage growth effects in Figure 6a, although in terms of overall wage growth since 2001, women fare more poorly than men which is just significant towards the end of the period (since 2013). The variations in wage growth by age are larger and very clear: higher wage growth is observed for younger employees compared to older employees (see Figures 5b and 6b). Education appears relevant for wage growth (Figure 5c), especially educational attainment at the university degree level provided additional wage growth in the pre-GFC period. Figure 6c shows clearly that the positive relationship of education with wage growth was much reduced post-GFC, as is visible through the flat lines relative to the base category. The contract type of casual work (Figures 5d and 6d) has been an important source of variation in wage growth over time: pre-GFC workers on a casual contract received a wage growth premium, whereas post-GFC, a wage growth penalty was received by these workers. The wage growth of workers with a fixed contract has been similar to workers on a permanent contract, maintaining a more or less constant wage growth advantage of around 3% achieved in the first year.

The results for the occupation indicators in Figure 5e show that workers who have more cognitive, less routine, occupations have a tendency to experience higher wage growth (although not necessarily significantly higher). These occupations include managers and professionals.[10] In contrast, occupations with more routine tasks such as machinery operators and labourers experience the lowest wage growth (see Figure 6e), which has become more evident in the most recent years. The results for the industry indicators in Figure 5f show that workers employed in economic sectors producing tradeables experience the highest wage growth, including workers in mining, supply of utilities, financial and real estate activities, although real estate has come down considerably in recent years. In contrast, workers in industries focusing on non-tradeables such as activities in agriculture and accommodation experience the lowest wage growth.

[10] See Autor and Dorn (2013) and Goos et al. (2014) for how a classification of occupations based on the Routine Task Intensity index is constructed for the US and Europe, respectively.



(a) Gender

(b) Age

(c) Education

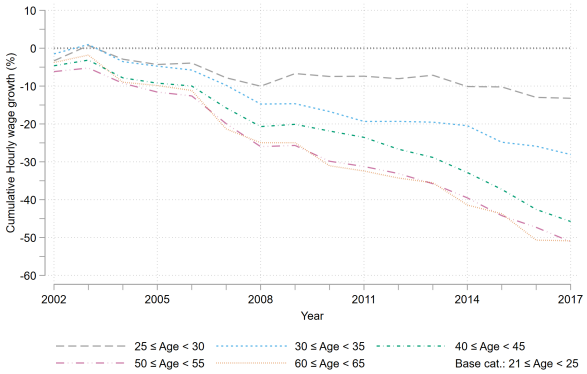
(d) Contract

(e) Occupation

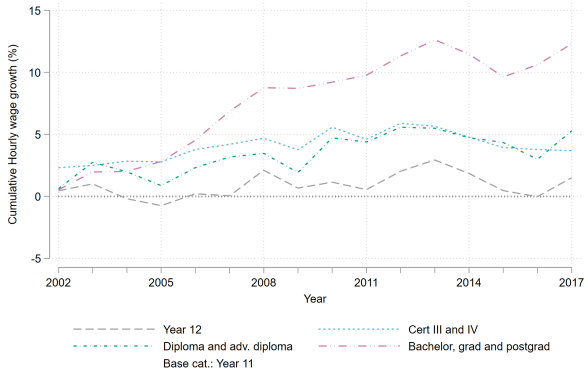
(f) Industry

Fig. 5. Year-to-year relative wage growth by subgroup (Eq. (2)).
Notes: All graphs are based on the same FE regression. See Figure 4 for additional notes. All individual and job characteristics are interacted with calendar year of observation, including the time-constant variables gender, Indigenous and born abroad. Several categories are left out to increase the clarity of the graphs, including several age, occupation and industry groups. R^2 equals 0.53.

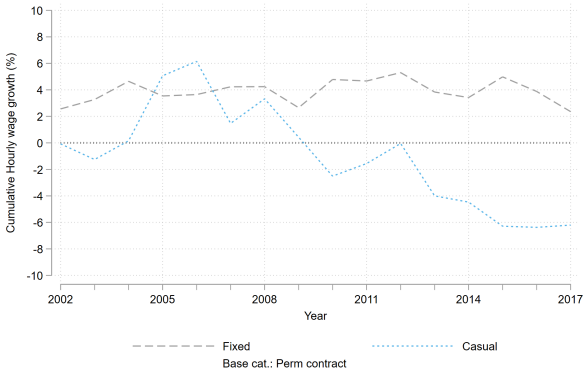
(a) Gender



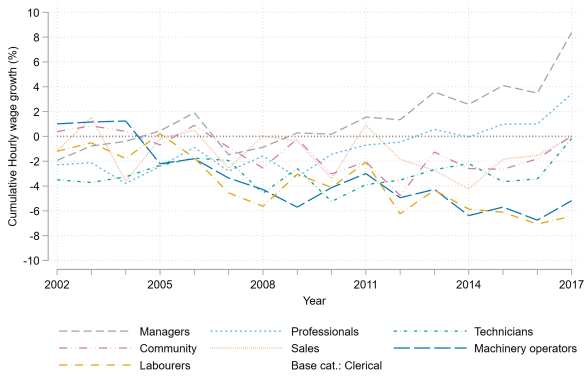
(b) Age



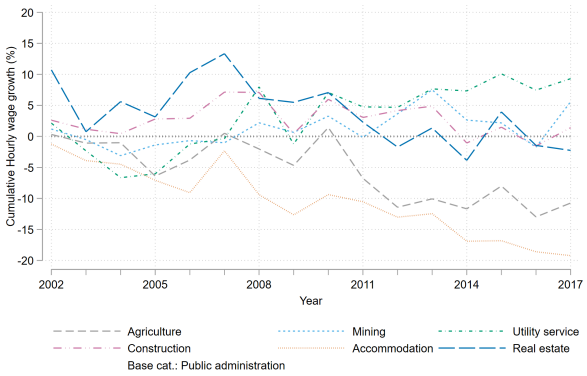
(c) Education



(d) Contract



(e) Occupation



(f) Industry

Fig. 6. Cumulative relative wage growth by subgroup (Eq. (2)).
Notes: All graphs are based on the same FE regression. See Figure 5 for additional notes.

