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The Impact of the 2008 Youth Minimum Wage Reform



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ABSTRACT

This paper analyses the impacts of the 2008 policy reform which replaced the youth minimum wage for 16-17 year-old workers, previously set at 80% of the adult minimum wage, with a *new entrants* minimum rate applicable for the first three months or 200 hours of employment, after which the adult minimum applies. This resulted in a 28% increase in the real value of the minimum wage faced by 16-17 year-old workers, making the minimum wage substantially binding for this age group. We estimate the impact of this reform on 16-17 year-olds employment and related labour market outcomes, by comparing the average outcomes of this group, before and after 2008, to those of 20-21 who were not directly affected by the reform. Although 18-19 year-olds were not directly affected by the 2008 policy change, they were potentially indirectly affected either by the adult minimum wage constraining their wages and/or by employment substitution effects from 16-17 year-olds; for this reason, we consider 20-21 year-olds a potentially less-affected comparison group.

We first show that, by 2008, minimum wages had a substantial effect on the wages of 16-17 year-olds and, to a lesser extent, 18-19 year-olds. Although we find no evidence of adverse employment effects immediately following the policy change in 2008, we conclude that it lowered the employment rate of 16-17 year-olds by 3-6 percentage points in the subsequent two years. Most of this employment loss was borne by students: in fact, the employment rate among non-students increased, there is no evidence of an increase in the percentage of 16-17 year-olds who were unemployed, and the overall inactivity rate of this age-group decreased following 2008. We also find evidence of employment substitution towards 18-19 year-olds, again largely among students. In addition, relative to 20-21 year-olds, we estimate the average hours worked by 16-17 and 18-19 year-olds fell after 2008, as did their earnings and total incomes.

EXECUTIVE SUMMARY

Key findings

The study found that the introduction of the New Entrants (NE) minimum wage was largely ignored by businesses and that most 16 and 17 year old workers were moved on to the adult minimum wage. Combined with a 75 cent increase in the adult minimum wage at the same time, this led to a 28.2 percent increase in the effective minimum wage for 16 and 17 year old workers.

This research found that this minimum wage increase accounted for approximately 20–40 percent of the fall in the proportion of 16 and 17 year olds in employment by 2010. Overall, this implies that the introduction of the NE minimum led to a loss of 4,500–9,000 jobs for 16 and 17 year olds (employment of 16 and 17 year olds fell from 61,400 to 39,500 between 2007 and 2010).

The introduction of the NE minimum wage did not have a significant impact on unemployment of 16 and 17 year olds, because employment losses occurred entirely among students who were combining study with part-time employment.

Introduction

The study examined the impact of the 2008 youth minimum wage reform that replaced the youth minimum wage for 16 and 17 year old workers (set at 80 percent of the adult minimum wage) with a New Entrants (NE) minimum wage (also set at 80 percent of the adult minimum) applicable for the first three months or 200 hours of employment, after which the adult minimum applies.

The repealing of the youth minimum wage in 2008 had a significant impact on the wage distribution of 16 and 17 year olds. In 2007, approximately 70 percent of 16 and 17 year olds reported hourly wages below the adult minimum wage. After the introduction of the NE minimum wage, around 20 percent of 16 and 17 year olds reported hourly wages below the adult minimum wage and 40 percent reported receiving the adult minimum wage.

The NE minimum wage was largely ignored by businesses and most 16 and 17 year old workers were moved on to the adult minimum wage, which resulted in an increase in the effective minimum wage of 28.2 percent (adjusting for inflation) for this group. This led to a rise in average hourly earnings of 8.5 percent for this group. The adult minimum wage, in comparison, only increased by 2.5 percent in 2008.

Research methodology

The study used survey data from the quarterly Household Labour Force Survey (HLFS), and the annual June-quarter Income Supplement to the HLFS, also known as the NZ Income Survey (NZIS).

The focus of the analysis is on the impact of the 2008 youth minimum wage policy change on the employment and other labour market outcomes of 16 and 17 year olds. The HLFS is used to measure wage and salary employment, weekly hours worked, self-employment, studying, unemployment, and inactivity and the NZIS provides measures

of hourly wages, receipt of non-student benefits, weekly earnings, and weekly total income.

The analysis estimates the impact of the 2008 minimum wage reform on the labour market outcomes of 16 and 17 year olds by comparing their outcomes, before and after 2008, to a comparison group of 20 and 21 year olds. The comparison group was selected because they were not directly affected by the 2008 reform and are considered to have been less-affected by the policy change than 18 and 19 year olds.

While 18 and 19 year olds were not directly affected by the 2008 reform, it is possible they were indirectly affected by the adult minimum wage constraining their wages or by employers hiring them instead of 16 and 17 year olds.

A regression model is used to control for other factors that may be related to changes in labour market outcomes, such as differences in outcomes that exist between different age groups and because of differences in the demographic and socio-economic characteristics of individuals. The model also controls of changes in outcomes caused by seasonal changes in the labour market and the impact of a growing or declining economy, and allows these effects to differ by age.

Labour market impacts of the 2008 youth minimum wage reform

The research found that the minimum wage increase lowered the proportion of 16 and 17 year olds in employment by between 3 and 6 percentage points in the subsequent two years (there was no impact on employment immediately following the policy change), which accounted for between 20 and 40 percent of the fall in the proportion of 16 and 17 year olds in work over this period (a loss of 4,500–9,000 jobs). The remaining 60 to 80 percent of the fall in employment can be attributed to the deteriorating economic conditions.

The introduction of the NE minimum wage appears to have impacted primarily on the employment prospects of 16 and 17 year olds who were combining study with part-time employment (80 percent of 16 and 17 year olds are in part-time jobs).

The finding that the minimum wage increase adversely affected the employment of students is likely to explain why the study did not find a strong negative impact on unemployment. The study finds some evidence that the proportion of 16 and 17 year olds unemployed increased in 2009 by 1.4–2.6 percentage points because of the minimum wage increase, but the negative impact on unemployment was not evident a year later in 2010.

The NE minimum wage appears to have encouraged more 16 and 17 year olds to stay at school or continue their education (this effect is in addition to an increase in studying due to the economic downturn). This may explain why the impact on unemployment had disappeared by 2010 and why the minimum wage increase was associated with lowering inactivity among 16 and 17 year olds. The research also found that, relative to 20 and 21 year-olds, average hours worked by 16 and 17, and 18 and 19 year olds fell after 2008, as did their earnings and total incomes.

Comparison with the 2001 youth minimum wage reform

Compared with the 2001 youth minimum wage reform, repealing the youth minimum wage in 2008 resulted in a smaller increase in the effective minimum wage for 16 and 17 year olds (28.2 percent, compared with 41 percent in 2001/02), but had a larger negative impact on their employment prospects.

The study of the 2001 reform found no evidence of an adverse effect on youth employment immediately following the reform, but some weak evidence of employment loss two years later in 2003. Changes in hourly wages, hours, and employment led to significant increases in earnings from work and total income for teenagers relative to young adults.

The stronger fall in employment in 2008 can be attributed to a larger proportion of 16 and 17 year olds being impacted by the minimum wage increase (60–70 percent, compared with 10–20 percent in 2001) and that the 2008 reform occurred immediately prior to a downturn in the economy. The current analysis cannot judge the relative importance of these two effects. In addition, the 2008 reform moved 16 and 17 year olds onto the same minimum wage as adults, which could have encouraged employers to replace them with older more mature workers.

The 2001 reform study did find evidence of a decline in educational enrolment and an increase in unemployment, inactivity, and benefit receipt, which suggests that while the 2001 reform increased the labour supply of teenagers, this was not matched by as large an increase in the supply of jobs from employers.

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1 INTRODUCTION

Prior to 2008, New Zealand's minimum wage legislation included an adult minimum wage rate that applied to workers aged 18 and over; and a youth minimum wage rate, set at 80% of the adult minimum wage, that applied to 16-17 year-old workers. In April 2008, the youth minimum wage was abolished and replaced with a *new entrants* minimum rate, set at 80% of the adult minimum wage, that applies to 16-17 year-olds for their first three months or 200 hours of employment, following which the adult minimum applies. At the same time, the adult minimum wage was increased from \$11.25 to \$12 per hour, or 2.5% in real terms. Together with this increase in the adult minimum wage, the 2008 youth minimum wage reform resulted a 28% increase in the real value of the minimum wage faced by 16-17 year-old workers who were not eligible for the new entrants rate.

In this paper, we analyse the impact this reform on labour market and associated outcomes for 16-17 year-olds. The reform provides a large and focused change in the minimum wage that had a large effect on the wages paid to the affected age group. We adopt a similar approach to that used by Hyslop and Stillman (2007) to analyse previous youth minimum wage reforms in 2001 and 2002. In particular, our analysis exploits the targeted nature of the policy change by comparing the outcomes of the directly affected 16-17 year-olds, before and after 2008, with the outcomes of 20-21 year-olds, who were not directly affected by the 2008 policy change. Although 18-19 year-olds were not directly affected by the reform, they were also potentially affected by firms substituting 18-19 year-old workers for 16-17 year-olds. For this reason, we consider 20-21 year-olds to be a better comparison group.

