

Final Report

Wage Transitions of Apprentices

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Table of Contents

Acknowledgements	1
Executive Summary	3
1. Introduction	6
2. Data	8
2.1 Longitudinal Survey of Australian Youth (LSAY)	8
2.2 Definitions of Apprenticeship	10
3. Overview of Apprentices and Trainees	11
3.1 Apprenticeship and traineeship participation	11
3.2 Characteristics of apprentices and trainees	13
3.3 Duration of Apprenticeships and traineeships	17
4. Employment and wage progression of apprentices and trainees - Descriptive analysis	22
5. Employment and wage progression of apprentices – in comparison with counterfactuals using matching methods	27
5.1 Sample definition and modelling strategy	27
5.2 Econometric method	29
5.3 Main results	31
5.4 Sensitivity Analysis	37
6. Conclusion	41
References	42
Appendix	43

Executive Summary

In this report, we use data from the Longitudinal Survey of Australian Youth (LSAY) cohort 1995 to:

- Explore the dynamics of apprenticeship and traineeship participation in early career development;
- Describe the characteristics of apprentices and trainees;
- Examine the employment probability and wage progression of apprentices and trainees since training commencement;
- Estimate the impact of apprenticeship participation decisions on labour market outcomes in subsequent years

LSAY samples over 13,000 students who were in year 9 in 1995 and follow up information was collected annually up to 2006. The data shows that the majority of individuals in this cohort entered apprenticeships or traineeships 3 to 7 years after year 9 education (aged 17 to 22) and over a third of apprenticeship entrants did not complete high school education. Trainees entered slightly later than apprentices and had a lower high school non-completion rate. Both Apprentices and trainees have slightly lower average literacy and numeracy test scores than the general population in this cohort and slightly lower social demographic background as measured by parents' occupational skill levels.

In terms of gender differences, over 80% of apprenticeship entrants are male while around 53% of traineeship entrants are female. Individuals born in non-English speaking countries are less likely to participate in apprenticeships and traineeships. Apprentices are more likely to be single and living with parents. As for activities in the previous year, apprentices are more likely to study full-time prior to entering the program than trainees. Both apprenticeship and traineeship entrants are less likely to work while studying full-time than the average population in the same cohort. The proportion of individuals unemployed in the previous year is the highest for trainees (6.5%) compared with the 4.5% of apprentices and 2.7% for the general population of employed individuals.

The average duration of completed apprenticeship spells in our sample is 2.75 years and the corresponding figure for traineeship spells is 1.14 years. Compared with trainees, apprentices have lower starting weekly earnings but steeper earnings profiles. The average weekly earnings for apprentices increased from around 270 dollars (in 2006 dollars) per week to

nearly 720 dollars (in 2006 dollars) per week in the 6 years after apprenticeship commencement.

In the multivariate analysis of the impact of apprenticeship participation decisions, semi-parametric matching methods are employed to match individuals with similar characteristics in three different groups- those who entered apprenticeship program, entered traineeship program and those who had not entered either of the programs (non-participants). The rich set of information on family background and initial ability (literacy and numeracy test scores) allows us to control for characteristics that may affect labour market outcomes which are not attributable to apprentice participation. The labour market outcomes up to 6 years after training commencement of the three matched groups are compared.

Compared to non-participants, apprentices always have higher employment rates and lower unemployment rates in our observation period. At the 6th year after training commencement, the difference in employment rates is 5.2 percentage points and -2.8 percentage points for the unemployment rate. As expected, the self-employment rate of apprentices exceeded that of non-participants soon after the training completed (3 years after commencement). By the time it reaches 6 years, the self-employment rate is 6.9 percentage points higher than the comparison group.

In terms of weekly earnings, apprentices started with lower earnings but are catching up very quickly. The earnings gap becomes positive (higher for apprentices) three years after training commencement which is in line with the average training spell length of 2.75. The weekly earnings gap becomes stable at around 100 dollars (2006 level). Hourly wage rate are also found to be higher for apprentices than the non-participants at the end of our observation period.

The results of the comparison between apprentices and trainees are similar to the comparison with non-participants. However, the weekly earnings difference is only 38 dollars between the two groups, reflecting the positive returns of traineeship compared with non-participants and the lower investment level for trainees compared with apprentices.

Our findings show that there are certainly positive returns to apprenticeship and traineeship participation, not only in terms of weekly earnings, but also in terms of employment. For individuals, even though there are some costs associated with the training (those in training being paid lower initial earnings), the earnings of apprentices catch up very

quickly. The returns are considerable if life-time earnings are taken into account. This provides a positive incentive for individuals to participate in apprenticeships and traineeships. However, the analysis is based purely on the point of view of individuals. Further analysis is required to examine whether apprenticeship is a cost-effective and efficient investment in education funding for the government and businesses.

1. Introduction

Vocational labour markets represent a key element of the Australian economy, making up 35.3 per cent of total employment as of August 2008 (Source: ABS Labour Force, Australia, Detailed). In addition to the direct employment effect, high level vocational skills are also a vital component for ensuring competitive production and effective infrastructural development, which are generally accepted as key determinants of economic growth. As a consequence, it is vital that policy makers have a good understanding of the nature of wage progression within vocational labour markets. Amongst other things, relative wages between individuals who have taken up vocational training and those who are similar but have pursued alternative pathways provide an indication of the extent to which the current supply of vocational skills is in line with current demand.

Apprenticeship training remains the key vehicle of vocational skill provision in Australia and levels of apprenticeship training have exceeded those of most European countries (Dockery, 1996). The numbers of Australian apprentices, which comprise of apprentices and trainees, have increased rapidly between 1996 and 2002 and remained steady (with only very moderate increases) from 2003 to date¹ (NCVER 2001, 2008). Much of this growth has been fuelled by the rapid expansion of traineeships with only moderate increases in traditional apprentices which accounted for only 7% of the total growth (NCVER, 2004). As of 30 June 2008, 428 100 individuals were in-training, with 48% being in trades and the remaining in non-trades (NCVER 2008). Despite the growth of both the levels and the rate of persons in training, there are still wide spread concerns of skill-shortages in the recent years, in particular in the trades sector. Given that the Australian apprenticeship training is the main pathways providing skill workforce in trades sector, it is important to understand the wage progression of apprentices. More specifically, whether the wage gap between apprentices and their counterparts without training provides positive incentive for individuals to take up apprenticeships and stay in the trades sector.

A fair amount of research has been carried out on the issue of apprenticeship pay. The most recent work is by Curtis (2008), which examines the earnings of VET completers (including apprentices and trainees) versus those who did not undertake any post-school studies as well as other variables of interest such as employment outcomes, job satisfaction

¹ Since 1998, the data submitted to the National Centre for Vocational Education Research (NCVER) by states and territories does not separately distinguish apprentices from trainees. The statistics of traditional apprenticeships were estimated figures documented in Brooks (2004)

and hours worked in 2004. This report, however, only provides descriptive statistics that illustrates the general trend concerning participation and pay. Hence, the most comprehensive study of the issue remains that of Dockery & Norris (1996) who, using data from the 1991 Census, provided estimates on the returns to various types of vocational training. Ten vocational occupations were considered, with the general return to an apprenticeship over no qualifications estimated at 46 per cent. However, substantial variations were found across occupations and, in four trades, incomes were found to be less than those of unqualified workers. In addition, the incomes of female tradespersons were found to be generally lower than those of unqualified females. These findings are particularly disturbing given that subsequent work by Dockery, Koshy, Stromback & Ying (1997) and Dockery, Kelly, Norris & Stromback (2001) found that apprenticeships are associated with high training costs which, one might conclude from the 1996 study, may not in all cases translate to higher worker productivity and / or wages. However, as mentioned, existing estimates on the returns to apprenticeship are based on data from 1991 and may not adequately reflect current conditions.

The key contribution of this paper is the utilization of longitudinal data. This report emphasises the different nature of pay progression rather than the static comparison of whether apprentices and trainees earn more than non-participants at a single point in time. This aspect is one that has not been explored much in the recent literature but is pertinent in determining whether individuals find it worthwhile to pursue vocational training.

In terms of methodology, unlike the literature that compares apprentices to those with either lower or higher levels of education using regression methods, the quasi-experimental matching method is employed in this paper using individuals with similar characteristics but who had not participated in apprenticeships as the comparison group. Thus, the comparison group is a mixture of individuals with similar ability but slightly higher or lower education than apprentices. The purpose is to create a counterfactual for apprentices had they not participated in apprenticeships. This is intuitive as it mimics individuals' decision making situations because some individuals would have gone on to further study and some would not if they had not participated in an apprenticeship. The estimated differences in labour market outcomes would reflect the true effect due to apprenticeship participation. It is much more realistic than the simple comparison between apprentices and those in higher or lower education groups.

In addition to the comparison between apprentices and those who had not participated in vocational training, we also contrast the labour market outcomes of apprentices and trainees. Our results show that apprenticeships contribute positively to labour market outcomes no matter which comparison group was used but the magnitude is higher when compared with non trainees. The findings are intuitive as they reflect the positive but shorter duration of human capital investment of trainees.

The arrangement of this report is as follows. Section 2 discusses the two datasets used in the analysis and the definition of apprentices. Section 3 provides an overview of the participation pattern and characteristics of apprentices in LSAY. The examination of the employment and wage progressions of apprentices and trainees is presented in two parts: Section 4 provides the descriptive analysis of such issues, followed by an analysis using matching methods in Section 5. Section 6 concludes the report.

2. Data

2.1 Longitudinal Survey of Australian Youth (LSAY)

The Longitudinal Surveys of Australian Youth (LSAY) project is a survey program which undertakes annual interviews of young Australians with the aim of studying the transition from school to further education or work. It is an annual panel survey which follows several cohorts of students for 12 years. Four different cohorts (1995, 1998, 2003, and 2006) have been surveyed so far. Here we focus on the 1995 cohort data that samples students who were in year 9 in 1995 and re-interviewed annually up to 2006. We focus on the 1995 cohort because it is the only cohort with data available for a sufficient length of time for the purpose of studying the wage progression of apprentices after the completion of training.

LSAY is the only long running panel that specifically targets Australian youths. For the 95 cohort, the sample size is over 13000, which is much larger than the youth sample in other household panel surveys. The survey covers a critical period of education and early career development- ages 15 to 26, thus making it suitable for the analysis of the participation and wage progression of apprentices. However, the focus on youths has its disadvantage as well. A complete life-time wage profile cannot be estimated, hence we are not able to analyse very long-term wage progression of apprentices. It is possible to use other survey data, such as *Household, Income and Labour Dynamics in Australia (HILDA)* or *ABS Survey of Education and Training Experience (SET)*, to estimate life-time wage profiles. SET is a cross-sectional survey where individuals' earnings are not tracked over time. Apprentices' life-time earnings

can only be approximated by earnings of different cohorts. Given that the Australian apprenticeship program had changed significantly in the 1990s, the cross-sectional estimates may not reflect the true earnings profile. Similarly, even though HILDA is a panel survey, the problem cannot be completely eliminated because the use of multiple cohorts is still necessary. Moreover, in both SET and HILDA, certificate obtained through apprenticeships, traineeships, and other vocational education courses are not distinguished. Hence only LSAY data is used in the analysis.

Another advantage of LSAY is the detailed individual characteristics. The rich set of information on education, family background and literacy and numeracy test scores allows us to control for characteristics that may affect labour market outcomes which are not attributable to apprenticeship participation. The literacy and numeracy test scores, which are not available in other Australian surveys, are particularly valuable as they can be used as proxies of individuals' initial ability, an essential control variable in the analysis of returns to education and training programs.

In terms of data quality, LSAY has two shortcomings. There is significant cross-wave inconsistency in survey questions in some subjects. Careful treatment of the data and interpretation of the results is necessary. A table that describes variables used in this paper and when and where the inconsistencies occurred are provided in the appendix. Further, with only 29 per cent of the initial sample in wave 1 responding to questions in wave 12, the attrition rate is higher than other household panel surveys such as HILDA¹. Even though the non-random attrition in descriptive tables can be partly addressed by applying weights, unfortunately weights provided in the data are not suitable for the type of analysis in this paper. Moreover, applying weights in multivariate analysis will not solve the problem when heterogeneous behaviour is expected (Deaton 1997). Hence, the analyses in this paper are all based on unweighted data.

Table 2.1 shows the extent of attrition across waves as well as the prevalence of missing wages among those employed. It is clear that attrition is very high across waves, in particular from wave 1 to wave 2. As for missing weekly earnings, the problem is most severe in earlier waves when the proportion of working persons is relatively low (around 14-17% of those working do not report their wages in earlier waves) whilst for later waves it is less severe (the equivalent figure is about 7-8%).

¹ In HILDA, the attrition rate ranges from 5 to 13% from one wave to the next.

Table 2.1 Sample attrition and labour force status information overview

	Unemployed	Not in the labour force	Working (w/out weekly earnings info)	Working (with weekly earnings info)	Number of obs.
1995 (Wave 1)	0.00	0.77	0.03	0.20	13613
1996 (Wave 2)	0.01	0.55	0.06	0.38	9837
1997 (Wave 3)	0.02	0.47	0.09	0.42	10307
1998 (Wave 4)	0.03	0.42	0.07	0.47	9738
1999 (Wave 5)	0.05	0.22	0.07	0.65	8783
2000 (Wave 6)	0.08	0.13	0.08	0.70	7889
2001 (Wave 7)	0.05	0.14	0.06	0.75	6876
2002 (Wave 8)	0.06	0.11	0.06	0.77	6095
2003 (Wave 9)	0.05	0.09	0.06	0.79	5354
2004 (Wave 10)	0.04	0.08	0.06	0.82	4660
2005 (Wave 11)	0.03	0.07	0.07	0.84	4233
2006 (Wave 12)	0.02	0.07	0.08	0.84	3914

Note: there are 13 people in wave 2 whose labour force status is not known.