5.1.2. Sensitivity Analyses

This section presents a number of robustness checks to assess the sensitivity of our results to changes in the set of independent variables and our sample selection.

First, to assess the impact of limiting the analysis to continuing full-time workers on year-to-year wage growth results, we also estimate the model underlying the results in Figure 4 (and Table A1) as an FD specification which reduces the sample size from 75,108 to 57,114 individual-year observations (equation (3)). Figure B4 in Appendix B shows that the estimated year-to-year wage growth remains very similar, except that in all years (for both nominal and real wages), wage growth estimates obtained through the FD approach are slightly higher (as we are now using a slightly more advantaged group of employees: i.e. those who were in full-time work for at least two consecutive years). However, the differences are small, consistent with the finding by Hyslop and Rice (2019) that most of the wage growth is due to continuing workers' wage growth rather than population composition changes.

Second, we re-estimate equations (1) and (2) adding a dummy for a new entry worker (i.e. the respondent is not observed working full-time in year t-1) to investigate any differences between "established" full-time workers and new full-time workers. Moreover, we run equations (1) and (2) on a sample that only includes an observation in the analysis if the respondent was observed in full-time work in the previous year, i.e. the same sample that is used for the FD analysis in the first sensitivity check. Our conclusions are robust to this variation, with the key coefficients in our models not changing much. Results are available upon request.

Third, we re-estimate a version of equation (1) adding the WPI, AWOTE and AAWI indices. These results are reported in columns 2 and 6 of Table A1 in Appendix A. The indices are only significant when occupation and industry are not included, where AAWI has the strongest correlation of the three wage indexes. However, none of these indexes add much to the goodness of fit of the model, indicating that no additional information is contained in these indexes once industry and occupation are included in the model.

Fourth, we re-estimate a version of equation (2) adding several transition indicators for job, occupation, industry and contract type. This extension aims to control explicitly for changes in wage growth over time through promotions by recording job, occupation and industry changes. We include transition indicators for contract type to control for changes in wage growth over time caused by for example workers who switch from a casual contract to a permanent contract, which leads to a loss of their casual wage premium. Adding these transition indicators does not change results much, as all these variables are statistically insignificant. We also add a health variable, indicating the presence of a long-term condition, which might hinder wage growth through for example a lower probability of promotion. Although employees with such a condition are at a

lower wage level than healthier workers, it does not seem to affect their year-to-year wage growth. Again, these results are available upon request.

5.2. Financial Stress and Poorness

The results in relation to our third question investigating the impact of wage growth on financial well-being are reported in Table 4. Table 4 shows a clear correlation of wage growth with financial stress (Columns (1) and (3)) and with the poorness index (Columns (2) and (4)), which is slightly smaller in the FE specification. The impact is fairly modest: e.g. a 10% increase in wage would reduce the financial stress index (which runs from 0 to 7) by around 0.003. A wage growth of 10% would reduce the poorness index (with values between 1 and 6) by 0.006 or 0.005 respectively for the OLS and FE specification. Several of the other characteristics appear more relevant than wage growth for these two indexes, although many of these become insignificant in the FE specification, whereas the wage growth remains (or becomes) significant. Income quintiles and having a long-term health condition are an obvious exception, with each having a significant coefficient in both specifications.

Women are less likely to rate themselves poor, but no less likely than men to experience financial stress. Age has an opposite effect on the poorness index for several age groups compared to the impact on the financial stress index, where older employees are less likely to experience financial stress. This appears due to the youngest group being different from the other groups in how they perceive prosperity, while the other age groups have similar outcomes relative to each other as are observed for the financial stress index.

When we add wage growth interactions with income and health, we find that the results for financial stress disappear with wage growth on its own becoming insignificant in both the OLS and FE specification.[11] The index is unaffected by wage growth for all quintiles, indicating that wage growth does not change financial stress much, if at all. For the poorness index, the results indicate a smaller impact of wage growth for higher-income employees (the lowest impact of -0.002 is observed for quintile 5), while employees in income quintile 1 experience the largest impact of a 10% wage growth (-0.015). None of the interactions in the FE specification are significant, but the overall wage growth effect is slightly stronger (-0.008).

[11] These results are available from the authors upon request.

Table 4
The role of wage growth in financial stress (Eq. (4)).