We first analyse trends in relevant summary statistics of the wages of these three age groups over the period since 1997, using data from the Household Labour Force Survey, June quarter Income Supplement (HLFS-IS). In the data, it is not possible to identify whether the new entrants or adult minimum rate applies to particular 16-17 year-old workers, but we show that the new entrants rate appears to be largely non-binding on 16-17 year-olds. Specifically, the fraction of 16-17 year-old workers reporting wages below the current youth minimum wage (prior to 2008) and new entrants (from 2008) declined noticeably after 2008, while the fraction paid exactly these rates are generally trivial.¹ In addition, while the trend in the fraction of 16-17 year-olds reporting wages less than the next year's youth minimum wage increased steadily to around 30% in 2007, since 2008 the fraction less than next year's new entrants' rate has been less than 10%. Based on these findings, we largely focus on the adult minimum rate as the relevant applicable minimum wage for 16-17 year-olds after 2008. By 2008, minimum wages were substantially binding on the wages of 16-17 year-olds and, to a lesser extent, 18-19 year-olds. For example, in 2007, 70% of 16-17 year-olds and 45% of 18-19 year-olds had wages below the 2008 adult minimum wage, while in 2008, 43% of 16-17 year-olds and 18% of 18-19 year-olds earned exactly the minimum wage.

¹ Sub-minimum reported wages may be due to either exemptions for people with disabilities, non-compliance on the part of firms, or measurement errors in reported wages. Based on the results of a simulation exercise reported in Hyslop and Stillman (2007), we believe that measurement errors accounts for most, if not all, of the reported sub-minimum wages.

We then analyse the impact of the policy change on employment and hours worked by 16-17 year-olds, using quarterly data from the main HLFS. We begin with simple difference-in-differences estimates of the impact on employment, that compare the change in the employment rate of 16-17 year-olds between the three years prior to the change (2005-07) and the three years after the change (2008-10) with the changes for both 18-19 and 20-21 year-olds. These estimates show that 16-17 year-olds' employment rate dropped by about 2.8 percentage points, or 6% of the pre-2008 45% employment rate, relative to that of 18-19 or 20-21 year-olds. Based on analogous difference-in-difference estimates of the average hours worked, we find no significant effect of the policy change.

We next use alternative regression specifications to control for various factors that may confound the estimated impact of the policy change. Based on such regression analysis, we find no evidence of adverse employment effects for 16-17 year-olds immediately following the policy change in 2008, but find that it lowered their employment rate by 3-6 percentage points in the subsequent two years. Further analysis of related outcomes, including educational enrolment, unemployment and inactivity rates, indicates that most of the adverse employment effect was borne by students. In fact, the employment rate among non-students increased, there is no evidence of an increase in unemployment among 16-17 year-olds, and the overall inactivity rate of this age-group decreased following 2008. We also find evidence of employment substitution towards 18-19 year-olds, again largely among students. In addition, relative to 20-21 year-olds, we estimate the average hours worked by 16-17 and 18-19 year-olds fell after 2008, as did their earnings and total incomes.

The remainder of the paper is organised as follows. In the next section, we discuss the background to the 2008 policy changes, provide a description of the data used in the analysis, and describe the effects of minimum wage changes over the past decade on relevant aspects of the wage distributions of 16-21 year-old workers. In section 3, we present our analysis of the impact of the policy change on employment, hours worked and other related outcomes. The paper concludes with a discussion in section 4.

2 BACKGROUND AND DATA DESCRIPTION

Following the 2005 general election, the Labour party entered into confidence and supply agreements with both New Zealand First and the Green party that included continuing to increase the (adult) “minimum wage, with a view to it being set at \$12.00 per hour by the end of 2008 if economic conditions permit” (New Zealand Labour Party’s 2005 Confidence and Supply Agreement with New Zealand First). Progressive increases in the minimum wages during the 2000s resulted in the adult minimum wage being set at \$12 per hour effective 1 April 2008. In addition to these agreements, the Green party sponsored a Youth Minimum Wage Bill to abolish the lower youth minimum wage rate for 16-17 year-olds, effectively lowering the age at which the adult minimum wage comes into effect from 18 to 16 years. This Bill also introduced a *new entrants* minimum rate, set at 80% of the adult minimum wage, that applies to 16-17 year-olds’ first three months or 200 hours of employment. This Bill was passed into law and also became effective on 1 April 2008.

Table 1 summarises the changes in the statutory minimum wage rates for different age groups since 1990.² The decade from 2000 witnessed significant changes in the minimum wages for all workers, especially teenagers. Between 2000 and 2009, the adult minimum wage was progressively increased at roughly twice the rate of inflation. In addition, the youth minimum wage, which was set at 60% of the adult rate and applied to 16-19 year-old workers prior to 2001, was first abolished for 18-19 year-olds in 2001 while the ratio was raised to 80% of the adult minimum in two steps in 2001 and 2002 for 16-17 year-olds; and then abolished for 16-17 year-olds in 2008.

The focus of this paper is on the 2008 policy change which replaced the youth minimum wage by the *new entrants* minimum hourly rate. Together with the increase in the adult minimum from \$11.25 to \$12.00 per hour (2.5% in real terms), the immediate effect of this change was to increase the minimum wage applying to 16-17 year old workers from \$9.00 to \$9.60 (a 2.5% real increase) per hour for new entrants, or \$12.00 per hour (a 28% real increase) for other 16-17 year-olds.

Figure 1 describes the trends in the real minimum wages (expressed in June 2006 dollar values), that applied to 16-17 and 18-19 year olds, and adult (aged 20 years and over) workers, and the *new entrants* rate since 1997. First, the figure shows that the real value of the adult minimum wage increased steadily between 2000 and 2009. In fact, the adult minimum wage increased 36% between 1999 and 2009 (3.1% annually), of which about one-half (19%) of the increase occurred between 2003 and 2007. Second, the three vertical lines in this figure highlight the increases in the minimum wage applying to teenage workers associated with youth minimum wage reforms in 2001 and 2002, and in 2008. Collectively, these reforms together with the adult minimum wage increases resulted in the minimum wage applying to teenagers increased by 126% in real terms between 1999 and 2009.

² In addition to the minimum wages shown in Table 1, since 2003 there has been a training minimum wage, set at 80% of the adult minimum wage, that applies to workers aged at least 16 who are doing at least 60 credits annually of recognised industry training.

Hyslop and Stillman's (2007) analysis of the youth minimum wage reforms in 2001 and 2002 relied on young adults (aged 20-25) being unaffected by the changes and providing a counterfactual for the labour market outcomes of teenagers that were affected by the reforms. The analogous preferred identification strategy for this study would be to treat the outcomes of 18-19 year olds as the counterfactual for the directly affected 16-17 year old age group. However, there are two potential issues with this counterfactual. First, given the significant increases in adult minimum wages over the period, by 2008 it is questionable whether 18-19 year olds are unaffected by minimum wages. Second, any adverse effects on 16-17 year olds employment may result in positive spill-over effects on 18-19 year olds employment. For these reasons we will largely treat the outcomes of 20-21 year olds as the counterfactual for measuring the impacts of the minimum wage changes on teenage outcomes.

2.1 The Household Labour Force Survey (HLFS)

Our analyses are based on survey data from the quarterly Household Labour Force Survey (HLFS), and the annual June-quarter Income Supplement (HLFS-IS, also known as the NZ Income Survey, NZIS). The HLFS began in 1986 and collects information on labour force status, hours worked, educational status together with sociodemographic information on individuals and their households. The core HLFS sample collects no information on wages or incomes but, since 1997, an annual supplement to the June-quarter HLFS collects information on wages and salaries, self-employment income, public transfers and other sources of income. The HLFS sample frame uses an eight-quarter rotating panel with about one-eighth of the sample rotating in/out each quarter, and consists of a representative sample of approximately 15,000 households and 30,000 individuals.

The focus of our analysis is on the impact of the 2008 youth minimum wage policy changes on 16-17 year-old employment and related outcomes. For this purpose, we construct samples of 16-21 year-olds from both the quarterly HLFS and the annual HLFS-IS samples. Our analysis of non-income related outcomes of interest – wage and salary employment, weekly hours worked, self-employment, studying, unemployment, and inactivity – uses the quarterly HLFS data; while our analysis of four income-related outcomes – hourly wages, receipt of non-student benefits, weekly earnings, and weekly total income – uses annual data from the HLFS-IS. We include in our samples all available data on individuals aged 16-21, including that collected by proxy interview and/or imputed when missing but, in our analysis, we include fully interacted controls for these observations, as such data is likely to contain significant measurement error.

Our main analyses use data pertaining to 16-21 year-olds from each of these sources over the period 1997–2010, but we also consider analyses over the full HLFS coverage period 1986–2010, and over the more recent sample period 2004–2010. There was a significant change in HLFS questionnaire in 2004 (June quarter) to collect consistent educational enrolment information from all respondents; prior to 2004, this was only systematically collected for those out of the labour force. Table 2 presents a summary of relevant sample characteristics over these periods for both the quarterly HLFS samples (Table 2A), and the annual HLFS-IS samples (Table 2B). For each sample, we summarise the characteristics of the full sample as well as the subsample of (wage and salary) workers. The summary statistics (and subsequent analyses) are weighted by the HLFS

sampling weights created by Statistics New Zealand that take account of the HLFS sample frame and non-random survey response and attrition.

Our 1997–2010 quarterly HLFS samples have 161,719 observations, and 83,469 (53%) wage and salary workers; and the 1997–2010 annual HLFS-IS samples have 38,885 observations, and 19,577 (51%) wage and salary workers.³ Less than 1% of 16-21 year-olds were self-employed, 28% studying (based on the pre-2004 information collected), 9% were unemployed and 18% were inactive.⁴ The summary statistics vary somewhat across the other sample periods, but are reasonably representative. The measured study rate is substantially higher (61% versus 29%) once additional data is collected on individuals who are in the labour force and studying starting in 2004. Comparing the full and worker-samples for each period, workers are, on average, older, more likely to be male, New Zealand born and Pakeha, and less likely to be studying, than non-workers. Wage and salary workers work about 26 hours per week on average, and earn \$11.89 per hour (2006 \$-values). Both the wage and salary employment rate, and average weekly hours worked, are slightly higher in the quarterly HLFS than the annual HLFS-IS samples, presumably reflecting seasonal differences, but otherwise the sample characteristics are very similar across the two samples.

