A higher education bubble?

The wage effect of the demand driven system

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Abstract

The human capital literature has often taken as sacrosanct that an increase in the number of years of schooling leads to an increase in the wage premium. However a less well-understood element of the research is whether a large increase in the supply of graduates will, over time, reduce the wage premium of a university degree. In this paper, we use a sudden policy decision by Australia's Federal Government in 2010, to expand the number of university places, to test the impact of an increase in the number of graduates on the wage premium of certain occupations. We analyse a longitudinal dataset of Australian taxpayers produced by the Australian Tax Office and find that completing a degree after the policy was introduced is associated with a log wage reduction of 8 percent. By occupations, we find that the negative effects persisted for engineering and accounting in all specifications of the model. Nursing and teaching were negative in most specifications of our model but were not robust to the inclusion of gender-cohort interactions.

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1 Introduction

World over, more and more students are being encouraged to take on a university qualification, as researchers and policy makers have extolled the financial benefits of the university degree. However it is unclear what the effect on wages will be from the introduction of policies that greatly expand access to university degrees. In this paper we investigate the financial outcomes of students who graduated before the introduction of the *demand driven system* in 2010, and compare these outcomes against students who graduated after the introduction of the policy. The demand driven system effectively uncapped the number of subsidised university places that could be offered to domestic undergraduate students in Australia. This paper provides initial evidence for the decline in the returns to higher education over the years since the introduction of a policy that expanded subsidised undergraduate places in Australian universities.

Standard economic theory suggests that a sudden increase in the supply of graduates within a specific occupation should affect the wages associated with that occupation, especially for new entrants. Our results show that the story is a bit more nuanced. Occupations with weaker wage bargaining structures were negatively affected by the introduction of the policy that uncapped undergraduate places. However for occupations that had relatively stronger wage bargaining systems, this effect was not robust.

In this paper we ask whether this increase in student enrolments and completions as a result of the introduction of the demand driven system had a negative impact on salaries of graduates, taking into account relevant person-level characteristics. In order to do this, we use the Australian Longitudinal Individual File (aLife). This paper is the first to use aLife data to review the financial outcomes of graduates under the demand driven system

and compare these with the cohorts that came before, and the associated wage premiums.

This is the first dataset of its kind to be released in Australia and is a sample of 10 percent of Australian taxpayers between 2000 and 2016. In order to identify graduates who completed before and after the uncapping, we created a measure using other variables within the tax files. When we looked at pooled cohorts, across all occupations, we find that those who graduated after the uncapping incurred a wage penalty, relative to those who graduated before. Overall we found that pre-reform wages were 9 percent higher than post-reform. Women in post-reform group do not have their wages discounted relative to women in the pre-reform group.

We refine the analysis by studying occupations that require a University degree.[1] The negative effect persists, in all model specifications for Engineering and Accounting graduates, but it is not robust for Nursing and Teaching. To some extent this could be explained by the tendency of occupations like Nursing and Teaching to be unionised, and wages determined through an enterprise bargaining agreement system which equalises wages in the industry. We also find that men who completed degrees after the uncapping experienced a 21 per cent log wage penalty relative to men in the pre reform category.
We present some robustness checks to test the validity of our results, and conclude with some caveats and options for further research.

The next section of the paper provides some background about the funding of the

[1]This allows us to be more certain that our sample contains only those who have graduated with at least a bachelor's degree. We have been working with the ATO to gain access to linked versions of the aLife dataset with a Department of Education module which will allow us to have better information on what courses were studied, where, and pinpoint year of completion. This will allows us to analyse all occupations and include more controls in our regressions. We expect to have this data early next year.

higher education system in Australia. Section 3 canvasses the literature on the returns to higher education in Australia and overseas. The data section will introduce the Australian Longitudinal Individual File (aLife) and explain the creation of the derived variables that are important in answering our policy question. The Methodology section will cover the regressions we used in this paper and explain the choice of variables. Section 6 presents the findings of the analysis, and the robustness checks. The final section concludes and presents some options for further analysis.

2 Background

The Higher Education System in Australia for the domestic undergraduate market is funded by both public and private contributions. The public funding takes the form of block funding to universities, through the Commonwealth Grant Scheme (CGS), which is dependent on the number of students enrolled. Private spending in higher education occurs primarily through an income contingent loan program called the Higher Education Loan Program (HELP) with subsidies from the government around lower rates of interest and write-off of doubtful debt.

More commonly referred to as HECS-HELP (at the undergraduate level), the program allows domestic undergraduate students to take on an interest-free loan to enrol in university courses, thereby incurring no up-front payments.[2] Students are only required to pay back this amount once they start earning above a certain threshold ($52,000 in 2017),[3] which is indexed annually. This system can be thought of as a co-payment between the government and individual where the private contribution is deferred through the HELP program. The amount that students contribute varies depending on the course of study undertaken.[4]

Introduced in 1989, the HELP system was designed to ensure that upfront fees would not deter students from enrolling in university qualifications [Chapman, 1997]. Undergraduate domestic places, prior to 2009, were allocated to universities by the government, based on need. This was considered by the government as being an inefficient system where the approval of the Education Minister was required for reallocating places between universities [Gillard, 2014].

[2] While interest-free, the debt is indexed to inflation

[3] Note that this threshold is due to change to 45,000 in 2019 with the rate of payment being 1 percent of annual wage.

[4] For a comprehensive review of the higher education system in Australia, see Mapping Higher Education Grattan Institute [Norton et al., 2014]

In 2009, the Gillard Government announced that it would be lifting the cap on the number of commonwealth supported places (CSP) for undergraduate students−places that attract a government subsidy−with a staged system of deregulation occurring between 2010 and 2012. This meant that a greater number of students would be able to apply to universities and be allowed to access the subsidised places. This decision, taken in response to the Bradley Review recommendations, was made in part because the existing system of allocation of places to universities was inefficient. Often simple requests such as moving 20-30 places from a university that wanted more places to a university that was willing to surrender it required sign off from the Education Minister [Gillard, 2014].

There was also a sense that the inequity in higher education attainment among people from disadvantaged backgrounds needed to be addressed and that the demand driven system of funding would help increase the attainment rates of students from low SES backgrounds [Bradley, 2008]. The Bradley Review also recommended that the government adopt a target of 40 percent tertiary attainment among Australians aged between 25 and 34 years. This was lauded at the time as a way of getting more students to benefit from the higher education wage premium [Yezdani, 2018].

