The Australian National University
Centre for Economic Policy Research
DISCUSSION PAPER

How and Why has Teacher Quality Changed in Australia?

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DISCUSSION PAPER NO. 534
September 2006

ISSN: 1442-8636
ISBN: 1 921262 06 0

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Acknowledgements
This paper was originally prepared as a report for the Australian Department of Education, Science and Training. The views expressed are those of the authors and do not represent the views of the Department of Education, Science and Training. We are grateful for feedback on an earlier draft from officers of the Department and from participants at a seminar at the Australian National University. Leigh also acknowledges support under the Australian Research Council's Discovery funding scheme (project number DP0665260).

ABSTRACT

International research suggests that differences in teacher performance can explain a large portion of student achievement. Yet little is known about how the quality of the Australian teaching profession has changed over time. Using consistent data on the academic aptitude of new teachers, we compare those who have entered the teaching profession in Australia over the past two decades. We find that the aptitude of new teachers has fallen considerably. Between 1983 and 2003, the average percentile rank of those entering teacher education fell from 74 to 61, while the average rank of new teachers fell from 70 to 62. One factor that seems to have changed substantially over this period is average teacher pay. Compared to non-teachers with a degree, average teacher pay fell substantially over the period 1983-2003. Another factor is pay dispersion in alternative occupations. During the 1980s and 1990s, non-teacher earnings at the top of the distribution rose faster than earnings at the middle and bottom of the distribution. For an individual with the potential to earn a wage at the 90th percentile of the distribution, a non-teaching occupation looked much more attractive in the 2000s than it did in the 1980s. We believe that both the fall in average teacher pay, and the rise in pay differentials in non-teaching occupations are responsible for the decline in the academic aptitude of new teachers over the past two decades.

JEL Codes: I21, I28, J31

Keywords: test scores, teacher salary, occupational choice

I. Introduction

Teacher quality has been shown to be an important component of educational productivity. There is therefore substantial concern at the prospect that teacher quality may have fallen over recent decades. In this paper, we test this hypothesis using data from Australia. Using panel surveys that test individuals' literacy and numeracy in high school, and then follow them to see which career they choose, we are able to estimate how the academic aptitude of those entering the teaching profession has changed over time.

Having estimated how the academic aptitude of new teachers, which we will tend to refer to more broadly as 'teacher quality', has changed, we then set about investigating the role that salary has played in these changes. We focus on three aspects of pay: the returns to aptitude in teaching, average teacher pay, and pay dispersion in non-teaching occupations. Using data from several sources, we investigate the effect of these changes on the quality of the teaching workforce.

Understanding how teacher aptitude has changed over time is an interesting question merely from the perspective of the labour market. According to the most recent survey, 264,919 Australians are school teachers, most on a full-time basis.[1] This makes teachers one of the largest occupations in the nation, accounting for 2.7 percent of all employees. It is inherently useful to see how the career decisions of such a large occupation have changed over time.

But teacher quality also matters from the perspective of students. Studies from the United States have shown that the performance gap between the best and worst teachers is substantial. Using panel data, with teacher and student fixed effects, Rockoff (2004) and Rivkin, Hanushek and Kain (2005), conclude that moving up one standard deviation on the teacher quality distribution is associated with a gain in student achievement of approximately 0.1 standard deviations. This suggests that switching from a teacher at the 10th percentile to a teacher at the 90th percentile would raise a student from the median to the 60th percentile.

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[1] Australian Bureau of Statistics, *Schools, Australia, 2004. Cat. No. 4221.0*. Table 64. Figures are from the August 2004 survey. The number of full-time equivalent teachers is 233,065.

To preview our results, we find that the academic aptitude of those entering teaching has fallen over the past twenty years. Exploring our various hypotheses, we find that declining average teacher pay and rising pay dispersion in non-teaching occupations both played a significant role in the decline in the academic aptitude of new teachers.

The remainder of this paper is structured as follows. Section II reviews the previous literature. Section III outlines the general trends in teacher aptitude in Australia. To better understand the reasons for these changes, Section IV then presents data on trends in teacher and non-teacher pay over the past quarter-century. In more formal analysis, we set out a simple model of occupational choice in Section V and use this model to econometrically analyse teacher quality trends in Section VI. The final section concludes.

II. Previous Literature

Trends in Teacher Aptitude

In the United States, several recent studies have shown that the academic aptitude of those who enter teaching in the US has fallen over recent decades. Corcoran, Evans and Schwab (2004a, 2004b) combine several longitudinal surveys and find that from the early-1970s to 2000, the percentile rank of the mean female teacher on standardized achievement tests fell from 65 to 46.[2] The decline took place steadily over the three decades, and was largely driven by a fall in the fraction of women in the top two deciles entering teaching. Evidence from the National Longitudinal Surveys of Youth (Murnane et al 1991; Bacolod 2003) and the ACT exam (Leigh and Mead 2005) support this conclusion. Corcoran, Evans and Schwab (2004b) also analyse male teachers, and observe no corresponding decline, though because most teachers are female, their estimates on men are less precise.

[2] This change compares teachers in the Project Talent dataset (observed as teachers in the early-1970s) with those in the National Education Longitudinal Study of 1988 (observed as teachers in 2000). Corcoran, Evans and Schwab (2004) also present results for the Wisconsin Longitudinal Study (observed as teachers in 1964). In the WLS, the average teacher was at the 60th percentile.

In Australia, a substantial literature exists on pedagogy and professional standards in teaching (for a recent review, see Watson 2005). However, little work has been done on the academic standards of those entering teaching, though the relatively low rank of those entering teacher education courses has occasionally been noted. For example, one government report (HED, DEET 1990) noted that 3 percent of those commencing teacher education courses in 1989 were in the top quartile of all university entrants, while 54 percent were in the bottom quartile. Analysis in the report of the Committee for the Review of Teaching and Teacher Education (2003, Table 14) found that 14.8 percent of those in teacher education courses were from the top achievement group in terms of Year 9 school performance (those at least one standard deviation above the average performance level), compared with 27.2 percent of those enrolled in other university courses. However, because not all those in teacher education courses go on to become teachers, these studies are not necessarily an accurate reflection of the ability distribution of new teachers. Such studies are also typically limited to a single snapshot – we are not aware of any study that has analysed the changing ability distribution of Australian teachers over time.

Factors Affecting Teacher Aptitude

What might have caused the decline in teacher aptitude observed in the United States over recent decades? Corcoran, Evans and Schwab (2004b) stress the role of women entering non-teaching professions. They show that in the 1960s, 49 percent of female university graduates were teachers. By the 1990s, female university graduates were more likely to be in management (14 percent) or clerical work (17 percent) than in teaching (12 percent). Using cross-state variation, Hoxby and Leigh (2004) formally test two hypotheses – changing gender pay gaps in alternative occupations and union-induced pay compression. They find that the rise in salaries of high-ability women in alternative occupations explains around one-quarter of the teacher quality decline, while approximately three-quarters was due to pay compression in teaching.

More generally, a literature exists on the relationship between teacher pay and teacher quality. In the US, Ballou and Podgursky (1995, 1997) present simulations showing that since teaching labor markets are typically in a state of excess supply, raising (or, presumably, lowering) average teacher pay would have a small effect at best on the

SAT scores of prospective teachers. By contrast, Figlio (1997) exploits cross-sectional variation in average salaries across school districts at a single point in time, and finds that school districts with higher teacher salaries tend to attract more teachers from selective universities and with subject matter qualifications. For Australia, Leigh (2006) uses state panel data, instrumenting for teacher pay using uniform salary schedules. He finds that a 1 percent rise in average teacher pay boosts the test scores of those entering teacher education courses by 0.8 percentage points. Other studies find a positive relationship between teacher salaries and student outcomes,[3] and between teacher pay and teacher retention.[4]

III. Trends in Teacher Quality in Australia

The aim of this section is to outline the broad trends in teacher quality in Australia over the past two decades. In measuring teacher quality, one would ideally want a broad metric, which captured the ability of teachers to raise student performance on tests, as well as on material regarded as important but difficult to test, such as social skills. A perfect teacher quality metric might also encapsulate the ability of a good teacher to work well with other teachers and school administrators, and to raise their performance in the classroom.

Unfortunately, since such a measure of teacher quality is not available over the period in question, we opt instead to use a narrower metric – the literacy and numeracy

[3] For the US, several studies have analysed the effect of teacher pay on student achievement. Card and Krueger (1992) find that a 10 percent rise in teachers' salaries leads to a 0.1 percentage point increase in the rate of return to schooling for white males born between 1920 and 1949, while Loeb and Page (2000) find that a 10 percent increase in the teaching wage reduces the high school dropout rate a decade later by 3-4 percent. But using more recent cohorts, Betts (1995) and Grogger (1996) find only a weak or non-existent relationship between pay and student performance. In a meta-analysis of 119 studies, Hanushek (1997) notes that 45 percent observe a positive relationship between teacher pay and student performance, 25 percent find a negative relationship, and the reminder did not specify the sign of the effect.

[4] In the UK, Zabalza (1979) and Chung, Dolton and Tremayne (2004) find a positive relationship between teacher pay and the supply of teachers. Another literature looks at the decision to quit teaching, and generally finds a robust relationship between pay and retention. For the US, see Hanushek, Kain and Rivkin (1999); for the UK, see Dolton and van der Klaauw (1999), but cf Frijters, Shields, and Wheatley-Price (2004). In the Australian context, Webster, Wooden and Marks (2004) cite a survey by Ministerial Council on Education, Employment, Training and Youth Affairs, which found that the most-frequently mentioned factor that would assist retention was remuneration, rating above reduced workloads and improved employment conditions. For an analysis of factors affecting teacher supply and demand in Australia, see Preston (1997). For a discussion of trends in Australian teacher salaries until the mid-1990s, see Crowley (1998).

performance of teachers in standardized tests while they were themselves at school. There are three limitations of using these tests as a measure of academic aptitude. First, such tests are measured with error, and students' results may be subject to random factors (eg. the classic barking dog outside the classroom). Our approach assumes that these random factors were uncorrelated with whether or not students went on to become teachers. Second, literacy and numeracy tests do not take into account a broader range of subject skills, such as computing and science. To the extent that these skills are uncorrelated with literacy and numeracy, failing to test them induces error into our measure of academic aptitude. And third, our approach assumes that the aptitude of an individual teacher does not change over time. To the extent that individuals mature at different rates, this will also induce measurement error into our aptitude variable. These three sources of measurement error should be borne in mind when interpreting our results.

The use of teacher aptitude as a proxy for teacher quality has been validated in other studies, which have found a strong positive correlation between teachers' classroom performance and their own standardized test scores. This relationship appears to hold for teachers' scores in state teacher certification exams (Ferguson 1991; Ferguson and Ladd 1996), and for teachers' exams when they were in high school (Ehrenberg and Brewer 1994). Comparing various predictors of teacher quality, Ehrenberg and Brewer (1994) conclude that a teacher's own test scores and the selectivity of the college that the teacher attended are both positively related to pupil achievement, with the teacher's test scores having the stronger effect.[5]

To measure teacher aptitude, we use the data from six Longitudinal Surveys of Australian Youth (LSAY) cohorts. These cohorts are the Youth in Transition 1961, 1965, 1970 and 1975 birth cohorts (YIT 61, YIT 65, YIT 70 and YIT 75) and the Longitudinal Surveys of Australian Youth 1995 and 1998 Year 9 cohorts (LSAY 95 and LSAY 98). These surveys have the advantage that they contain information on literacy and numeracy tests, university course choices, and career choices. While some institutional features of teacher education have changed over this period

[5] A meta-analysis by Hanushek (1997) found that in 64% of studies looking at the relationship between teacher test scores and student outcomes, the relationship was positive, while the relationship was negative in only 25% of studies (in the remaining 11% of studies, the sign was unspecified).