	OLS		FE	
	Fin. stress index	Poorness index	Fin. stress index	Poorness index
	(1)	(2)	(3)	(4)
Change in hourly wage (%)	-0.0003**	-0.0006***	-0.0003***	-0.0005***
	(0.0001)	(0.0001)	(0.0001)	(0.0001)
Demographic characteristics:				
Female	-0.0030	-0.0868***		
	(0.0132)	(0.0142)		
$25 \leq age < 30$ years	0.0171	0.1219***	-0.0223	0.0489***
	(0.0203)	(0.0161)	(0.0236)	(0.0179)
$30 \leq age < 35$ years	0.0343	0.2042***	-0.0535*	0.0672***
	(0.0237)	(0.0193)	(0.0318)	(0.0242)
$35 \leq age < 40$ years	0.0209	0.2393***	-0.0557	0.0836***
	(0.0255)	(0.0213)	(0.0393)	(0.0300)
$40 \leq age < 45$ years	-0.0054	0.2514***	-0.0487	0.0911**
	(0.0265)	(0.0216)	(0.0455)	(0.0361)
$45 \leq age < 50$ years	-0.0656**	0.2273***	-0.0479	0.0862**
	(0.0255)	(0.0217)	(0.0515)	(0.0414)
$50 \leq age < 55$ years	-0.1058***	0.1993***	-0.0296	0.0841*
	(0.0252)	(0.0223)	(0.0572)	(0.0468)
$55 \leq age < 60$ years	-0.1404***	0.1709***	-0.0101	0.0599
	(0.0250)	(0.0239)	(0.0652)	(0.0528)
$60 \leq age < 65$ years	-0.1503***	0.1607***	0.0164	0.0567
	(0.0281)	(0.0293)	(0.0728)	(0.0605)
Year 12	-0.0019	-0.0450**	-0.0391	-0.0064
	(0.0249)	(0.0213)	(0.0684)	(0.0547)
Cert III and IV	-0.0030	-0.0322*	0.0256	0.0247
	(0.0214)	(0.0186)	(0.0541)	(0.0376)
Diploma and adv. diploma	-0.0295	-0.0767***	0.0437	0.0897*
	(0.0262)	(0.0247)	(0.0615)	(0.0496)
Bachelor, grad and postgrad	-0.0633***	-0.1562***	-0.0391	0.0073
	(0.0213)	(0.0221)	(0.0722)	(0.0584)
Income groups:				
Second quintile	-0.0594***	-0.0549***	-0.0516***	-0.0418***
	(0.0170)	(0.0141)	(0.0170)	(0.0119)
Third quintile	-0.1145***	-0.1293***	-0.0651***	-0.0801***
	(0.0186)	(0.0155)	(0.0192)	(0.0135)
Fourth quintile	-0.1845***	-0.2336***	-0.1099***	-0.1339***
	(0.0189)	(0.0170)	(0.0205)	(0.0148)
Fifth quintile	-0.2259***	-0.4349***	-0.1221***	-0.2071***
	(0.0198)	(0.0190)	(0.0214)	(0.0165)
Health status:				
Long-term health condition	0.1353***	0.1089***	0.0206*	0.0177**
	(0.0141)	(0.0120)	(0.0114)	(0.0088)
Number of observations	57,114	51,707	57,114	51,707
Number of individuals	10,671	10,107	10,671	10,107
R^2	0.084	0.183	0.030	0.042

Notes: Each column gives output of a different regression. Parameter estimates are reported. Clustered (by individual) standard errors are in parentheses. ***,**,*, correspond to the significance level of 1%, 5%, 10%, respectively. The reference categories of female, age and education consist of workers who are male, aged 21 to 25 years and attained year 11 or below, respectively. The reference categories of income and health status consist of workers in the first income quintile and no long-term health condition, respectively. The regressions include zero-one indicator variables for Indigenous, born abroad, number of household members (3), marital status (5), number of own resident children (3), employment contract (2), occupation (7), job industry (18), private sector, job-to-job turnover, occupation-to-occupation turnover, industry-to-industry turnover, the SA3 regional location of the household (320) and calendar year (15).

6. Conclusion

As in many other countries, employees in Australia have experienced declining wage growth since the GFC. In this paper, we have examined how within-individual year-to-year wage growth is distributed across full-time workers and to what extent it is explained by individual characteristics and job characteristics. We use the Australian HILDA survey data covering the period from 2001 to 2017, which allows us to take into account a rich set of observable characteristics and to examine whether low wage growth has a social impact by making people vulnerable to financial distress.

Our descriptive analysis shows that wage growth has been lower over the past few years, especially since 2010 suggesting that wage increases are pro-cyclical. Moreover, we show that average individual year-to-year wage growth is always higher than the aggregate wage growth indexes indicate, possibly (at least partly) due to our focus on full-time workers and partly due to annual increments in pay scales, and promotions and job changes that individual workers may experience over time (in addition to increases due to increased award rates).

Our empirical analysis shows that wage growth seems largely determined by worker characteristics such as age and education. Gender seems less important for wage growth, particularly when controlling for the worker's job characteristics. The worker's age is important in explaining wage growth, consistent with the literature on wage growth over the life cycle that suggests higher wage growth early in the career (i.e. at younger ages). In terms of education, it is especially the university graduates who experience higher wage growth than workers with other levels of education, although this has been less in recent years.

Job characteristics such as occupation and industry are also clearly important. The employment contract of a worker seems relevant for wage growth mainly through differences between casual and other types of workers, as fixed-term and permanent workers experience a comparable wage growth. Casual workers received higher wage growth pre-GFC, but lower wage growth post-GFC. Workers who have occupations that are more cognitive, less routine, such as managers and professions, experience relatively high wage growth from 2014 onwards. In contrast, labourers and machinery operators have experienced low wage growth since 2005. Workers employed in economic sectors that produce tradeables experience higher wage growth, while especially workers in the accommodation or agriculture sector are lagging behind. Our findings suggest that underlying mechanisms based on human capital theory, and on search and matching theory, are both important for wage growth.

Overall, our results suggest that both individual and aggregate factors are relevant for wage growth. The worker's individual and job characteristics are just as important as business cycle effects in explaining wage growth. In this regard, much wage growth inequality still exists across full-time workers independent of where the economy is in the business cycle. Finally, although the

impact is small, wage growth has a significant positive correlation with financial well-being indicators, which appears somewhat larger for lower income quintiles. Continued low wage growth at the individual level (especially for those on low incomes already) could potentially have a social impact; this is however not evident in the short term.