Before we analyse the impact of the 2008 minimum wage changes on teenage outcomes, we first provide a description of the changes in the wage distributions of teenagers and young adults over the period before and after 2008. This provides a sense of how much the prevailing minimum wages affected teenage and young adult workers before the youth minimum was abolished in 2008, as well as how much the 2008 change affected 16-17 year olds wages.

2.2 The New Entrants wage effects

We begin by considering the extent to which the *new entrants* minimum hourly rate appears to be a relevant minimum rate for 16-17 year-olds after 2008. This rate was set at 80% of the adult minimum wage, and applied to the first 200 hours or 3 months employment. In the HLFS data, it is not possible to identify whether the relevant minimum wage rate applicable to an individual 16-17 year-old is the new entrants rate or the adult minimum. However, in order to try to assess the extent to which employers may have paid 16-17 year-olds below the adult minimum wage, Figure 2 plot the trends in the fractions of 16-17 year-olds' wages in relation to each of the new entrants (or youth minimum wage prior to 2008) and the adult minimum wage.

³ These samples imply age-specific average cell sizes of 481 (and 248 workers) per quarter in the HLFS, and 463 (and 233 workers) annually in the HLFS-IS.

⁴ Individuals are coded as studying if they are i) out of the labour force and record study as their main activity or, ii) report that they are still in school when asked about their qualifications. The rate here is slightly lower than in Hyslop and Stillman (1997) because, in that paper, supplemental questions on why individuals left their last job and why they are not available for work are used to code some individuals who were not employed as studying. The information needed to do this is no longer available in the version of the data to which we have access. Our measure of unemployment is the percentage of the total population that is out of work and searching for a job as opposed to the standard unemployment rate defined as the percentage of the labour force. This is done so all our rate measures have the same denominator. Inactivity is defined as being neither employed nor studying. We do not exclude individuals taking care of children as is done in the official SNZ definition because we do not want to preclude this as a pathway out of employment.

First, Figure 2(a) shows the fraction of workers whose wage is respectively, below or exactly-at the current new entrants minimum wage, and below the next year's new entrants minimum wage. As the minimum wages increased during the 2000s, there was a steady increase in the fraction of 16-17 year-olds with current wages below the next year's youth minimum wage, peaking at 32% in 2007, before falling to less than 10% after the 2008 changes. The fraction of workers with reported wages below the current youth/new-entrants minimum was never more than 11%, and was lower after 2008 (4-7%) than before (9-11% between 2003 and 2007). Also, except for 2007 when 13% of workers reported wages at exactly the youth minimum (presumably largely due to the minimum wage being exactly \$9 per hour in 2007), this fraction has been less than 3% since 2003, and less than 2% since 2008.

Figure 2(b) shows the corresponding fractions of 16-17 year-olds with wages in relation to adult minimum wage rates since 1997. More than 40% of 16-17 year-olds reported wages below the (current) adult minimum rate between 2003 and 2007, and this fraction dropped to 20% in 2008-09, before rising to 35% in 2010. There was also a dramatic increase in the fraction earning exactly the adult minimum from about 4% before 2008 (curiously more than the fraction earning the youth minimum), to around 40% in 2008-09 and 28% in 2010.

In Figure 2(c), we describe the trend in the fraction of 16-17 wages that lie between the Youth/New-entrant and adult minimum wages over the period, together with the sub-fraction that lies near (up to \$0.50 above) the youth/new-entrants minimum, and the fraction that lies near (within \$0.50 below) the adult minimum wage. This shows a generally declining trend in the fraction between the two minima bounds until 2007, and followed by a substantial drop in 2008, and a noticeable increase again in 2010. The fraction of 16-17 year-olds' wages that lie near the new entrant minimum wage is less than 5% after 2008 and, while the fraction near the adult rate is also low in 2008 and 2009, it is nearly 20% in 2010 and accounts for most of the fraction between the two bounds in that year.

Finally, Figure 8 in the appendix describes in detail the histograms of wages (rounded to the nearest \$0.10) between the youth/new-entrant and adult minimum wages for 16-17, 18-19, and 20-21 year-olds in each year since 2007. These histograms show the fraction of all wages at each \$0.10 value, and highlight several effects. First, the binding nature of the youth minimum on 16-17 year-olds' wages, and the adult minimum on 18-19 year-olds' wages, in 2007 (Figure 8(a)). Second, the huge clearing effect on wages below \$12 of the 2008 changes (Figure 8(b)). Third, the relative importance of round \$1 and \$0.50 reported wages, which are particularly noticeable at \$12 and \$12.50 for both teenage group in Figure 8(c) and (d). We believe such round-wage reporting contributes to the substantial fraction of wages at a minimum wage when it coincides with a round value. Also, given that about 10% of 18-19 year-olds also report \$12.50 wages in 2010, we suspect the prevalence of sub-adult minimum wages for 16-17 year-olds in 2010 may be largely due to reporting errors associated with such round wage values rather than firms paying such wages in accordance with the new entrants minimum wage floor.

Although not definitive, we believe these patterns suggest the new entrants wage was largely non-binding after 2008. In addition, we suspect that, in practice, there may be

significant issues associated with the information employers require on young workers employment experience and wage equity across their workers that inhibit employers using the new entrants rate. Below, we also show that, after 2008, the adult minimum wage appears to have a substantial binding effect on the wage distribution of 16-17 year-old workers. For these reasons, in our subsequent analysis we will assume that the adult minimum wage is the relevant minimum wage for all 16-17 year-olds after 2008.

2.3 Changes in the wage distributions

We now turn to trends in the patterns of wage distribution summary statistics across the age groups. Figure 3 summarises relevant aspects of the hourly wage distributions of teenage and young adult workers estimated from the HLFS-IS over the period from 1997 to 2010. In each graph, we plot the annual trends for 16-17 year olds (dashed lines), 18-19 year olds (solid lines), and 20-21 year olds (dotted lines), and the vertical lines mark the dates of youth minimum wage reforms.

First, Figure 3(a) shows the fraction of wage and salary workers whose reported main-job hourly wage is below the current minimum wage that applies to each age group.⁵ Around 5% of 16-17 year old workers reported sub-minimum wages prior to the 2001 change; this fraction increased to about 10% in 2002 and stayed around that level through until 2007, before increasing to 20% in 2008 and 2009 and 35% in 2010. For 18-19 year olds, only 1-2% reported sub-minimum wages prior to 2001, while the fraction increased steadily from about 10% in 2001 to 23% in 2007, before falling to 14-15% in 2008 and 2009 and rising to 27% in 2010. Although the fraction for 20-21 year olds workers reporting wages below the minimum wage appears to have increased over the period, this fraction was less than 10% over the entire period.

Second, Figure 3(b) shows the fraction of workers who report exactly minimum wage rates in each year. This provides one measure of the extent to which the minimum wage is binding. Prior to the 2001 changes, almost no workers (less than 1%) in any age group reported earning exactly the minimum wage. Between 2001 and 2006 there are noticeable increases for both teenage groups (up to 7% for 18-19 year olds) and a marginal increase for 20-21 year olds. However, these trends change dramatically from 2007. The fraction of 16-17 year-olds reporting exactly the minimum wage is 13% in 2007, 43% in 2008, 38% in 2009 and 28% in 2010. Less dramatic, but substantial increases also occur for 18-19 year-olds, from 11% in 2007 to 23% in 2009 and 13% in 2010, while the fraction of 20-21 year-olds increase to 10% in 2009 before also falling to 5% in 2010.

Third, Figure 3(c) shows the fraction of workers in each year who report wage rates below next year's (nominal) minimum wage. This provides a measure of the fraction of workers whose wages are directly affected by next year's minimum wage.⁶ For all three age groups, this fraction tends to increase over the period from 2000. For 20-21 year-

⁵ Note that, in Figure 3, the relevant minimum wage for 18-19 year-olds changes from the youth minimum to the adult minimum wage in 2001, and for 16-17 year-olds from the youth minimum to the adult minimum wage in 2008.

⁶ Assuming the nominal wage distribution is increasing, and because it ignores any secular increases in wages that may occur before the minimum wage change, this should provide an upper bound estimate of the fraction of workers directly affected by next year's minimum wage.

olds, this presumably reflects the steadily increasing real value of the adult minimum wage, so that by 2006 around 20% of 20-21 year-old workers have wages less than the next year's minimum. The increases are more dramatic for the teenage groups. For 18-19 year-olds, the fraction increases from less than 5% in 1999 to 17% in 2000 (in anticipation of the 2001 youth reforms), and continued to increase to around 45% in 2006 and 2007 before falling back to under 40% in 2008 and 2009. For 16-17 year-olds, the fraction increases steadily from about 10% in 1999 to 20-25% in 2005 and 2006, before jumping dramatically to around 70% in 2007 and 2008, and then falling to 60% in 2009. The 2007-8 fractions suggest that nearly three-quarters of 16-17 year-old workers were potentially affected by the abolition of the youth minimum wage in 2008.

Finally, Figure 3(d) shows the trends in the average real hourly wage of the three age groups (in 2006\$). Although the real wages of each group show trend increases over the period, more importantly the average wages of 16-17 year-olds increases substantially (8.5%) in 2008, and shows significant convergence towards the average of 18-19 year olds after 2007. Between 1999 and 2009, the real average hourly wage of 16-17 year-old workers increases 35%, compared to 18% for 18-19 year-olds and 17% for 20-21 year-olds. Perhaps surprisingly, although the minimum wage increases over the period appear to have become increasingly binding on 18-19 year-olds, the average wage of this group has not increased noticeably more than for 20-21 year-olds.