(incorporation into universities, lengthening of courses and the move to specialised secondary teaching degrees rather than general degrees followed by graduate teaching diplomas as the typical course followed by secondary teachers), the data and our approach of measuring course and career choices over a number of years allow us to deal with these changes. More information on the data is provided in Appendix I.

Standardised tests were administered at age 14 (or year 9 for most of the cohorts), and respondents were then followed through their post-school education and into their working lives. In most cases, the cohorts were observed until at least their mid-20s. Those in the first cohort sat the literacy and numeracy tests in 1975, and were observed as teachers around 1983. Those in the last cohort that has graduated from university sat the tests in 1995, and were observed as teachers around 2003.

Although the literacy and numeracy tests taken by some of the LSAY cohorts were designed to be comparable across time, we opt to standardise them for each year. This is because our focus is on the career choices of the highest and lowest academic performers within each cohort. We then average each individual's scores in the literacy and numeracy tests, and rank each cohort.[6]

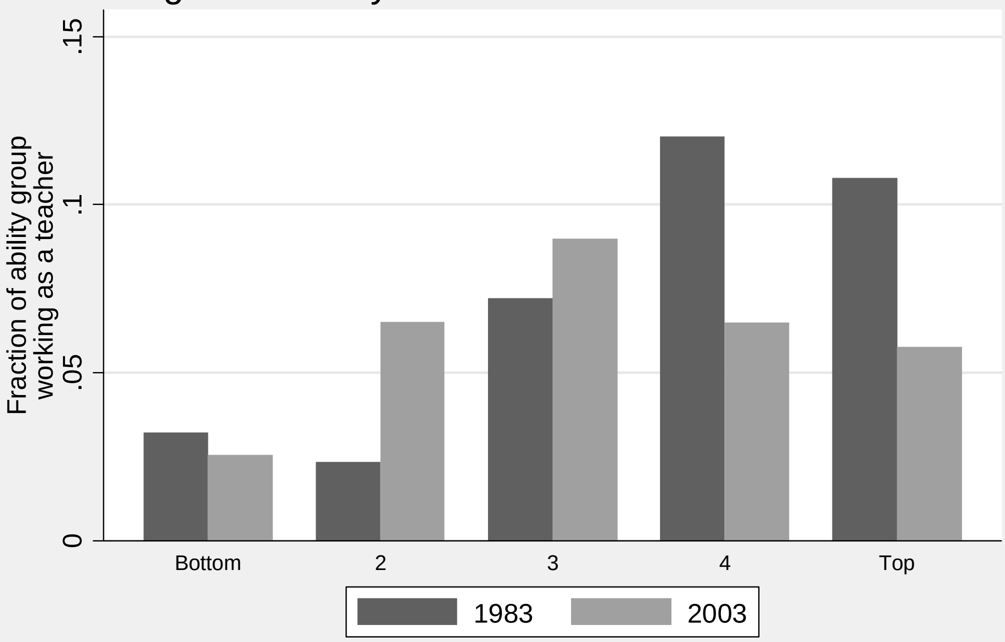
Figure 1 shows the ability distribution of new female teachers in our first and last cohorts. We divide respondents into five achievement quintiles based on the average of their literacy and numeracy tests. The horizontal axis shows the year around which the cohort was observed in the labour force, while the vertical axis shows the fraction of people in each quintile who entered teaching. Over this twenty-year period, the fraction of women in the top achievement quintile becoming teachers fell from 11 percent to 6 percent, while the fraction of women in the second-top achievement quintile fell from 12 percent to 6 percent. On average, we observe a substantial decline in the academic achievement of new female teachers. In 1983, the average woman entering teaching was at the 70th percentile of the achievement distribution. In 2003, the average woman entering teaching was at the 59th percentile of the

[6] Note that our approach compares the academic ability of teachers with those in their cohort, and hence ignores changes in the average academic ability of the entire cohort. If the average academic ability of those taking the test had risen over time, this might mitigate our findings somewhat. However, this does not appear to have occurred. Rothman (2002) finds no statistically significant change in mean literacy and numeracy scores if one compares 14 year olds across the 1975-1998 tests, and a slight decline if one compares 14 year olds in year 9 across the 1975-1998 tests.

achievement distribution. The change in the percentile rank of new female teachers between the first and last cohorts is statistically significant at the 1 percent level.

Recall that Corcoran, Evans and Schwab (2004a, 2004b) found for the US that the percentile rank of the mean female teacher on standardized achievement tests fell from 65 in the early-1970s to 46 in 2000. Assuming that the decline in both countries was constant over time, this suggests that the teacher quality drop has been a little smaller in Australia than in the US, and that the average academic aptitude of Australian teachers today is higher than their US counterparts.

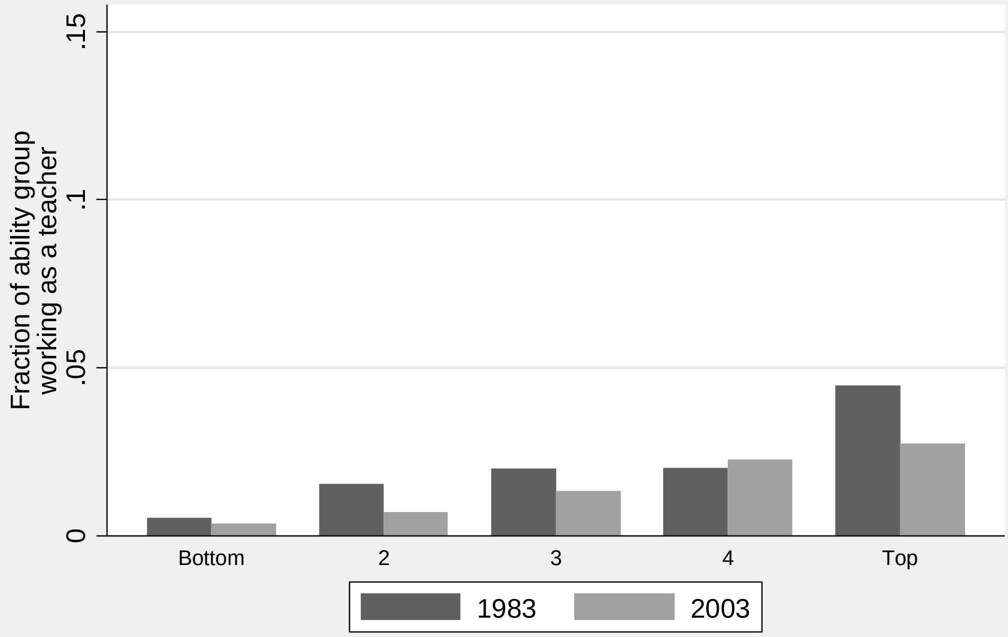
Figure 1: Ability distribution of new female teachers



Source: Longitudinal Surveys of Australian Youth

Figure 2 shows the results for men. As with women, we observe a drop in the fraction of men in the top achievement quintile becoming teachers (from 4 percent to 3 percent). However, we do not observe any significant change in the fraction becoming teachers from the second-top achievement quintile. Moreover, the share of men becoming teachers from the lowest three achievement quintiles fell over this period. On average, we observe a slight rise in the average achievement of men entering teaching. In 1983, the average man entering teaching was at the 71st percentile of the achievement distribution. In 2003, the average man entering teaching was at the 74th percentile of the achievement distribution.

Figure 2: Ability distribution of new male teachers



Source: Longitudinal Surveys of Australian Youth

Overall, since three-quarters of teachers are women throughout our sample period, the substantial declines in teacher quality among women swamp the small rise among men. Combining both men and women, the average person entering teaching was at the 70th percentile of the achievement distribution in 1983, and at the 62nd percentile of the achievement distribution in 2003. The change in the percentile rank of new teachers between the cohorts is significant at the 1 percent level.

In Figure 3, we focus on the ability distribution of women entering teacher education courses. This is a useful exercise, since it allows us to see whether the patterns observed among new female teachers are due to choices made at the beginning or the end of university. Among female teacher education students, we indeed see a similar pattern. From 1983 to 2003, the fraction of women in the top achievement quintile studying to be teachers fell from 11 percent to 5 percent, while the fraction of women in the second-top achievement quintile fell from 13 percent to 7 percent. In 1983, the average woman studying to be a teacher was at the 72nd percentile of the achievement distribution. In 2003, the average woman studying teacher education was at the 60th percentile of the achievement distribution. The change in the percentile rank of females entering teaching courses between the cohorts is statistically significant at the 1 percent level.

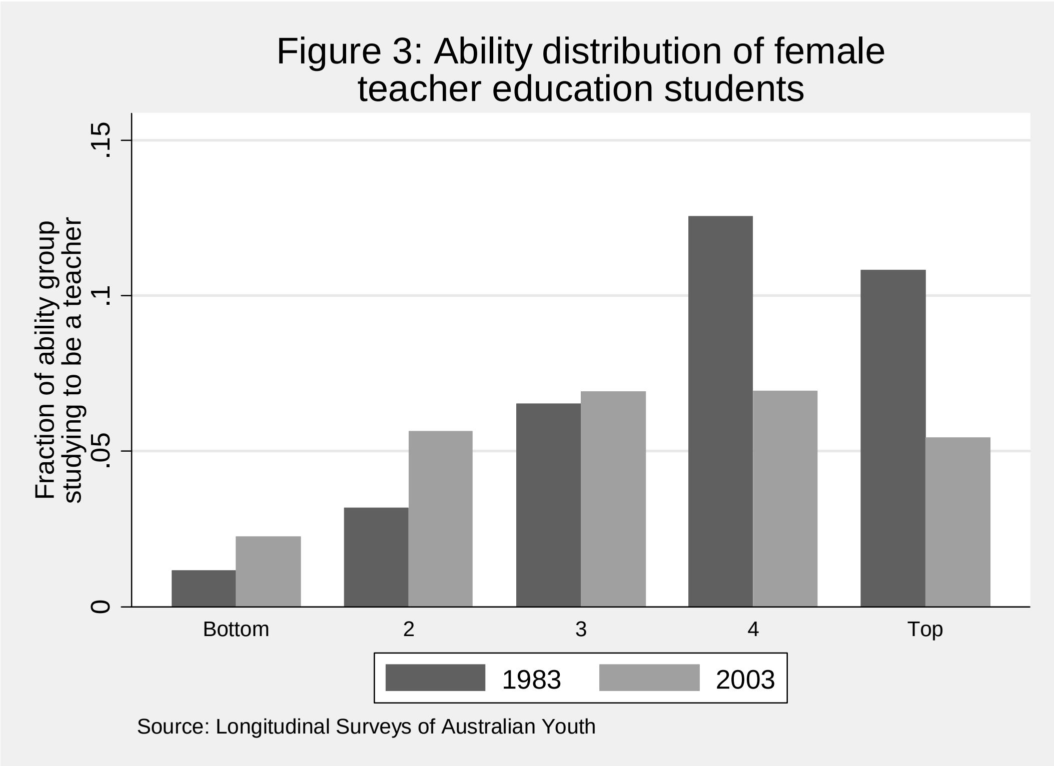
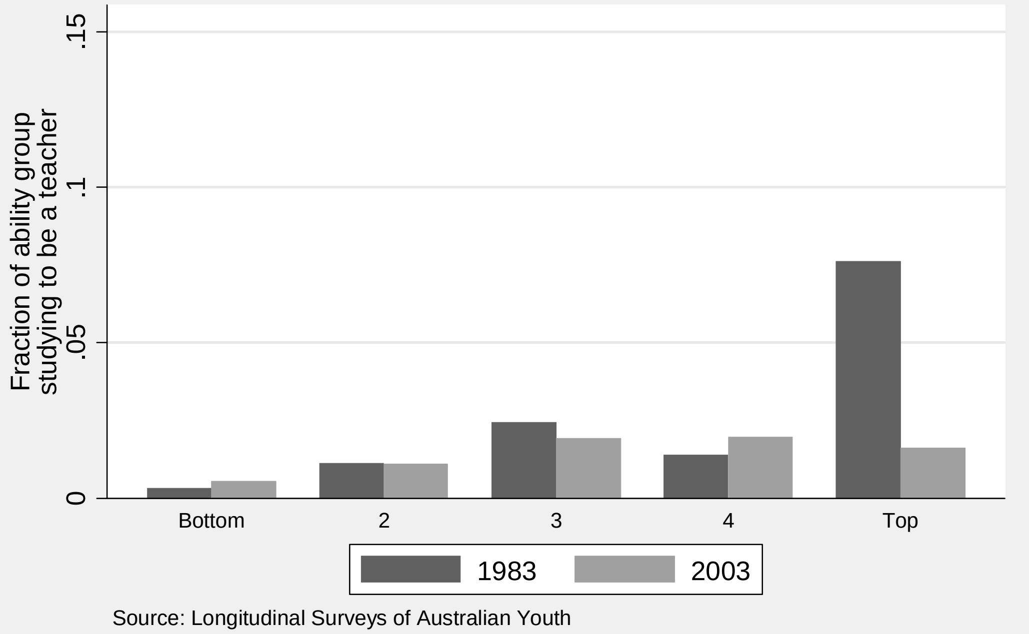