2.2 Definitions of Apprenticeship

Since the introduction of the Australian New Apprentice system in 1998, Apprenticeships and traineeships were brought together under the umbrella of “new apprenticeships”. Traditionally apprenticeships were focused on the skilled trades and related occupations such as the metal and engineering trades, the automotive trades, the electrical and electronics trades, building and construction trades, and hairdressing. In 1985, traineeships were introduced to complement traditional apprenticeships by extending the coverage of ‘apprenticeship-type’ training to a much wider range of occupations across the whole labour market. Apprenticeship participants typically studied at the equivalent of Australian Qualifications Framework (AQF) level III and above for three to four years, and traineeship participants at the equivalent of AQF level I and II for one to two years. Even though the New apprenticeships were a national commitment to dispense with legislative and administrative distinctions between the formerly different training systems, the distinctions between trades apprentices and non-trade trainees continued to be made. Therefore, in this report, apprenticeship and traineeship are treated separated for their distinctive job natures. Thus, from this point onwards, apprenticeship refers to the traditional apprenticeships in which the traineeships are not included.

In LSAY, the definition of current apprentice (trainee) is anyone who reports that he/she is currently doing an apprenticeship (traineeship) or continuing with the apprenticeship

(traineeship) study reported in the last interview. School based apprenticeship and traineeship courses are not included. Those individuals who commenced an apprenticeship/traineeship and then drop out of the training in between interviews were not identified. As a result, the number of apprenticeship/traineeship spells in section 3.3 below are likely to be underestimated. Given that most drop out from these program occur within the first year of commencing (Ball and John, 2005), the completion rates in our sample might not be comparable to official statistics of Apprenticeship completion rates.

3. Overview of Apprentices and Trainees

This section provides an overview of apprenticeship and traineeship participation, characteristics of the respective participants and the length of participation based on LSAY data. Throughout this paper, the comparison group for trainees will be apprentices in terms of their characteristics and wage progressions.

3.1 Apprenticeship and traineeship participation

Table 3.1 shows the numbers and proportion of our sample entering and currently participating in apprenticeship and traineeship by waves. The definition of apprenticeship commencement is based on the current participation indicator in all waves. The majority of individuals enter apprenticeships between waves 3 and 6 (age 17-20) and this group accounts for nearly 80% of all the apprenticeship entries we observed. For traineeships, the commencement occurs slightly later than apprenticeships. There are still 113 individuals (1.6% of all sample) entering traineeships at 21 years of age. These result in the concentration of both apprenticeship and traineeship participation between waves 3 and 8, with a peak at wave 6 for apprentices and wave 5 for traineeship.

Table 3.1 Apprenticeship and traineeship take up in early career in LSAY sample

	Commence apprenticeship		Numbers of apprentices		Commence traineeship		Number of trainees		Total No. of obs.
	Obs.	%	Obs.	%	Obs.	%	Obs.	%	
Wave 1 (age 15)	-	-	-	-	-	-	-	-	13613
Wave 2 (age 16)	65	0.7	65	0.7	14	0.1	14	0.1	9837
Wave 3 (age 17)	236	2.3	286	2.8	108	1.0	113	1.1	10307
Wave 4 (age 18)	233	2.4	448	4.6	150	1.5	169	1.7	9738
Wave 5 (age 19)	359	4.1	660	7.5	407	4.6	435	5.0	8783
Wave 6 (age 20)	185	2.3	680	8.6	237	3.0	325	4.1	7889
Wave 7 (age 21)	79	1.1	469	6.8	113	1.6	156	2.3	6876
Wave 8 (age 22)	40	0.7	136	2.2	83	1.4	106	1.7	6095
Wave 9 (age 23)	28	0.5	72	1.3	53	1.0	75	1.4	5354
Wave 10 (age 24)	22	0.5	57	1.2	25	0.5	41	0.9	4660

Wave 11 (age 25)	19	0.4	57	1.3	21	0.5	34	0.8	4233
Wave 12 (age 26)	15	0.4	47	1.2	20	0.5	30	0.8	3914

Note: 1. Age presented here is the mode of the age variable. The age of students in year 9 (wave 1) ranges from 13 to 18 and the majority are aged 15. In wave 12, the age range is 24 to 29.

3.2 Characteristics of apprentices and trainees

Tables 3.2 and 3.3 below provide the distribution of demographics and job characteristics of apprenticeship and traineeship entrants as well as all working persons and all individuals surveyed. However, due to the nature of the timing of apprenticeship and traineeship entry, strictly speaking, neither the sample of working persons nor the whole sample are directly comparable with apprenticeship and traineeship entrants. The last two columns are only provided to illustrate the distribution of characteristics in the average population group. In this section, emphasis will be placed on the comparison between apprenticeship and traineeship entrants.

It is clear that apprenticeship and traineeship entrants differ considerably in their characteristics. While around 47% of traineeship entrants are male, over 80% of apprenticeship entrants are male. This might be due to the differences in occupational choices between men and women. Trainees are more concentrated in the service industries, whereas apprentices are predominately working as tradespersons in industries such as manufacturing and construction.

In terms of education, apprenticeship entrants are clearly less educated than traineeship entrants. A larger proportion of apprenticeship entrants than traineeship entrants only completed year 11, whereas the reverse is true for those who progressed beyond year 11. This is consistent with the relatively worse performance of apprenticeship entrants in literacy tests and numeracy tests (though to a lesser degree) as well as the fact that the apprenticeship entrants are, on average, younger than traineeship entrants. These differences may contribute to apprentices' \$40 (in 2006 terms) lower weekly earnings compared to trainees despite their higher average weekly hours (40 hours as opposed to 38 hours for trainees). However, the average working hours should be read with caution as 25% of apprenticeship entrants and 20% of trainee entrants did not report working hours.

Concerning ethnicity, about 2% more of apprenticeship start-ups are Australian born versus migrants or from a minority group when compared with trainees. As for family background, 8% more of the apprentices are living with both parents whereas there is an increase of an equivalent amount in trainees who are living with non relatives. This is mainly driven by the fact that more of the apprenticeship entrants are single when compared to trainees. In terms of the influence of parents, the major difference is to be found with the

father's occupation- the proportion of apprentices whose fathers are tradespersons, clerks, or farmers is 8% more than that for trainees, with the difference equally spread across the skilled, semi-skilled and low skilled occupations. Compared to the general population in this cohort, apprentices and trainees are more likely to be from slightly lower social economic backgrounds with a lower proportion of individuals having parents who are skilled workers.

Regarding activity in the previous year, 56% of apprenticeship entrants were studying full time while only 47-8% of trainees were doing so. In terms of participation in the labour market, however, the proportion of trainees who were working in the year prior to undertaking a traineeship is 11 percentage points higher when compared to apprenticeship start-ups (3 percentage points higher in both those working full time and part time and 5 percentage points higher in those working but did not report working hours). At the same time, though, 2% more of the trainees were unemployed.

Table 3.2 Characteristics of apprenticeship/traineeship entrants

	Apprenticeship/Traineeship entrants		All working persons	All persons
	Apprentices	Trainees		
Personal characteristics				
Male	84.91	46.58	47.05	47.38
Average Age	18.17	18.98	19.54	18.45
Education				
Below year 10	5.69	1.54	13.41	25.90
Year 10-11	32.46	20.06	14.61	15.85
Year 12	32.39	43.27	44.40	38.06
Post school qualification	29.23	34.36	25.32	18.55
Tertiary	0.24	0.77	2.26	1.65
Literacy test score	9.14	10.32	11.50	11.30
Numeracy test score	9.40	9.63	10.87	10.74
Ethnic Background				
Australian born- non ATSI	93.15	90.54	90.34	88.32
Born in English speaking countries	2.48	3.05	3.27	3.33
Born in non English speaking countries	2.06	2.89	4.77	6.42
ATSI	2.31	3.53	1.61	1.92
Family background				
Living arrangements				
Living with one parent	11.65	12.95	10.06	10.94
Living with both parents	66.5	57.74	54.30	56.55
Living with relatives	2.3	1.99	1.32	1.53
Living with non-relatives	15.9	23.99	30.00	27.09
Living alone	3.66	3.34	4.32	3.89
Family type				
Partnered with children	0.84	1.33	2.00	2.49
Partnered without children	5.14	9.46	13.44	10.77
Sole parent	0.42	0.31	0.61	0.96
Single	93.6	88.90	83.95	85.77
Wave 1 Father occupation				
Not working	1.09	1.24	1.34	1.63
Skilled	5.97	8.68	13.81	14.19
Semi-skilled	16.92	18.78	23.40	22.85
Intermediate	48.51	40.66	36.92	36.29
Unskilled	27.06	30.29	23.89	24.40
Others	0.45	0.35	0.64	0.64
Wave 1 Mother occupation				
Not working	19.23	21.33	17.36	18.89
Skilled	1.70	2.55	3.88	4.13
Semi-skilled	20.26	20.98	25.73	25.08
Intermediate	34.40	32.22	33.01	32.12
Low skilled	24.32	22.83	19.87	19.63
Others	0.09	0.09	0.16	0.16

Note: 1. parents' occupation: 'skilled' refers to upper professional & manager; semi-skilled refers to Lower professional, manager & paraprofessional; Intermediate refers to trade, clerk, sales representative & farmer; Unskilled refers to Sales assistant, plant operators & lab workers.

2. Original adjusted Literacy and numeracy scores in LSAY are used. They range from -7 to 20.

Table 3.3 Job characteristics of apprenticeship/traineeship entrants

	Apprenticeship/ Traineeship entrants		All working persons
	Apprentices	Trainees	
Job characteristics			
Average weekly pay (in 2006 \$)	284.68	320.57	326.59
Average working hours	40.32	37.92	22.49
Industry			
Agriculture	1.86	4.77	3.89
Mining	1.34	0.42	0.66
Manufacturing	15.27	8.79	5.98
Electricity, gas & water	0.72	0.74	0.40
Construction	24.56	3.71	4.82
Wholesale	1.75	3.07	2.25
Retail trade	22.19	20.34	32.13
Accommodation, café & restaurants	5.99	9.32	10.88
Transport & storage	1.65	2.01	1.57
Communications	0.21	0.85	0.99
Finance	0.00	2.22	2.38
Property	5.88	12.39	10.88
Government	2.06	7.63	2.90
Education	2.58	6.04	4.18
Health& community services	1.14	9.43	6.38
Cultural& personal services	11.15	6.36	7.95
Undetermined	1.65	1.91	1.77
Occupation			
Undetermined	0.00	0.08	0.21
Manager & administrators	0.68	1.84	1.60
Professionals	1.11	4.88	11.61
Associate professionals	2.65	9.20	8.79
Tradesperson	77.56	11.20	12.19
Clerks, sales& service workers	3.92	51.52	45.77
Plant and machine operators	1.54	3.52	3.55
Labourers	12.03	17.36	16.00
Missing	0.51	0.40	0.27
Previous year activity status			
Studying full time and working	31.12	26.44	28.14
Studying full time and not working	25.67	21.37	15.12
Work full-time	9.00	12.30	12.04
Work part-time	11.37	14.91	9.35
Unemployed	4.34	6.46	2.70
Not in labour force	2.61	2.00	1.89
Working but don't know hours	8.45	13.99	23.58
Undetermined	7.42	2.54	7.17
Previous year weekly income (in 2006 \$)	152.86	188.83	267.82

Note: 40.36% of the sample didn't report working hours. This number should be read with caution.

3.3 Duration of Apprenticeships and traineeships

Table 3.4 explores the characteristics and duration of apprenticeship and traineeship spells. (Ideally, each spell should trace out only one apprenticeship or traineeship course. However, due to data problems, multiple courses might be contained within a single spell). Spells are characterised into 4 categories: left censored, right censored, both left censored and right censored and uncensored spells. Left censored spells occur when the individuals were not interviewed (or provide apprenticeship related information) in the year before the observed spell commencement. Since, by definition, it is not possible for an apprenticeship to occur in wave 1, left censored spells often occurred in wave 3 because there are a considerable proportion of individuals who responded to wave 3 questions but not wave 2. The right censored spells are defined as those whose end points are not observed. They often occur where individuals drop out of survey in the next year from the time apprenticeship/traineeship participation is last observed. Therefore we do not know whether the individual continued the training or stopped. If both the starting point and end point are clearly determined, the spells are defined as uncensored spells. Within the uncensored spells, we further separate them into spells in which the individual completed apprenticeship/traineeship and spells in which he/she dropped out. Here, dropping out is defined as discontinuing a course or having deferred during a spell and completion is simply defined as the reverse. However, due to the fact that discontinuation and deferrals are self-reported, we suspect that not all dropout behaviour was fully captured in the data. In addition, as mentioned above, current participation is defined such that if an individual undertakes an apprenticeship/traineeship course and terminates it in between the interview dates, such behaviour is not identified as a drop-out spell. As a result, the completion rates of apprentices and trainees might appear artificially higher when compared to other studies (Ball and John, 2005). The numbers here are provided to enhance understanding of our sample.