2.1 Higher Education Finance

The higher education financing system has gone through numerous changes since its introduction in 1989 [Chapman, 1997].[5] Tested and tweaked over the years, the HELP system has helped ensure that credit constraints are not an issue for students seeking to undertake

[5]These changes included moving the system from a single uniform charge, irrespective of the course studied, to varied bands for different courses of study in 1996.

a higher education qualification [Norton and Kemp, 2014].[6]

A key outcome of the higher education loan program has been equity − that students, irrespective of their socio economic background, can access a high quality education. And, when they are able to, graduates should pay for the private benefits that they receive from their education [Chapman, 1997].

More recently the HELP program has provided a blueprint for other countries to follow, with some researchers advocating the benefits of using income contingent loans for other public policy issues such as legal aid, health care, entrepreneurship and social insurance [Barr et al., 2017, Higgins, 2014].

Successive governments from all sides of politics have continued to reform the program, making it easier for more students to benefit from tertiary education in Australia. For example, alongside the introduction of the demand driven system, the government introduced an allocation of funding devoted to supporting students from low socio-economic status (SES) backgrounds called the Higher Education Participation and Partnerships Programs (HEPPP). Under this program, universities applied for funding for initiatives designed to attract, retain and graduate students from low SES backgrounds within their institutions [Department of Education, 2018].

Notably, enrolment statistics show that these policies were correlated with an increase in the number of students from low SES background and the number of regional students who took on a higher education qualification [Department of Education, 2017].

Following significant public debate about reforms to the higher education sector, including a number of unsuccessful legislation attempts, the Turnbull Liberal government

[6]Note that the HELP system is now offered at the Postgraduate and the vocational education levels. In a review of the demand driven system in 2014, Norton and Kemp recommended that extending the demand driven system to "pathway courses" (sub bachelor places) would ensure that students who wanted to get better prepared for university would not be unduly financially penalised for doing so.

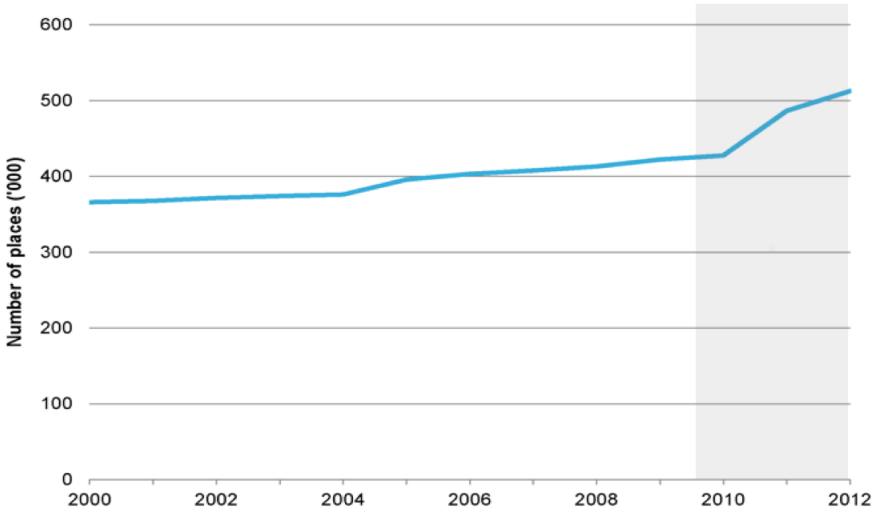
announced, in its 2017 mid year economic and fiscal outlook (MYEFO) statement, a freeze in the indexation of the Commonwealth Grant Scheme (CGS) [ABC News, 2018]. This is expected to deal the university sector a large blow with some suggesting that it could lead to a drawback of the demand driven system, as universities are forced to offer fewer places to offset the reduction in their budgets [ABC News, 2018].

We can see from Figure 1 that the uncapping of the system, starting in 2010, was associated with a rapid increase in the take-up of subsidised undergraduate places. While the university sector has seen an increase in enrolments, the VE system has seen a decline in enrolment rates [NCVER, 2018]. In 2016, 261,000 new domestic students commenced a bachelor undergraduate degree at an Australia university, and given current trends this is expected to increase. However, it is also anticipated that about 50,000 students will not go onto to complete their qualification [Cherastidtham et al., 2018]. Cherastidtham et al. [2018] identify that the characteristics associated with non completion were students undertaking study part time and that students with ATARs[7] below 60 were twice as likely to drop out than otherwise similar students who had ATARs above 90.

Given the recent MYEFO cuts to higher education funding, this is an opportune time to reflect on whether the demand driven system policy has benefited all students equally. Are all students likely to benefit from improved access to higher education qualifications and the expansion of educational opportunity? Our paper seeks to answer this question.

[7] Australian university entrance rank

Figure 1: Up tick in enrolments since 2010



Source: Parliamentary Library (2015)

3 Literature Review

In 1997, 96 percent of male and 77 percent of female HELP debts were expected to be paid by the time the graduates were aged 65 years. However, the amount of doubtful debt (debt that the government expects to not collect) is estimated to be 17 percent of all new lending [Norton and Cherastidtham, 2014]. Since the introduction of the demand driven system government policy has had to be reactive to the fiscal challenges of the uncapping – including putting forward recommendations to deregulate fees in the undergraduate market, which would allow universities to charge as much as they liked, and ramping up efforts to collect debt from HELP debtors who are living overseas [Australian Government, 2018a,b]. The government, in August 2018, passed legislation to reduce the lowest threshold for payment of HELP debt to $45,000 [Australian Parliament, 2018].

The UK Government's Department of Education conducted analysis on a longitudinal dataset of outcomes of students that graduated from UK universities at the institution level [UK Government Department of Education, 2018]. They found that the post graduate destinations of students had not changed much over a 10-year period.While the median for most degrees has been in the GBP 20,000-30,000 range, there have been some outliers like Medicine and Dentistry in the GBP 50,000-60,000 bracket. However these estimates only hold for the institution level and not individual level. Our paper adds to this literature by conducting this analysis at the individual level.