Figure 4 presents the same data for men entering teacher education. Unlike women, the ability distribution of men entering teacher education does seem to differ from the ability distribution of new male teachers. While the average ability of new male teachers rose slightly between 1983 and 2003, the average ability of men entering teacher education courses fell from 78 to 64. Among women, we see little evidence that the individual's academic achievement affects the probability of proceeding from teacher education into teaching, but among men, those of lower academic ability appear to have been slightly less likely to proceed from teacher education into teaching. However, because the samples of men are smaller than those for women, the results are also less precise.

Figure 4: Ability distribution of male teacher education students



Until now, we have only used the first and last cohorts to discuss the changes over time. However, it is instructive to see the pace of change over time. Figure 5 therefore plots the fraction of men and women in the top 20 percent of the achievement distribution entering teaching. For women, the decline is approximately uniform, while for men, a fall in the 1980s appears to have been followed by a slight rise in the 1990s.

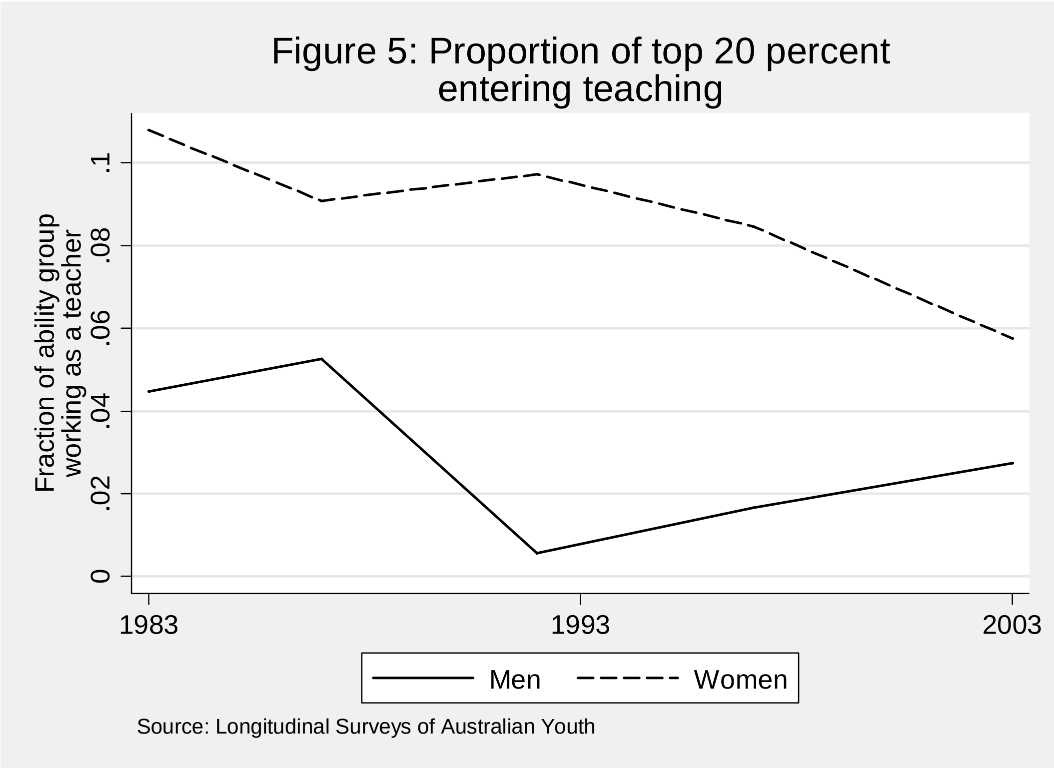
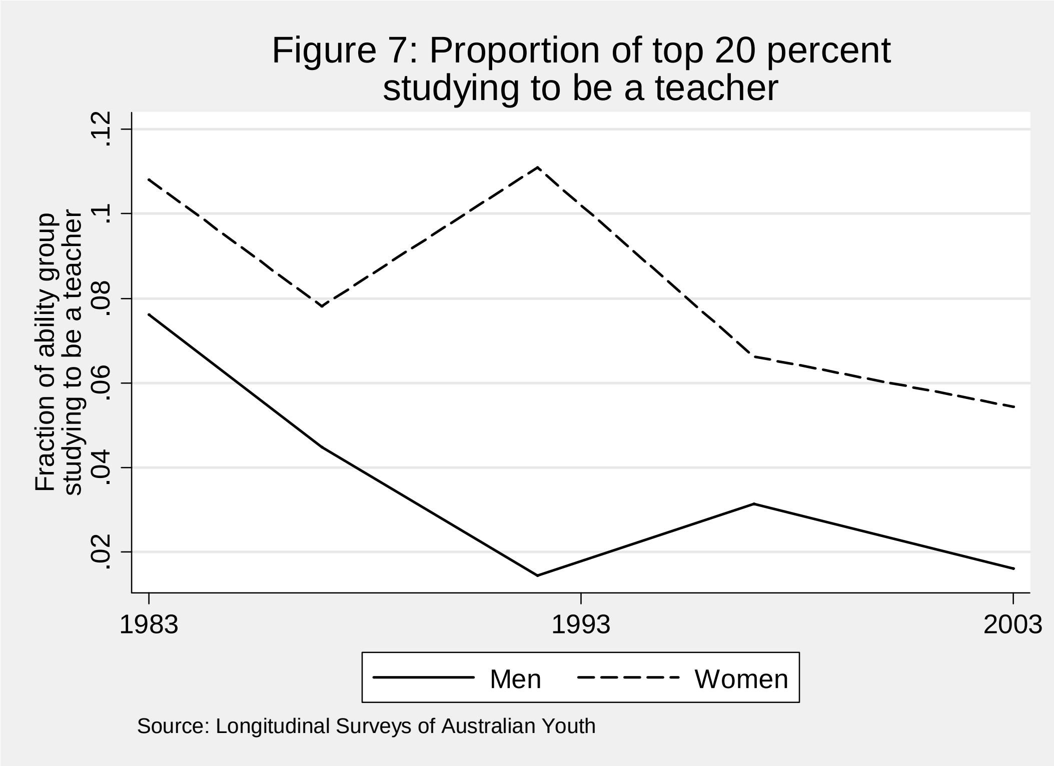
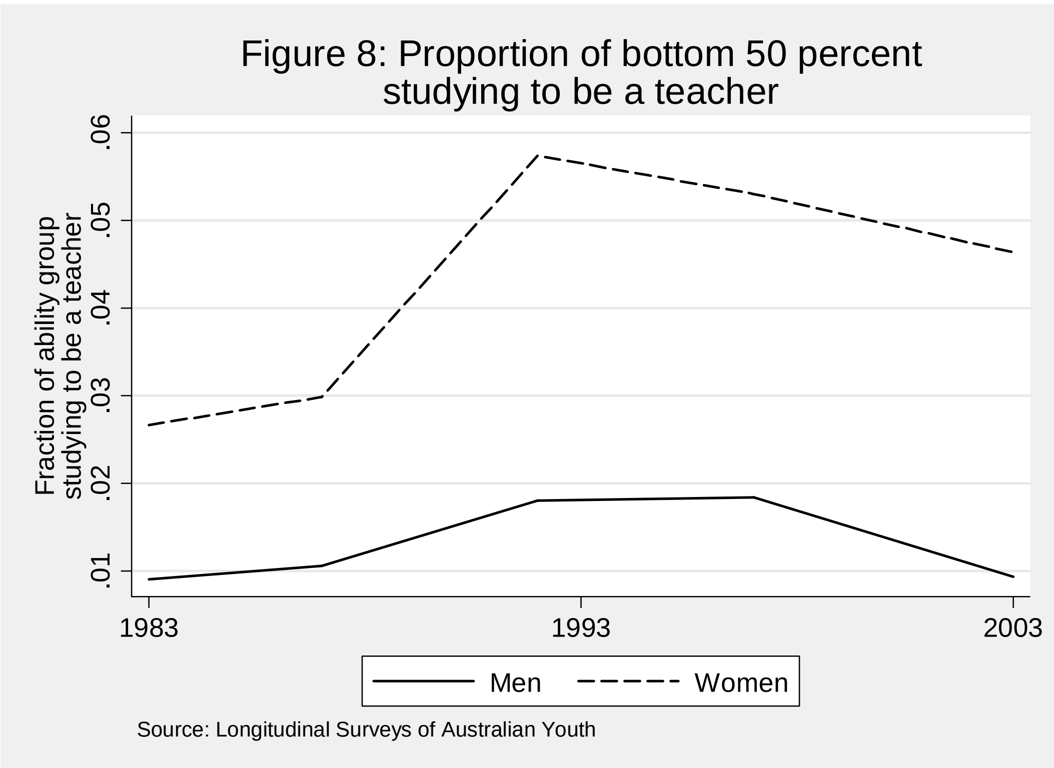


Figure 6 plots the probability that those in the bottom half of the achievement distribution will enter teaching, which shows a steady rise for women. In 1983, women in the top quintile were three times more likely to become teachers (11 percent probability) as those in the bottom half (3 percent probability). By 2003, the probabilities were the same for both groups (6 percent probability among the top quintile, 5 percent among the bottom half). For new male teachers, we observe little change in the share from the bottom quintile over time.

Figure 6: Proportion of bottom 50 percent entering teaching

Among those entering teacher education courses, the patterns appear similar. We plot the probability of top-quintile women entering teacher education courses in Figure 7, and probability of women in the bottom half of the distribution entering teacher education courses in Figure 8. For women, the changing ability distribution among those studying teacher education are similar to the changes among new female teachers. For men, the decline in high-ability men studying teacher education (Figure 7) is not mirrored in the share of high-ability men entering teaching (Figure 5), though in both cases the numbers are relatively small.





Since women substantially outnumber men in teaching, it is reasonable to say that the general trends in the ability distribution of new teachers and the trends in the ability distribution of teacher education students mirror one another. This suggests that the ability of students entering teacher education courses is a valid proxy for the ability of new teachers. For example, Appendix II estimates the minimum entry standard for a Bachelor of Education at the University of Sydney over the period 1977-2005, indicating a steady decline from 1977-1999, followed by a modest increase in the years 2001-2005.