Table 3.4 Duration of apprenticeship participation

	Numbers of Spells	Avg. duration of spells
Left censored spells	45	2.69
Right censored spells	435	2.00
Both left and right censored spells	49	2.10
Not Censored spells	737	2.55
Completed apprenticeship	620	2.75
Drop out of apprenticeship	117	1.50

Total spells	1266	2.35
Average numbers of spells per individual who has participated in apprenticeship		1.03
Proportion of individuals ever participated in Apprenticeship (within 12 year since year 9)		9.02

Table 3.5 Duration of traineeship participation

	Numbers of Spells	Avg. duration of spells
Left censored spells	23	1.22
Right censored spells	198	1.19
Both left and right censored spells	8	1.13
Not censored spells	1072	1.14
Completed traineeship	901	1.15
Drop out of traineeship	171	1.09
Total spells	1301	1.15
<hr/>		
Average numbers of spells per individual who has participated in apprenticeship		1.10
Proportion of individuals ever participated in Apprenticeship (within 12 year since year 9)		8.68

On average, our sample consists mainly of individuals who undertake only one apprenticeship/ traineeship spell. About 9.02% of individuals had undertaken an apprenticeship some time during the observation period while 8.68% had undertaken a traineeship. Among such individuals, the most frequently experienced spells are uncensored spells, followed by right censored spells. There is not much of interest in the duration of traineeship spells, as all the average durations are close to 1 year, which is the usual duration of a traineeship course. For apprenticeship spells, the average duration of censored spells range from 2 to 2.69, suggesting that for some spells we might have missed out 1-2 periods of observation, since apprenticeships are usually of 4 years in duration. For the uncensored spells, the average duration of drop out spells are 1.5, suggesting that individuals often discontinue or defer an apprenticeship after studying 1 to 2 years. The average duration of uncensored completed spells in our sample is 2.75 years. This might be due to the fact that drop outs are not fully identified.

Table 3.6 compares the main demographics and job characteristics at commencement of those who have completed apprenticeship/traineeship to the exits, in which both discontinuation and deferral are included. While almost 86% of apprenticeship completions were male, the proportion of males who exited was 79%. For trainees, 45% of completions were male, whereas 56% of exits were male. With regards to the average age of commencement and education, those who exited apprenticeship/traineeship are, on average, younger and less educated than the completions. This is reflected in the commencement pay of apprenticeship/traineeship exits being lower than the completions.

Table 3.6 Initial characteristics - Comparison between those completed spells and those with non-completion exits (dropouts/defer)

	Apprenticeship		Traineeship	
	completed	Exits	completed	Exits
Male	85.65	79.17	45.07	56.25
Average age at commencement	18.26	17.54	19.05	18.56
Education				
Below year 10	5.61	6.25	1.33	2.84
Year 10-11	30.12	50.69	17.78	34.66
Year 12	33.96	20.14	44.8	33.52
Post school qualification	30.04	22.92	35.38	27.84
Tertiary	0.27	0.00	0.71	1.14
Average weekly pay at commencement (in 2006\$)	294.52	269.24	332.37	318.73
Industry at commencement				
Agriculture	1.89	1.65	4.79	4.65
Mining	1.42	0.83	0.49	0.00
Manufacturing	14.74	19.01	7.98	13.95
Electricity, gas & water	0.71	0.83	0.86	0.00
Construction	24.76	23.14	3.68	3.88
Wholesale	1.89	0.83	3.07	3.10
Retail trade	21.11	29.75	20.12	21.71
Accommodation, café & restaurants	5.78	7.44	8.83	12.40
Transport & storage	1.89	0.00	2.21	0.78
Communications	0.12	0.83	0.86	0.78
Finance	0.00	0.00	2.33	1.55
Property	5.90	5.79	12.64	10.85
Government	2.36	0.00	8.34	3.10
Education	2.83	0.83	6.26	4.65
Health & community services	1.30	0.00	9.33	10.08
Cultural & personal services	11.44	9.09	6.63	4.65
Undetermined	1.89	0.00	1.60	3.88
Occupation at commencement				
Manager & administrators	0.67	0.75	1.85	1.80
Professionals	1.06	1.50	5.08	3.59
Associate professionals	2.98	0.00	9.70	5.99
Tradesperson	77.86	75.19	10.34	16.77
Clerks, sales & service workers	3.66	6.02	52.17	47.31
Plant and machine operators	1.44	2.26	3.32	4.79
Labourers	11.74	14.29	16.99	19.76
Undermined or Missing	0.58	0.00	0.55	0.00

In addition, the industry and occupation that the completions and exits were working in at commencement were different. Due to the small sample size, however, it is hard to attribute such differences to any genuine job characteristic differences and this has to be kept in mind during interpretation. Nevertheless, more of the apprenticeship exits appeared to be working in manufacturing and retail trade industries (5% and 8%, respectively) while 5% more of the

exits were clerks and sales and services workers or labourers as opposed to associate professionals and tradespersons at the commencement of the apprenticeship. For traineeship exits, a higher proportion (4% and 6%, respectively) were working in accommodation, café & restaurants and manufacturing, accompanied by a 9% drop in the proportion of workers in government, education, cultural and personal services industries. Regarding occupations, about 5% less of the traineeship exits were professionals and associated professionals at the commencement of their course and 6% more were already tradespersons. In addition, the exits were almost 4-5% less likely to be in a clerical or sales position at commencement of their courses but 3% more likely to be working as a labourer.

4. Employment and wage progression of apprentices and trainees - Descriptive analysis

Table 4.1 presents the labour market outcomes one year after exiting an apprenticeship or traineeship program. These exits are separated into two types: completion and non-completion which includes deferrals and dropouts. The individuals who exited without completing their apprenticeship contain a much higher proportion of individuals who are unemployed and not in the labour force than those who completed an apprenticeship. Only 75.2 per cent of dropouts have a job in the year after exit. Similar patterns can be found for trainees but with a smaller gap between those who completed and those who exited traineeships. For those who are working, as expected, the average weekly pay is higher for those who completed apprenticeships, reflecting their skill premiums. The non-completion exits have a higher wage gain in the presence of jobs. This indicates that apprenticeship dropouts have two extremes, with some individuals dropping out of apprenticeship because of good job offers but others exiting for other reasons.

Table 4.1 Outcomes one year after exiting Apprenticeship/traineeship

	Apprenticeship		traineeship	
	Completion	Non-completion	Completion	Non-completion
Labour force status first year after exit apprenticeship/traineeship				
Working	92.79	75.20	88.59	80.77
Unemployed	4.91	16.00	7.67	11.54
Not in labour force	2.30	8.80	3.74	7.69
Weekly pay				
Average level	\$559.69	\$448.77	\$428.30	\$510.87
Average Amount of increase	\$112.63	\$148.42	\$97.19	\$81.65
Median Amount of increase	\$92.21	\$128.22	\$92.59	\$97.62
Median Percentage of increase	26.0%	57.0%	34.7%	24.0%

Note: due to the large number of observations with missing information on industry, we do not report proportion of individuals who changed industry after exits. In addition, the occupation categorization is inconsistent over time, therefore, changes in occupation cannot be examined. (See Appendix for details).

The comparisons of weekly pay between the two different types of exits for trainees do not share the same patterns as apprentices. The average weekly pay right after exit and the median amount of increase is higher for these dropouts but the average amount of increase and the median percentage of pay increase is actually lower. This might be due to the fact that only 53 of the trainees are identified as dropouts and information on weekly pay after exit is available for only 35 of them such that the pattern of weekly pay for trainee exits is quite erratic due to the influence of outliers in a small sample.

Table 4.2 presents the labour force participation for apprentices and trainees in each of the subsequent years since their spell commencement. Instead of following their progression after exiting the program, the outcomes since spell commencement are presented to gain a complete picture of the two groups' labour market progression. It is worth noting that the numbers of observations decrease as the length of time from spell commencement increases. This is caused by the nature of the data structure. For example, for individuals entering an apprenticeship program in wave 3, 9 years' worth of outcome information (waves 4 to 12) is available; while for those who entered the program in wave 9, only 3 years' worth of outcome information (waves 10-12) is available. In addition, high attrition also contributes significantly to the reduction in sample size. Thus, the number of observations becomes quite small when it reaches 6 years. Only 9 per cent of total apprenticeship entrants have information on year 9 outcomes, thus, years 9 and 10 are excluded from the following discussions.

For apprenticeship participants, the employment rate falls slightly in the first couple of years since commencement and stays steady at around 93 per cent with an increasing proportion leaving the labour force. The unemployment rate remains very low, particularly after finishing the program. The proportion of workers who became self-employed increased significantly to 11 per cent at year 4, the year when the majority of apprentices completed their program, and kept increasing up to nearly 20% at year 8. As for the traineeship participants, the employment rates are lower, remaining at around 90 each year up to 7 years after training commencement. The unemployment rate also decreased over time in contrast to the increasing rate of non participation in the labour market. The unemployment rates of trainees are much lower than the average rate among all youths.

Table 4.2 Labour force participation of apprenticeship and traineeship participants in subsequent years

Years since commencement	Employed	Unemployed	Not in the labour force	Self EMP working	<u>Sample with LFS info</u>	
					No. of obs.	% all appr
<i>Apprentices</i>						
Year 1	96.4	2.3	1.3	0.7	1063	84.0
Year 2	94.3	4.2	1.6	1.2	888	70.1
Year 3	94.9	2.4	2.7	4.1	748	59.1
Year 4	93.6	3.1	3.3	11.0	610	48.2
Year 5	93.4	2.7	3.9	13.7	517	40.8
Year 6	93.5	1.9	4.6	14.4	417	32.9
Year 7	93.8	0.3	5.9	14.7	290	22.9
Year 8	92.4	1.4	6.3	19.5	144	11.4
Year 9	90.5	2.7	6.8	28.4	74	5.8
Year 10	100.0	0.0	0.0	35.7	14	1.1
<i>Trainees</i>						
Year 1	89.6	6.2	4.2	1.2	1126	86.5
Year 2	89.3	5.9	4.8	1.7	963	74.0
Year 3	89.7	4.5	5.7	2.1	837	64.3
Year 4	89.4	3.7	6.9	3.4	695	53.4
Year 5	89.5	3.6	6.9	3.8	554	42.6
Year 6	90.2	3.0	6.8	6.6	438	33.7
Year 7	90.4	2.5	7.1	7.5	280	21.5
Year 8	88.0	2.4	9.6	13.7	83	6.4
Year 9	88.6	5.7	5.7	9.7	35	2.7
Year 10	100.0	0.0	0.0	0.0	5.0	0.4

Figures 4.1a and 4.1b presents progression of real average weekly pay in 2006 dollars by commencement year for apprentices and trainees. For clarity of the graphs, only groups in every second commencement year are included. The earnings profiles are very steep for apprentices, which is not surprising as their wages in the initial period were lowered to reflect the training costs. The starting weekly pay is higher for those who start an apprenticeship later, possibly due to their greater maturity, higher education level and better economic condition at entry year. For the two larger groups (commenced in 1998 and 2000), there is a visibly larger increase from year 3 to 4, the time when apprenticeships were completed. The patterns are not as clear for other groups. There is no clear reason why the pattern of earnings progression for those who commenced in 2002 differs from other groups. It might be caused by non-random attrition which will be taken into account using the econometric method outlined in the next section.

The starting earnings for trainees also increases by year of entry except for the last group (commenced in 2004) and the levels are similar to apprentices. However, the earnings profile is not as steep as apprentices, which is not surprising as the length of training is longer

for apprentices and thus there should be greater returns for them. The average earning increments after year 5 are very small and the real weekly earnings reach a steady level of around \$600 per week. It is important to note that the analysis here only gives a rough picture of the wage progression of apprentices and trainees. Some differences in earnings could be driven by the differences in individuals' characteristics and previous experiences. Thus, it is not possible to make arguments about how apprenticeship programs contribute to individuals' wage progression without constructing some appropriate comparison groups. The quasi-experimental matching method will be applied in the next section to perform a proper comparison among apprentices, trainees and those who participated in neither of the two programs.