Next, Figure 4 presents kernel density estimates of the distributions of log(real hourly wage) from workers' main-jobs, separately for 16-17, 18-19, and 20-21 year-old workers for the three year periods before and after the 2008 change – i.e. 2005-07 and 2008-10 respectively. In each figure, we have also included vertical lines corresponding to the 2006 and 2008 relevant age-group minimum wage levels. The changes in the wage distribution for these groups are consistent with the patterns of summary statistics shown in Figure 3. For example, Figure 4(a) shows a large drop in the density in the left hand tail of the distribution, together with a large spike around the adult minimum wage, for 16-17 year-olds after 2008. Also, Figure 4(a) provides further support to the notion that, after 2008, the adult minimum provides a more relevant minimum wage for 16-17 year-olds' than does the new entrant minimum rate. Analogous, although less extreme effects can be seen for 18-19 year-olds in Figure 4(b); and there are much smaller, albeit noticeable, changes in the distribution of 20-21 year-olds wages in Figure 4(c).

Taken together, the patterns of changes observed in Figure 3 and Figure 4 indicate that the 2008 youth minimum wage change clearly had a large impact on the wages of 16-17 year-olds. It appears that the changes in the adult minimum wages around this time also potentially had a significant impact on the wages of 18-19 year-olds, and these increases were affecting the wages of 20-21 year-olds by the end of the period.

2.4 Descriptive trends in labour market outcomes

We now describe the trends in various labour market and related outcomes of teenagers and young adults for assessing the impacts of the abolition of the youth minimum wage in 2008. The key labour market outcomes are the wage and salary employment rate, which captures the extensive margin of employment, and the hours worked conditional of being employed, which captures the intensive margin. In addition to these outcomes, we also consider the related outcomes of self-employment, unemployment, studying, and inactivity (defined as neither employed nor studying), which are each measured

quarterly in the HLFS; and welfare-benefit receipt, employment earnings, and total income, which are each measured annually in the HLFS-IS.⁷

Figure 5 graphs the trends in each age-group's wage and salary employment rate, self-employment rate, and average weekly hours worked by wage and salary workers over the period 1986–2010. The three vertical lines in each graph correspond to the dates of the youth minimum wage reforms during the period – vis 2001, 2002, and 2008. Each of the three graphs show differences in both employment and hours worked across the age groups, particularly between 16-17 year-olds and the older two groups.⁸ Also, prior to 2008 the employment and average hours patterns are procyclical over the business cycle, with a strong cyclical pattern from 1986 up until 1997 and a weaker cyclical pattern during the post-97 growth period. Reassuringly for our identification strategy, the impact of the last large recession in 1991 on employment was quite similar for 16-17 year-olds and the older two groups. If the same holds true for the current recession, then the impact of the business cycle on employment can be controlled for by comparing changes in outcomes for the different age groups.

Figure 5(a) also shows that the wage and salary employment rate of 16-17 year-olds dropped substantially after 2008, while there are smaller declines for 18-19 and 20-21 year-olds. For example, the employment rate of 16-17 year-olds fell by one-third (14.6 percentage points) from 43.1% in first quarter 2008 to 28.5% fourth quarter 2010. By comparison, the employment rate of 18-19 year-olds fell 4.1 percentage points from 57.3% to 53.1% over the same period, and that of 20-21 year-olds appears to have trended down also, although was 60.6% in both first quarter 2008 and fourth quarter 2010. Figure 5(b) shows the self-employment rates of these age-groups are both low and variable over the period, with little discernible difference.

Figure 5(c) also shows that the average hours worked by both teenage groups declined over the latter part of the period, although these trends appear to begin before 2008: from about 2007 for 16-17 year-olds, and perhaps from as early as 2004 for 18-19 year-olds. From the first quarter 2008 to the final quarter 2010, the average weekly hours worked of 16-17 year-olds fell 2.5 hours per week (14%) from 17.6 to 15.1 hours (from a high of 21.0 in the fourth quarter 2006); in comparison, 18-19 year-olds average hours worked fell 2.6 hours per week (10%) from 26.9 to 24.3 (from a high of 31.4 in the fourth quarter 2005), and 20-21 year-olds average hours worked were 30.8 and 30.9 in these quarters, respectively.

To the extent that business cycle effects are similar for each age-group, these comparative changes in employment rates and hours worked by the various age groups suggest the abolition of the youth minimum wage in 2008 had a potentially strong impact on both dimensions of employment for 16-17 year-olds. We will explore this more formally in a regression analysis since it is necessary to control for other potentially confounding differences to confirm this hypothesis.

⁷ See footnote 4 for variable definitions.

⁸ The average wage and salary employment rate over the period since 1997 for 16-17 year-olds is 41.7% versus 56.5% for 18-19 year-olds and 61.1% for 20-21 year-olds; while the self-employment rates are 0.4%, 0.7% and 1.4% respectively. Similarly, average hours worked per week are 17.7, 28.3 and 31.1 for 16-17, 18-19, and 20-21 year-olds, respectively.

We next consider the trends in the three related outcomes of unemployment, studying and inactivity, graphed in Figure 6 for the three age groups. Figure 6(a) shows the percentage unemployed of the three age-groups over the 1986–2010 period. This graph shows the unemployment is more strongly (counter)cyclical than the employment rate in Figure 5(a). The percentage unemployed for all three groups increases strongly during the recession period from first quarter 2008 until second quarter 2009, from 8.1% to 13.5% for 16-17 year-olds, 7.8% to 10.6% for 18-19 year-olds, and from 4.8% to 10.5% for 20-21 year-olds, and stay around these levels until the end of the period.

In Figure 6(b), we show the trend in the rate of studying for each age group over the 1986–2010 period, with additional information graphed for the 2004–2010 period when a more consistent measure of studying activity was measured in the HLFSS survey. The rate of study activity trend upwards for each age group over most of the period and, if anything, the rates for teenagers appear to increase relative to that of 20-21 year-olds after 2008 regardless to which set of figures are examined. For example, between fourth quarters in 2007 and 2010, the study-activity rate of 16-17 year-olds using the more accurate study measure increased from 80.3% to 86.7%, compared to increases from 46.3% to 54.9% for 18-19 year-olds and from 45.3% to 45.5% for 20-21 year-olds. Figure 6(c) shows the trends in inactivity rates for the three age groups since 1986, again with revised more accurate numbers available since 2004. The trends in this graph largely follow those of unemployment in Figure 6(a), except at relatively different levels across the age groups, reflecting that inactivity includes as well as the unemployed, those neither employed nor studying and not activity looking for work.

Finally, in Figure 7 we graph the annual trends in the fractions of individuals reporting non-student benefits (Figure 7(a)), average weekly main-job earnings conditional on employment (Figure 7(b)), and average weekly total income (Figure 7(c)) for the three age groups from the HLFSS-IS over the period 1997–2010. The benefit receipt trend is quite strongly countercyclical for 20-21 year-olds, less so for 18-19 year-olds, and barely so for 16-17 year-olds, with the rates increasing after 2006, but no obvious break in trend around 2008.

The average real weekly earnings of 20-21 year-old workers is comparatively flat over the full period. In contrast, the average earnings of teenage workers increase up until 2006/7. For example, 18-19 year-olds average earnings increase 21% 2000 and 2007, and then decline 24% through to 2010; while, for 16-17 year-olds, average earnings increase 42% from 2000 to 2006, and then decline 18% though to 2010. Some of the difference between the relative declines in the teenage groups' average earnings is that the higher wages for 16-17 year-olds following 2008 acts to off-set their lower hours worked.

Figure 7(c) presents the trends in average unconditional real total incomes for the three age groups. This measure is immune to non-random selection effects associated with employment, because individuals' total income aggregates their employment, hours worked and wages as well as any study or welfare benefit income received. The trends in average total income are similar to those for average earnings, but show relatively stronger decreases after 2007: average income declined 42% for 16-17 year-olds, versus 23% for 18-19 year-olds and 10% for 20-21 year-olds.

3 ANALYSIS OF THE IMPACT OF YOUTH MINIMUM WAGE CHANGES

3.1 Difference-in-differences' estimates of employment and hours worked

We begin our analysis of the impact of the 2008 abolition of the youth minimum wage on labour market outcomes of 16-17 year-olds, with simple difference-in-differences estimates of the impact on their (wage and salary) employment rate and the average weekly hours worked conditional on being employed. While conceptually 18-19 year-olds provide the more natural comparison group for 16-17 year-olds outcomes than do 20-21 year-olds, as shown in Figure 3 and Figure 4, by 2008 18-19 year-olds wages were also potentially significantly affected by the minimum wage. For example, any direct impact on 16-17 year-olds may result in employers substituting 18-19 year-old workers. Hence, we consider difference-in-difference estimates of 16-17 year-old outcomes relative to those of both 18-19 and 20-21 year-olds.

Table 3 summarises the levels and changes in employment and hours worked for 16-17, 18-19 and 20-21 year-olds during the two years (2006Q1–2007Q4) before the change was announced and two years (2008Q2–2010Q1) after it occurred. Panel (A) focuses on employment, and shows the employment rate before (row 1) and after (row 2) the change for each age-group, the change in employment rate between the two periods (row 3), as well as the differences in employment rates between 16-17 and 18-19 year-olds (column (4)) and between 16-17 and 20-21 year-olds (column (5)). The entries in bold in columns (4) and (5) or row 3, are the difference-in-differences estimates of the impact on 16-17 year-olds employment rate. Panel (B) presents analogous estimates for hours worked.