IV. Trends in Teacher Pay

In this paper, our focus is on whether changing salaries for teachers and non-teachers might have caused the decline in the academic aptitude of new teachers that we observed in Section III. We leave for future research the possibility that the decline could be attributable to non-salary factors, though we believe this is less likely.[7]

In this section, we focus on three separate hypotheses. First, we investigate whether returns to aptitude in teaching changed over time. For example, if returns to aptitude fell for teaching, we would expect this to lower the mean aptitude in teaching (so long as an individual's aptitude in teaching and non-teaching occupations is positively correlated).

Second, we explore changes in the salary of new teachers, relative to new workers in other occupations. All else equal, a fall in teacher pay should lower the average aptitude of the teaching workforce.

Third, we focus on pay dispersion in non-teaching occupations. For an individual with the potential to earn a wage at the 90th percentile of the non-teaching distribution, what matters is not only shifts in average pay, but also changes in pay dispersion. If pay dispersion widened in non-teaching occupations, while staying constant in teaching, then we would expect this to disproportionately pull high-ability men and women out of teaching.

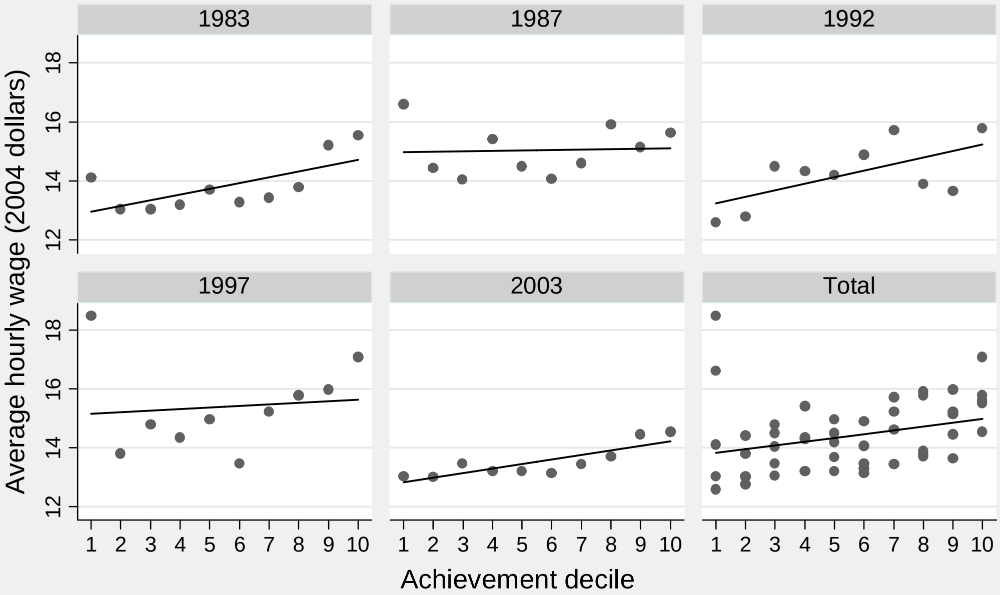
[7] One of the most important non-wage characteristics of teaching is the student-teacher ratio, which has fallen steadily over time. For example, the average teacher-student ratio was 18.6 in 1976, 16.1 in 1983, 15.3 in 1993, and 14.5 in 2003 (ABS, *Schools, Australia,* Cat No 4221.0).

Returns to Aptitude in Teaching

The returns to aptitude hypothesis suggests that in a simple model of occupational choice (eg. Roy 1951), in which workers choose between two sectors with the same average wage, high ability workers will prefer the sector with larger returns to aptitude, while low-ability workers will prefer the sector with smaller returns to aptitude. All else equal, a fall in the returns to aptitude will reduce the mean ability in a given sector.

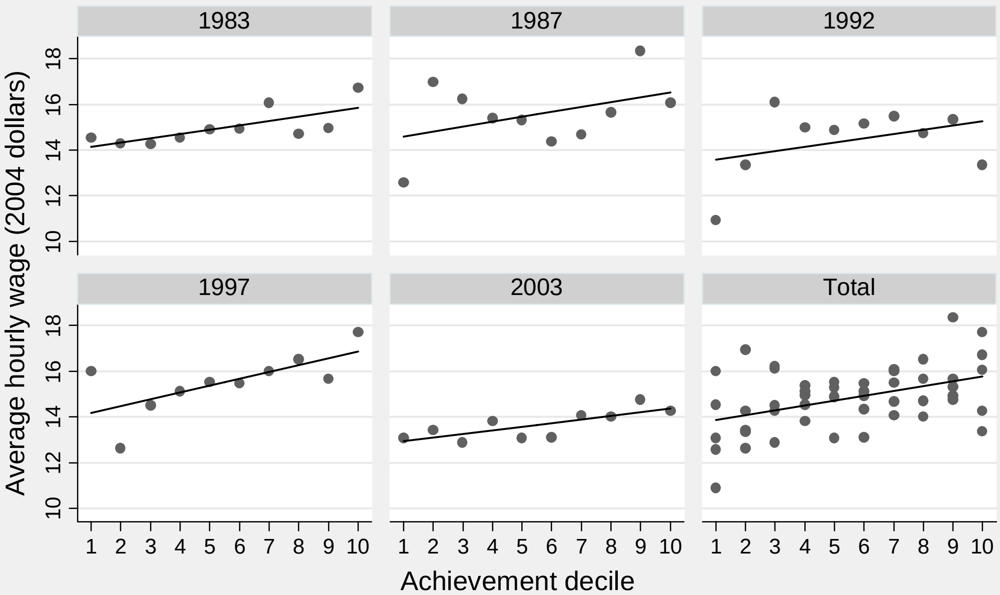
In order to estimate returns to aptitude, we need a dataset that provides both aptitude and earnings data. For this purpose, we are restricted to using the LSAY, but do so with the caveat that wages are less precisely measured in the LSAY than in other surveys (for testing other theories, we will use alternative sources of wage data). To begin, we estimate the relationship between aptitude and earnings for all workers in non-teaching occupations. As Marks and Fleming (1998) have shown for earlier LSAY cohorts, individuals who scored in higher achievement deciles tend to earn higher wages. We replicate their findings, restricting the sample, to non-teachers. The fitted regression lines show a positive relationship between academic aptitude and earnings for women (Figure 9) and men (Figure 10). With the exception of men in 1987 and women in 1997, moving up one achievement decile boosts hourly wages in each of the groups by $0.15-0.30. We do not observe any systematic differences in the return to aptitude between men and women, or between earlier and later cohorts.

Figure 9: Average earnings of women in non-teaching occupations by achievement decile



Source: Longitudinal Surveys of Australian Youth

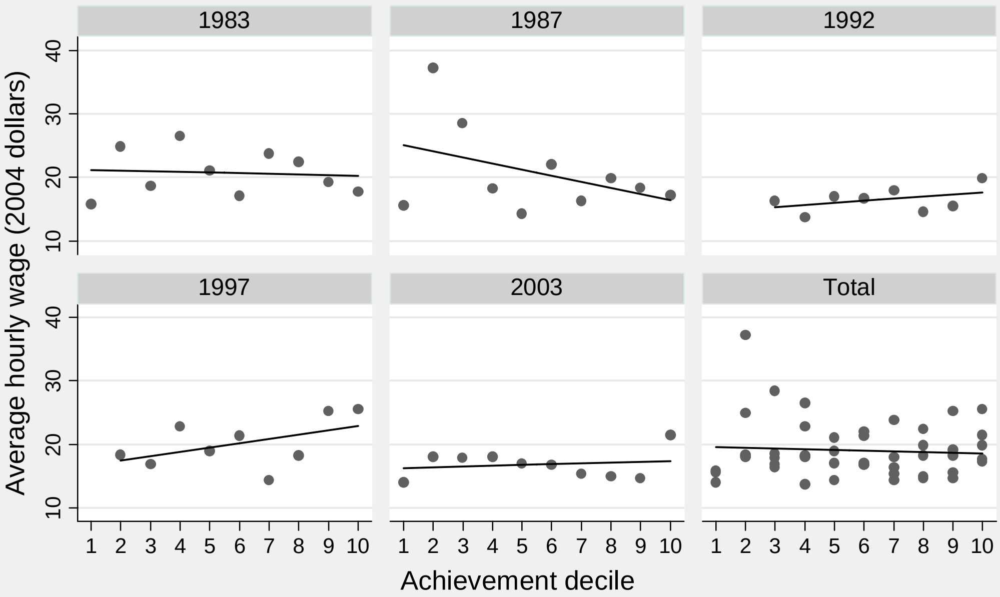
Figure 10: Average earnings of men in non-teaching occupations by achievement decile



Source: Longitudinal Surveys of Australian Youth

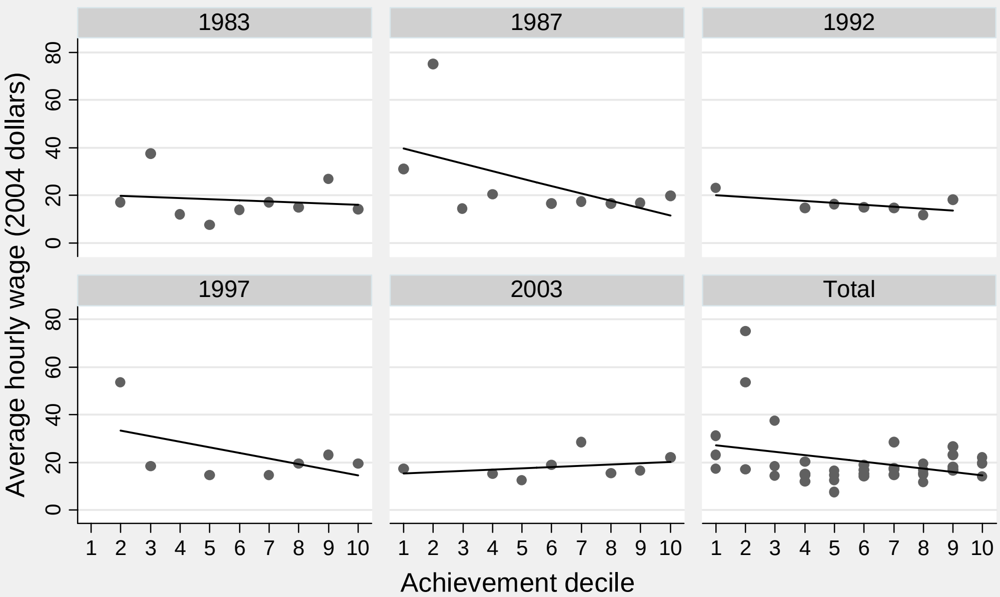
Next, we look at the returns to aptitude among female teachers (Figure 11) and male teachers (Figure 12). In both cases, we find little evidence that those in higher aptitude groups systematically receive higher wages.

Figure 11: Average earnings of female teachers by achievement decile



Source: Longitudinal Surveys of Australian Youth

Figure 12: Average earnings of male teachers by achievement decile



Source: Longitudinal Surveys of Australian Youth

As a further test of the returns to aptitude, we regress hourly wages on each individual's achievement percentile for all employees, those with a university degree, those in professional occupations, and teachers. The results are presented in Table 1. Among all non-teachers, non-teachers with a degree, and non-teaching professionals, we observe positive and statistically significant returns to aptitude. However, among teachers, the coefficient on aptitude is negative and statistically insignificant.