Figure 4.1a Weekly earning progressions of apprentices

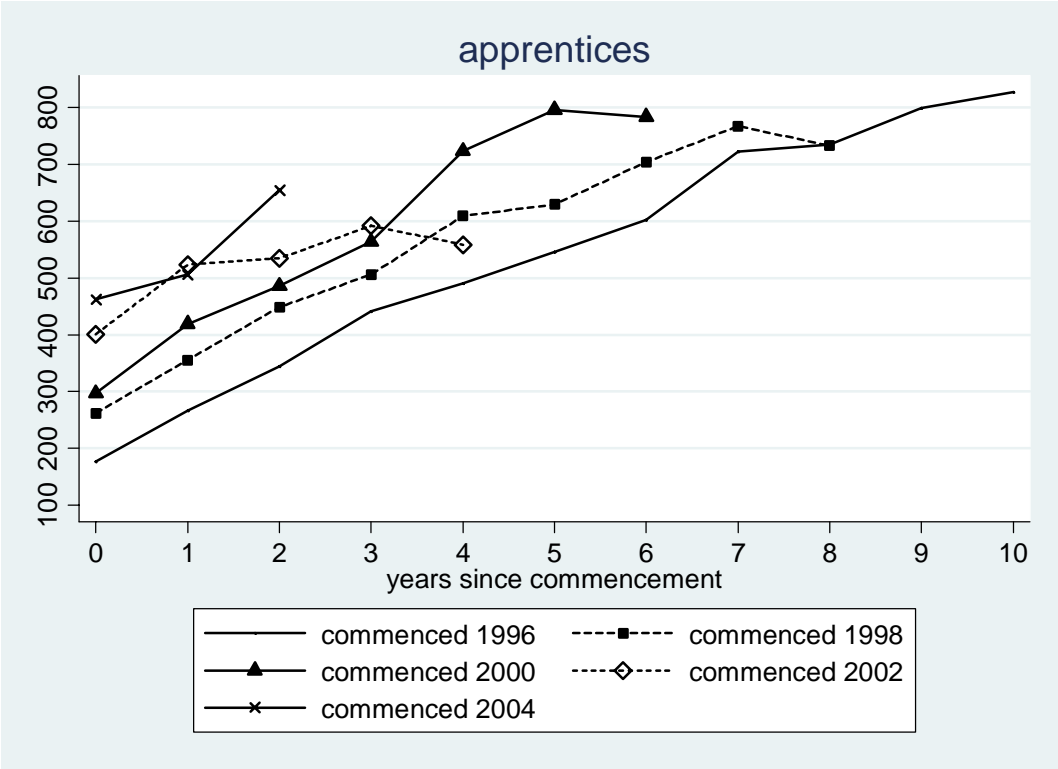
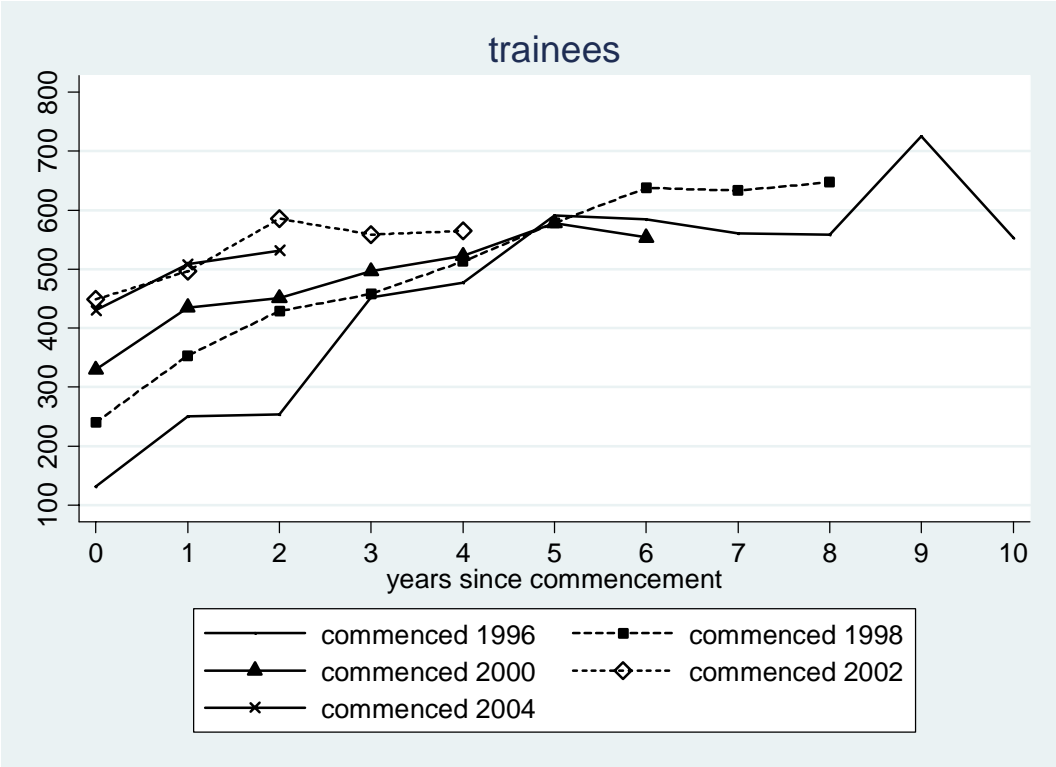


Figure 4.1b Weekly earning progressions of trainees



5. Employment and wage progression of apprentices – in comparison with counterfactuals using matching methods

In this section propensity score matching methods are used to select a proper comparison group whose characteristics are similar to apprentices. The labour market outcomes of this matched comparison group are used as a proxy for the counterfactual outcomes of apprentices had they not undertaken an apprenticeship. The methodology is discussed below followed by estimation results and sensitivity analysis.

5.1 Sample definition and modelling strategy

As shown in section 3, individuals can enter an apprenticeship program at different stages of life. Such dynamic nature of the participation decision adds significant complication to the sample selection and modelling strategy. Ideally, the apprentices at apprenticeship commencement should be matched to non-apprentices in the same wave (calendar year) because they are at the same career development stage and there is no effect of economic condition involved. The labour market outcome of both groups in subsequent years can then be compared over time. However, the comparison group who were non-apprentices in a given year could take up apprenticeships in later years. The estimated wage premiums then are not purely the returns to apprenticeship participation, therefore, they are unsuitable for cost-benefit analysis. If we defined the comparison group as those who had never commenced an apprenticeship during our observation window (1995-2006), that is, we exclude those who commence an apprenticeship in later waves in the comparison group, then we are investigating the effects according to *ad hoc* decisions and creating unobserved sample selection bias. For example, consider two persons who had identical characteristics prior to year t and were both not an apprentice in year t , person A had a job and person B did not in year $t+1$. In year $t+3$, person B decided to take up an apprenticeship to acquire more skills. Suppose we would like to compare year t apprenticeship entrants with their counter parts based on characteristics up to and including year t . If we exclude person B in the comparison group, the expected outcome for the comparison group is biased.

Considering the trade off between the two different methods, we decided to define the comparison group as individuals who had not commenced an apprenticeship up to the current wave, which is similar to the approach used in Sianesi (2004) and Borland and Tseng (2007). In this case, the comparison group includes individuals who may have started an apprenticeship in later years. The differences in outcomes between apprentices and matched

non-apprentices could then be interpreted as the effects of taking up an apprenticeship at a given point of time. These parameters are relevant from a behavioural point of view because they mirror the decision that an individual has to make at a given point in time — to take up an apprenticeship now or not. If the individual does not take up an apprenticeship now, he/she could do so later. Since the aim of this paper is not cost-benefit analysis, the second method is more meaningful and accurate. However, the outcomes of the comparison group defined as those who have never participated in an apprenticeship are also estimated as sensitivity analysis.

Another important issue to consider is the different types of vocational training. As shown in Table 3.1, there are a considerable number of individuals who participated in traineeships. It is intuitive to separate trainees from the non-participants. Given that traineeships and apprenticeships differ not only in the length of training but also in the patterns of outcomes, as shown in previous section, it is reasonable to model the outcomes of apprenticeships and traineeships separately. Full-time students are excluded given the vocational training focus of this study. Therefore, the sample to be analysed consists of the following three groups:

- 1) Apprenticeship entrants at wave t ,
- 2) Traineeship entrants at wave t ,
- 3) Individuals who were not studying in wave t and had not participated in traineeship or apprenticeship in wave t or prior.

The matching method described in the following section is then applied separately each wave to construct weights for groups 2 and 3 such that their average characteristics are similar to apprentices (group 1). Since only observations in the same waves are matched, the effects of economic condition are assumed to be the same across groups.

While the definition of non-participation group in our preferred definition may seem complicated, in fact, the complication is not unique to the matching analysis. As mentioned, the complication arises from the complication of individuals' decision making process where they can take up an apprenticeship course in different time periods. Hence, this complication applies to any multivariate analysis which takes into account the dynamic property of training participation and attempts to correct for sample selection bias.

However, policy makers may also be interested in the effect of apprenticeship participation versus no training. We also included a set of analysis where individuals who

have never participated in apprenticeships in our sample period are used as the comparison group instead of group 3 (non-participant group) outlined in the previous paragraph. As mentioned earlier, this set of estimates are not perfect. However, with careful application of matching method where post-matching matching tests are applied, we do not expect a large bias resulting from this estimation.

5.2 Econometric method

The model we adopt is based on the binary potential states model (Rubin 1974) and its extension by Imbens (2000) and Lechner (2001) to multiple, mutually exclusive states. The three states analysed in this study are apprentices, trainees and non-participants, denoted as ap , tr , and n , respectively. Since the focus of this paper is on the wage progression of apprentices, we therefore estimate the average wage premium of apprenticeship participation for apprenticeship participants. That is the “treatment effect on the treated (ATET)” in the terminology used by the program evaluation literature. Lechner (2001, 2005) discussed the differences between average treatment effect (ATE) and average treatment effect on the treated (ATET) in the context of multiple treatment programs. The ATE refers to the expected effects on the entire population. In a world of heterogeneous agents, it is expected that treatment effects would differ across individuals. Therefore, the ATET would differ from the ATE. This paper chooses to focus on the ATET due to its policy relevance as well as for reasons relating to data constraints. Given the design of apprenticeship programs, a considerable proportion of the population has nearly zero probability of taking up an apprenticeship, so the ATE is not very meaningful. In addition, given the high attrition rate and lack of proper longitudinal sampling weights in the data set, the ATE would not be representative of the population. It is therefore better to concentrate on the ATET measure.

The basic assumption behind matching methods is that, conditional on observable characteristics which determine treatment participation, outcomes would be independent of treatment assignment (conditional independence assumption, CIA). Under the CIA that $Y^{ap}, Y^{tr}, Y^n \perp C \mid S \mid X$, the effect of apprenticeship participation for the apprenticeship participants can be written as follows:

$$\begin{aligned} \gamma_{S=ap}^{ap,n} &= E(Y^{ap} - Y^n \mid S = ap) = E(Y^{ap} \mid S = ap) - E(Y^n \mid S = ap) \\ &= E(Y^{ap} \mid X = x, S = ap) - E(Y^n \mid X = x, S = n) \end{aligned} \quad (1)$$

Where $\gamma_{S=ap}^{ap,n}$ denotes the average effect of apprenticeship participation in comparison to non-participation, and the subscript $S=ap$ represents the fact that the effect is averaged across apprenticeship participants. Y^{ap} and Y^n represent the outcomes of apprenticeship and non participation, respectively. Since $E(Y^n | S = ap)$ is not observed, the average outcome of the matched non-participants group, $E(Y^n | X = x, S = n)$, can be used to calculate the ATET.

This type of pair-wise comparison could be applied to any of the apprentices, trainees and non-participants combinations. Previous descriptive analysis shows that apprenticeship participants are more similar to traineeship participants than non-participants. It is worthwhile exploring the effects of apprenticeship compared to their traineeship participant counterparts. The average effect of apprenticeship participation in comparison with traineeship participation under CIA could be written as

$$\begin{aligned}\gamma_{S=ap}^{ap,tr} &= E(Y^{ap} - Y^{tr} | S = ap) = E(Y^{ap} | S = ap) - E(Y^{tr} | S = ap) \\ &= E(Y^{ap} | X = x, S = ap) - E(Y^{tr} | X = x, S = n)\end{aligned}\tag{2}$$

In practice, the determinant of selection into treatment is often unknown and it relies on controlling for a rich set of variables to fulfil CIA. The CIA is plausible in this specific application as the dataset used in this study, LSAY, contains not only demographic information but also family backgrounds and literacy and numeracy test scores, which were viewed as the most important determinants of apprenticeship participation. In addition, the longitudinal aspect of LSAY allows us to generate labour market history and school experience, which are documented as important features of formal training and labour market outcomes in the literature. To deal with the curse of dimensionality, propensity scores can be used to match treatment and control groups instead of the set of characteristics (Rosenbaum and Rubin, 1983 and Lechner 1999). The full-list of control variables and results for propensity score model is listed in the appendix. The following describes the steps in the matching procedure applied in this study.

- a. Apply the multinomial probit model to estimate $\hat{P}^{ap}(x)$, $\hat{P}^{tr}(x)$, $\hat{P}^n(x)$
- b. Compute conditional probability

$$\hat{P}^{ap|ap,n} = \frac{\hat{P}^{ap}(x)}{\hat{P}^{ap}(x) + \hat{P}^n(x)}, \text{ and } \hat{P}^{ap|ap,tr} = \frac{\hat{P}^{ap}(x)}{\hat{P}^{ap}(x) + \hat{P}^{tr}(x)}$$

- c. Apply nearest neighbour matching algorithm to match each observation in the apprentice group with the non-participant group based on the conditional probability

$\hat{P}^{ap|ap,n}$ to obtain weights for the non-participant group. Kernel matching algorithm with bandwidth equal to 0.1 is also performed as sensitivity analysis. For details of these two matching algorithms, see Borland and Tseng (2007).

- d. Apply the same methods (as in step c) to match apprentices (treatment group) and traineeship participants (control group).
- e. Compute the weighted average outcome of matched control groups (non-participants and trainees) using weights generated from steps c and e.

In comparison to the regression methods, the matching method has the advantage that it is a semi-parametric approach, which avoids imposing the functional form restrictions implicit in regression models. Smith and Todd (2005) suggest that avoiding these functional form restrictions can be important in reducing bias. Although the results of regressions could be improved by adding higher-order terms and interaction terms, this is not often done. In this specific application, even though the probability of participation is estimated using multinomial probit regression which is a parametric estimation procedure, the final functional form of the multinomial probit equation is determined by a post-balancing test. That is, by performing t-test for equal mean between the apprentices and matched (weighted) non-participants for each control variables in the regression. The functional form is then adjusted to achieve balanced characteristics between the two groups. In addition, the matching method explicitly addresses the “common support” problem. In other words, the analysis is only restricted to individuals with similar probabilities of participation. It avoids incorporating information from individuals who are very unlikely to participate in a treatment or is nearly certain to participate and therefore making the comparison between two groups more meaningful.

5.3 Main results

The key outcome variables examined in this study include employment rate, unemployment rate and the average weekly earnings in each year since apprenticeship commencement for up to 6 years. Hourly wages and rate of self-employment for those who are working are also analysed. The main results presented in this section are for the sample with their labour force status reported in all years since the entry year of apprenticeship or traineeship. This is done to avoid the potential bias caused by non-random sample attrition. Nevertheless, this restriction does come with a price. The estimated average effect can only be tied to a subgroup of apprentices, which comprises approximately 39% of the sample.