In answering the questions in this paper, we need to keep in mind that a study of wage growth is by definition excluding the most disadvantaged groups in society: those out of the labour force and those in unemployment. However, we observe even for full-time employed workers declining wage growth, and among these workers also large differences in wage growth. Given the changes over time that we observe in the aggregate wages indexes for the entire Australian population, more disadvantaged workers are likely to have been worse off than full-time workers.

References

Australian Bureau of Statistics, 2018a. Average Weekly Earnings, Australia. Cat.no. 6302.0.
URL http://www.abs.gov.au/AUSSTATS/abs@.nsf/Lookup/6302.0Main+Features1Nov%202018?OpenDocument

Australian Bureau of Statistics, 2018b. Wage Price Index, Australia. Cat.no. 6345.0.

Australian Government Department of Jobs and Small Business, 2018. Trends in Federal Enterprise Bargaining Report.

Autor, D. H., Dorn, D., 2013. The growth of low-skill service jobs and the polarization of the US labor market. American Economic Review 103 (5), 1553–1597.
URL http://www.aeaweb.org/articles?id=10.1257/aer.103.5.1553

Bell, D. N., Blanchflower, D. G., 2018a. The lack of wage growth and the falling NAIRU. National Institute Economic Review 245 (1), R40–R55.
URL https://doi.org/10.1177/002795011824500114

Bell, D. N., Blanchflower, D. G., 2018b. Underemployment and the lack of wage pressure in the UK. National Institute Economic Review 243 (1), R53–R61.
URL https://doi.org/10.1177/002795011824300114

Bishop, J., 2018. The effect of minimum wage increases on wages hours worked and job loss. RBA Bulletin.

Bowlus, A. J., Liu, H., 2013. The contributions of search and human capital to earnings growth over the life cycle. European Economic Review 64, 305–331.
URL http://www.sciencedirect.com/science/article/pii/S0014292113001293

Brouillette, D., Ketcheson, J., Kostyshyna, O., Lachaine, L., 2017. Wage growth in Canada and the United States: Factors behind recent weakness. Bank of Canada: Staff Analytical Note.

Burdett, K., 1978. A theory of employee job search and quit rates. The American Economic Review 68 (1), 212–220.
URL http://www.jstor.org/stable/1809701

Burdett, K., Carrillo-Tudela, C., Coles, M. G., 2011. Human capital accumulation and labor market equilibrium. International Economic Review 52 (3), 657–677.
URL http://onlinelibrary.wiley.com/doi/abs/10.1111/j.1468-2354.2011.00644.x

Daly, M. C., Hobijn, B., 2017. Composition and aggregate real wage growth. American Economic Review: Papers and Proceedings 107 (5), 349–352.
URL http://www.aeaweb.org/articles?id=10.1257/aer.p20171075

Elsby, M. W. L., Shin, D., Solon, G., 2016. Wage adjustment in the Great Recession and other downturns: Evidence from the United States and Great Britain. Journal of Labor Economics 34 (S1), S249–S291.
URL http://www.journals.uchicago.edu/doi/abs/10.1086/682407

Goldin, C., 2014. A grand gender convergence: Its last chapter. American Economic Review 104 (4), 1091–1119.
URL http://www.aeaweb.org/articles?id=10.1257/aer.104.4.1091

Goos, M., Manning, A., Salomons, A., 2014. Explaining job polarization: Routine-biased technological change and offshoring. American Economic Review 104 (8), 2509–26.
URL https://ideas.repec.org/a/aea/aecrev/v104y2014i8p2509-26.html

Gregory, T., Salomons, A., Zierahn, U., 2019. Racing with or against the machine? Evidence from Europe. IZA Discussion Papers 12063.
URL https://www.iza.org/publications/dp/12063/racing-with-or-against-the-machine-evidence-from-eur

Hirsch, B., Jahn, E. J., Schnabel, C., 2018. Do employers have more monopsony power in slack labor markets? ILR

Review 71 (3), 676–704.
URL https://doi.org/10.1177/0019793917720383

Hyslop, D. R., Rice, A., 2019. Contributions of employment change to annual wage growth in New Zealand. Australian Economic Review 52 (1), 107–115.
URL http://onlinelibrary.wiley.com/doi/abs/10.1111/1467-8462.12310

Jacobs, D., Rush, A., 2015. Why is wage growth so low? RBA Bulletin.

Lagakos, D., Moll, B., Porzio, T., Qian, N., Schoellman, T., 2018. Life cycle wage growth across countries. Journal of Political Economy 126 (2), 797–849.
URL http://www.journals.uchicago.edu/doi/full/10.1086/696225

Lass, I., Wooden, M., 2019. Non-standard employment and wages in Australia. RBA conference paper.