Table 1: Returns to Aptitude in Non-Teaching and Teaching
Dependent variable: Hourly wage (2004 dollars)

	All non-teachers	Non-teachers with degree	Non-teaching professionals	Teachers
Panel A: Women				
Achievement percentile/10	0.204***	0.335**	0.281**	-1.331
	[0.045]	[0.155]	[0.132]	[1.136]
Cohort Fixed Effects	Yes	Yes	Yes	Yes
Respondents	7038	1272	1557	525
R-squared	0.01	0.02	0.01	0.00
Panel B: Men				
Achievement percentile/10	0.211***	0.579**	0.579**	-0.870
	[0.060]	[0.292]	[0.230]	[0.916]
Cohort Fixed Effects	Yes	Yes	Yes	Yes
Respondents	6435	903	1172	135
R-squared	0.01	0.00	0.01	0.05

Notes: Pooled regressions, estimated from LSAY data. Robust standard errors in brackets. ***, ** and * denote statistical significance at the 1%, 5% and 10% levels, respectively.

It is important to note that the findings above differ from those of Hoxby and Leigh (2004) for the United States. They observed that the return to aptitude (measured by college selectivity) was strongly positive for those entering the teaching profession in the 1960s, but approximately zero in the 1990s. By contrast, we do not observe any evidence of returns to aptitude in Australian teaching in the 1980s, 1990s or 2000s.

Most likely, these results are driven by the widespread use of uniform salary schedules in public schools throughout the period in question. These schedules apply to all public school teachers in a given state or territory, and typically prescribe the starting salary for new teachers, with little flexibility for more academically gifted teachers to be placed on a higher rung of the schedule. By contrast, salary schedules were more flexible in the US during the 1960s. Another factor in the move towards uniform salary schedules in the US was that teacher unions grew much more industrially powerful from the 1960s to the 1990s (Hoxby 1996); by contrast, Australian teacher unions were industrially effective both in the 1980s and 2000s, and uniform salary schedules applied across this period.

Given that we do not observe any significant returns to aptitude in the Australian teaching profession throughout the period in question, we do not believe that this factor played a role in the decline in teacher quality that occurred between 1983 and 2003. We therefore turn to our two other factors – average teacher salaries, and pay dispersion in non-teaching occupations.

Average Teacher Salaries

In this sub-section, we consider how changing average teacher pay might have affected the ability distribution of the teaching workforce. All else equal, a rise in teacher salaries should boost the quality of those choosing to study teacher education, and to work as teachers. However, for the US, Ballou and Podgursky (1997) argue that teacher markets are typically in a state of excess supply, and therefore that raising average teacher pay would have a small effect at best on the aptitude of prospective teachers. For Australia, Leigh (2006) finds that a 1 percent rise in average teacher pay boosts the test scores of those entering teacher education courses by 0.8 percentage points. One possible reason that teacher pay might have a larger impact on teacher aptitude in Australia is that teacher education courses have fixed quotas, and entry is determined solely by standardised tests and other assessments of student academic performance. Thus if a rise in teacher pay attracts high-ability students into teacher education courses, it will prevent low-ability students from taking those courses. When these students graduate, this should lead to an increase in the average aptitude of new teachers – even in the event that hiring decisions are uncorrelated with ability.

To analyse long-run trends in average teacher pay, we obtain salary data from the Graduate Destination Survey (GDS), a large survey of new graduates which covers around 15,000 respondents annually, of whom about 15 percent are teachers.[8] This

[8] A number of past studies have analysed long-run trends in Australian teacher pay. Crowley (1998) presented data on trends in the pay of new teachers relative to other new university graduates, but did not disaggregate the data by gender. Zappala and Lombard (1991) compared the pay of new and

allows us to compare the salaries of those entering teacher education with the salaries of other university graduates. Because the GDS has a much larger sample than the LSAY, we are able to observe more precisely the earnings of teachers and non-teachers. The GDS data are described in more detail in Appendix I.

Figure 13 shows the ratio of teacher earnings to the earnings of non-teachers with a degree. For women, the ratio rose from 1978-1983, but fell during the 1980s. Since 1990, female teacher pay has kept pace with the earnings of women with a degree. For men, teacher pay steadily declined throughout the 1980s and 1990s.

Figure 13: Ratio of teacher earnings to non-teachers with a degree

Source: Graduate Destination Survey. Sample is recent university graduates working full-time

Since our focus in Section III was on changes between 1983 and 2003, it is useful to compare over this period the earnings of new teachers with non-teachers who have an undergraduate degree. For women, teacher pay fell from 114 percent to 103 percent of non-teacher pay between 1983 and 2003. For men, teacher pay fell from 108 percent to 91 percent of non-teacher pay.[9]

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experienced NSW teachers to average weekly earnings, but did not account for shifts in the age composition of the workforce, nor did they look separately at men and women. Both studies observed a decline in the relative pay of teachers during the 1980s and 1990s.

[9] Given the widespread use of uniform salary schedules, it is not obvious to us why the relative pay of male teachers should have fallen more than the relative pay of female teachers (since the same patterns is observed when looking at real pay trends, we can rule out differences in the denominator as a factor).

In Appendix III, we analyse trends in average teacher pay in more detail, using a different data source which provides earnings of all teachers, and taking account of shifts in the age composition of teachers and non-teachers. This analysis supports the trends shown in Figure 15 in three respects: (a) teacher pay kept pace with non-teacher pay in the late-1970s and early-1980s; (b) teacher pay fell behind non-teacher pay over the period 1983-2003; and (c) the relative decline in teacher pay was sharper for men than for women.

Pay Dispersion in Non-Teaching Occupations

A third factor that might have affected the decision to enter teaching is a change in pay differentials in non-teaching occupations. As a simple Roy-type model suggests, rising pay dispersion in non-teaching occupations might have disproportionately attracted high-ability university graduates away from teaching and into alternative occupations.

To measure salaries, we again use the GDS. However, since we do not observe ability in the GDS, we need to make the assumption that ability and wages are positively correlated in non-teaching occupations. In this, we rely on the results shown in Table 1, which indicate a strong positive correlation between wages and ability for men and women in non-teaching occupations.

Figure 14 shows the ratio of earnings at the 90th percentile to earnings at the 10th percentile in non-teaching occupations over the period 1976 to 2003. Over this period, the pay gap in non-teaching occupations steadily widened. For men, the 90/10 ratio increased from 2 to 2.5, while for women, the 90/10 ratio in non-teaching occupations rose from 1.8 to 2.

One possibility is that salaries in high schools (where most men teach) had previously been substantially higher than salaries in primary schools (where most women teach), and that this gap narrowed during the 1980s and 1990s.

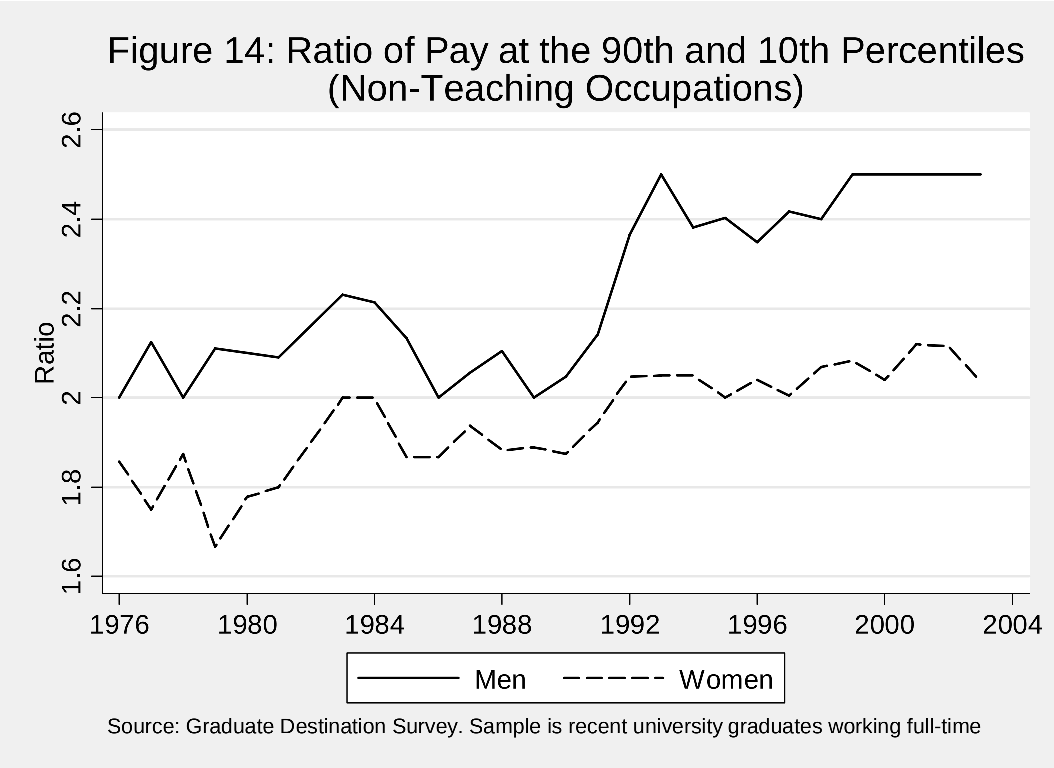
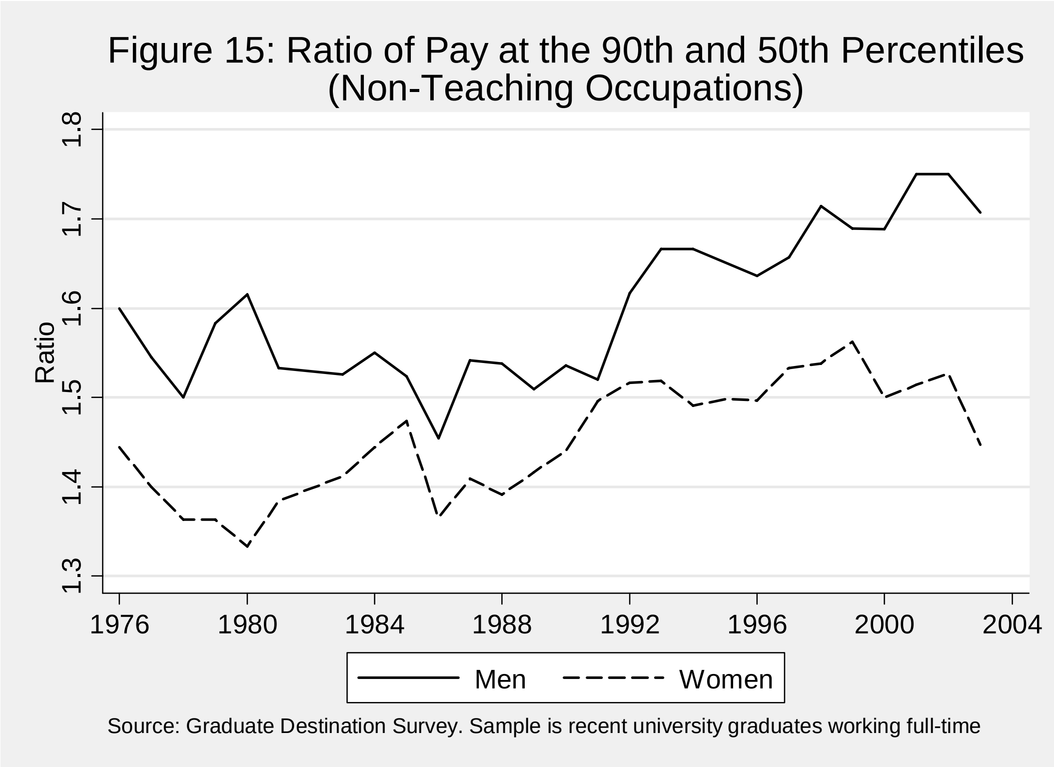


Figure 15 presents data on the ratio of earnings at the 90th percentile to earnings at the median (the 50th percentile), which allows us to focus on changes at the top of the distribution. This chart indicates that for men, the 90/50 ratio in non-teaching occupations rose from approximately 1.55 to 1.7, while for women, the 90/50 ratio rose from approximately 1.4 to 1.5.