Investigating the returns to education around the word, World Bank researchers found that the returns to schooling are higher for countries where the economy is dependent on agriculture. The study found that the return to a tertiary education was much lower in rich countries than it was in agrarian or resource rich countries [Montenegro and Patrinos, 2013]. Brown et al. [2015] estimate the returns to income using a lifecycle model that estimates accumulation of income for persons across their working life (between 22 and 65 years) for the US. They find that the gains to education, once accounting for taxation is much lower than the literature suggest (of the order of approximately USD 400,000) above what a high school graduate would earn [Brown et al., 2015]. Furthermore, the rise in expected earnings was offset by increase in earnings risk (probability of finding employment), which points to a reduction in the value of education [Brown et al., 2015].

In Australia, the wage premium to higher education is strong, with some estimates suggesting that high school leavers can earn up to $1.2 million more over the course of their lifetime by taking up a university qualification [Cassells et al., 2012]. It is therefore understandable that policymakers would like to see many more students benefit from expanded access to higher education.

It has since transpired that a university education, in addition to conferring a wage premium, is now a necessary ticket of entry into most professional jobs [Caplan, 2017]. This has led some to suggest that there is a kind of credential inflation at play in the labour market, though this has not necessarily translated into higher levels of workforce productivity [Caplan, 2017].

Recent literature has begun to question the dominance of university as a higher education destination. This is especially the case in instances where students forego other more lucrative careers because of the prestige value of universities [Caplan, 2017].

This debate has particularly taken off in the US where the sticker price of American college increased nearly 400 per cent in the last 30 years [Thompson, 2017]. The returns to education, while higher than they have been in the past, has stopped growing since the 2000s. Some authors have attributed this to other movements in the labour market like the shift away from medium skilled occupations driven by technological change, and a reduction in the demand for cognitive skills[Valletta, 2016].

Often referred to as the bubble in higher education, there have been many (spirited) debates about how the increased access to education affects the wage premium associated with it, and if the entry of more and more people into the system negatively affects the earnings for all[Caplan, 2017, Thompson, 2017].

To our knowledge, no study has been able to disentangle this relationship. The Australian policy change between 2010 and 2012 provides a good natural experiment to test the effect of a rapid increase in the number of domestic undergraduate subsidised places on

graduate outcomes. Today, almost 8 years after the policy was introduced, we have data on the first waves of the students who enrolled under the the demand driven system, and their financial outcomes in the labour market.

4 Data

4.1 aLife

aLife is a 10 percent sample of tax-paying individuals, and follows them over the years 2000-2016. It is a de-identified dataset that provides approved researchers with access to tax and superannuation data, from the Australian Tax Office, via a secure virtual environment.[8]

The file contains information about the occupation of the individuals (4 digit level), the broad location area, the superannuation balances, and importantly for our purposes, the level of HECS debt they have with the ATO. The richness of the data and the relative speed with which the policy was introduced allows us to identify the changes in the returns to earnings since the introduction of the demand driven system and determine whether the cohorts that graduated after its introduction experienced a reduction in their wages.

The literature has been scarce on exploring the likely impact of the demand driven system on the outcomes of students. The existing longitudinal data files which are based on surveys do not have the sample size required to investigate this question. The ATO Longitudinal file (aLife) provides researchers with a unique opportunity to gain insights in

[8]The file is a sample of tax records that have been stripped of names, addresses and other identifying details. The data is also protected through rigorous training modules that approved researchers have to complete to ensure that the data and results are extracted in a way that does not compromise the security of the individuals [Australian Tax Office, 2018].

policy questions that were previously unanswerable because of the long lead times associated with surveys and the small number of observations these usually contain.

For example our study looks at the people aged 18-28 years in 2008, and continued to follow them till they turned 26 -36 in 2016. We then examined the categories by different occupations and added in local labour market measures as a control. In our data, this sample consists of about 300,000 total observations. By contrast, Australia's most popular longitudinal dataset - the Household of Income and Labour Dynamics in Australia (HILDA) - has in total 15,000 observations, across all age groups. The ATO file covers the whole gamut of the wage earning population whereas existing surveys only cover a small proportion.

In a research paper to the National Academy of Education, Professor Susan Dynarski a prominent US education economist espouses the benefits of administrative datasets that are matched over time to create longitudinal student-level data. According to Dynarski, a commitment to linking the (National Centre for Education Statistics) NCES longitudinal surveys to administrative data would broaden their scope, increase their accuracy, and enhance their usefulness to researchers and policy makers [Dynarski, 2014]. The aLife dataset marks the first time data of this nature has been made available to researchers in Australia, and this paper is the first to use this data to estimate the impact of the demand driven system on the outcomes of students.

4.2 Classifying tax lodgers who had a HELP debt

While administrative longitudinal data has a number of advantages, such as large sample size, smaller measurement errors and a longitudinal structure, it does not have the same level of detail as survey data. The richness provided by survey data is hard to replicate with administrative data.

aLife does not record when someone has finished a degree or what they studied.[9] But we do have information on their HELP debt amounts and whether this was increasing, decreasing or staying relatively constant over the period of observation.
The structure of the HELP system and the way the information on students debt is collected and recorded, we were able to create rules around the HELP loan variable that allowed us to obtain the information we required.

An additional control we applied was to limit our research to four occupations that required a bachelor's degree to attain employment − Teaching, Nursing, Engineering and Accounting. Because of this rule, we do not necessarily need to have a "completion of degree" variable in the data as the taxlodger would have had to complete their degree to be employed in that field.

Second we created a few variables that allowed us to identify if the person had completed their degree, or were still studying.

Completion of degree

A key variable of our paper is identifying those who graduated before and after the uncapping of the system (pre-reform and post-reform). Our identification strategy in this paper is dependent on accurately identifying whether the taxlodgers completed their qualification

[9] We have been working with ATO to obtain an enhanced version of the dataset which will contain this information

before or after the uncapping, which is then added into our regression.

Figure 2 outlines a few case studies to make the process of creating the variable clearer. We coded the cohort variable such that it took on a value "pre-reform" if the person's loan amount reached a peak between 2008 and 2011, and "post-reform" if the person's loan amount reached a peak between 2012 and 2015.[10] We excluded from our analysis any loan amounts that were less than $10,000 and greater than $45,000 so that there were no non-completers or postgraduate degree holders in our sample.[11]

We expect that this rule combined with a specified range on loan amounts ($10,000-$45,000), and limiting our focus to professions that required an undergraduate degree to be employed (Nursing, Accounting, Teaching and Engineering), will give us an accurate grouping of the sample into those that completed before and after the policy change.[12]

4.3 Summary Statistics

This section presents some summary statistics of the data that we investigate in this research paper. The total size of the sample of 18-28 year olds in 2008 to who were 26-36 years in 2016 was about 330,000 observations. Accounting for missing information and observations that dropped out over that time, our final sample size reduced to about 25,000 observations. Most of the attrition out of our sample occurred because we removed those

[10] As the years progress and more data becomes available, we intend to expand the period over which we research student outcomes.