Loprest, P. J., 1992. Gender differences in wage growth and job mobility. American Economic Review: Papers and Proceedings 82 (2), 526–532.
URL http://www.jstor.org/stable/2117456

Manning, A., 2003. The real thin theory: Monopsony in modern labour markets. Labour Economics 10 (2), 105–131.
URL http://www.sciencedirect.com/science/article/pii/S0927537103000186

Moscarini, G., Postel-Vinay, F., 2016. Wage posting and business cycles. American Economic Review: Papers and Proceedings 106 (5), 208–213.
URL http://www.aeaweb.org/articles?id=10.1257/aer.p20161051

Moscarini, G., Postel-Vinay, F., 2017. The relative power of employment-to-employment reallocation and unemployment exits in predicting wage growth. American Economic Review: Papers and Proceedings 107 (5), 364–368.
URL http://www.aeaweb.org/articles?id=10.1257/aer.p20171078

Moscarini, G., Postel-Vinay, F., 2018. On the job search and business cycles. IZA Discussion Papers 11853.
URL https://www.iza.org/publications/dp/11853/on-the-job-search-and-business-cycles

Pinheiro, R., Yang, M., 2017. Wage growth after the Great Recession. Federal Reserve Bank of Cleveland Economic Commentary (2017-04).
URL https://www.clevelandfed.org/newsroom-and-events/publications/economic-commentary/2017-economic-commentaries/ec-201704-wage-growth-after-great-recession

Treasury, 2017. Analysis of wage growth. Commonwealth of Australia Report.

Appendix A Additional Tables

Table A1
The role of worker characteristics in wage levels (Eq. (1)).

	Log hourly wage					
	(1)	(2)	(3)	(4)	(5)	(6)
Demographic characteristics:						
Age: reference group is $21 \leq age < 25$ years						
$25 \leq age < 30$ years	0.0717***	0.0728***	0.0724***	0.0687***	0.0660***	0.0674***
	(0.0055)	(0.0055)	(0.0055)	(0.0054)	(0.0053)	(0.0054)
$30 \leq age < 35$ years	0.1166***	0.1195***	0.1173***	0.1117***	0.1091***	0.1123***
	(0.0081)	(0.0082)	(0.0081)	(0.0080)	(0.0079)	(0.0080)
$35 \leq age < 40$ years	0.1218***	0.1244***	0.1226***	0.1167***	0.1161***	0.1185***
	(0.0101)	(0.0102)	(0.0100)	(0.0099)	(0.0098)	(0.0099)
$40 \leq age < 45$ years	0.1030***	0.1047***	0.1035***	0.0988***	0.0993***	0.1010***
	(0.0118)	(0.0119)	(0.0118)	(0.0117)	(0.0116)	(0.0117)
$45 \leq age < 50$ years	0.0712***	0.0740***	0.0716***	0.0678***	0.0675***	0.0700***
	(0.0135)	(0.0136)	(0.0135)	(0.0134)	(0.0134)	(0.0135)
$50 \leq age < 55$ years	0.0301**	0.0330**	0.0305**	0.0292*	0.0274*	0.0294*
	(0.0153)	(0.0154)	(0.0153)	(0.0152)	(0.0152)	(0.0153)
$55 \leq age < 60$ years	-0.0167	-0.0155	-0.0164	-0.0156	-0.0184	-0.0183
	(0.0174)	(0.0175)	(0.0174)	(0.0174)	(0.0173)	(0.0175)
$60 \leq age < 65$ years	-0.0633***	-0.0620***	-0.0634***	-0.0595***	-0.0629***	-0.0628***
	(0.0199)	(0.0200)	(0.0199)	(0.0198)	(0.0198)	(0.0199)
Education: reference group is < Year 12						
Year 12	-0.0407**	-0.0375**	-0.0408**	-0.0367*	-0.0343*	-0.0318*
	(0.0191)	(0.0187)	(0.0191)	(0.0188)	(0.0184)	(0.0181)
Cert III and IV	-0.0022	0.0000	-0.0021	-0.0010	-0.0005	0.0021
	(0.0135)	(0.0130)	(0.0135)	(0.0134)	(0.0133)	(0.0127)
Diploma and adv. diploma	0.0165	0.0149	0.0168	0.0173	0.0210	0.0189
	(0.0177)	(0.0169)	(0.0177)	(0.0175)	(0.0173)	(0.0165)
Bachelor, grad and postgrad	0.0377*	0.0408*	0.0377*	0.0338	0.0305	0.0332
	(0.0217)	(0.0212)	(0.0217)	(0.0213)	(0.0209)	(0.0205)
Wage indices:						
WPI		0.0061***				-0.0007
		(0.0020)				(0.0019)
AWOTE		0.0004*				0.0003
		(0.0003)				(0.0003)
AAWI		0.0091***				-0.0031
		(0.0035)				(0.0039)
Job characteristics:						
Contract type: reference group is permanent contract						
Fixed-term contract			0.0094**	0.0082**	0.0091**	0.0093**
			(0.0040)	(0.0039)	(0.0039)	(0.0039)
Casual contract			0.0173***	0.0218***	0.0223***	0.0196***
			(0.0060)	(0.0059)	(0.0058)	(0.0060)
Occupation: reference group is clerical and admin						
Managers				0.0437***	0.0409***	0.0413***
				(0.0053)	(0.0052)	(0.0052)
Professionals				0.0299***	0.0287***	0.0281***
				(0.0053)	(0.0052)	(0.0052)
Technicians and trades				0.0214***	0.0205***	0.0176**
				(0.0070)	(0.0069)	(0.0069)
Community and personal service				-0.0025	-0.0021	-0.0023
				(0.0089)	(0.0086)	(0.0086)
Sales				-0.0059	-0.0068	-0.0069
				(0.0073)	(0.0072)	(0.0072)
Machinery operators and drivers				0.0098	0.0074	0.0069
				(0.0081)	(0.0079)	(0.0080)
Labourers				0.0068	0.0067	0.0066
				(0.0082)	(0.0080)	(0.0083)

Table A1 (Continued)