As we have shown above, the returns to aptitude in teaching occupations did not rise over this period (they were always approximately zero). Consistent with this, there was no rise in pay dispersion within teaching. Figures 16 and 17 show the 90/10 and 90/50 ratios within teaching. Given the smaller samples, these measures are more volatile than those for all recent university graduates, but it is clear that, in contrast to non-teaching occupations, there is no long-run increase in pay dispersion within the teaching profession between the mid-1970s and mid-2000s.

Figure 16: Ratio of Pay at the 90th and 10th Percentiles (Teaching)

Source: Graduate Destination Survey. Sample is recent university graduates working full-time as teachers.

Figure 17: Ratio of Pay at the 90th and 50th Percentiles (Teaching)

Source: Graduate Destination Survey. Sample is recent university graduates working full-time as teachers.

Given that pay dispersion rose in non-teaching occupations, but not in teaching, we would expect this to have disproportionately attracted high-ability men and women into non-teaching occupations. As we will show below, it is plausible that these changes in pay dispersion in non-teaching occupations are as important to explaining the decline in teacher aptitude as are changes in average pay.

V. A Model of Occupational Choice

We turn now to understanding why the academic aptitude of new teachers might have declined. In this section, we set out a formal model of the decision to enter teaching using a simple career choice model, akin to that in Hoxby and Leigh (2004). In Section VI, we apply this model to the data.

Assume all individuals enter teaching or an alternative non-teaching career, and that the alternate occupation also requires a university degree, thus making it possible to ignore the costs of university education. Assume further that in making the occupational choice, students' decisions are not influenced by the possibility of later switching into a different career.

The probability that an individual of ability i, gender s, in year t chooses a teaching career (denoted by the superscript *tchr*), instead of an alternative non-teaching career (denoted by the superscript *alt*) will therefore be determined by the individual's expected pay in teaching and in an alternative occupation.[10]

$$P(tchr)_{ist} = F\left[E\left(w_{it}^{s.tchr}\right), E\left(w_{it}^{s.alt}\right)\right] \quad (1)$$

Next, we take logs, and add an aptitude group fixed effect, a gender fixed effect, a year fixed effect, and a normally distributed error term, ε:

$$P(tchr)_{ist} = \beta_0 + \beta_1 Ln\left(w_{it}^{s.tchr}\right) + \beta_2 Ln\left(w_{it}^{s.alt}\right) + I_i^{apt} + I_s^{sex} + I_t^{year} + \varepsilon_{ist} \quad (2)$$

From the results above, we saw that there were no statistically significant returns to aptitude in teaching in the years covered by our analysis. We can therefore replace $Ln\left(w_{it}^{s.tchr}\right)$ with $Ln\left(\overline{w}_{t}^{s.tchr}\right)$, and estimate the equation:

[10] Leigh (2006) also models the non-wage characteristics. For simplicity, we ignore this factor here.

$$P(tchr)_{ist} = \beta_0 + \beta_1 Ln\left(\overline{w}_t^{s.tchr}\right) + \beta_2 Ln\left(w_{it}^{s.alt}\right) + I_i^{apt} + I_s^{sex} + I_t^{year} + \varepsilon_{ist} \quad (3)$$

Where the coefficient on β_1 represents the effect of average teacher pay, and the coefficient on β_2 represents the effect of wages for that aptitude group in alternative (non-teaching) occupations.
We should expect the probability of entering teaching to be positively correlated with average teacher pay (ie. $\beta_1>0$) and negatively correlated with the wage in alternative occupations (ie. $\beta_2<0$).

VI. Econometric Analysis

In this section, we use the model to formally analyse the changes in teacher quality, as measured by academic aptitude. Given the limitations of the wage data in the LSAY, we instead impute earnings using the GDS. From the GDS, we can calculate real earnings for teachers and non-teachers, which we impute based upon the year in which a typical LSAY respondent was observed in the labour force.

For teachers, we assign all respondents the average teaching wage for their gender and year. For non-teachers, wages are assigned according to gender, year and ability. To impute ability group wages, we divide LSAY respondents into five ability quintiles, and assign to these groups GDS wages at the 10th, 30th, 50th, 70th and 90th percentiles respectively.

Table 2 shows the changes in our key dependent and independent variables between the first and last LSAY cohort. The first row shows that the average real salary of a starting female teacher fell by 4 percent over this period. By contrast, real wages in alternative occupations grew, by 4 percent for the bottom aptitude group, and by 27 percent for the top aptitude group. Rows 3 to 10 show the same declines in teacher aptitude discussed in Section III.

For men, row 11 shows that the average real salary of a starting male teacher fell by 13 percent. Row 12 shows that – just as for women – average male pay rose more substantially at the top of the distribution than at the bottom. Rows 13 to 20 show changes in teacher aptitude for men.

Table 2: Changes in Dependent and Independent Variables

Panel A: Women					
Achievement quintile	**Bottom**	**2**	**3**	**4**	**Top**
(1) $\Delta Ln\left(\overline{w}_t^{f.tchr}\right)$			-0.040 (for all)		
(2) $\Delta Ln\left(w_{it}^{f.alt}\right)$	0.043	0.072	0.076	0.164	0.267
(3) Share who are teachers 1983	0.032	0.023	0.072	0.120	0.108
(4) Share who are teachers 2003	0.026	0.065	0.090	0.065	0.058
(5) Share who are studying teacher education 1983	0.012	0.032	0.065	0.126	0.108
(6) Share who are studying teacher education 2003	0.022	0.056	0.069	0.070	0.054
(7) Share of all female teachers 1983	0.090	0.066	0.202	0.338	0.304
(8) Share of all female teachers 2003	0.084	0.216	0.296	0.214	0.190
(9) Share of all female teacher ed. 1983	0.034	0.094	0.190	0.366	0.316
(10) Share of all female teacher ed. 2003	0.082	0.208	0.254	0.256	0.200
Panel B: Men					
(11) $\Delta Ln\left(\overline{w}_t^{m.tchr}\right)$			-0.126 (for all)		
(12) $\Delta Ln\left(w_{it}^{m.alt}\right)$	-0.037	0.007	-0.035	-0.027	0.077
(13) Share who are teachers 1983	0.005	0.015	0.020	0.020	0.045
(14) Share who are teachers 2003	0.004	0.007	0.013	0.023	0.027
(15) Share who are studying teacher education 1983	0.003	0.011	0.024	0.014	0.076
(16) Share who are studying teacher education 2003	0.005	0.011	0.019	0.020	0.016
(17) Share of all male teachers 1983	0.050	0.146	0.190	0.190	0.424
(18) Share of all male teachers 2003	0.050	0.094	0.180	0.306	0.370
(19) Share of all male teacher ed. 1983	0.026	0.088	0.190	0.108	0.590
(20) Share of all male teacher ed. 2003	0.076	0.154	0.270	0.276	0.226

We now turn to estimating equation (3). Given our available data, there are a number of important limitations in our approach. First, as we have already noted, we do not estimate the effect of returns to aptitude in teaching, since we observe no consistent returns to aptitude in any years that we analyse. Second, unlike the analysis of Hoxby and Leigh (2004) for the US, we use variation between men and women in place of cross-state variation. To the extent that the career choice decisions of men and women interact with one another, this may affect our estimated coefficients. Third, since we do not attempt to instrument for our pay variables, there remains the possibility that our variation in salary is in fact endogenous with respect to the quality of those entering teacher education.

Table 3 shows the results from estimating our career choice equations. In the first column, we find that average teacher pay is positively correlated with whether a woman enters teaching, while the pay in alternative occupations is negatively correlated with the decision to become a teacher. In the second column, the dependent variable is the decision to study teacher education, and we again find that average teacher pay is positively correlated with the share studying teaching, while pay in alternative occupations is negatively related to entry into teacher training courses. However, only the coefficients on alternative occupation salaries are statistically significant.

Table 3: Estimating the effect of salary on career choice

	(1) **Dependent variable is share who become teachers**	(2) **Dependent variable is share who study teacher education**
$Ln\left(\overline{w}_t^{s.tchr}\right)$	0.022	0.099
	[0.177]	[0.151]
$Ln\left(w_{it}^{s.alt}\right)$	-0.170***	-0.178***
	[0.062]	[0.060]
Aptitude group, gender and year fixed effects	Yes	Yes
Observations	50	50
R-squared	0.73	0.74

Notes: Pooled regressions, estimated from LSAY occupational choice data and GDS data, collapsed to aptitude*sex*cohort cells. Robust standard errors in brackets. ***, ** and * denote statistical significance at the 1%, 5% and 10% levels, respectively.

With the caveat that our coefficients for average teacher salary are not significant, it is possible to now combine the estimates from Tables 2 and 3 to see the effects of pay changes on teacher aptitude. For example, the share of women in the top aptitude group working as teachers fell by approximately 5 percentage points between 1983 and 2003. Our results suggest that this was due in part to falling mean teacher salaries (-0.04*0.022=-0.0009), but mostly to rising wages in alternative occupations (0.267*-0.170=-0.045). To take another example, the fraction of top-quintile men studying teacher education fell by 6 percentage points between 1983 and 2003. Our results suggest that this was due about equally falling mean teacher salaries (-0.126*0.099=-0.013) and rising wages in alternative occupations (0.077*-0.178=-0.014).

Overall, our econometric results and the changes in the independent variables suggest three conclusions. First, the fall in mean salaries mattered more for men than for women. Second, rising returns to aptitude in non-teaching occupations mattered more for women than for men. And third, mean salaries affected the decision to study teacher education more than they affected the decision to become a teacher.

VII. Conclusion

Using data from a variety of sources, we estimate the changes in teacher quality over the past quarter-century. We observe a substantial decline in the academic aptitude of the typical teacher over this period. Between 1983 and 2003, the average percentile rank of those entering teacher education fell from 74 to 61, while the average rank of new teachers fell from 70 to 62.

What caused this change? We are able to reject one hypothesis – that the returns to aptitude in teaching declined. Looking across cohorts, we find no evidence that more academically talented individuals have ever been paid more in teaching. This is perhaps because teacher unions in Australia have consistently rejected merit pay, and have remained industrially powerful throughout the period in question.

Our econometric analysis focuses on two remaining explanations for the decline in teacher quality. The first is average pay. Over the period 1983-2003, the average salary of a starting teacher fell both in real terms, and relative to non-teachers. In real terms, teacher salaries declined by 4 percent for women, and by 13 percent for men. Relative to university graduates entering other occupations, starting teacher pay fell by 11 percent for women, and by 17 percent for men.

The 1980s and 1990s also saw changes in the returns to aptitude in non-teaching occupations. Between 1983 and 2003, the real wages of top quintile female university graduates entering non-teaching occupations rose by 27 percent, while the real wages of top quintile male university graduates entering non-teaching occupations rose by 8 percent. For both men and women, real wages at the bottom quintile grew more slowly. As non-teaching occupations became more attractive for high-ability university graduates, fewer were inclined to choose teaching.

We believe that both these factors – falling average pay for teachers and rising returns to aptitude in non-teaching occupations – are responsible for the declining academic aptitude of new entrants to the teaching profession. We find some evidence that average pay has been more important in the decline of male teacher quality, while returns to aptitude in alternative occupations mattered more for the decline in female teacher quality.

Lastly, it is important to emphasise that our study focuses on the reasons for the decline in the academic aptitude of teachers over the past quarter-century. Reversing these factors is not the only way of raising teacher aptitude. For example, while boosting average teacher pay may be one way of encouraging more able people to enter teaching, it is also possible that increasing the returns to aptitude in teaching may be a more cost-effective way of raising the quality of the teaching profession.[11]

[11] For a proposal of this type in the Australian context, see Webster, Wooden and Marks (2005).