[11] This will not catch all double degree holders. but this is irrelevant for our research as long as one of the degrees completed pertains to their employment which, by design, it does

[12] Note that teachers here corresponds to the four digit ASCO for Primary, Secondary School and Special Education Teachers; Engineering includes Chemical and Materials Engineers, Civil Engineering Professionals, Electronics Engineers, Electrical Engineers, Other Engineering Professionals, Mining Engineers, Industrial, and Mechanical and Production Engineers; Nursing includes Registered Nurses and Midwives and Accounting includes Accountants, as per the ANZSCO code.

Figure 2: Schematic of cohort code

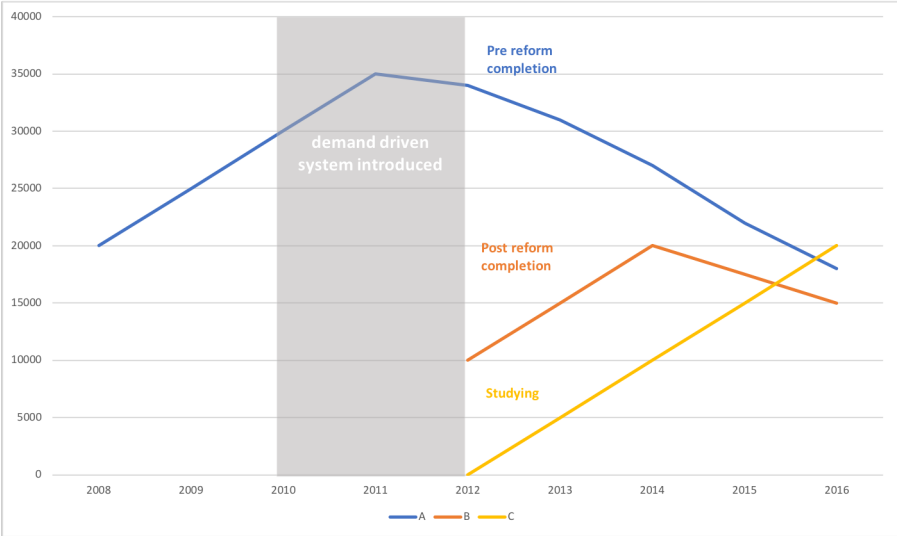
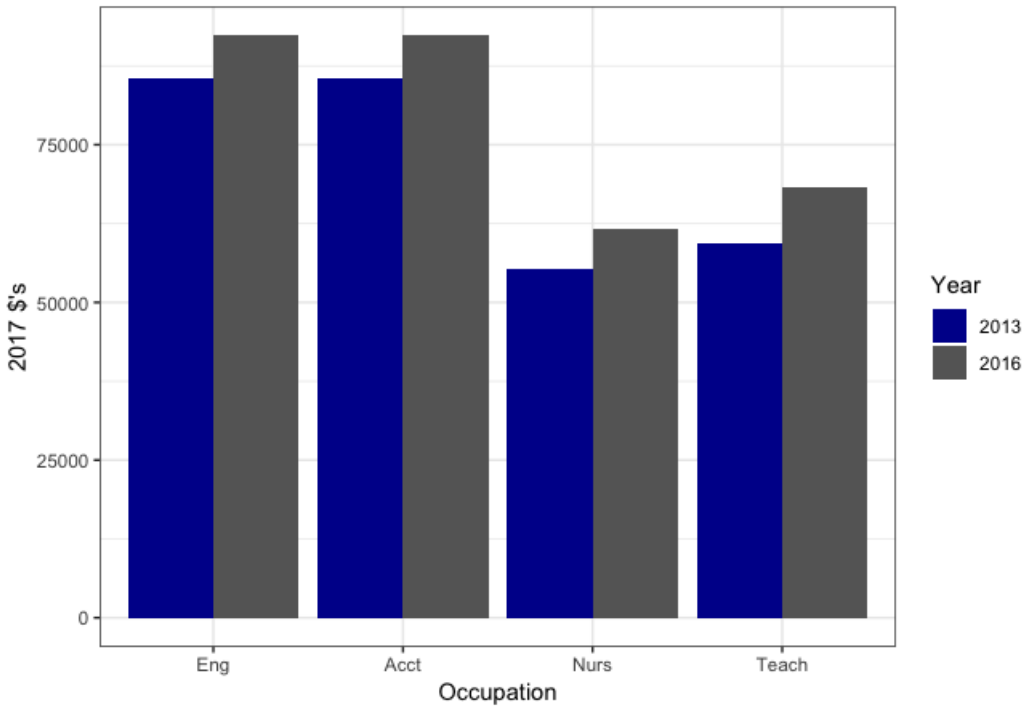


Table 1: Rules for creating studying and cohort variables

`pmax_h_loan`	gives a max value for the `h_loan_year` variables
`highest_loan`	the year for which the loan was highest, thereby indicating possible completion (has to be over 10000-weed out non completers, but under 45000-to weed out postgraduate)
`studying_3`	identifies if person was studying over the time period of the sample by looking at the outstanding help amount
`cohort_code`	assigns a cohort code based on `highest_loan`

Figure 3: Wages between pre and post cohort by occupation



Source: ALIFe(2018)

who did not have a university degree and, those who did not respond to key variables in our analysis. Table 2 presents the summary statistics for the Pre-reform and Post-reform cohort by each of the continuous variables we considered in the model. The wages for each occupation by pre and post cohort is given by Figure 3.

Note that the pre-reform cohort observations are, on average, older, earn more and have more super than the post-reform cohort. This is in line with what we expect as the pre-reform cohort have been in the workforce for longer than the post-reform cohort. We present the sample sizes for the cohorts by occupation in the brackets below the average age values.