Consistent with the levels and trends shown in Figure 5, both the employment rate and average hours worked of 16-17 year-olds were substantially lower than those of 18-19 and 20-21 year-olds before 2008. The employment rate of each age-group dropped substantially after 2008: for 16-17 year-olds by 7.4 percentage points, and for 18-19 and 20-21 year-olds by 4.7 and 4.5 percentage points, respectively. The difference-in-differences estimates show statistically significant negative impacts of the 2008 youth minimum wage change on 16-17 year-olds employment rate: equal to -2.7 percentage points ($p=0.06$) and -2.8 percentage points ($p=0.08$) relative to 18-19 and 20-21 year-olds, respectively. Compared to the pre-2008 16-17 year-olds employment rate of 45%, these estimates imply the abolition of the youth minimum wage caused 16-17 year-olds employment to fall by about 6%.

Average hours worked also declined after 2008 for each of the three age-groups, by approximately 3 hours per week for 16-17 and 18-19 year-olds, and 2 hours per week for 20-21 year-olds. The implied difference-in-differences estimates of the change in 16-17 year-olds average hours worked is +0.11 relative to 18-19 year-olds, and -1.03 relative to 20-21 year-olds, with neither estimate being statistically significant.

3.2 Regression analysis of employment

We now consider estimates of the impact of the 2008 changes on 16-17 year-olds employment from regression specifications that control for various factors that may vary

either across the age groups and/or over time. Ignoring individual and time-subscripts, the basic regression specification we use is as follows:

$$Y = \delta * (Age16_17 * Post_2008) + X' \beta + \varepsilon \quad (1)$$

where Y is the outcome of interest (e.g. employment); $Age16_17$ and $Post_2008$ are dummy variables equal to 1 for individuals aged 16-17, and for the observation occurs after the 2008 policy change (i.e. from 2008Q2 onwards) respectively; X is a vector of covariates that may also affect the outcome; and δ and β are regression coefficients. Our primary focus of interest is on δ , which is the effect on the outcome for 16-17 year-olds after the policy change conditional on the effects of the X -variables.

Table 4 reports results from alternative regressions, estimated over the 1997–2010 period. We first consider a simple specification that estimates a post-2008 effect on 16-17 year-olds employment, controlling for single-year age effects that are constant over the period, quarter-specific effects that are constant across the age-groups, a pre-2003 indicator variable and an interaction between the pre-2003 indicator variable and being a 16-17 year-old. This approach effectively means that the minimum wage impacts are estimated by comparing the change in outcomes for 16-17 year-olds after 2008 to those from 2003-2008 to the same change for 18-21 year-olds, while the data from 1997-2002 is only used to estimate long-run age differences in employment rates (and later possible seasonal and business cycle effects). We do this so our estimates will not be contaminated by the impact of the 2001 minimum wage reforms.

The estimated impact of the 2008 changes on 16-17 year-olds employment from this specification, presented in column (1), is -5.1 percentage points, which is substantially larger than the difference-in-difference estimates of -2.8 percentage points.

We next sequentially add control variables for; individual-specific demographic covariates, which include dummy variables for gender, marital status, ethnicity, New Zealand-born, and both rural/urban and region of residence, and the relative population size of each age group in each year to control for possible supply-side effects (column (2)); post-2008 effects on 18-19 year-olds employment to allow for possible impacts and/or spillovers (column (3)); and a dummy variable for whether a proxy interview was used in the HLFS survey (column (4)). The estimated impacts of the 2008 changes on the 16-17 year-old employment rate from these specifications vary between -3.9 percentage points and -5.1 percentage points, with each estimate being statistically significant. The estimated effects on the 18-19 year-old employment rate in columns (3) and (4) are small (0 and 0.2 percentage points) and statistically insignificant.

The subsequent specifications allow the policy effects on 16-17 year-olds employment to vary in each of the three years after 2008 (i.e. 2008Q2-2009Q1, 2009Q2-2010Q1, and 2010Q2-2010Q4) after the policy change, and also allow for analogous effects on 18-19 year-olds employment.

$$Y = \sum_{t=2008}^{2010} \{ \delta'_{16_17} * (Age16_17 * Year_t) + \delta'_{17_19} * (Age18_19 * Year_t) \} + X' \beta + \varepsilon \quad (2)$$

The results in column (5) for this specification suggest that the adverse employment effects for 16-17 year-olds increased over time: from a small and statistically

insignificant positive effect (0.5 percentage points) on the 16-17 year-old employment rate in 2008, followed by statistically significant negative effects in 2009 and 2010 (of -3.8 and -5.2 percentage points, respectively). In contrast, the effects on the 18-19 year-old employment rate are positive and statistically significant in 2008 (+3.3 percentage points), and negative and insignificant in 2009 and 2010.

In columns (6) and (7) of Table 4, we further control for possible effects associated with the announcement of the 2008 changes in December 2007 (column (6)); and age-specific quarter seasonal effects that are constant over time (column (7)), to allow for possibly different patterns associated (e.g.) different age-specific study patterns. Finally, columns (8) and (9) include alternative controls for possible business cycle and/or secular time effects. In column (8), we use the adult unemployment rate to characterise the (aggregate) business cycle, and allow for single-age dummy variable interactions to allow the business cycle employment impacts to vary by age. Finally, as an alternative to the business cycle effects, in column (9) we control for age-specific linear trends that will control for any age-specific secular (linear) trends in employment.⁹

The year-specific estimated policy effects on 16-17 and 18-19 year-olds employment rates shown in column (5) are qualitatively robust to these alternative specifications. In particular, we consistently find insignificantly positive estimates on the 16-17 year-old employment rate in 2008, followed by increasingly negative effects in 2009 and 2010, which are statistically significant except for the estimated 2009 effect in the final specification. Similarly, the estimated 18-19 year-old employment rate effects are consistently positive and statistically significant in 2008, and insignificant in 2009 and 2010.

Based on the results in Table 4, we conclude that the 2008 changes to the youth minimum wages had little effect on the 16-17 year-old employment rate in 2008, but increasingly negative effects subsequently on the order of 3-4 percentage points in 2009, and 5-6 percentage points in 2010. There also appears to have been an increase in the employment rate of 18-19 year-olds in 2008 relative to that of 20-21 year-olds, on the order of 3-4 percentage points. The estimated effects on 16-17 year-olds employment implies increasing minimum wage impacts over time, although we are not sure of an adequate explanation for such a profile. One explanation may be that, rather than laying off existing workers, firms adjusted gradually by reducing their hiring of new 16-17 year-old workers in favour of 18-19 year-olds. If this occurred then we might expect to see an increase in the average age of workers among those 16-17 year-olds employed, however there is little evidence to suggest this.¹⁰ Alternatively, if employers increasingly substitute 18-19 for 16-17 year-old workers, we might expect to find increasingly

⁹ Given the absence of any obvious employment rate trends in Figure 5 over the 1997 – 2008 period, we expect the specification in column (8) will be more robust. However, the specification in column (9) provides a robustness test for the results.

¹⁰ Using detailed information in the HLFS data extract on respondents' month of birth and the month of survey to estimate the average age of employed workers, we observe a slight increase in the average age of 16-17 year-olds in 2008 – e.g., the average age of employed 16-17 year-olds was 17.0 years in 2007 and 17.1 years in 2010. However, similar increases occur also for 18-19 and 20-21 year olds.

positive effects on 18-19 year-olds employment after 2008, while the estimates suggest the opposite.¹¹

3.3 Regression analysis of other outcomes from the quarterly HLFS

We now consider the impact of the 2008 youth minimum wage policy changes on other relevant outcomes. First, Table 5 contains results for weekly hours worked conditional on being (wage and salary) employed, self-employment, whether studying, unemployed, and inactive, each of which are measured quarterly in the HLFS. Given the robustness of the employment results across the various specifications considered, we present results based on the specifications in columns (7) and (8) of Table 4, that exclude and include age-specific business cycle controls, respectively, for each of the various outcomes. These results are presented in Table 5A and Table 5B respectively, together with the wage and salary employment outcome results presented in Table 4.

First, column (2) contains the estimated policy impacts on weekly hours worked, which find statistically insignificant effects for 16-17 year-olds in 2008, and significantly negative effects in 2009 and 2010 on the order of 2.5 (panel A) and 1.2 (panel B) hours per week. Compared to the 18.8 average hours worked of 16-17 year-olds in the two years before the change, these estimates imply a fall of 6-14%. There is also some evidence of a statistically significant decline of 1.4-2.8 hours in 18-19 year-olds average weekly hours in 2009 and 2010, or 5-10% compared to the 2006-07 average of 29.3 hours per week. Column (3) presents the results for the self-employment rate, which show no effects for 16-17 year-olds, and a statistically significant 0.7% lower self-employment for 18-19 year-olds in 2008.

The remainder of the table contains results for studying (columns (4) and (5), using the alternative study measures from the HLFS), unemployment (column (6)), and inactivity (columns (7) and (8), also using the alternative measures of studying). There is some evidence that the percent of 16-17 year-old unemployed increased after 2008, particularly in 2009 by 1.4-2.6 percentage points, but the evidence is relatively weak. Using the standard questions on studying that have been asked throughout the HLFS history, there appears to have been a strong increase in the fraction of 16-17 year-olds studying in 2010 of 4-6 percentage points (column (5)), and little evidence of any impact on inactivity (column (8)). Using the more complete study information that has been collected since 2004, the results show smaller, but still significant, effects of the policy change on study rates of 16-17 year-olds (column (4)), but stronger negative effects on the inactivity rates after 2008 (column (7)).¹²

¹¹ However, if the 18-19 year-old impacts confound positive substitution effects and negative direct minimum wage effects the estimate will be difficult to interpret.