	Log hourly wage					
	(1)	(2)	(3)	(4)	(5)	(6)
Job characteristics (Continued):						
Industry: reference group is public admin and safety						
Agriculture, forestry and fishing				-0.0902***	-0.0782***	
				(0.0180)	(0.0177)	
Mining				0.1129***	0.1071***	0.1034***
				(0.0173)	(0.0164)	(0.0165)
Manufacturing				-0.0200**	-0.0187**	-0.0197**
				(0.0092)	(0.0091)	(0.0091)
Electricity, gas, water and water supply				0.0277	0.0276	0.0271
				(0.0175)	(0.0171)	(0.0170)
Construction				0.0038	0.0037	0.0041
				(0.0096)	(0.0094)	(0.0101)
Wholesale trade				-0.0473***	-0.0451***	-0.0445***
				(0.0097)	(0.0095)	(0.0095)
Retail trade				-0.0829***	-0.0781***	-0.0804***
				(0.0104)	(0.0101)	(0.0104)
Accommodation and food service activities				-0.0891***	-0.0812***	-0.0822***
				(0.0130)	(0.0129)	(0.0132)
Transportation and storage				-0.0293***	-0.0263**	-0.0235**
				(0.0108)	(0.0105)	(0.0104)
Information and communication				-0.0050	-0.0030	-0.0052
				(0.0132)	(0.0131)	(0.0132)
Financial and insurance activities				0.0043	0.0054	0.0042
				(0.0123)	(0.0121)	(0.0121)
Rental, hiring and real estate activities				-0.0991***	-0.0912***	-0.0932***
				(0.0160)	(0.0156)	(0.0156)
Professional, scientific and technical activities				-0.0323***	-0.0305***	-0.0300***
				(0.0087)	(0.0085)	(0.0085)
Administrative and support service activities				-0.0534***	-0.0512***	-0.0517***
				(0.0098)	(0.0097)	(0.0098)
Education and training				-0.0461***	-0.0400***	-0.0383***
				(0.0121)	(0.0119)	(0.0120)
Human health and social work activities				-0.0330***	-0.0296***	-0.0299***
				(0.0093)	(0.0091)	(0.0092)
Arts and recreation service activities				-0.0637***	-0.0570***	-0.0582***
				(0.0139)	(0.0137)	(0.0138)
Other service activities				-0.0615***	-0.0600***	-0.0634***
				(0.0104)	(0.0103)	(0.0104)

Table A1 (Continued)

	Log hourly wage					
	(1)	(2)	(3)	(4)	(5)	(6)
Business cycle effects:						
Year 2002	0.0434***	0.0440***	0.0433***	0.0429***	0.0437***	0.0452***
	(0.0044)	(0.0045)	(0.0044)	(0.0044)	(0.0044)	(0.0045)
Year 2003	0.0924***	0.0905***	0.0926***	0.0924***	0.0938***	0.0946***
	(0.0050)	(0.0051)	(0.0050)	(0.0049)	(0.0050)	(0.0051)
Year 2004	0.1419***	0.1382***	0.1423***	0.1406***	0.1429***	0.1446***
	(0.0052)	(0.0054)	(0.0052)	(0.0052)	(0.0052)	(0.0055)
Year 2005	0.1982***	0.1924***	0.1985***	0.1966***	0.1993***	0.2018***
	(0.0055)	(0.0058)	(0.0055)	(0.0055)	(0.0055)	(0.0058)
Year 2006	0.2631***	0.2563***	0.2635***	0.2612***	0.2645***	0.2667***
	(0.0060)	(0.0062)	(0.0060)	(0.0059)	(0.0059)	(0.0062)
Year 2007	0.3362***	0.3306***	0.3368***	0.3335***	0.3368***	0.3381***
	(0.0063)	(0.0065)	(0.0063)	(0.0063)	(0.0063)	(0.0065)
Year 2008	0.3987***	0.3926***	0.3992***	0.3942***	0.3981***	0.4005***
	(0.0067)	(0.0069)	(0.0067)	(0.0066)	(0.0066)	(0.0069)
Year 2009	0.4503***	0.4438***	0.4509***	0.4461***	0.4502***	0.4530***
	(0.0070)	(0.0072)	(0.0070)	(0.0070)	(0.0069)	(0.0072)
Year 2010	0.5009***	0.4993***	0.5014***	0.4960***	0.4998***	0.5006***
	(0.0075)	(0.0077)	(0.0075)	(0.0075)	(0.0074)	(0.0076)
Year 2011	0.5476***	0.5457***	0.5483***	0.5419***	0.5463***	0.5485***
	(0.0078)	(0.0078)	(0.0078)	(0.0077)	(0.0076)	(0.0077)
Year 2012	0.5905***	0.5893***	0.5912***	0.5846***	0.5894***	0.5926***
	(0.0082)	(0.0082)	(0.0082)	(0.0081)	(0.0080)	(0.0081)
Year 2013	0.6246***	0.6271***	0.6253***	0.6181***	0.6218***	0.6239***
	(0.0086)	(0.0087)	(0.0086)	(0.0085)	(0.0085)	(0.0085)
Year 2014	0.6584***	0.6669***	0.6591***	0.6518***	0.6556***	0.6575***
	(0.0091)	(0.0093)	(0.0091)	(0.0090)	(0.0089)	(0.0091)
Year 2015	0.6961***	0.7081***	0.6970***	0.6896***	0.6939***	0.6951***
	(0.0094)	(0.0098)	(0.0095)	(0.0093)	(0.0093)	(0.0096)
Year 2016	0.7356***	0.7509***	0.7366***	0.7286***	0.7337***	0.7342***
	(0.0099)	(0.0104)	(0.0099)	(0.0098)	(0.0097)	(0.0103)
Year 2017	0.7729***	0.7897***	0.7738***	0.7657***	0.7712***	0.7708***
	(0.0103)	(0.0110)	(0.0103)	(0.0102)	(0.0102)	(0.0109)
Number of observations	75,108	73,898	75,108	75,108	75,108	73,898
Number of individuals	11,240	11,137	11,240	11,240	11,240	11,137
R^2	0.4918	0.4936	0.4920	0.4990	0.5077	0.5088
SA3 regional area FE	No	No	No	No	Yes	Yes