Table 3 presents the summary statistics for the different categorical variables in the

Table 2: Summary statistics for continuous variables

Age	**Pre-reform**	**Post-reform**
Accountants	29.25	27.17
	(2087)	(1037)
Engineers	29.16	26.56
	(1976)	(1074)
Nurses	28.96	27.15
	(2682)	(1140)
Teachers	29.44	27.16
	(4306)	(2902)
Other	29.43	27.45
	(30,978)	(21,188)
Super	($'s)	($'s)
Accountants	46,076	27,237
Engineers	53,255	25,725
Nurses	46,793	27,343
Teachers	44,145	23,434
Other	45,388	23,921
Wage	($'s)	($'s)
Accountants	83,669.72	67,507.47
Engineers	100,294.79	77,265.82
Nurses	61,949.00	58,540.71
Other	72,066.99	56,517.97
Teachers	66,745.63	60,675.07

dataset. We present the counts for each of the variables by pre-reform and post-reform category.

Table 3: Counts of discrete variable (share in brackets)

Gender	**Pre-reform**	**Post-reform**
Male	17,487	11,196
	(61)	(39)
Female	24,542	16,145
	(60)	(40)
Primary Earner		
Primary Earner	11,668	4,194
	(74)	(26)
Not Primary Earner	10,098	4,212
	(71)	(29)
Not applicable	20,263	18,935
	(52)	(48)
Partnered Status		
No info	20,261	18,932
	(52)	(48)
Spouse for full year	20,671	7,738
	(73)	(27)
Partnered	906	572
	(61)	(39)
State		
VIC	11,150	7,821
	(59)	(41)
NSW	12,355	8,091
	(60)	(40)
TAS	669	419
	(61)	(39)
NT	313	210
	(60)	(40)
WA	4,598	2,662
	(63)	(37)
ACT	1,299	840
	(61)	(39)

5 Methodology

To answer our research question we look at cohorts of graduates who started university before the policy came into effect and comparing this with the earnings of the cohort that came after the policy came into effect. The introduction of the demand driven system can be thought of as a pseudo natural experiment that greatly expanded access to higher education. Universities, post-2012, could enrol as many students as they saw fit and, in response, there was a large increase in the take-up of these subsidised place.

To estimate the changes to the returns to education, we use a linear model and regress person level characteristics on the log wage. We run this model for salaries in the cohort that graduated before and after the policy change, and use a cohort dummy variables to identify those who graduated post-reform and pre-reform.

In all of these regressions, the key variable of interest is the post reform cohort variable. This was constructed to identify those who completed before (2008-2011) and after the reform (2012-2015). A negative value for the 2016 cohort indicates that controlling for all other person level characteristics, completing an undergraduate degree in the 2016 cohort was associated with a reduction in the returns to tertiary education.

The methodology we propose here is similar to that used by Hanushek et al. [2015] to investigate worker displacement effects on different age groups from plant closures. It relies on adequately identifying the treatment variable which, in our case, is the post-reform variable.

The format of our basic pooled linear model is as follows

$$ln(Y_{it}) = \alpha_t \text{post-reform} + \beta_I X_{it} + \epsilon_{it} \tag{1}$$

where Y_{it} is wages post-reform is the cohort dummy, X_{it} is a vector of person level characteristics

We then run a model with an interaction effect for the post reform variable and occupation.

$$ln(Y_{it}) = \alpha_{0t}\text{post-reform} + \alpha_{1t}\text{post-reform} \times \text{occupation} + \beta_I X_{it} + \epsilon_{it} \tag{2}$$

And for each occupation, j, we run the following regression

$$ln(Y_{it}|j) = \alpha_{0t}\text{post-reform} + \beta_t X_{it} + \alpha_{1t}\text{post-reform} \times gender + \epsilon_{it} \tag{3}$$

We also included the taxlodgers superannuation balance into our X_{it} vector. And Z_{it} contains measures of the local labour market, in this case unemployment rate amongst 15-34 year olds by Statistical Area Level 4 area classification for 2013 and 2016 [Australian Bureau of Statistic, 2018].

$$ln(Y_{it}) = \alpha_t\text{post-reform} + \gamma_t Z_{it} + \beta_I X_{it} + \epsilon_{it} \tag{4}$$

6 Results

The key question of our paper concerns the impact of an increase in subsidised places on the wage premium associated with a higher education degree. The first set of regressions presents a basic model where person-level characteristics are regressed against the log wage of persons in the cohort. The variable of interest here is the post-reform variable. If the post reform variable is negative, this shows that, controlling for all other effects, completing a qualification and entering the labour market after the policy was introduced had a negative impact on the wages earned, when compared to those that came before.

We present the first set of regressions from the base model in the first column of Table 4. Being in the post reform cohort had a negative coefficient, which implies that graduating after the reform was introduced was associated with a reduction in wages earned of about 20 per cent of log wage. We also find being male was associated with a positive coefficient, as was being a primary earner. We control for the interaction effects between male and primary earner and find these to be positive and significant, suggesting that male primary earners earned more than women, and this remained true in all versions of our model.

In the second iteration of the model (second column of Table 4), we run the same basic model but add in superannuation balance, with the expectation that this will allow us to control for experience and time spent in the formal labour market.[13]
We find a reduction in log wage of the post reform cohort of about 9 percent when including controls for superannuation balance.

[13]We also experimented with starting salaries, i.e., the salary and wages value after the person had completed their degree. However we found this to be unreliable as there were a number of zero observations. This is likely due to the gap in completion of qualification and starting employment. In future iterations of this paper, with linked education data from the ATO, we expect this to be less of an issue

The next iteration of the model (column 3) uses an interaction term between gender and cohort to estimate whether there was a noticeable impact of gender and being in either cohort on wages. The coefficient associated with being male and in the post-reform cohort was associated with a reduction in log wage of about 21 percent.

The final column of Table 4 displays the coefficients of the model after controlling for local labour market effects. The local labour market measures take the form of SA4 ID (Statistical Area Level 4) unemployment rates for 2013 and 2016 for those aged between 15 and 34 years of age [Australian Bureau of Statistic, 2018]. We see here that the post reform cohort variable still takes on a statistically significant negative values but the magnitude is much lower than in the first iteration of the model, though similar to the effects observed in model 2 and 3.