Considering the trade off between representativeness and unbiasedness, we decided to use the estimates from the restricted sample as the main results. The results using the entire sample including observations with incomplete outcome information are presented in the next section as sensitivity analysis.

Table 5.1 presents the outcomes of the matched sample of wave 3 to wave 6, weighted using the sample size of apprentices. We exclude those who commenced apprenticeships prior to wave 3 as the sample size is too small. Those who entered apprenticeships after wave 6 were also not examined due to the insufficient length of data for the outcome variables. Given that apprenticeships generally last 3 or 4 years, it is essential to follow those individuals for at least 6 year to see the wage progression after completion. This set of results represent the effects of commencing apprenticeship participation in a given point in time versus not participating at that time. As mentioned earlier, the comparison group (non-participant) could take up apprenticeship or traineeship in later years. The contemporaneous participation in apprenticeships/traineeships is often associated with a lower wage, partly reflecting the lower productivity in the learning stage and partly the sharing of the training cost. Thus, investigating the evolution of training activities for the three matched groups as presented in Table 5.2 would contribute significantly to the understanding of their outcome comparisons. By definition, 100 per cent of the apprentice group participated in an apprenticeship in the base year and, one year later, 86.9 per cent of them remained in the apprenticeship program. The majority, 85.6 per cent, finished an apprenticeship by 4 years after the commencement year. There is only a small proportion of trainees and non-participants who joined apprenticeships in subsequent years. By contrast, only 19.6 per cent of trainees remain in a traineeship one year after commencement. All three groups have some individuals who returned to formal education in subsequent years, with the highest proportion being in year 2 for the non-participant group. The differences in the participation rate of education and training activities reduce significantly in year 4 and are negligible by 6 years after commencement. Therefore, the comparisons of year 6 outcomes are closest to the full effects after apprenticeship completion and will be emphasized in the following discussion.

In table 5.1, the first three rows show the outcomes of the three groups for reference as these figures are expected to differ from those presented in the previous section due to different sample selection rules and weights derived from the matching method. Our discussion below will focus on the difference in outcomes presented in the last two rows of each outcome panel. It is worth to keep in mind that after the application of matching

methods, the matched trainees and non-participants group have similar characteristics. For example, there is significant difference in gender composition between apprentices and trainees, while after matching, the proportion of male in the matched trainee group is 0.86 which is the same as the apprentice group. Hence, the differences in the average outcome which are attributable to individuals' characteristics have been eliminated.

The employment rate for apprentices is almost always higher than the other two groups with only one exception, where trainees' employment rate exceeded apprentices at year 5. The largest employment rate gap between apprentice and non-participants occurred during years 1 to 3, when some of the non-participants took further study as shown in table 6.2. The largest gap of employment rate between apprentices and trainees occurred at one year after commencement when the trainees completed training and started to look for work. This is also evident in the 9.1 percentage point higher unemployment rate for trainees. Since the calculation of unemployment does not include individuals who are out of the labour force, the unemployment rate gap was not directly affected by the large differences in education participation in years 2 to 4. Nevertheless, in year 6, the employment rate of the apprentice group is 5 to 6 percentage points higher than the other two groups, with the unemployment rate being 2.8 percentage points lower than non-participants and 6.1 percentage points lower than trainees. In terms of self-employment, the proportion of workers who are self-employed is higher for apprentices than for the other two groups after year 3 when the training was completed. In year 6, the gap is around 6.5 percentage points. This is not surprising given the high concentration of tradespersons in the apprentice group.

In terms of weekly pay, both apprentices and trainees have low starting weekly pay compared with non-participants. The trainees' weekly pay increases dramatically in the year after commencement, that is, their training completion year, while apprentices' weekly pay remains relatively low for three years. This translates to negative differences (apprentice minus trainees) in the first four years and positive differences thereafter. The gap between apprentices and non-participants become positive in year 3. The weekly pay premium for apprentices in year 6 is around \$100 comparing with non-participants and \$38 compared to trainees, which is not as large because of the returns to the one year training for trainees.¹ However, weekly pay is a product of working hours and hourly wages, where hourly wages reflect the productivity of workers in a competitive labour market. Hence, to fully understand the returns to skill accumulation through apprenticeship participation, it is important to

¹ Weekly pay information is not available for self-employed persons.

investigate the progression of hourly wages. However due to the large number of missing values in working hours, the hourly wage rate comparison should be read with caution. The proportion of missing values in weekly pay and hourly wages are presented in table C2 in the appendix. The pattern of hourly wage gaps over time shares the same pattern as weekly pay. In the final observation year, the wage premiums for apprentices are \$4.5 and \$4.3 per hour compared to non-participant and trainees respectively.

Table 5.1 Labour market outcomes of Apprentices and matched trainees and matched non-participants (non-participants: those who have not commenced apprenticeship and traineeship)

Outcomes	Years since apprenticeship commencement						
	0	1	2	3	4	5	6
Employment rate							
Apprentices	100.0	97.3	95.1	95.9	92.9	93.2	93.4
Non participant	91.3	84.7	84.7	86.1	87.4	87.2	88.3
Trainees	100.0	87.4	93.7	94.3	87.4	97.5	87.4
<i>Diff.(apprentice vs non participant)</i>	8.7	12.6	10.4	9.8	5.5	6.0	5.2
<i>Diff (apprentice vs trainee)</i>	0.0	9.8	1.4	1.6	5.5	-4.4	6.0
Unemployment rate							
Apprentices	0.0	1.7	3.3	2.2	3.1	2.3	1.7
Non participant	6.5	8.8	7.2	5.7	5.6	6.4	4.5
Trainees	0.0	10.8	5.0	3.6	6.5	0.6	7.9
<i>Diff.(apprentice vs non participant)</i>	-6.5	-7.2	-3.8	-3.5	-2.5	-4.1	-2.8
<i>Diff (apprentice vs trainee)</i>	0.0	-9.1	-1.6	-1.4	-3.4	1.7	-6.1
Self employment rate working							
Apprentices	0.0	1.2	1.2	3.4	11.5	12.9	13.4
Non participant	1.5	3.9	6.8	2.9	2.8	6.6	6.5
Trainees	0.0	0.0	0.6	2.2	4.2	0.6	6.7
<i>Diff.(apprentice vs non participant)</i>	-1.5	-2.7	-5.6	0.5	8.7	6.3	6.9
<i>Diff (apprentice vs trainee)</i>	0.0	1.2	0.6	1.1	7.3	12.3	6.7
Weekly pay							
Apprentices	268.3	359.5	450.0	523.2	634.6	705.3	718.0
Non participant	340.8	361.2	479.0	477.9	520.0	577.3	616.8
Trainees	276.1	410.7	484.2	558.5	598.7	654.4	680.4
<i>Diff.(apprentice vs non participant)</i>	-72.5	-1.7	-28.9	45.3	114.6	127.9	101.2
<i>Diff (apprentice vs trainee)</i>	-7.8	-51.2	-34.2	-35.4	35.8	50.9	37.6
Hourly wage							
Apprentices	6.9	8.7	11.1	12.8	16.4	17.1	19.8
Non participant	9.9	10.0	20.7	12.2	12.5	13.6	15.3
Trainees	7.4	11.0	11.7	13.8	15.2	15.1	15.5
<i>Diff.(apprentice vs non participant)</i>	-3.0	-1.2	-9.6	0.6	4.0	3.6	4.5
<i>Diff (apprentice vs trainee)</i>	-0.5	-2.3	-0.6	-0.9	1.2	2.1	4.3

Table 5.2 Apprenticeship, traineeship and education participation in subsequent years

	Years since apprenticeship commencement						
	0	1	2	3	4	5	6
Apprenticeship participation							
Apprentices	100.0	86.9	71.3	33.3	4.4	2.5	2.7
Non participant	0.0	8.2	11.7	9.0	4.1	1.6	0.0
Trainees	0.0	7.9	8.5	9.3	2.5	2.2	3.0
<i>Diff.(apprentice vs non participant)</i>	<i>100.0</i>	<i>78.7</i>	<i>59.6</i>	<i>24.3</i>	<i>0.3</i>	<i>0.8</i>	<i>2.7</i>
<i>Diff (apprentice vs trainee)</i>	<i>100.0</i>	<i>79.0</i>	<i>62.8</i>	<i>24.0</i>	<i>1.9</i>	<i>0.3</i>	<i>-0.3</i>
Traineeship participation							
Apprentices	0.0	0.8	1.4	0.0	0.5	0.3	0.0
Non participant	0.0	4.1	2.7	5.2	1.1	1.6	1.1
Trainees	100	18.6	7.9	3.8	0.3	0.3	1.4
<i>Diff.(apprentice vs non participant)</i>	<i>0.0</i>	<i>-3.3</i>	<i>-1.4</i>	<i>-5.2</i>	<i>-0.5</i>	<i>-1.4</i>	<i>-1.1</i>
<i>Diff (apprentice vs trainee)</i>	<i>-100</i>	<i>-17.8</i>	<i>-6.6</i>	<i>-3.8</i>	<i>0.3</i>	<i>0.0</i>	<i>-1.4</i>
Study							
Apprentices	0.0	2.2	3.3	5.9	3.8	8.4	6.0
Non participant	3.3	19.4	28.1	28.7	17.6	16.6	7.4
Trainees	0.0	8.2	11.4	18.6	16.5	7.7	8.1
<i>Diff.(apprentice vs non participant)</i>	<i>-3.3</i>	<i>-17.2</i>	<i>-24.9</i>	<i>-22.7</i>	<i>-13.8</i>	<i>-8.3</i>	<i>-1.4</i>
<i>Diff (apprentice vs trainee)</i>	<i>0.0</i>	<i>-6.0</i>	<i>-8.2</i>	<i>-12.7</i>	<i>-12.6</i>	<i>0.7</i>	<i>-2.1</i>

5.4 Sensitivity Analysis

The first set of sensitivity analysis restricts the non-participants sample to those who have never participated in apprenticeship or traineeship. The results are presented in Table 5.3. This set of results is used as proxies of the pure apprenticeship participation effect (participation versus non-participation). Basically, the differences in the outcome patterns were similar to the results from the main model. For the estimates of outcome differences in year 6, the estimated gap in the employment rate between apprentices and non-participants is smaller than those in the main results. The differences in weekly earnings estimates appear to be larger for both comparisons. However, these differences are not expected to be statistically different.

Table 5.3 Labour market outcomes of apprentices and matched trainees and matched non-participants(non-participants: those who have never participated in apprenticeship and traineeship)

Outcomes	Years since apprenticeship commencement						
	0	1	2	3	4	5	6
Employment rate							
diff. (apprentice vs. non participant)	11.5	10.7	6.0	12.6	7.1	7.7	3.8
diff. (apprentice vs. trainee)	0.0	10.4	0.3	4.6	10.4	-0.3	6.3
Unemployment rate							
diff. (apprentice vs. non participant)	-9.8	-4.5	0.0	-4.4	-2.6	-4.8	-3.2
diff. (apprentice vs. trainee)	0.0	-9.3	0.0	-2.7	-4.3	1.4	-5.6
Self employment rate working							
diff. (apprentice vs. non participant)	-0.9	-2.6	-3.5	0.1	5.7	7.3	6.3
diff. (apprentice vs. trainee)	0.0	0.1	-0.2	1.4	6.5	10.9	6.7
Weekly pay							
diff. (apprentice vs. non participant)	-82.8	-22.7	12.0	24.0	119.5	131.4	118.6
diff. (apprentice vs. trainee)	-3.0	-43.3	-38.2	-25.7	32.4	28.0	76.5
Hourly wage							
diff. (apprentice vs. non participant)	-3.8	-3.8	-2	-2.8	3.3	1.9	4.5
diff. (apprentice vs. trainee)	-0.4	-2	-0.4	-0.6	2.4	0.7	4.4

Note: the characteristics of matched sample are listed in appendix.

Next, the estimates using the full sample and those using samples of those who responded in all 6 years following the spell commencement are compared. Table 5.4 presents the response rates of the matched sample in the three groups and their differences. The response rate reduction of all three groups is highest in year 1 and remains in 2 digits figures up to year 4. By year 6, only 39% of all samples in the matched apprentices group responded. One good thing is that the response rates do not differ much between groups, as reported in

the last two rows. Unless there are different patterns of attrition across the three different groups, the estimates using the full sample (including those with incomplete information) would not differ much when compared with our basic estimates. The argument is supported by the similarity in the estimates between the two different samples presented in Figures 5.1a and 5.1b.

In Figure 5.1, Panel A illustrates the differences in estimated effects on the employment rate, while panel B contrasts the estimates in weekly earnings. The results from the full-sample are denoted by dotted lines. In terms of employment rates, full sample estimation yields slightly more moderate effects of apprenticeship participation for the apprentices versus non participants. For the weekly earnings, the full-sample estimates shifted the line of estimated effects up slightly. However, the patterns of estimated effects are quite similar for the two different samples.