Notes: Each column gives output of a different FE regression. Parameter estimates are reported. Clustered (by individual) standard errors are in parentheses. ***,**,*, correspond to the significance level of 1%, 5%, 10%, respectively. The reference categories of female, age and education consist of workers who are male, aged 21 to 25 years and attained year 11, respectively. The reference categories of employment contract, occupation, job industry and year consist of workers with a permanent contract, managers, mining industry and year 2001, respectively. The regressions include zero-one indicator variables for Indigenous, born abroad, number of household members (3), marital status (5), number of own resident children (3), job industry (18), private sector, the SA3 regional location of the household (320) and calendar year (16). The year effects provided in Column 5 are used for Figure 4 and Figure B4 (nominal growth).

Appendix B Additional Figures

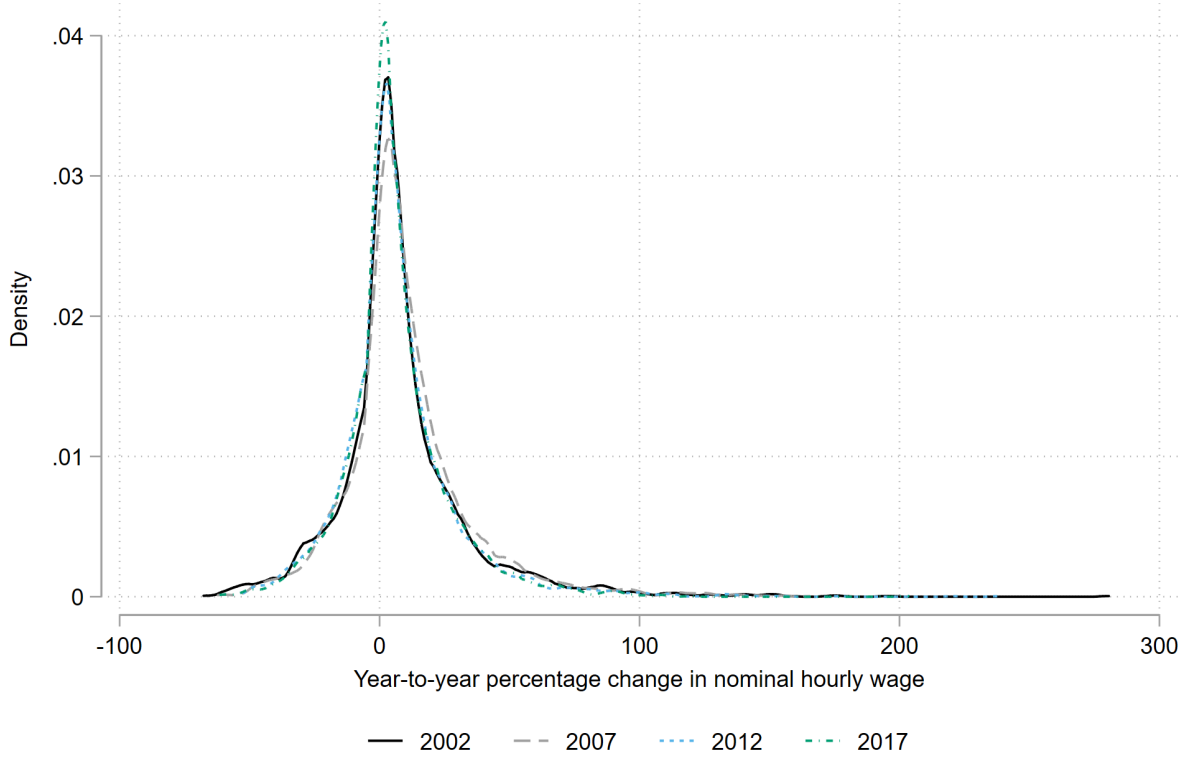


Fig. B1. Year-specific density plot of percentage change in nominal hourly wages (main job).
Notes: N=57,114.

Fig. B2. Year-to-year growth in median weekly nominal hourly wages over time by gender (main job). *Notes:* N=57,114.