¹² We have examined the robustness of the estimated impacts using samples covering different periods, and present the results in the appendix. In particular, Table 8 contains the results estimated over the full 1986–2010 HLFS sample period for the same outcomes presented in Table 5 (except for the study and inactivity outcomes using the more complete study information collected from 2004 onwards); and Table 9 contains the results estimated over the 2004–2010 period. The estimated impacts of the policy changes are generally qualitatively robust across these three periods. The main exception is in regards to the effects on the wage and salary employment rates of teenagers for the specification that controls for age-specific business cycle factors over the 2004–2010 sample: for this case, the estimated effects on 16-17 year-olds employment rate is

In order to investigate the contrasting effects of the policy change on the study and inactivity outcomes depending on the measure of study adopted, we have reestimated various related effects using data from 2004 onwards. In particular, Table 6 contains the estimated effects for wage and salary employment, and studying in columns (1) and (2), and, in columns (3) – (6), the results for the mutually exclusive (and exhaustive) measures of work-only (including both wage and salary, and self-employment), work-study, study-only, and inactivity (i.e. neither work nor study) based on the more complete measure of studying. The results in panel A, which control for seasonal effects, tend to be stronger than those in panel B, which control for business cycle effects. Again, because of the difficulty of identifying business cycle patterns over the 2004-10 period, we focus on the former estimates. These results show that most of the impact of the 2008 minimum wage change on 16-17 year-olds employment and study fell on individuals who were both studying and working, while the impact on 18-19 year-olds employment was among those also studying. This suggests there may have been a substitution of employment opportunities away from younger (16-17 year-old) towards older (18-19 year-old) students. In fact, the results in column (3) show that the employment rate of 16-17 year-olds not studying increased by 3-4 percentage points in 2008 and 2009. In contrast, the increase in the 2008 employment rate of 18-19 year-olds appears to have been largely among those also studying (column (4)). The work-study (column (4)), and study-only (column (5)) results suggest that the employment rate of 16-17 year-olds studying fell by 5-6 percentage points in 2009 and 2010, which was more than matched by an increase in the fraction only-studying.

3.4 Regression analysis of other outcomes from the annual HLFS-IS

Finally, we consider the impact of the 2008 minimum wage changes on outcomes measured annually in the HLFS-IS: i.e. the receipt of non-student benefits, weekly main-job earnings, and weekly total income. Our main set of results for this analysis, estimated over the 1997–2010 period, are presented in Table 7, while Table 10 in the appendix contains the equivalent results estimated over the 2004–2010 period. Each table contains two sets of results: the specification in panel (A) controls for age-specific and year-specific factors, analogously to the specification in column (8) of Table 4, and the specification in panel (B) additionally controls for age-specific business cycle effects. The results are generally qualitatively robust across the two sample periods.

Controlling for age- and year-specific effects, we estimate the fraction of 16-17 and 18-19 year-olds receiving benefits fell significantly relative to that of 20-21 year-olds after the 2008 policy changes. The estimates controlling for business cycle effects, in panel (B), are weaker. The impacts on main-job earnings, as measured by $\log(\text{weekly earnings})$, are also generally negative and largely reflect the decline in hours worked shown in Table 4, although they are somewhat sensitive to the specification estimated. The estimates in panel (A) imply 16–17 year-olds earning fell by around 15% in 2009, but increased by about 10% in 2010: the latter perhaps reflecting a combination of non-

positive but not statistically significant in each year after 2008, and the estimated effects on 18-19 year-olds employment rates are also positive and significant in 2010 (as well as 2008). We are inclined to discount these findings because the limited variation in the adult unemployment rate between 2004 and 2008 makes it difficult to accurately control for business cycle effects using this approach in this sample.

random selection into (non)employment and higher wages among those employed. The estimates in panel (A) imply 18-19 year-olds earnings fell by 10-15% in 2009 and 2010. Finally, the estimates of the impacts on 16-17 year-olds total weekly income suggest generally negative but rather muted effects, on the order of 5-10% decline in 2009 and 2010 (panel (A)), but these again depend on the particular specification adopted.

4 CONCLUDING DISCUSSION

In this paper, we have analysed the effects of the large increase in the minimum wage for 16-17 year-old workers that occurred in 2008 on employment and related labour market outcomes. First, we showed that the abolishment of the statutory youth minimum wage in 2008 had a substantively large and binding impact on the wage distribution of 16-17 year-olds. For instance, in 2007 and 2008, about 70% of 16-17 year-olds' wages were below the following year's (2008 and 2009) adult minimum wage. Subsequently, about 40% of 16-17 year-olds' wages in 2008 and 2009 were exactly equal to, while 20% remained below, the prevailing minimum wages in those years. Although the 2010 fraction exactly at the minimum was lower (28%) and the fraction below the minimum was higher (35%), likely reflecting that the round-dollar and 50-cent value of the minimum wage in 2008 and 2009 was a contributing factor, we believe most employers now pay 16-17 year-olds according to the adult minimum wage rather than the new entrants rate. The progressive increases in the adult minimum wage during the 2000s have also resulted in the adult minimum wage binding on 18-19 year-olds' wages, with 13-23% being paid exactly minimum wages since 2008.

Second, our analysis finds consistent evidence of adverse employment effects of the 2008 policy change for 16-17 year-olds. Although the estimates vary some according to the specification adopted, we conclude that the minimum wage increase for this group, lowered the employment rate by 3-6 percentage points in 2009 and 2010. However, this adverse effect appears to be entirely due to lower employment among students, with the employment rate of non-students increasing by around 3 percentage points. Perhaps associated with these effects, we also find evidence of a substitution towards 18-19 year-old student employment, and significant declines in the average weekly hours worked by both groups of teenagers after 2008.

Third, we find some evidence that both the education enrolment and unemployment rates of 16-17 year-olds increased, but stronger evidence of a decline in the inactivity rate. Finally, our analysis also suggests there was a decline in the average weekly earnings and income of both groups of teenagers, although this evidence is less conclusive.

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Table 1: Summary of minimum wage changes

Announcement Date	Effective Date	Nominal minimum wage affecting			New Entrants' wage
		Adults (Aged 20+)	18-19 year olds	16-17 year olds	
	17 September 1990	6.13	-	-	-
	31 March 1994	-	3.68	3.68	-
	22 March 1995	6.25	3.75	3.75	-
	18 March 1996	6.38	3.83	3.83	-
	1 March 1997	7.00	4.20	4.20	-
	6 March 2000	7.55	4.55	4.55	-
14 December 2000	5 March 2001	7.70	7.70	5.40	-
30 January 2002	18 March 2002	8.00	8.00	6.40	-
19 December 2002	24 March 2003	8.50	8.50	6.80	-
23 February 2004	1 April 2004	9.00	9.00	7.20	-
21 December 2004	21 March 2005	9.50	9.50	7.60	-
21 December 2005	27 March 2006	10.25	10.25	8.20	-
18 December 2006	1 April 2007	11.25	11.25	9.00	-
19 December 2007	1 April 2008	12.00	12.00	12.00	9.60
9 February 2009	1 April 2009	12.50	12.50	12.50	10.00
27 January 2010	1 April 2010	12.75	12.75	12.75	10.20
2007-2008 Change⁽¹⁾		2.5%	2.5%	28.2%	

Notes: ⁽¹⁾ Real change, adjusted for increases in the CPI inflation.

Table 2A: Sample characteristics - HLFS quarterly samples

	1986-2010		1997-2010		2004-2010	
	Full sample	Workers	Full sample	Workers	Full sample	Workers
Age	18.5 (0.003)	18.7 (0.004)	18.4 (0.004)	18.7 (0.006)	18.4 (0.006)	18.7 (0.008)
Female	0.495 (0.001)	0.481 (0.001)	0.490 (0.001)	0.477 (0.002)	0.490 (0.002)	0.475 (0.002)
Married	0.083 (0.000)	0.090 (0.001)	0.084 (0.001)	0.095 (0.001)	0.088 (0.001)	0.101 (0.002)
NZ born	0.819 (0.001)	0.860 (0.001)	0.814 (0.001)	0.866 (0.001)	0.794 (0.001)	0.846 (0.002)
Pakeha	0.503 (0.001)	0.559 (0.001)	0.612 (0.001)	0.714 (0.002)	0.589 (0.002)	0.693 (0.002)
Maori	0.147 (0.001)	0.111 (0.001)	0.190 (0.001)	0.156 (0.001)	0.193 (0.001)	0.159 (0.002)
Pacific Islander	0.054 (0.000)	0.037 (0.000)	0.073 (0.001)	0.053 (0.001)	0.075 (0.001)	0.053 (0.001)
Asian	0.053 (0.000)	0.030 (0.000)	0.082 (0.001)	0.049 (0.001)	0.099 (0.001)	0.065 (0.001)
Wage & salary worker	0.543 (0.001)	1	0.527 (0.001)	1	0.528 (0.002)	1
Weekly hours	28.2 (0.041)	28.2 (0.041)	26.4 (0.059)	26.4 (0.059)	26.2 (0.085)	26.2 (0.085)
Self employed	0.010 (0.000)	0.000 (0.000)	0.008 (0.000)	0.000 (0.000)	0.007 (0.000)	0.000 (0.000)
Studied (standard Qs)	0.252 (0.001)	0	0.281 (0.001)	0	0.288 (0.002)	0
Studied (all sources)					0.609 (0.002)	0.490 (0.002)
Unemployed	0.095 (0.001)	0	0.088 (0.001)	0	0.085 (0.001)	0
Inactive (standard Qs)	0.190 (0.001)	0	0.180 (0.001)	0	0.173 (0.001)	0
Inactive (all sources)					0.116 (0.001)	0
No. Observations	328,110	173,563	161,719	83,469	77,198	40,032

Notes: Samples are restricted to individuals aged 16-21 years. Estimated standard errors are in parentheses.