Table 5.4 Comparison of response rates among matched samples

Response rate	Years since apprenticeship commencement						
	0	1	2	3	4	5	6
Apprentices	100.0	85.5	72.1	61.7	50.4	44.1	39.1
Non participant	100.0	86.7	75.0	63.3	52.1	42.4	36.8
Trainees	100.0	85.0	68.8	62.5	53.3	46.3	41.8
<i>Diff.(apprentice vs non participant)</i>	0.0	-1.3	-2.9	-1.6	-1.7	1.7	2.4
<i>Diff(apprentice vs trainee)</i>	0.0	0.4	3.3	-0.7	-2.9	-2.2	-2.7

Figure 5.1a Comparisons between balance panel and all sample (employment rate)

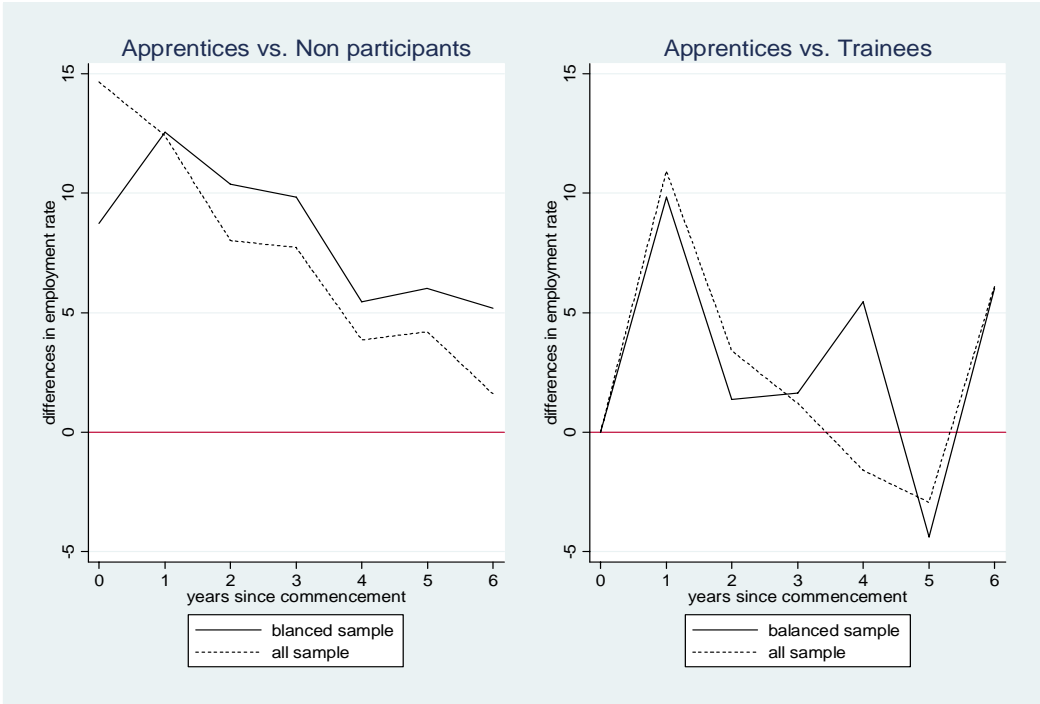
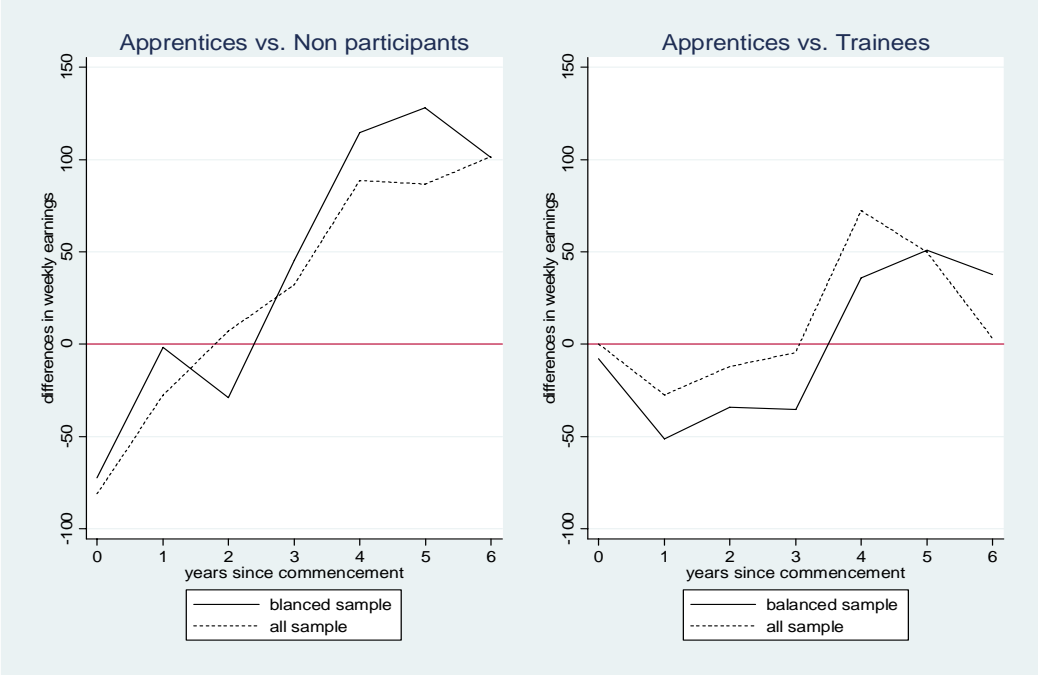


Figure 5.1b Comparisons between balance panel and all sample (weekly earnings)



The next set of graphs (Figures 5.2a and 5.2b) compares the results from different matching algorithms based on the main sample. Kernel matching results shown by dotted lines are slightly smoother. This is not surprising because in kernel matching, each treatment group observation is matched to a number of control group observations weighted by the kernel function, while in nearest neighbor matching, each treatment group is matched to one control group observation only. Kernel matching estimated a slightly lower employment gain of apprenticeship participation compared to non-participants but a slightly larger gap in weekly earnings between apprentices and trainees. Again, the differences are not large and the patterns are similar.

Figure 5.2a Comparisons between matching algorithms (differences in employment rate)

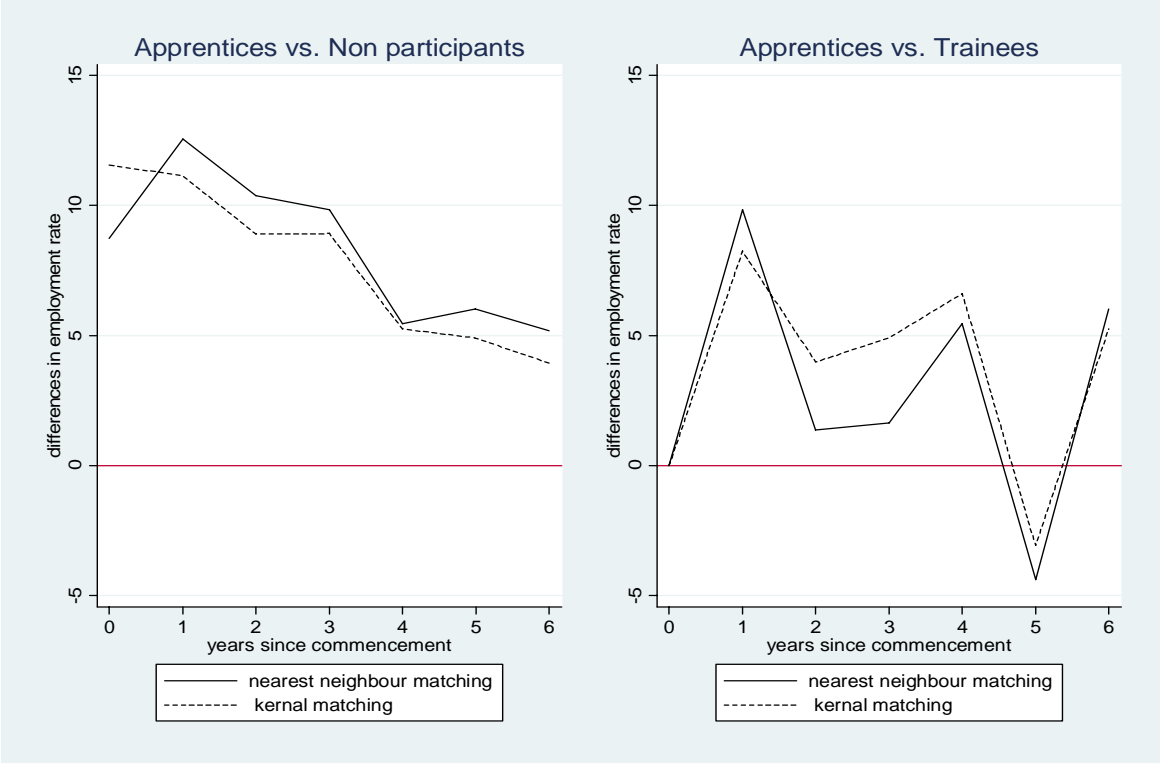
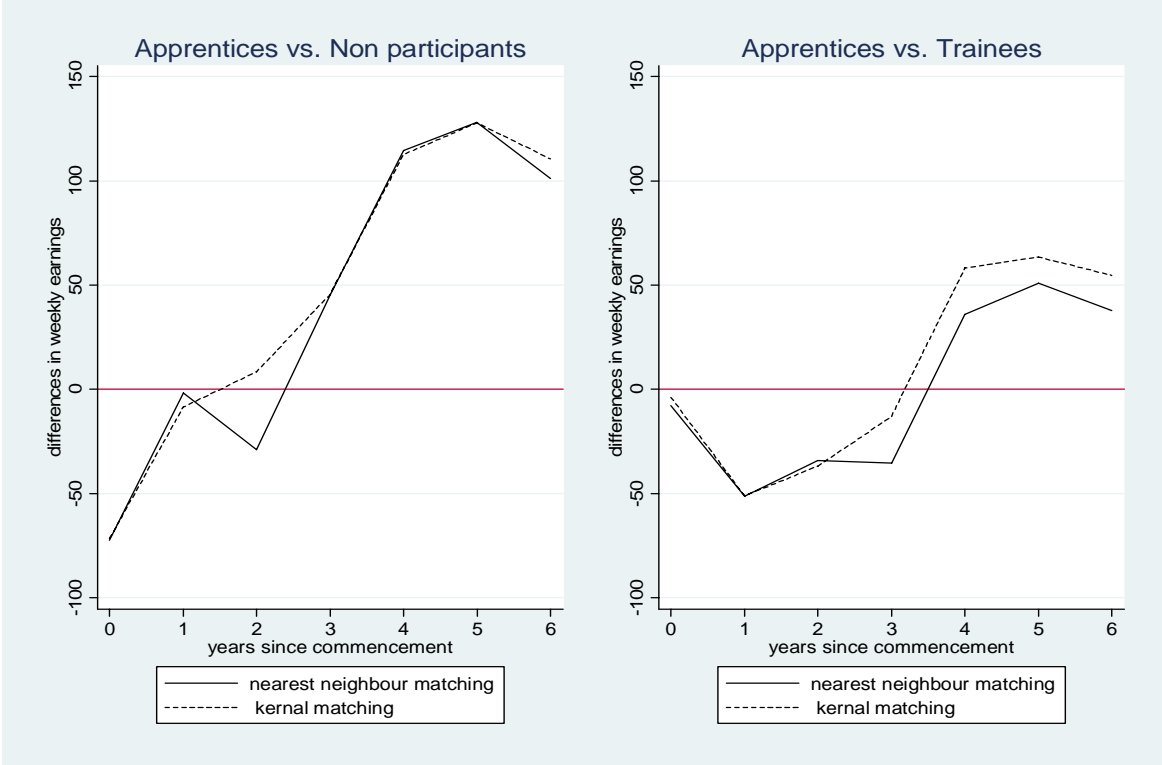


Figure 5.2b Comparisons between matching algorithms (differences in weekly earnings)



6. Conclusion

This study examines the dynamics of apprenticeship and traineeship participation and the returns associated with such vocational training decisions. Semi-parametric matching methods are employed to match individuals with similar characteristics in three different groups - those who entered an apprenticeship program, entered a traineeship program and those who had not entered either of the programs. The labour market outcomes up to 6 years after training commencement of the three matched groups are compared.

Compared to non-participants, apprentices always have higher employment rates and lower unemployment rates in our observation period. At the 6th year after training commencement, the difference in the employment rate is 5.2 percentage points and -2.8 percentage points for the unemployment rate. As expected, the self-employment rate of apprentices exceeded that of non-participants soon after the completion of training (3 years after commencement). By year 6, the self-employment is 6.9 percentage points higher than the comparison group.

In terms of weekly earnings, apprentices started with lower earnings but are catching up very quickly. The earnings gap becomes positive (higher for apprentices) three years after training commencement, which is in line with the average training spell length of 2.75 years. The weekly earning gaps become stable at around 100 dollars (2006 level). Hourly wage rates are also found to be higher for apprentices than the non-participants groups at the end of our observation period.

The results of the comparison between apprentices and trainees are similar to the comparison to non-participants. However, the weekly earnings difference is only \$38 between the two groups, reflecting the positive returns of traineeship compared with non-participants.

Our findings show that there are certainly positive returns to apprenticeship participation not only in terms of weekly earnings, but also in terms of employment. For individuals, even though there are some costs associated with the training (those in training being paid lower initial earnings), the earnings of apprentices catch up very quickly. The returns are considerable if life-time earnings are taken into account. However, the analysis is based purely on the point of view of individuals. Further analysis is required to examine whether apprenticeship is a cost-effective and efficient investment in education funding for the government.