When looking at occupation, we find that the coefficient for Engineering is positive in all iterations of our base model relative to Accountants. Nursing and Teaching have statistically significant negative effects and these persist even after we add in controls for labour market and superannuation balance. This could be an indication that the strong wage performance of accountants might be affecting our results. A recent report from Seek [2018] suggests that accountants are some of the highest paid professionals in the country, and in particular in the ACT where they command 10 percent more than Consultants and strategists. This would also explain the negative coefficients associated with each of the state variables as these were run relative to the ACT as baseline (not displayed).
In all iterations of our model, men fare better than women in the labour market, with men earning between 8 and 17 percent more than women.

Table 4: Base regressions

	Dependent variable:							
	log_i_salary_wage							
	(†1)		(†2)		(†3)		(†4)	
Post	−0.204***	(0.014)	−0.087***	(0.014)	−0.008	(0.017)	−0.088***	(0.014)
Male	0.082***	(0.022)	0.097***	(0.021)	0.161***	(0.023)	0.097***	(0.021)
Prim.	0.353***	(0.015)	0.328***	(0.014)	0.331***	(0.014)	0.329***	(0.014)
Dep. child	−0.180***	(0.008)	−0.170***	(0.008)	−0.169***	(0.007)	−0.168***	(0.008)
Age	0.020***	(0.003)	−0.011***	(0.003)	−0.010***	(0.003)	−0.012***	(0.003)
Engineering	0.108***	(0.037)	0.100***	(0.036)	0.097***	(0.036)	0.101***	(0.036)
Nursing	−0.158***	(0.034)	−0.173***	(0.033)	−0.172***	(0.033)	−0.168***	(0.033)
Teaching	−0.118***	(0.030)	−0.096***	(0.029)	−0.097***	(0.029)	−0.090***	(0.029)
Log super			0.249***	(0.009)	0.248***	(0.009)	0.249***	(0.009)
Unemp 2013							−0.694***	(0.180)
Unempt 2016							−0.028	(0.174)
Male:Prim	0.090***	(0.027)	0.067***	(0.026)	0.047*	(0.026)	0.066**	(0.026)
Male:Post					−0.208***	(0.026)		
Constant	10.542***	(0.103)	8.746***	(0.117)	8.703***	(0.116)	8.797***	(0.117)
Observations	10,622		10,619		10,619		10,619	
R^2	0.216		0.274		0.278		0.275	
Adj R^2	0.214		0.272		0.276		0.273	
Resid Std. Err	0.576 (df = 10601)		0.554 (df = 10597)		0.552 (df = 10596)		0.554 (df = 10595)	
F Stat	145.895*** (df=20;10601)		190.220***(df=21;10597)		185.442***(df=22;10596)		174.743***(df=23;10595)	

Note: *p<0.1; **p<0.05; ***p<0.01
State controls:†Yes

In Table 5 we present an alternative version of the model displayed in table 4 where we interact the post-reform variable with occupation. The first two columns are the same as that of table 4 and is included for comparison purposes.

Column 3 contains our estimates after including an interaction term for the post-reform cohort and occupation, and state controls. We see here that the Engineering post-reform cohort is negative (although not statistically significant). However the coefficient associated with being a nurse, and completing the qualification in the post reform period was positive, implying that on average nurses graduating in 2016 could earn up to 17 percentage points after controlling for other factors.

The fourth column in this table presents the effects observed after incorporating local labour market measures. Here again we see that the estimates are similar to those in column 3. It is possible that part of the reason for this similarity is that the state factor variables which we had included in previous versions of the model had already accounted for the area based variation.

One reason why nurses could have been positively affected by the uncapping was the strong growth of employment in the healthcare and social assistance sector, with the industry growing by about 22 percent in the five years leading to 2018. The mean growth rate across all industries over that same period was 7.1 percent [Department of Jobs and Small Business, 2018].

Table 5: Including Cohort:Occupation interaction terms

	Dependent variable:							
	log_i_salary_wage							
	(†1)		(†2)		(†3)		(§†4)	
Post	−0.204***	(0.014)	−0.008	(0.017)	−0.113*	(0.062)	−0.113*	(0.062)
Male	0.082***	(0.022)	0.161***	(0.023)	0.098***	(0.021)	0.098***	(0.021)
Prim.	0.353***	(0.015)	0.331***	(0.014)	0.329***	(0.014)	0.330***	(0.014)
Dep child	−0.180***	(0.008)	−0.169***	(0.007)	−0.170***	(0.008)	−0.168***	(0.008)
Age	0.020***	(0.003)	−0.010***	(0.003)	−0.011***	(0.003)	−0.011***	(0.003)
partnered	−0.017	(0.023)	0.015	(0.022)	0.013	(0.022)	0.011	(0.022)
Engineering	0.108***	(0.037)	0.097***	(0.036)	0.116***	(0.040)	0.118***	(0.040)
Nursing	−0.158***	(0.034)	−0.172***	(0.033)	−0.203***	(0.036)	−0.198***	(0.036)
Other	−0.100***	(0.026)	−0.092***	(0.025)	−0.090***	(0.028)	−0.088***	(0.028)
Teaching	−0.118***	(0.030)	−0.097***	(0.029)	−0.122***	(0.033)	−0.117***	(0.033)
Super			0.248***	(0.009)	0.249***	(0.009)	0.249***	(0.009)
Male:Prim.	0.090***	(0.027)	0.047*	(0.026)	0.065**	(0.026)	0.064**	(0.026)
Male:post					−0.208***	(0.026)		
Post:Eng.					−0.086	(0.089)	−0.090	(0.089)
Post:Nursing					0.164**	(0.083)	0.166**	(0.082)
Post:Other					0.008	(0.063)	0.007	(0.063)
Post:teachers					0.112	(0.071)	0.113	(0.071)
Constant	10.542***	(0.103)	8.703***	(0.116)	8.750***	(0.117)	8.802***	(0.118)
Observations		10,622		10,619		10,619		10,619
R^2		0.216		0.278		0.275		0.276
Adj. R^2		0.214		0.276		0.273		0.274
Resid. Std. Err,	0.576 (df=10601)		0.552 (df=10596)		0.554 (df=10593)		0.553 (df=10591)	

Note: *p<0.1; **p<0.05; ***p<0.01

State controls:†Yes Labour market controls: §Yes

In table 6 we analyse the returns to education over time, for each of the four selected occupations − Nursing, Accounting, Engineering, and Teaching, and analyse how these effects differ within the different occupations. This model includes controls for states and local labour market conditions. Engineering and accounting graduates suffered a drop in wages if they completed their degree after the reform. For nurses and teachers graduating post-reform resulted in an increase in wage, relative to those who completed in the pre-reform cohort. However this effect is not robust and when we interact gender with the post-reform cohort we find a negative effect for Nurses, Teachers and Accountants (though only statistically significant for Teachers).