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Appendix I: Data Description

Longitudinal Surveys of Australian Youth

This project uses data from six Longitudinal Surveys of Australian Youth (LSAY) cohorts. These cohorts are the Youth in Transition 1961, 1965, 1970 and 1975 birth cohorts (YIT 61, YIT 65, YIT 70 and YIT 75) and the Longitudinal Surveys of Australian Youth 1995 and 1998 Year 9 cohorts (LSAY 95 and LSAY98).

The YIT cohorts were age-based cohorts. When first surveyed in the initial survey year of each cohort, the respondents were aged 14 years (or 10 years depending on the cohort – see below), so that most of them were born in the year reflected in the suffix of each of the acronyms used for the cohorts. In most cohorts, students of a common age were distributed across three grades. The actual grades students were in across Australia when first surveyed reflected differences in the structure of the schooling systems, school commencement procedures across Australian jurisdictions and the timing of the survey (or at least, the reference date for age in the survey of the beginning of October of the year they were first surveyed).

The LSAY 95 and LSAY 98 cohorts are grade-based panel. Students were in Year 9 in 1995 and 1998 respectively, but were different ages, again depending on differences in the structure of the schooling systems, school commencement procedures across Australian jurisdictions and the timing of the survey (or at least, the reference date for age in the survey of the beginning of October).

All cohorts were drawn from two-stage cluster samples of Australian school children. In the first stage, schools were randomly selected. In the second stage, students from those schools were randomly selected. In the YIT 61 and YIT 75 cohorts, individual 14-year-old students were randomly selected; in the YIT 65 and YIT 70 cohorts individual 10-year-old students were randomly selected; in the LSAY 95 and LSAY 98 cohorts intact classes were randomly selected. The samples were stratified by school sector (government, Catholic or independent private schools) and in the case of the first two cohorts by metropolitan and non-metropolitan regions. In all surveys, students completed literacy and numeracy tests at their schools, along with a short questionnaire to elicit background information. In the YIT 61, YIT 75, LSAY 95 and

LSAY 98 cohorts these tests were conducted when students were in the middle of secondary school, at age 14 or in Year 9, while in the YIT 65 and YIT 70 cohorts the tests were undertaken when subjects were in primary school, at age 10 years. Participants were surveyed in subsequent years by mail and/or telephone questionnaires. The surveys on which the YIT cohorts were based captured some 2 - 3 per cent of students of that age in Australia, the LSAY cohorts over 5 per cent of Year 9 students.

Our aim is to analyse critical characteristics of the individuals who studied to become teachers and of those who actually worked as teachers, along with their experiences early in their careers. Hence we want to be able to identify individuals from the data who studied to become teachers in the years we would expect to see them studying and those who commenced work in approximately the year in which they would have started work. A number of issues complicate this measurement: individuals defer their studies; they take longer to complete courses than is standard; they may take holidays after they complete their studies. When looking at data over the period studied here, there are other issues that may affect their comparability: the nature of education courses has changed. Where students were once undertook their courses in Teachers Colleges and Colleges of Advanced Education in the earlier cohorts, they are now undertake them in Universities. Where secondary school teachers once completed courses across numerous disciplines before undertaking a graduate diploma in teaching, they now more typically undertake undergraduate courses in secondary teaching. The length of teaching courses has also increased.

Our approach then to dealing with these comparability issues is to measure whether individuals were studying teaching or working as teachers over a number of years. We assess whether individuals studied teaching in either of the first two years after they could possibly have been in Year 12, given the grade they were in when first surveyed as part of their cohort. We assess whether individuals worked as teachers in either of the fourth, fifth or sixth years after they could possibly have been in Year 12, given the grade they were in when first surveyed as part of their cohort. This allows some leeway in terms of picking up courses of varying lengths and those who may have deferred their studies. A further complication is that in the first four cohorts, individuals were of a common age, but in different grades in school. For these cohorts, we measure whether individuals studies or became teachers in varying calendar years, depending on their grade when first surveyed. The years in which we measure these events for the various cohorts is summarised in Figure 1.

A few features of Figure 1 are worth noting. First, individuals in the LSAY 98 cohort are too young to be observed working as teachers yet, thought they it is possible to observe whether they are studying to become teachers. Second, field of study variables for the first cohort were incomplete, so that cohort is not included in the analysis of those who studied to become teachers. Third, data were not collected from the YIT 61 cohort in 1985, which means for those in the lowest grade we do not have data for their sixth year out from Year 12.

The wage data used in this report from these cohorts are "take home weekly wages" – that is they are net of taxation and other deductions. These wage data have been converted to 2004 dollars using changes in male average weekly total earnings as the deflator.[12]

A few other features of note about the data are as follows: hourly net wages are truncated at $75 per hour; individuals who reported they worked part-time but did not specify the hours were assigned 15 hours of work; those who reported they worked full-time 35 hours; for the 1975 cohort, occupations were not coded to an occupational classification in 1997, 1998 or 1999, so the verbatim responses were analysed to identify 'teachers'; this latter problem affects the identification of 'professionals' for those years – for those the professionals and group with degrees overlap; only individuals who answered that they had full-time job provided wage data in 1983 for the YIT 61 cohort.

[12] The series is based on published ABS data to 1984, with estimates for 1981 to 1983 based on splicing an RBA published series for male average weekly total earnings onto the 1984 ABS estimates.

Appendix Table 1: Years teacher data were extracted by cohort

	Studying to become a teacher			Working as a teacher		
	Year 8	Year 9	Year 10	Year 8	Year 9	Year 10
1978						
1979						
1980						
1981						
1982						
1983					YIT 61	
1984		YIT 65				
1985						
1986						
1987					YIT 65	
1988		YIT 70				
1989						
1990						
1991						
1992					YIT 70	
1993		YIT 75				
1994						
1995						
1996						
1997					YIT 75	
1998						
1999		LSAY 95				
2000						
2001						
2002		LSAY 98				
2003					LSAY 95	
2004						

Appendix Table 2: Number of people studying teacher education and working as teachers in LSAY cohorts

Cohort	Studying to become a teacher	Working as a teacher
YIT 61	n/a[(a)]	166
YIT 65	138	106
YIT 70	99	87
YIT 75	169	103
LSAY 95	325	243
LSAY 98	188	n/a[(b)]

(a) Field of study was not coded in all relevant years for those undertaking post-school studies in YIT 61

(b) Members of this cohort remain too young to have completed degrees by 2004, the latest year of data to have been released.

Graduate Destination Surveys

The Graduate Destination Survey (GDS) is a mail-out survey of recent university graduates, conducted in April of each year. Annual salaries are derived from the 1976-2003 Graduate Destination Surveys. We restrict the sample to those who have just graduated with a bachelor's degree or a diploma, and are working full-time. Respondents are asked for their annual salary, which is rounded to the nearest $1000. To avoid any bias from outliers, responses in the 1st and 100th earnings percentiles are dropped. We do not use the surveys in 1974 and 1975, since the codebooks do not allow us to accurately identify teachers. In 1982, salary information is collapsed into only two bands, so we also drop this year from our analysis. For the purposes of the analysis in Section VI, we deflate teacher earnings by the CPI.

Appendix II: Additional Evidence on Teacher Aptitude

Another way of estimating teacher aptitude is to focus on the minimum entry standards into teacher education courses.[13] To this end, we wrote to all state bodies that regulate entry into university courses in Australia, with the goal of obtaining comparable long-run data on minimum entry standards. Although most states were unable to provide us with these data, we did obtain assistance from the Universities Admissions Centre, which regulates admissions into universities in NSW and the ACT. The course on which UAC has the best long-run data is the Bachelor of Education (Primary) at the University of Sydney, which has been offered in every year since 1977.

Although UAC provided the entry standards into this degree in all years, the metric differed over time. This necessitated the following adjustments.

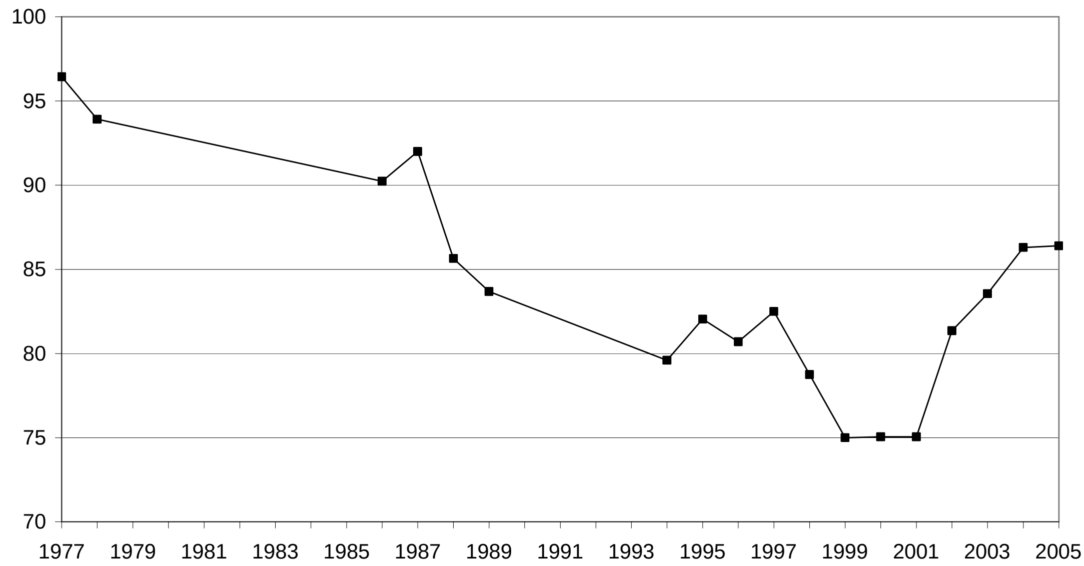
1977-1989: In these years, UAC reported the Tertiary Entrance Score (TES), which was a mark out of 500. However, in the years 1977, 1978, and 1986-1989, UAC also reported for each course and university the percentage of school candidates who achieved the cut-off. We used this figure, in conjunction with the year 12 retention rate for NSW, to calculate the fraction of the age cohort who achieved the cut-off. Subtracting this number from 100 percent provided us with a UAI-type measure.

1990-1997: In these years, UAC reported scores as a Tertiary Entrance Rank (TER). This was a percentile ranking was from 0 to 100, based only on those students who were eligible for a TER in a given year. Therefore it was not possible to compare students across years if retention rates changed. We used tables provided by UAC (Cooney 1998, Table 4) to convert TERs into UAIs.

1998 onwards: UAC reported scores as a University Entrance Rank (UAI), which was based on their age cohort, including those who did not complete year 12. We report these scores directly.

[13] Although cutoff scores are frequently discussed in the media, surprisingly little systematic research on this topic exists. An exception is Abbott-Chapman et al (1991), who present a graph showing that cutoff scores for various teacher education courses declined during the late-1980s.