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Appendix

A. Description of relevant variables available in LASY

Survey inconsistencies for Key variables

Definition of apprentices/ trainees

- 96 survey- apprenticeship/traineeship status determined from main activity since leaving school rather than current study
- 97 survey- apprenticeship/traineeship status determined from current study
- 98-2000 survey- apprenticeship/traineeship status determined from current study and continuing of apprenticeship/traineeship studied last year
- 01 survey- see education below
- 02 survey onwards- see education below

Education

- 95-97 survey- contains information only on secondary school levels
- 98 survey- asks for attainment of qualification since secondary school and last interviewed and follows up such qualifications
- 99 survey- allows for possibility that respondent went back to secondary school after leaving it (previously ignored)
- 2000 survey- asks whether they completed yr 12 at TAFE (previously not an option)
- 01 survey- asks about course done ever since left secondary school rather than current study- containing information up to 4 courses
- 02 survey onwards- respondents separated by qualification that they were studying in the previous year and asked different sets of questions accordingly

Labour force status

- In 95 and 96 survey, no information to separate out those unemployed with those not in the labour force, and hence assumptions needed to be made

List of definition and quality of relevant variables

Variable name	Definition	Inconsistency across waves	Notes
<u>Apprentices and Trainees</u>			
Current apprentice	Undertaking apprenticeship in current wave	Major inconsistency	Changes at Wave 4, 7, 8
Current trainee	Undertaking traineeship in current wave	Major inconsistency	Changes at Wave 4, 7, 8
Start of traineeship	Identifier for the starting of a traineeship spell	Major inconsistency	Changes at Wave 7, 8
Apprentice deferrals	Identifier for deferred from apprenticeship in current wave	Major inconsistency	Changes at Wave 6, 7, 8 Not correctly identified

Apprentice dropouts	Identifier for dropped out of apprenticeship in current wave	Major inconsistency	Changes at Wave 6, 7, 8 Not correctly identified
Apprentice exit	Dummy variable to indicate exit from apprenticeship spell	Major inconsistency	Changes at Wave 6, 7, 8
Intention for further study	What type of course respondent intends to study in future	Only available in wave 1	
<u>Demographics</u>			
Country of birth	Distinguish b/w immigrants from English speaking and non-speaking countries and ATSI	Only available in wave 1	
First language	Whether it's English or not	Only available in wave 1	
Frequency of English spoken at home		Only available in wave 1	
Disability	Whether the respondent has disability or not	Major inconsistency	Major inconsistency in wave 1 b/w multiple related variables Discontinuous, only have info. for wave 1, 3-4 and 7
Disability support pension	Whether the respondent receives disability support pension or not	N, but with missing info.	Missing for only wave 1-2 and 4
Remoteness	3 categories: metro; regional and rural	Only available in wave 1	
Marital status	Includes de facto	N	Minor changes for coding
Living arrangements	The types of people the respondent lives in the same household with	N	Minor changes for coding
Partnered and children status	Whether have partner and/or children	N	Minor changes for coding
Father's occupation	6 categories: not working; upper prof. & manager; para. prof., trades; low skilled workers; others	Only available in wave 1	
Mother's occupation	6 categories: not working; upper prof. & manager; para. prof., trades; low skilled workers; others	Only available in wave 1	

Father's education	5 categories: no sec; some sec; high school; trade qual; degree or diploma	Only available in wave 1	
Mother's education	5 categories: no sec; some sec; high school; trade qual; degree or diploma	Only available in wave 1	
<u>Education</u>			
Current study status	Whether studying FT, PT or not at all in current wave (apprenticeship/traineeship not counted)	Major inconsistency	Changes at Wave 7, 8
Date left school	Date left high school	N	
Year level when left school	Each respondent might have multiple values if left sec. school multiple times	N	
Highest education attainment		Major inconsistency	Changes at Wave 7, 8
<u>Labour force</u>			
Labour force status	4 categories: FT, PT, UNE and NLS	Minor inconsistency	Assumptions needed to be made for waves 1-2 re: UNE and NLS
Weekly hours		Minor inconsistency	Changes at Wave 3
Weekly earning	Take home pay for employees only	Minor inconsistency	Some waves don't have info. abt self-employed
Employee type	3 categories: employee, self-employed and others	N	Missing for wave 1-2
Occupation in main job (ASCO)		Major inconsistency	Wave 1- no standard; Wave 2-5- ASCO 1ed; Wave 6 onwards- ASCO 2ed
Industry (ANZSIC)	2 digit code and 1 digit code version available	Minor inconsistency	Change from 4 digit code to 3 digit at Wave 6 Large number of missing values
Work experience	Derived from LFS	Minor inconsistency	For those who exited survey in wave 2 but came back in 3, assumed not working in wave 2
Income	Labour plus welfare income for respondent	Major inconsistency	In wave 1-2, no record of receiving welfare or not

B. List of control variables and multinomial probit estimation results (Main sample, wave 5)

	Trainees		Non-Participants	
	Coefficient	Standard Error	Coefficient	Standard
1 st quintile of literacy test score	0.302	0.208	0.168	0.192
2nd quintile of literacy test score	-0.268	0.218	0.081	0.187
3rd quintile of literacy test score	-0.360	0.275	-0.169	0.240
4 th quintile of literacy test score	-0.497	0.241	-0.297	0.212
1 st quintile of numeracy test score	0.346	0.216	0.382	0.185
2nd quintile of numeracy test score	0.389	0.223	0.441	0.189
3rd quintile of numeracy test score	0.510	0.243	0.282	0.214
4 th quintile of numeracy test score	0.045	0.280	-0.121	0.255
Working in previous year	-0.282	0.219	0.273	0.190
Studying in previous year	-1.473	0.285	-0.937	0.219
Male	1.332	0.176	-0.233	0.133
Older (1=age 16 and 17 in wave 1)	-0.477	0.195	-0.406	0.162
Living with parent	0.341	0.203	0.041	0.150
Mother edu- completed high school	0.368	0.199	0.485	0.169
Mother edu- post sch qualification	-0.016	0.230	-0.083	0.193
Mother edu- missing	0.063	0.191	-0.080	0.168
Semi-skilled	0.344	0.325	-0.099	0.256
Trades, clerk, sales rep. &farmer	0.820	0.307	-0.063	0.244
Unskilled-sales assistant, labourers	0.549	0.321	0.027	0.253
Others	0.206	0.368	0.183	0.283
Living in Regional Area	-0.349	0.181	0.177	0.156
Living in Remote and rural Area	-0.259	0.193	0.342	0.163
State- VIC	0.092	0.234	0.250	0.209
State- QLD	-0.002	0.230	0.197	0.204
State- SA	-0.224	0.259	0.436	0.209
State- WA	-0.293	0.284	-0.646	0.282
State- TAS	0.070	0.383	0.485	0.320
State- NT	-0.012	0.482	-0.112	0.400
State- ACT	-0.292	0.420	0.613	0.314
further study intension:				
University	-0.386	0.222	-0.337	0.189
apprenticeship	0.751	0.242	0.404	0.233
Other TAFE	0.326	0.236	0.173	0.202
Other	0.252	0.253	-0.251	0.232
Full time work experience	0.553	0.192	0.659	0.172
Part time work experience	0.081	0.075	0.195	0.065
Constant	-3.353	0.560	-2.346	0.448

Appendix C Matching Estimation Results

Table C.1 Results from of Raw data (before matching)

Outcomes	Years since apprenticeship commencement						
	0	1	2	3	4	5	6
Employment rate							
Apprentices	100.0	97.3	95.1	95.9	92.9	93.2	93.4
Non participant	75.8	77.6	79.3	79.7	81.1	81.8	82.5
Trainees	100.0	90.0	89.1	88.3	88.5	89.1	88.9
<i>Diff.(apprentice vs non participant)</i>	24.2	19.7	15.8	16.2	11.8	11.4	11.0
<i>Diff (apprentice vs trainee)</i>	0.0	7.3	6.0	7.6	4.4	4.1	4.5
Unemployment rate							
Apprentices	0.0	1.7	3.3	2.2	3.1	2.3	1.7
Non participant	17.0	10.6	9.5	9.0	8.7	7.9	6.5
Trainees	0.0	5.6	6.8	6.9	4.7	4.4	3.8
<i>Diff.(apprentice vs non participant)</i>	-17.0	-9.0	-6.2	-6.7	-5.6	-5.6	-4.8
<i>Diff (apprentice vs trainee)</i>	0.0	-4.0	-3.4	-4.7	-1.6	-2.1	-2.1
Self employment rate working							
Apprentices	0.0	1.2	1.2	3.4	11.5	12.9	13.4
Non participant	1.8	2.9	3.6	3.6	4.4	4.8	6.2
Trainees	0.0	1.5	1.9	2.8	3.5	2.8	6.5
<i>Diff.(apprentice vs non participant)</i>	-1.8	-1.8	-2.5	-0.2	7.1	8.1	7.2
<i>Diff (apprentice vs trainee)</i>	0.0	-0.3	-0.7	0.6	8.0	10.2	6.9
Weekly pay							
Apprentices	268.3	359.5	450.0	523.2	634.6	705.3	718.0
Non participant	296.8	336.0	397.9	440.0	482.0	522.8	556.9
Trainees	255.1	376.4	443.5	474.7	511.3	560.7	567.9
<i>Diff.(apprentice vs non participant)</i>	-28.5	23.5	52.1	83.1	152.6	182.5	161.2
<i>Diff (apprentice vs trainee)</i>	13.3	-16.8	6.5	48.5	123.2	144.5	150.1
Hourly wage							
Apprentices	6.9	8.7	11.1	12.8	16.4	17.1	19.8
Non participant	10.1	11.2	13.9	13.2	13.6	14.3	15.2
Trainees	7.6	10.9	12.5	12.8	13.2	14.8	14.9
<i>Diff.(apprentice vs non participant)</i>	-3.2	-2.5	-2.8	-0.4	2.9	2.9	4.7
<i>Diff (apprentice vs trainee)</i>	-0.7	-2.2	-1.4	0.0	3.2	2.4	4.9

Table C2 Proportion of variables with missing value for the matched sample (Main sample)

	Years since apprenticeship commencement						
	0	1	2	3	4	5	6
Weekly pay missing working							
Apprentices	3.7	5.8	4.5	6.7	13.6	17.6	19.6
Non participant	7.0	10.0	11.0	10.5	11.3	12.3	13.1
Trainees	3.1	7.6	8.9	10.5	7.2	9.6	11.9
<i>Diff.(apprentice vs non participant)</i>	-5.2	-4.8	-6.9	-4.5	0.5	5.8	6.4
<i>Diff (apprentice vs trainee)</i>	-0.2	-2.3	-4.0	-4.2	6.7	9.0	7.1
Hourly rate missing working							
Apprentices	18.2	61	80.5	82.3	69.9	71.9	76.4
Non participant	44.2	55.9	62.8	63.8	66.6	70.0	72.5
Trainees	22.6	52.2	63.5	67.5	67.2	68.3	69.8
<i>Diff.(apprentice vs non participant)</i>	-10.9	14.5	19.5	18.4	2.4	3.6	8.2
<i>Diff (apprentice vs trainee)</i>	-1.6	15.7	18.3	18.3	7.4	6.2	8.4

Table C3 Education and training participation and proportion of variables with missing value for the matched sample (non-participants: those who have never participated in apprenticeship and traineeship)

	Years since apprenticeship commencement						
	0	1	2	3	4	5	6
Apprenticeship participation							
Apprentices	100.0	86.9	71.3	33.3	4.4	2.5	2.7
Non participant	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Trainees	0.0	6.6	9.0	5.5	1.4	1.4	1.4
<i>Diff.(apprentice vs non participant)</i>	100.0	86.9	71.3	33.3	4.4	2.5	2.7
<i>Diff (apprentice vs trainee)</i>	100.0	67.4	45.9	18.1	1.5	0.6	0.2
Traineeship participation							
Apprentices	0.0	0.8	1.4	0.0	0.5	0.3	0.0
Non participant	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Trainees	100.0	14.2	7.1	5.5	1.4	0.0	1.4
<i>Diff.(apprentice vs non participant)</i>	0.0	0.8	1.4	0.0	0.5	0.3	0.0
<i>Diff (apprentice vs trainee)</i>	-100.0	-13.4	-5.7	-5.5	-0.8	0.3	-1.4
Study							
Apprentices	0.0	2.2	3.3	5.9	3.8	8.4	6.0
Non participant	5.7	23.9	39.3	39.4	28.7	22.9	7.6
Trainees	0.0	8.4	5.5	15.1	12.5	9.3	8.3
<i>Diff.(apprentice vs non participant)</i>	-5.7	-21.6	-36.1	-33.5	-24.9	-14.6	-1.6
<i>Diff (apprentice vs trainee)</i>	0.0	-6.2	-2.3	-9.2	-8.6	-4.2	-2.3
Weekly pay missing working							
Apprentices	3.7	5.8	4.5	6.7	13.6	17.6	19.6
Non participant	3.3	8	10.1	9.2	16.6	12.6	14.4
Trainees	2.2	3.4	3.3	10	6.4	5.8	11.3
<i>Diff.(apprentice vs non participant)</i>	0.4	-2.2	-5.6	-2.5	-3.1	5	5.2
<i>Diff (apprentice vs trainee)</i>	1.5	2.3	1.1	-3.2	7.1	11.8	8.3
Hourly rate missing working							
Apprentices	18.2	61	80.5	82.3	69.9	71.9	76.4
Non participant	25.7	50.6	65.5	63.8	69.3	74.3	70.5
Trainees	24.5	36.9	66.1	70.1	70.5	61.4	69.1
<i>Diff.(apprentice vs non participant)</i>	-7.5	10.4	14.9	18.5	0.6	-2.4	5.9
<i>Diff (apprentice vs trainee)</i>	-6.3	24.1	14.4	12.2	-0.6	10.5	7.3

Table C4 Estimation results using all samples (unbalanced panel)