These results suggest that, while our first model showed that the uncapping of places led to a reduction in the wage premium, the demand driven system's impact on wages varied by the occupation chosen. To some extent, this could also be explained by the characteristics of the occupation themselves. While engineering as a profession has a high barrier to entry,[14] the industry's wages are not as tightly controlled as those of teachers and nurses. It is likely that the enterprise bargaining agreements that cover teachers and nurses have helped insure employees against a significant reduction in the wage premium. In addition to the workplace relations structure of the occupation, both of these professions have also seen an expansion in the demand for their services. The health care and social assistance industry has posted strong growth of about 22.2 percent over the five years to August 2018, and teaching by 12.5 percent over the five years to August 2018 [Department of Jobs and Small Business, 2018]

[14]Bachelor degree with honours and accreditation by the peak body

Table 6: Local labour market by occupation

	Dependent variable:							
	log_i_salary_wage							
	(Engineers)		(Accountants)		(Nurses)		(Teachers)	
Post	−0.485***	(0.138)	−0.071	(0.080)	0.107*	(0.061)	0.103**	(0.051)
Male	0.105	(0.082)	0.193**	(0.085)	0.064	(0.169)	0.295***	(0.081)
Prim.	0.345***	(0.088)	0.329***	(0.058)	0.338***	(0.043)	0.250***	(0.038)
Dep. child	−0.076***	(0.025)	−0.230***	(0.032)	−0.223***	(0.026)	−0.198***	(0.024)
Age	0.027**	(0.011)	0.007	(0.013)	−0.063***	(0.014)	−0.039***	(0.012)
Partnered	−0.033	(0.056)	0.011	(0.070)	0.027	(0.082)	0.043	(0.067)
NSW	0.196	(0.163)	−0.044	(0.132)	−0.064	(0.169)	−0.063	(0.111)
NT	0.225	(0.260)			−0.142	(0.225)	0.086	(0.264)
QLD	0.214	(0.163)	−0.005	(0.135)	−0.321*	(0.171)	−0.156	(0.114)
SA	0.104	(0.172)	−0.193	(0.151)	−0.212	(0.174)	−0.077	(0.120)
TAS	−0.022	(0.261)	−0.071	(0.209)	−0.225	(0.195)	−0.086	(0.166)
VIC	0.085	(0.164)	−0.149	(0.133)	−0.388**	(0.169)	−0.141	(0.113)
WA	0.416**	(0.166)	0.002	(0.146)	−0.230	(0.175)	−0.165	(0.122)
log superannuation	0.158***	(0.027)	0.184***	(0.032)	0.450***	(0.057)	0.364***	(0.043)
Unempt 2013	−0.281	(0.631)	−0.231	(0.752)	−1.748***	(0.606)	−0.569	(0.465)
Unempt 2016	0.973	(0.603)	−0.733	(0.755)	1.394**	(0.603)	0.099	(0.430)
Male:Postreform	0.359**	(0.141)	−0.156	(0.107)	−0.215	(0.209)	−0.363***	(0.089)
Male:Primary earner	−0.073	(0.106)	−0.066	(0.099)	0.181	(0.186)	−0.070	(0.091)
Constant	8.466***	(0.374)	9.016***	(0.460)	8.087***	(0.533)	8.321***	(0.424)
Observations	481		512		697		1,345	
R^2	0.379		0.310		0.358		0.192	
Adjusted R^2	0.354		0.285		0.340		0.180	
Resid. Std. Err	0.353(df=461)		0.462 (df=493)		0.511 (df=677)		0.589 (df=1324)	
F Statistic	14.821*** (df=19;461)		12.321*** (df=18;493)		19.855*** (df=19;677)		15.781*** (df=20;1324)	

Note: *p<0.1; **p<0.05; ***p<0.01

7 Robustness checks

In this section we discuss some of the robustness checks that were conducted as part of the research conducted in this paper. Our first step was to tighten the cohort definitions. In the base model and all of the models we have run so far, we assumed that the pre reform cohort was anyone who completed between 2008 and 2011. To check the sensitivity of our analysis to changes to this, we experiment with an alternative time frame and change the pre reform cohort to anyone graduating between 2008 and 2011 and the post cohort to anyone graduating between 2013 and 2015.

We find that the completing a degree and earning a wage after the reform is associated with a negative coefficient; implying a wage 85 percent of that earned by those that graduate in the pre reform cohort, relative to 92 percent in our base model in Table 4.

We also note here that, from the earlier regressions in tables 4 and 5, controlling for area-based labour market effects did not dampen the reduction in wages estimated from the uncapping for engineers and accountants.

We were also curious about whether zero inflated numbers in terms of the people earning zero wages were having an impact on our estimates so we re-ran these models,, by occupation, including zero-wage values. The results of this set of regressions is available in Table 8 of the appendix.[15]

[15] We took this one step further and ran probit models to test whether there were any significant predictors of employment. However we find that the number of zero counts on wages in each of the professions chosen was low. This can be explained by the very nature of tax returns - one generally needs to earn a wage to be considered employed in an occupation. It would be unusual that a person's occupation would be recorded as being an engineer, for example and they would be earning a zero wage. These results are available from the author upon request.

Table 7: Robustness Checks

	Dependent variable:	
	log_i_salary_wage	
Post	-0.145^{**}	(0.056)
Male	0.188^{***}	(0.017)
Prim. Earn	0.476^{***}	(0.011)
Dep. child	-0.160^{***}	(0.005)
Age	0.019^{***}	(0.002)
Partnered	0.031	(0.020)
ACT	0.004	(0.208)
NSW	-0.186	(0.207)
NT	-0.150	(0.212)
QLD	-0.240	(0.207)
SA	-0.293	(0.207)
TAS	-0.294	(0.209)
VIC	-0.304	(0.207)
WA	-0.179	(0.207)
Engineers	0.050^{*}	(0.030)
Nurses	-0.217^{***}	(0.027)
Teachers	-0.188^{***}	(0.025)
log super	0.056^{***}	(0.003)
Male:Prim. earn	0.009	(0.021)
Postreform:Engineers	-0.042	(0.080)
Post-reform:Nurses	0.154^{**}	(0.075)
Post-reform:Teachers	0.122^{*}	(0.064)
Constant	10.050^{***}	(0.217)
Observations	24,616	
R^2	0.243	
Adjusted R^2	0.242	
Residual Std. Error	0.654 (df = 24589)	
F Statistic	303.851^{***} (df = 26; 24589)	
Note:	*p<0.1; **p<0.05; ***p<0.01	

8 Conclusion

In this paper we present some initial evidence of how the wage premium associated with a higher education degree was affected by a significant expansion in subsidised undergraduate places. We find that, on the whole, graduating after the uncapping was associated with a reduction in log wage of 8 per cent.