Appendix Figure 1: Minimum UAI for Entry Into BEd(Primary) at the University of Sydney



Over this period, we observe a steady decline in the minimum entry standard into a Bachelor of Education at the University of Sydney. This suggests that the fall in entry standards was smaller during the ten years 1977-1986 (down 6 points, from 96 to 90), than in the ten years 1987-96 (92 to 81). While the entry standard appears to have risen over recent years (from 75 in 2001 to 86 in 2005), it remains well below its level in the late-1970s.[14]

Alternatively, instead of converting all cutoff scores into UAIs, we can simply use the original TES/TER/UAI scores, and compare minimum entry standards for the Bachelor of Education to those for other courses at the University of Sydney. In 1977, the entry standard for the Bachelor of Education was 365, well above the Bachelor of Economics (284), and not far below a combined Bachelor of Arts/Bachelor of Laws

[14] Over the past decade, the entry standards for Bachelor of Education courses seem to have risen in NSW and ACT universities, but fallen in Queensland universities. We obtained comparable data on cutoff scores over the past decade or more from UAC and the Queensland Tertiary Admissions Centre (QTAC). UAI cutoffs for Bachelor of Education courses have risen at the University of Wollongong (77.4 in 1994, 79.6 in 2005), the University of Technology, Sydney (79.6 in 1994, 80.45 in 2005), and the University of Canberra (69.85 in 1996, 75.00 in 2005). UAI cutoffs for Bachelor of Education courses have fallen at the Queensland University of Technology (85.50 in 1993, 80.00 in 2005) and Griffith University (82.75 in 1993, 78.00 in 2005). For earlier years, NSW TERs are converted to UAIs using conversion tables provided by UAC, and Queensland OP scores are converted to UAIs using conversion tables provided by QTAC. Other states were not able to provide us with data in a comparable form over this period.

(390). By 1987, the cutoff for the Bachelor of Education (352) was below the Bachelor of Economics (369), and substantially below the combined Bachelor of Arts/Bachelor of Laws (433). The same held true in 2005: Bachelor of Education 86.4, Bachelor of Economics 91.1, combined Bachelor of Arts/Bachelor of Laws 99.6.

Appendix III: Long-Run Trends in Teacher Pay

Since our paper is focused on the decisions made by new teachers, in the paper we primarily draw salary data from the Graduate Destination Survey (GDS), a large mail-out type survey conducted in April of each year, which covers around 15,000 respondents annually, of whom about 15 percent are teachers. This allows us to compare the salaries of those entering teacher education with the salaries of other university graduates.

However, another approach is to compare teacher salary data using national surveys of all teachers, conducted by the Australian Bureau of Statistics. There are two reasons that such a comparison might be instructive – first, it provides a check on the trends we observe in the GDS, and second, it allows us to compare teachers with those working in professional occupations, and with all full-time workers.

To make this comparison, we use the Employee Earnings and Hours Survey (EEH).[15] This survey has been conducted at least every two years since 1974.[16] In 1974-75, the survey does not identify the earnings of teachers. From 1976-85, the survey separately identifies the earnings of "teachers" (a category which encompasses both university lecturers and school teachers), and from 1986 onwards, the survey separately identifies the earnings of "school teachers". Our series therefore shows a break from 1985 to 1986. While the EEH does not provide information on the share of teachers who were school teachers, data from the 1986 Census suggest that this share was close to three-quarters, so we are confident that most teachers were likely to have been school teachers in the earlier surveys (particularly for women).

Our earnings measure is average ordinary time weekly earnings for full-time, non-managerial adults. Ordinary time earnings include performance pay and over-award payments, but exclude overtime (school teachers generally do not receive overtime, but using a consistent measure of earnings is important for our comparison groups).

[15] ABS Cat No 6306.0

[16] The EEH was conducted in the following years: 1974-81, 1983, 1985, 1986-1996, 1998, 2000, 2002 and 2004.

Until 1981, adults are defined as employees aged 21 or over. After this, adults are defined as employees aged 21 and over, or aged under 21, but paid at the adult rate.

We use two comparison groups. The first is professionals, a category that includes natural scientists, engineers, doctors, business professionals, university lecturers and school teachers. The second is all employees. In both cases, our comparison is restricted to non-managerial adults working full-time.

In comparing the earnings of teachers with those of other workers, it is important to take account of the age composition of the teaching profession and the general workforce. To see this, suppose that all workers are only two ages – young or old, and that old workers get paid more than young workers. Now suppose that the ratio of young teachers' earnings to young non-teachers' earnings remained constant, the ratio of old teachers' earnings to old non-teachers' earnings also remained constant, but the share of teachers who are old increased, while the share of non-teachers who are old stayed constant. In this situation, the ratio of teachers' pay to non-teachers' pay will rise.

In practice, it seems quite likely that this has occurred. In 1986, the median teacher was 34, younger than the median full-time worker (aged 38). By 2001, the median teacher was 43, older than the median full-time worker (aged 40). Even if the ratio of teacher pay to non-teacher pay at every age remained constant, the aging of the teaching workforce would have increased the ratio of teacher pay to non-teacher pay.

To work out the impact that changing age composition had on the ratio of teacher pay to non-teacher pay, we need to know the age distribution of teachers and full-time workers, and the returns to age for teachers and full-time workers. We obtain the age distribution of teachers from DEST (2003, 56) and Preston (1997, 55), and the age distribution of full-time workers from ABS Labour Force Statistics (Cat No 6202.0). The age distribution of teachers is broken into four age bands, and is not decomposed by gender.[17] We therefore treat the data for full-time workers in the same manner.

[17] In the teacher age data, the four age bands are 21-30, 31-40, 41-50 and 51+. In ABS Labour Force Statistics and the 1991 Census, the four bands are 20-29, 30-39, 40-49 and 50+. We use these interchangeably.

Note that our approach assumes that all teachers are full-time, and that the changes in age distribution of employees and returns to age do not differ by gender. Since we only have the age distribution of teachers in 1963, 1979, 1989, 1996 and 1999, and the age distribution for full-time workers in 1978-2005, we interpolate (extrapolating where necessary) for other years.

To estimate the returns to age for teachers and non-teachers, we use the 1 percent sample from the 1991 Australian Census. The year 1991 is chosen because school teachers can be identified, and because it is approximately at the midpoint of the period in question. For each of the four age bands, we estimate average full-time earnings for teachers, and for all employees. We then calculate *R*, the ratio of earnings in each age group to earnings for full-time workers aged 21-30 (our base category). Where *S* is the share of workers in age group *a* in year *t*, we calculate an adjustment ratio relative to 1991, according to the following formula:

$$AdjustmentRatio_t = \sum_{a=31-40}^{51+} \left(S_{ta}^{teachers} - S_{1991,a}^{teachers}\right) R_{1991,a}^{teachers} - \sum_{a=31-40}^{51+} \left(S_{ta}^{employed} - S_{1991,a}^{employed}\right) R_{1991,a}^{employed}$$

We then adjust the ratio of average teacher pay to average pay for any given year as:

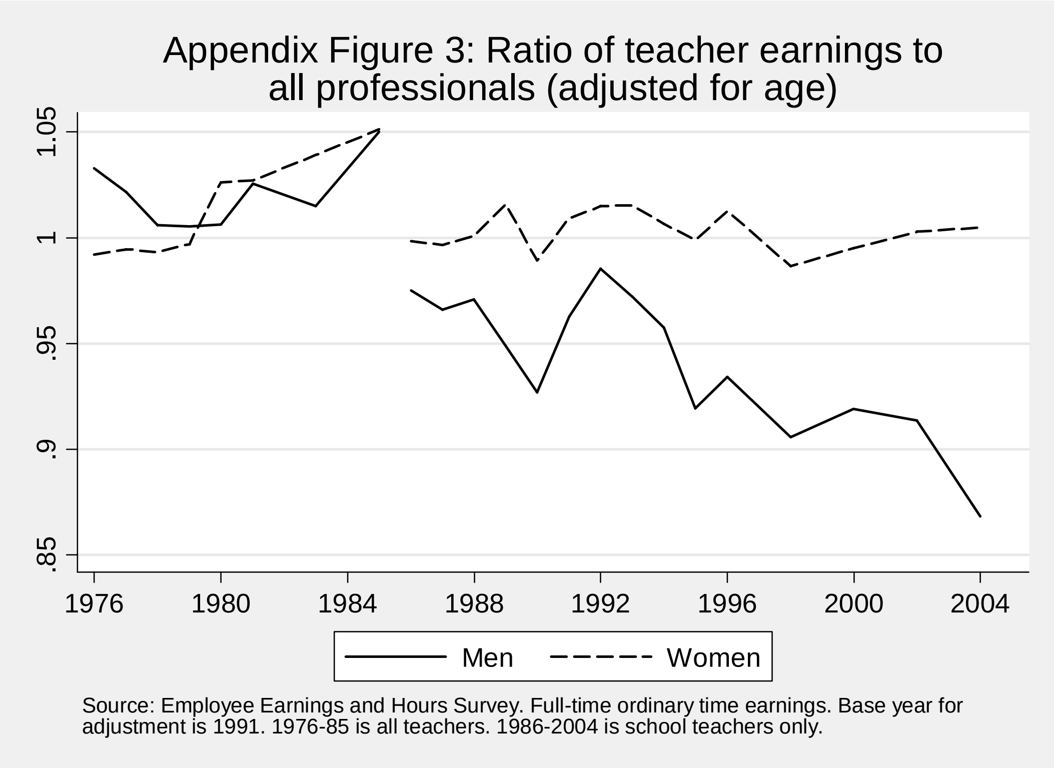
$$Ratio\left(AgeAdjusted\right)_t = Ratio\left(NonAgeAdjusted\right)_t + AdjustmentRatio_t$$

The figures below show the ratios over the period 1976-2004. Appendix Figures 2 and 3 present the ratio of teacher earnings to earnings of all professionals. For women, the ratio of teacher pay to professional pay appears to have risen over the period 1976-85 (slightly in the unadjusted series, substantially in the adjusted series). From 1986-2004, we observe little change in the ratio of teacher to professional worker earnings for women, whether or not the series is adjusted for age. In most years, the ratio is close to one. A possible reason for this is that the subcategory of female professionals is dominated by school teachers, but since we do not know the shares of each occupation, we cannot account for this.

For men, the ratio of teacher earnings to earnings of professionals seems to change more substantially. In the period 1976-85, the ratio of male teacher pay to professional pay falls in the unadjusted series, but rises when accounting for age. In 1986-2004, the ratio of male teacher earnings to professionals' earnings fell sharply in both the unadjusted and adjusted specifications. Adjusting for age composition effects, the ratio of the earnings of male teachers to the earnings of male professionals fell by 11 percent – from 0.98 to 0.87.

Appendix Figure 2: Ratio of teacher earnings to all professionals (not adjusted for age)

Source: Employee Earnings and Hours Survey. Full-time ordinary time earnings.
1976-85 is all teachers. 1986-2004 is school teachers only.



In Appendix Figures 4 and 5, we compare the earnings of teachers with those of all full-time non-managerial workers. This has the advantage that teachers themselves only comprise a small share of the denominator, but has the disadvantage that it may be capturing unrelated shifts in the labour market, such as changing returns to a university degree.

In the comparison with all employees, the trends for women and men are more similar than in the comparison with professionals. From 1976-1985, the ratios for both genders are relatively stable in the non-adjusted specification, and rising in the age-adjusted specification. Over the period 1986-2004, the ratio of teacher earnings to all full-time workers seems to have fallen sharply between 1986-1990, risen slightly in the early 1990s, and declined thereafter. In the age-adjusted specifications, the ratio of female teacher earnings to all female employees fell from 1.37 to 1.26, while the ratio of male teacher earnings to all male employees fell from 1.32 to 1.15. Between 1986 and 2004, these changes represent a decline in relative teacher pay of 8 percent for women, and 13 percent for men.

Appendix Figure 4: Ratio of teacher earnings to all employees (not adjusted for age)

Source: Employee Earnings and Hours Survey. Full-time ordinary time earnings. 1976-85 is all teachers. 1986-2004 is school teachers only.

Appendix Figure 5: Ratio of teacher earnings to all employees (adjusted for age)

Source: Employee Earnings and Hours Survey. Full-time ordinary time earnings. Base year for adjustment is 1991. 1976-85 is all teachers. 1986-2004 is school teachers only.