Outcomes	Years since apprenticeship commencement						
	0	1	2	3	4	5	6
Employment rate							
Apprentices	100.0	96.3	93.7	94.4	92.8	93.3	93.2
Non participant	75.2	77.9	80.0	81.8	84.4	86.2	87.0
Trainees	100.0	88.3	88.7	90.1	89.4	90.0	90.5
<i>Diff.(apprentice vs non participant)</i>	27.2	21.3	16.2	15.8	12.4	12.0	11.4
<i>Diff (apprentice vs trainee)</i>	0.0	9.0	6.1	5.7	3.7	3.4	4.6
Unemployment rate							
Apprentices	0.0	2.7	4.6	3.1	3.4	2.1	1.9
Non participant	15.8	9.4	8.9	8.1	6.6	5.1	4.2
Trainees	0.0	7.4	6.7	5.4	4.3	4.3	2.9
<i>Diff.(apprentice vs non participant)</i>	-20.8	-11.4	-7.5	-7.4	-5.9	-5.9	-5.0
<i>Diff (apprentice vs trainee)</i>	0.0	-6.0	-3.2	-3.7	-1.3	-2.1	-2.1
Self employment rate working							
Apprentices	0.0	0.5	1.0	2.8	11.2	12.5	13.5
Non participant	2.0	2.5	3.0	3.4	4.3	4.9	5.8
Trainees	0.0	1.1	1.4	2.1	3.7	3.6	6.5
<i>Diff.(apprentice vs non participant)</i>	-1.6	-1.5	-2.0	-0.5	7.1	7.9	7.3
<i>Diff (apprentice vs trainee)</i>	0.0	-0.6	-0.1	0.9	7.6	9.2	7.0
Weekly pay							
Apprentices	267.2	353.8	455.3	526.6	641.8	697.4	712.8
Non participant	302.2	342.8	398.2	452.6	506.7	552.0	596
Trainees	275.2	384.5	442.8	487.7	513.4	566.4	572.7
<i>Diff.(apprentice vs non participant)</i>	-31.4	12.8	57.8	83.9	156.9	178.2	158.8
<i>Diff (apprentice vs trainee)</i>	8.9	-10.8	17.4	47.9	132.1	134.6	145.8
Hourly wage							
Apprentices	7.2	9.2	11.4	12.9	15.9	17.2	19.3
Non participant	11.4	12.3	13.6	13.9	14.2	15.1	15.8
Trainees	7.9	11	12.5	13.6	13.2	14.8	14.9
<i>Diff.(apprentice vs non participant)</i>	-2.8	-1.8	-1.5	-0.2	2.4	3.0	4.2
<i>Diff (apprentice vs trainee)</i>	-0.4	-1.4	-0.8	-0.3	2.8	2.2	4.5

Table C5 Education and training participation and proportion of variables with missing value for the matched sample - All sample (unbalanced panel)

	Years since apprenticeship commencement						
	0	1	2	3	4	5	6
Apprenticeship participation							
Apprentices	100.0	72.6	49.6	21.6	2.9	1.2	1.1
Non participant	0.0	6.4	7.3	4.7	1.6	1.1	1.0
Trainees	0.0	5.2	3.7	3.5	1.4	0.5	0.9
<i>Diff.(apprentice vs non participant)</i>	100.0	66.2	42.4	16.9	1.3	0.1	0.1
<i>Diff (apprentice vs trainee)</i>	100.0	67.4	45.9	18.1	1.5	0.6	0.2
Traineeship participation							
Apprentices	0.0	0.9	1.2	0.2	0.3	0.1	0.0
Non participant	0.0	4.3	3.0	1.6	1.6	1.1	0.4
Trainees	100.0	19.8	6.6	1.6	0.7	0.6	0.4
<i>Diff.(apprentice vs non participant)</i>	0.0	-3.4	-1.8	-1.4	-1.3	-1.0	-0.4
<i>Diff (apprentice vs trainee)</i>	-100.0	-18.9	-5.5	-1.4	-0.4	-0.5	-0.4
Study							
Apprentices	0.0	1.7	2.5	4.3	3.5	7.9	5.9
Non participant	0.6	17.9	23.0	23.1	15.2	17.4	8.7
Trainees	0.0	8.0	14.5	15.1	15.6	9.0	8.5
<i>Diff.(apprentice vs non participant)</i>	-0.6	-16.3	-20.5	-18.8	-11.7	-9.4	-2.8
<i>Diff (apprentice vs trainee)</i>	0.0	-6.4	-12.0	-10.8	-12.1	-1.1	-2.6
Weekly pay missing working							
Apprentices	5.3	5.6	4.7	8.5	14.9	17.9	19.9
Non participant	8.2	9.3	12.4	11.3	14.7	10.6	17.5
Trainees	9.4	9.8	11.0	12.5	8.0	11.9	9.8
<i>Diff.(apprentice vs non participant)</i>	-2.8	-3.7	-7.7	-2.7	0.2	7.2	2.4
<i>Diff (apprentice vs trainee)</i>	-4.1	-4.2	-6.3	-4.0	6.9	6.0	10.1
Hourly rate missing working							
Apprentices	19.4	55.3	81.1	80.1	69.2	71.6	76.2
Non participant	23.4	47.2	65.6	64.0	71.5	71.3	73.0
Trainees	28.5	49.1	65.3	65.1	67.1	68.1	68.8
<i>Diff.(apprentice vs non participant)</i>	-4.0	8.1	15.5	16.1	-2.3	0.4	3.1
<i>Diff (apprentice vs trainee)</i>	-9.1	6.2	15.8	15.1	2.1	3.5	7.3

Table C6 Kernel matching estimation results using main samples

Outcomes	Years since apprenticeship commencement						
	0	1	2	3	4	5	6
Employment rate							
Apprentices	100.0	97.2	95.0	95.9	92.8	93.4	93.4
Non participant	88.5	86.1	86.1	86.9	87.6	88.5	89.4
Trainees	100.0	89.0	91.1	91.0	86.3	96.2	88.2
<i>Diff.(apprentice vs non participant)</i>	11.5	11.1	8.9	8.9	5.3	4.9	3.9
<i>Diff (apprentice vs trainee)</i>	0.0	8.2	4.0	4.9	6.6	-3.1	5.3
Unemployment rate							
Apprentices	0.0	1.7	3.4	2.3	3.2	2.3	1.8
Non participant	8.2	6.7	6.8	6.5	6.0	5.6	4.0
Trainees	0.0	8.8	6.3	7.0	8.2	1.1	6.0
<i>Diff.(apprentice vs non participant)</i>	-8.2	-5.0	-3.4	-4.2	-2.8	-3.3	-2.2
<i>Diff (apprentice vs trainee)</i>	0.0	-7.2	-3.0	-4.8	-5.1	1.2	-4.3
Self employment rate working							
Apprentices	0.0	1.2	1.2	3.4	11.7	13.0	13.6
Non participant	2.1	2.3	4.9	3.5	4.5	5.6	6.1
Trainees	0.0	0.6	1.4	2.8	4.1	1.8	5.4
<i>Diff.(apprentice vs non participant)</i>	-2.1	-1.1	-3.7	-0.1	7.2	7.5	7.4
<i>Diff (apprentice vs trainee)</i>	0.0	0.5	-0.2	0.6	7.4	11.1	8.0
Weekly pay							
Apprentices	268.2	359.7	450	523.6	636.4	699.1	719.7
Non participant	339.6	368.3	441.5	478.1	523.6	571.4	609.2
Trainees	272.2	410.5	486.8	536.2	576.3	641.8	663.4
<i>Diff.(apprentice vs non participant)</i>	-71.4	-8.6	8.5	45.5	112.7	127.8	110.5
<i>Diff (apprentice vs trainee)</i>	-3.9	-51	-36.8	-13	58.3	63.4	54.7
Hourly wage							
Apprentices	6.9	8.7	11.1	12.9	16.5	17.1	19.9
Non participant	10.2	11.3	13.6	12.8	12.8	13.9	15.2
Trainees	7.6	10.9	12.0	12.9	13.6	15.0	15.4
<i>Diff.(apprentice vs non participant)</i>	-3.3	-2.5	-2.4	0.0	3.7	3.3	4.7
<i>Diff (apprentice vs trainee)</i>	-0.7	-2.2	-0.8	-0.1	2.8	2.2	4.4

Table C7 Education and training participation and proportion of variables with missing value for the matched sample – Kernel Matching (main sample)

	Years since apprenticeship commencement						
	0	1	2	3	4	5	6
Apprenticeship participation							
Apprentices	100.0	86.7	71.0	32.6	4.4	2.5	2.8
Non participant	0.0	6.9	10.3	7.5	3.9	2.3	2.3
Trainees	0.0	5.7	7.0	6.7	2.5	3.0	3.7
<i>Diff.(apprentice vs non participant)</i>	100.0	79.9	60.7	25.1	0.5	0.2	0.5
<i>Diff (apprentice vs trainee)</i>	100.0	81.2	64.3	26.6	1.9	-0.5	-0.9
Traineeship participation							
Apprentices	0.0	0.8	1.4	0.0	0.6	0.3	0.0
Non participant	0.0	4.3	3.6	3.8	2.0	2.1	1.3
Trainees	100.0	18.7	7.7	4.0	0.8	0.9	1.8
<i>Diff.(apprentice vs non participant)</i>	0.0	-3.5	-2.2	-3.8	-1.5	-1.8	-1.3
<i>Diff (apprentice vs trainee)</i>	-100.0	-17.9	-6.4	-4.0	-0.2	-0.6	-1.8
Study							
Apprentices	0.0	2.3	3.3	6.0	3.9	8.2	6.1
Non participant	2.4	22.0	26.0	30.2	18.9	17.6	7.5
Trainees	0.0	8.5	10.1	23.6	17.7	9.3	9.6
<i>Diff.(apprentice vs non participant)</i>	-2.4	-19.7	-22.7	-24.1	-15.1	-9.4	-1.4
<i>Diff (apprentice vs trainee)</i>	0.0	-6.3	-6.8	-17.6	-13.9	-0.9	-3.6
Weekly pay missing working							
Apprentices	3.7	5.5	4.5	6.5	13.4	17.8	19.6
Non participant	6.2	8.7	8.5	9.6	12.4	10.2	11.6
Trainees	6.4	5.8	6.5	11.5	5.8	7.2	11.8
<i>Diff.(apprentice vs non participant)</i>	-2.5	-3.1	-3.9	-3.1	1.1	7.5	7.9
<i>Diff (apprentice vs trainee)</i>	-2.8	0	-2.1	-4.8	7.8	10.4	7.8
Hourly rate missing working							
Apprentices	18.4	61.4	81.2	82.3	70.2	71.9	76.8
Non participant	25.1	48.6	65.2	68.6	75.2	70.8	72.7
Trainees	27.6	40.7	66.3	67.7	67.1	61.5	70.5
<i>Diff.(apprentice vs non participant)</i>	-6.7	12.8	15.9	13.8	-5.1	1.1	4.1
<i>Diff (apprentice vs trainee)</i>	-9.4	20.3	14.2	14.6	2.8	10.4	6.0

Table A.4 Differences in labour market outcomes between groups by wave

Difference in EMP rate	apprentice vs. non participant				apprentice vs. trainee			
	Wave 3	Wave 4	Wave 5	Wave 6	Wave 3	Wave 4	Wave 5	Wave 6
years since commencement								
0	9.9	6.6	7.5	12.7	0.0	0.0	0.0	0.0
1	19.8	7.9	10.3	14.3	38.3	-6.6	6.8	0.0
2	8.6	11.8	11.0	9.5	6.2	-6.6	4.8	-3.2
3	4.9	11.8	11.0	11.1	12.3	-6.6	0.7	0.0
4	9.9	5.3	6.8	-3.2	3.7	-6.6	11.6	7.9
5	6.2	9.2	4.1	6.3	-6.2	-10.5	-1.4	-1.6
6	14.8	6.6	0.0	3.2	27.2	-7.9	4.1	0.0

Difference in UE rate	apprentice vs non participant				apprentice vs trainee			
	Wave 3	Wave 4	Wave 5	Wave 6	Wave 3	Wave 4	Wave 5	Wave 6
years since commencement								
0	-6.4	-5.3	-6.3	-8.3	0.0	0.0	0.0	0.0
1	-16.1	-0.5	-5.8	-6.9	-36.1	5.3	-5.6	0.0
2	-3.0	-2.0	-5.2	-3.8	-9.7	4.1	-2.2	3.2
3	-1.4	-7.4	-2.6	-3.4	-13.7	2.7	2.8	0.0
4	-3.0	-1.7	-2.3	-3.1	-7.4	4.1	-0.3	-14.4
5	-4.1	-9.9	-0.1	-6.6	2.6	4.2	0.7	0.0
6	-3.2	-1.8	-2.1	-4.8	-31.6	5.6	-0.8	0.0

Difference in weekly pay	apprentice vs non participant				apprentice vs trainee			
	Wave 3	Wave 4	Wave 5	Wave 6	Wave 3	Wave 4	Wave 5	Wave 6
years since commencement								
0	-22.8	-48.9	-60.4	-110.0	53.5	-8.9	-23.8	-43.1
1	-14.0	-13.7	-3.9	39.0	-24.4	-60.5	-76.2	38.5
2	1.3	1.6	-62.0	-5.1	72.2	-71.1	-84.5	12.0
3	19.8	1.9	65.2	55.0	-176.1	-0.5	-20.7	108.1
4	27.7	85.9	157.1	101.7	-32.2	-54.3	73.4	134.1
5	100.6	58.3	144.0	157.2	59.3	-105.3	30.5	263.1
6	51.4	73.7	121.7	127.3	67.6	-177.2	47.7	237.6