In all iterations of our model, men fare better than women in the labour market, with men earning between 8 and 17 percent more than women.

Looking at specific occupations we find that the story is a bit more nuanced. Engineering graduates suffered a drop in wages if they completed after the reform, however, male engineers were better off. Further while Accountants, Teachers and Nurses seemed to be better off after the policy, introducing interaction terms between gender and the post reform variable revealed negative effects for male nursing graduates.

It appears that the occupations that have stronger wage bargaining structures were not as badly affected by the uncapping of the system, relative to occupations with weaker bargaining structures. Notably, over the same period, industries of healthcare and social assistance and education and training posted strong growth rates which may have resulted in an increased demand for the skills of nurses and teachers [Department of Jobs and Small Business, 2018].

Answering whether or not the demand driven system has been good for undergraduate students is inherently difficult and beyond the scope of this paper. However we are able to say that there is some evidence to suggest that there is a downward impact on wages for those students who graduated after the uncapping.

It has been suggested that the demand driven system has encouraged students to em-

bark on a university qualification without having the necessary academic preparedness to do so. And that students have likely foregone far more suitable options such as a trade qualification through the Vocational education system. In future iterations of this paper we hope to explore this question further.

Appendices

aLife

aLife, the Australian Longitudinal Individual File, is a new longitudinal tax data file created by the Australian Tax Office (ATO). The data is a ten percent sample of individual taxfilers living in Australia.

The ATO announced in December 2016 that they would be making a longitudinal tax file available to researchers, as part of a push to make government data more accessible to researchers. In a submission to the Productivity Commission's report on data privacy, they revealed that approved researchers would be able to access and analyse deidentified tax record data within the secure environment. However researchers would only be permitted to publish aggregate results once these have been verified by the department [ATO, 2018].

Process of attaining access to aLife data

In order to access the data we were required to submit an application to the ATO outlining the specific goals of the project and how the research would benefit the community. Accessing the data also required ethics approval from the university.

SURE environment

The data was made available through the Sax Institute's Secure Unified Research Environment (SURE), which allows researchers to access the data through a virtual environment. Analysis can only be run within the environment and there are strict protocols around what kind of analysis can be taken out of the environment. For example any descriptive statistics of the sample could only be run if the groupings had over twenty observations.

This is also why we were unable to present any regression diagnostics or scatter plots of the data in this paper.

We conducted our analysis for this paper in R. We used a series of markdown files which allows the user to embed code alongside the results of the analysis in an html format. To export the data out of the environment, we were required to complete an output clearance form for the ATO's records, and upload the html to the SURE website internally. The ATO, once it was satisfied that the results did not compromise the privacy of the individuals in the dataset, would release the results of this. The process of results approval could take anywhere between one day, and a week depending on the timelines of the ATO.

Supplementary tables

Table 8: Regression results including zero-wage values

	Dependent variable:							
	log_i_salary_wage							
	(1)		(2)		(3)		(4)	
Post	−0.472	(0.320)	−0.070	(0.145)	0.129	(0.091)	0.127**	(0.057)
Male	0.064	(0.190)	−0.109	(0.152)	0.117	(0.254)	0.306***	(0.090)
Prim	0.362*	(0.205)	0.293***	(0.105)	0.393***	(0.064)	0.255***	(0.042)
Dep child	−0.131**	(0.059)	−0.249***	(0.058)	−0.200***	(0.039)	−0.217***	(0.026)
Age	0.022	(0.026)	0.010	(0.024)	−0.077***	(0.021)	−0.041***	(0.013)
Partnered	−0.003	(0.129)	0.070	(0.128)	0.052	(0.122)	0.050	(0.074)
NSW	0.074	(0.379)	−0.094	(0.239)	−0.141	(0.254)	−0.050	(0.123)
NT	0.192	(0.339)			−0.166	(0.339)	0.099	(0.292)
QLD	0.177	(0.380)	0.018	(0.244)	−0.345	(0.257)	−0.152	(0.126)
SA	0.091	(0.400)	−0.153	(0.274)	−0.222	(0.262)	−0.071	(0.133)
TAS	−0.108	(0.608)	−0.067	(0.379)	−0.233)	(0.292)	−0.082	(0.183)
VIC	−0.045	(0.381)	−0.116	(0.241)	−0.461*	(0.253)	−0.130	(0.125)
WA	0.446	(0.385)	−0.182	(0.264)	−0.253	(0.263)	−0.238*	(0.134)
Log super	0.189***	(0.063)	0.220***	(0.058)	0.445***	(0.086)	0.390***	(0.048)
Unempt 2013	1.838	(1.458)	0.212	(1.361)	−2.120**	(0.910)	−0.510	(0.514)
Unempt 2016	−0.532	(1.394)	−1.126	(1.365)	1.598*	(0.904)	−0.040	(0.476)
Make:Post	0.429	(0.328)	0.009	(0.194)	−0.297	(0.313)	−0.379***	(0.098)
Male:Prim.	−0.133	(0.245)	0.167	(0.177)	0.146	(0.280)	−0.070	(0.101)
Constant	8.336***	(0.868)	8.589***	(0.835)	8.495***	(0.801)	8.078***	(0.469)
Observations	483		514		699		1,346	
R^2	0.111		0.127		0.212		0.182	
Adjusted R^2	0.074		0.095		0.190		0.170	
Residual Std. Error	0.822 (df=463)		0.839 (df=495)		0.767 (df=679)		0.651 (df=1325)	
F Statistic	3.032*** (df=19;463)		3.995*** (df=18;495)		9.635*** (df=19;679)		14.780*** (df=20;1325)	
Note:							*p<0.1; **p<0.05; ***p<0.01	

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