All summary statistics are weighted by the HLFS sampling weights. Hours worked are conditional on wage and salary employment.

Table 2B: Sample characteristics – HLFS-IS annual samples

	1997-2010		2004-2010	
	Full sample	Workers	Full sample	Workers
Age	18.4 (0.009)	18.7 (0.012)	18.4 (0.012)	18.7 (0.017)
Female	0.490 (0.003)	0.478 (0.004)	0.491 (0.004)	0.474 (0.005)
Married	0.082 (0.001)	0.093 (0.002)	0.086 (0.002)	0.099 (0.003)
NZ born	0.811 (0.002)	0.865 (0.002)	0.792 (0.003)	0.845 (0.004)
Pakeha	0.611 (0.002)	0.711 (0.003)	0.586 (0.004)	0.691 (0.005)
Maori	0.189 (0.002)	0.157 (0.003)	0.193 (0.003)	0.158 (0.004)
Pacific Islander	0.072 (0.001)	0.051 (0.002)	0.074 (0.002)	0.051 (0.002)
Asian	0.083 (0.001)	0.052 (0.002)	0.098 (0.002)	0.068 (0.003)
Wage & salary worker	0.514 (0.003)	1	0.516 (0.004)	1
Weekly hours	25.7 (0.119)	25.7 (0.119)	25.5 (0.168)	25.5 (0.168)
Self employed	0.007 (0.000)	0.000 (0.000)	0.006 (0.001)	0.000 (0.000)
Studying (incl student bens)	0.473 (0.003)	0.250 (0.003)	0.476 (0.004)	0.251 (0.004)
Unemployed	0.086 (0.001)	0	0.084 (0.002)	0
Inactive (incl student bens)	0.133 (0.002)	0	0.130 (0.002)	0
Received benefits	0.110 (0.002)	0.040 (0.001)	0.095 (0.002)	0.033 (0.002)
Real hourly wage		11.89 (0.048)		12.42 (0.052)
Real weekly earnings		334.6 (1.8)		349.6 (2.6)
Real total weekly income	213.0 (1.2)	352.1 (1.7)	218.3 (1.8)	366.2 (2.5)
No. Observations	38,885	19,577	19,173	9,719

Notes: Samples are restricted to individuals aged 16-21 years. Estimated standard errors are in parentheses. All summary statistics are weighted by the HLFS sampling weights. Hours worked and earnings are conditional on wage and salary employment. Earnings and incomes are in constant (2006) \$-values.

Table 3: Difference-in-differences' estimates of Employment and Hours worked impacts

	Age group			Difference (16-17 from)	
	16-17 (1)	18-19 (2)	20-21 (3)	18-19 (4)	20-21 (5)
(A) Wage and salary employment					
1. Before (2006Q1 - 2007Q4)	0.449 (0.007) [8,725]	0.604 (0.008) [6,853]	0.644 (0.010) [6,398]	-0.154 (0.010)	-0.195 (0.012)
2. After (2008Q2 - 2010Q1)	0.376 (0.006) [9,419]	0.557 (0.008) [7,805]	0.599 (0.008) [7,149]	-0.181 (0.010)	-0.223 (0.010)
3. Difference (After-Before)	-0.074 (0.009)	-0.047 (0.011)	-0.045 (0.013)	-0.027 (0.014)	-0.028 (0.016)
(B) Main-job Actual Hours worked					
1. Before (2006Q1 - 2007Q4)	18.77 (0.31) [3,910]	29.32 (0.28) [4,069]	31.31 (0.31) [4,126]	-10.55 (0.41)	-12.55 (0.44)
2. After (2008Q2 - 2010Q1)	15.79 (0.29) [3,534]	26.23 (0.37) [4,160]	29.36 (0.37) [4,208]	-10.44 (0.47)	-13.57 (0.47)
3. Difference (After-Before)	-2.98 (0.42)	-3.09 (0.46)	-1.96 (0.49)	0.11 (0.63)	-1.03 (0.65)

Notes: Estimated standard errors are in parentheses, and number of observations are in square brackets. The numbers in bold are the difference-in-differences estimates of the impact of the abolition of the youth minimum wage on 16-17 year-olds employment and hours worked.

Table 4: Estimated impacts of changes in youth minimum wages on wage and salary employment

	No Covariates	Covariates	18-19 spillover	Proxy controls	Separate Year effects	Announce effects	Age- Seasonals	Age U-rate	Age trends
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
age16_17 Post-2008	-0.0510** (0.010)	-0.0463** (0.010)	-0.0456** (0.012)	-0.0388** (0.012)					
2008					0.0054 (0.017)	0.0115 (0.020)	0.0094 (0.019)	0.0091 (0.018)	0.0228 (0.019)
2009					-0.0384* (0.016)	-0.0369* (0.016)	-0.0383* (0.017)	-0.0332+ (0.020)	-0.0209 (0.019)
2010					-0.0524** (0.019)	-0.0578** (0.017)	-0.0641** (0.017)	-0.0587** (0.019)	-0.0419+ (0.024)
age18_19 Post-2008			0.0003 (0.011)	0.0020 (0.011)					
2008					0.0330* (0.016)	0.0385* (0.018)	0.0371* (0.018)	0.0365* (0.016)	0.0497** (0.018)
2009					-0.0114 (0.016)	-0.01 (0.016)	-0.0127 (0.015)	-0.0171 (0.017)	0.0032 (0.016)
2010					-0.0080 (0.019)	0.0070 (0.018)	0.0039 (0.018)	-0.0008 (0.019)	0.0237 (0.021)
R-squared	0.04	0.11	0.11	0.11	0.11	0.11	0.11	0.11	0.11
Observations	161,719	161,574	161,574	161,574	161,574	161,574	161,574	161,574	161,574

Notes: Huber-White standard errors, that allow for arbitrary correlation in individual errors within age-quarter cells, are in parentheses; coefficients followed by +, *, and ** are significantly different from zero at the 10%, 5% and 1% level respectively. All specifications are estimated by OLS. The covariates include dummy variables for individual-age and quarter, gender, marital status, ethnicity, New Zealand born, rural/urban, region of residence, and the relative population size in each age group in each year.

Table 5A: Estimated impacts of changes in youth minimum wages on other HLFS quarterly outcomes

	Wage & Salary Employed (1)	Weekly Hours Worked (2)	Self- Employed (3)	Studied			Inactive	
				All Sources (4)	Standard Questions (5)	Unemployed (6)	All Sources (7)	Standard Questions (8)
age16_17								
2008	0.0094 (0.019)	-0.876 (0.622)	-0.0031 (0.002)	-0.0163 (0.016)	-0.0066 (0.017)	-0.0002 (0.008)	-0.0202** (0.006)	0.0015 (0.010)
2009	-0.0383* (0.017)	-2.434** (0.404)	0.0021 (0.002)	0.0013 (0.011)	0.0193 (0.012)	0.0138+ (0.008)	-0.0321** (0.008)	0.0157 (0.011)
2010	-0.0641** (0.017)	-2.579** (0.617)	0.0002 (0.003)	0.0313** (0.012)	0.0631** (0.013)	0.0066 (0.013)	-0.0430** (0.008)	0.0023 (0.014)
age18_19								
2008	0.0371* (0.018)	-0.119 (0.472)	-0.0071** (0.002)	-0.0045 (0.019)	-0.0261* (0.013)	-0.0002 (0.010)	-0.0011 (0.008)	-0.0016 (0.013)
2009	-0.0127 (0.015)	-1.425** (0.422)	0.0009 (0.003)	0.0069 (0.011)	0.0036 (0.013)	0.0034 (0.009)	-0.0091 (0.008)	0.0077 (0.012)
2010	0.0039 (0.018)	-2.831** (0.679)	-0.0005 (0.003)	0.0295* (0.014)	-0.0135 (0.015)	0.0093 (0.014)	-0.0009 (0.007)	0.0116 (0.010)
R-squared	0.11	0.20	0.01	0.21	0.15	0.02	0.08	0.06
Observations	161,574	82,961	161,574	77,101	161,574	161,574	77,101	161,574

Notes: Huber-White standard errors, that allow for arbitrary correlation in individual errors within age-quarter cells, are in parentheses; coefficients followed by +, *, and ** are significantly different from zero at the 10%, 5% and 1% level respectively. All specifications are estimated by OLS and include the same set of control variables, including age-specific quarterly seasonal effects, as in the specification in Table 4, column (7).