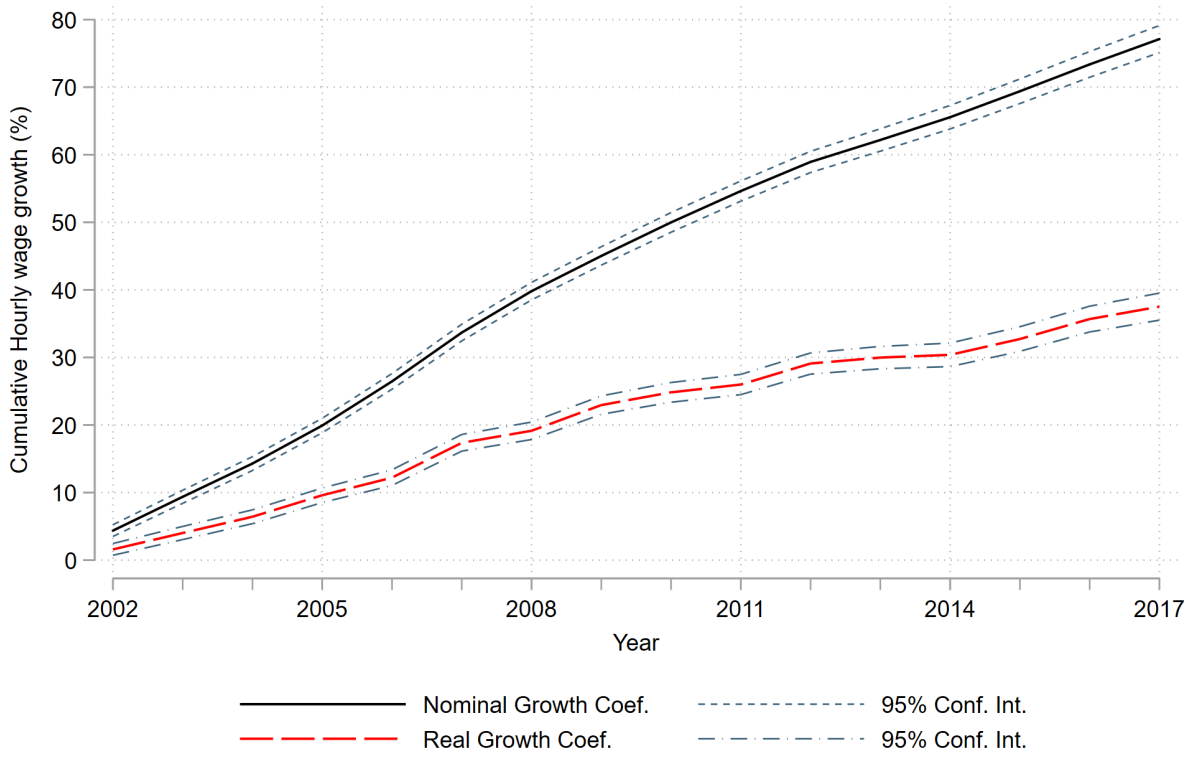


Fig. B3. Cumulative wage growth (Eq. (1)).
Notes: See Figure 4 for additional notes.

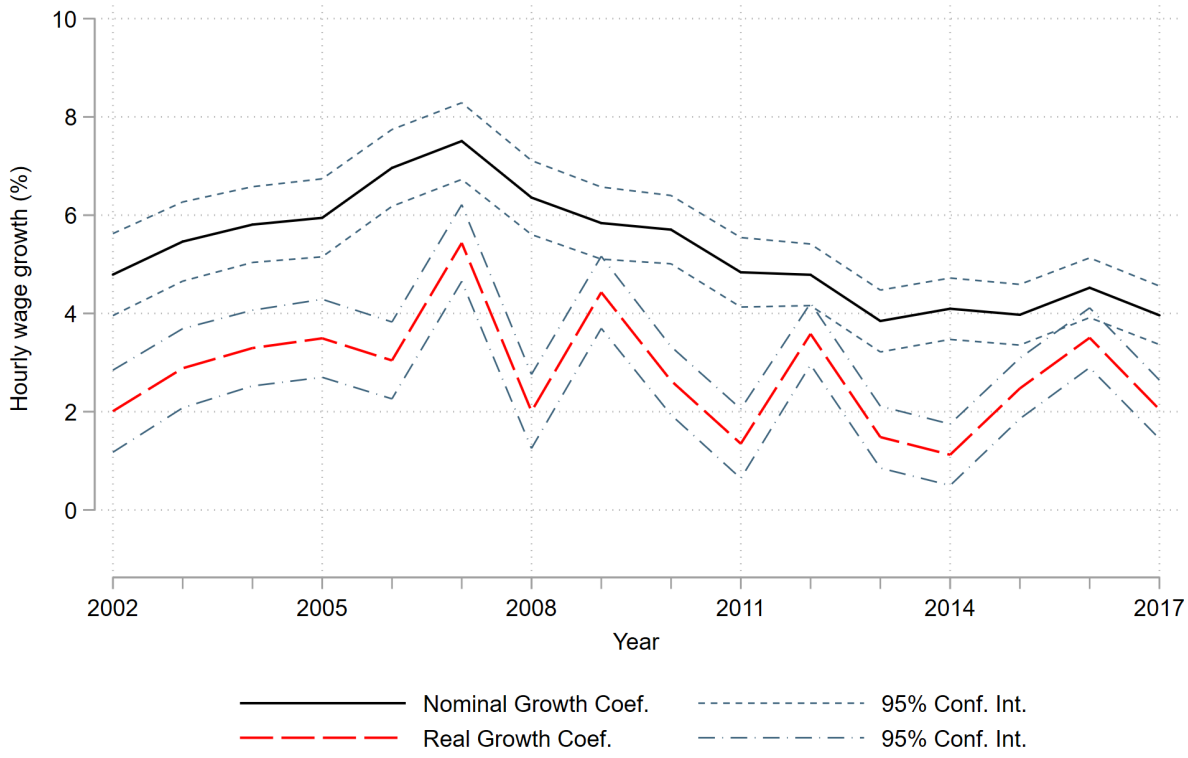


Fig. B4. Year-to-year wage growth (FD model, Eq. (3)).
Notes: The nominal and real wage coefficients are based on a FD regression (see Table A3 in Appendix A). The 95% confidence intervals are computed using clustered standard errors by individual. The regressions include zero-one indicator variables for age (8), education (4), number of household members (3), marital status (5), number of own resident children (3), type of contract (2), job occupation (7), job industry (18), private sector and the SA3 regional location of the household (320). The sample of analysis includes 57,114 individual-year observations and 10,671 unique individuals. R^2 equals 0.073 and 0.034 for the nominal and real wage growth model, respectively.