Table 5B: Estimated impacts of changes in youth minimum wages on other HLFS quarterly outcomes

	Wage & Salary Employed (1)	Weekly Hours Worked (2)	Self- Employed (3)	Studied			Inactive	
				All Sources (4)	Standard Questions (5)	Unemployed (6)	All Sources (7)	Standard Questions (8)
age16_17								
2008	0.0091 (0.018)	-0.818 (0.625)	-0.0033 (0.002)	-0.0196 (0.016)	-0.0059 (0.017)	-0.0005 (0.007)	-0.0199** (0.005)	0.0013 (0.010)
2009	-0.0332+ (0.020)	-1.192* (0.509)	0.0032 (0.003)	-0.019 (0.018)	0.0027 (0.014)	0.0255** (0.010)	-0.0149 (0.010)	0.0246+ (0.013)
2010	-0.0587** (0.019)	-1.201+ (0.726)	0.0014 (0.003)	0.0086 (0.021)	0.0445** (0.014)	0.0199 (0.014)	-0.0248* (0.010)	0.0127 (0.015)
age18_19								
2008	0.0365* (0.016)	-0.0915 (0.465)	-0.0071** (0.002)	-0.0053 (0.019)	-0.0254* (0.012)	-0.0005 (0.009)	-0.0041 (0.007)	-0.0017 (0.012)
2009	-0.0171 (0.017)	-0.202 (0.515)	0.0015 (0.003)	-0.0054 (0.016)	-0.0026 (0.014)	0.0128 (0.010)	-0.0182+ (0.009)	0.0171 (0.014)
2010	-0.0008 (0.019)	-1.382+ (0.757)	0.0003 (0.003)	0.0138 (0.021)	-0.0217 (0.016)	0.0211 (0.014)	-0.0107 (0.010)	0.0232* (0.012)
R-squared	0.11	0.20	0.01	0.21	0.15	0.02	0.08	0.06
Observations	161,574	82,961	161,574	77,101	161,574	161,574	77,101	161,574

Notes: Huber-White standard errors, that allow for arbitrary correlation in individual errors within age-quarter cells, are in parentheses; coefficients followed by +, *, and ** are significantly different from zero at the 10%, 5% and 1% level respectively. All specifications are estimated by OLS and include the same set of control variables, including age-specific business cycle effects captured by age-specific interactions with the adult unemployment rate, as in the specification in Table 4, column (8).

Table 6: Effects on mutually exclusive employment, study & inactivity

	Wage & Salary Employed (1)	Study (All Sources) (2)	Mutually exclusive & exhaustive outcomes			
			Work Only (3)	Work & Study (4)	Study Only (5)	Inactive (6)
A: Controlling for Age-specific seasonal factors						
age16_17						
2008	0.0206 (0.017)	-0.0163 (0.016)	0.0365* (0.014)	-0.0191 (0.014)	0.0026 (0.019)	-0.0200** (0.006)
2009	-0.0264 (0.018)	0.0013 (0.011)	0.0309* (0.012)	-0.0524** (0.015)	0.0534** (0.020)	-0.0319** (0.008)
2010	-0.0483* (0.020)	0.0313** (0.012)	0.0116 (0.013)	-0.0581** (0.016)	0.0891** (0.019)	-0.0426** (0.008)
age18_19						
2008	0.0401* (0.018)	-0.0045 (0.019)	0.0056 (0.018)	0.0243+ (0.012)	-0.0290+ (0.017)	-0.0009 (0.007)
2009	-0.0130 (0.014)	0.0069 (0.011)	0.0022 (0.015)	-0.0145 (0.012)	0.0210 (0.014)	-0.0086 (0.008)
2010	0.0062 (0.019)	0.0295* (0.014)	-0.0285* (0.014)	0.0318+ (0.018)	-0.0027 (0.014)	-0.0006 (0.007)
R-squared	0.12	0.21	0.14	0.06	0.18	0.08
B: Controlling for Age-specific business cycle factors						
age16_17						
2008	0.0262 (0.017)	-0.0196 (0.016)	0.0395** (0.014)	-0.0159 (0.014)	-0.0040 (0.018)	-0.0196** (0.005)
2009	0.0279 (0.026)	-0.0190 (0.018)	0.0339+ (0.018)	0.0040 (0.023)	-0.0234 (0.026)	-0.0145 (0.010)
2010	0.0127 (0.030)	0.0086 (0.021)	0.0162 (0.021)	0.0042 (0.025)	0.0039 (0.028)	-0.0243* (0.010)
age18_19						
2008	0.0406* (0.017)	-0.0053 (0.019)	0.0094 (0.018)	0.0209+ (0.012)	-0.0265+ (0.016)	-0.0038 (0.007)
2009	0.0164 (0.013)	-0.0054 (0.016)	0.0236 (0.017)	-0.0052 (0.018)	-0.0008 (0.014)	-0.0177+ (0.009)
2010	0.0424* (0.019)	0.0138 (0.021)	-0.0032 (0.021)	0.0447* (0.022)	-0.0312+ (0.017)	-0.0103 (0.010)
R-squared	0.12	0.21	0.14	0.06	0.18	0.08
Observations	77101	77101	77101	77101	77101	77101

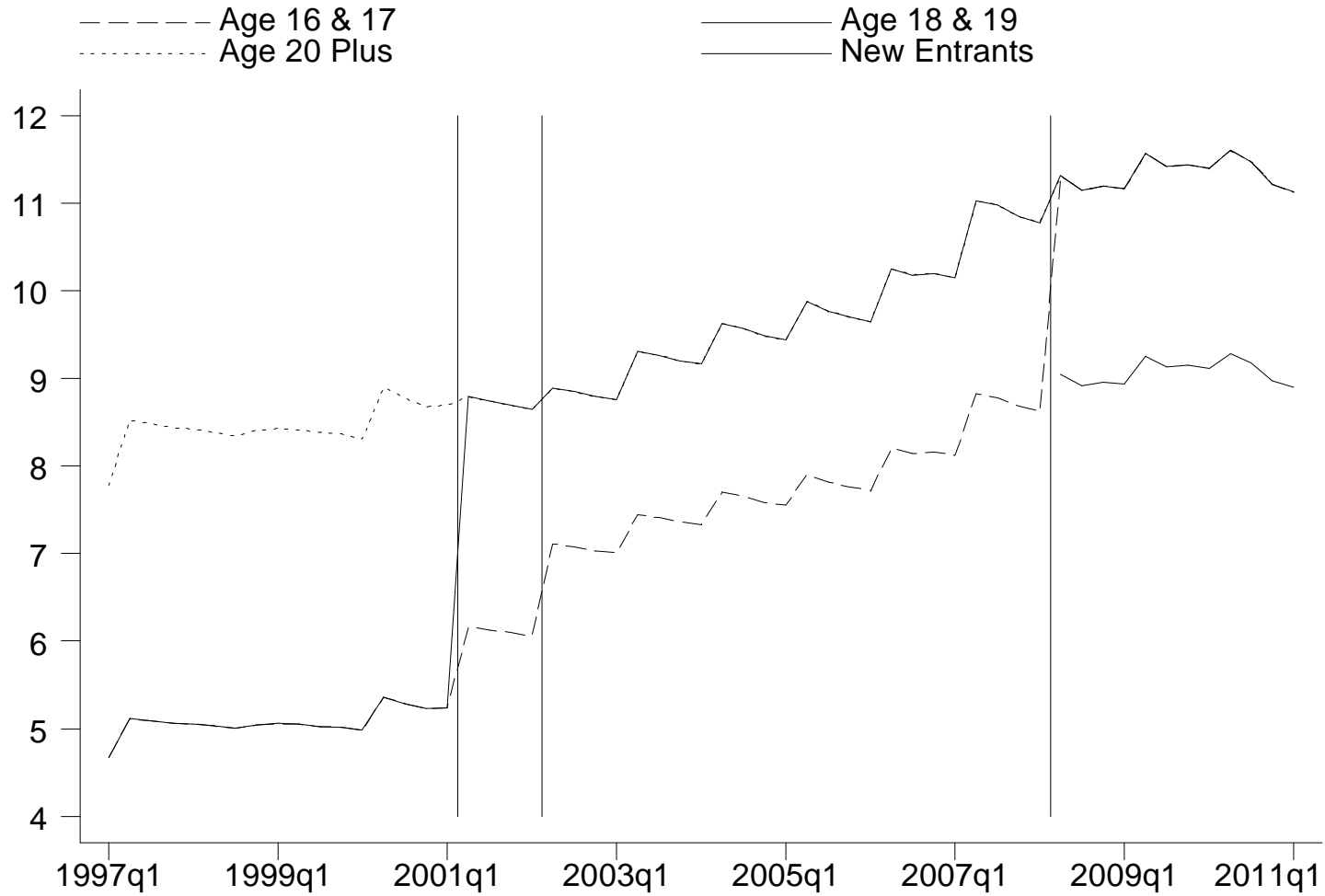
Notes: Huber-White standard errors, that allow for arbitrary correlation in individual errors within age-quarter cells, are in parentheses; coefficients followed by +, *, and ** are significantly different from zero at the 10%, 5% and 1% level respectively. All specifications are estimated by OLS over the sample period 2004–2010, and include the same set of control variables, including age-specific quarterly seasonal effects (panel A), and age-specific business cycle effects (panel B), as in the specifications in Table 4, columns (7) and (8).

Table 7: Estimated impacts of changes on HLFS-IS annual outcomes

	Received Benefits	Log(weekly earnings)	Log(weekly income)
A: Controlling for age-specific and year-specific factors			
age16_17 2008	-0.022 (0.015)	0.0073 (0.052)	0.0441 (0.077)
2009	-0.0172+ (0.009)	-0.164** (0.040)	-0.0445 (0.047)
2010	-0.0364* (0.014)	0.0934+ (0.051)	-0.0662+ (0.035)
age18_19 2008	-0.0261 (0.018)	-0.0265 (0.035)	0.0768 (0.073)
2009	-0.0177+ (0.010)	-0.117** (0.042)	-0.0087 (0.046)
2010	-0.0144 (0.009)	-0.144* (0.059)	0.0164 (0.034)
R-squared	0.11	0.32	0.29
B: Controlling for Age-specific business cycle factors			
age16_17 2008	-0.0221+ (0.013)	0.0054 (0.051)	0.045 (0.065)
2009	-0.0098 (0.012)	-0.084 (0.054)	0.0096 (0.048)
2010	-0.0232 (0.021)	0.230** (0.070)	0.0177 (0.053)
age18_19 2008	-0.0243 (0.015)	-0.0287 (0.039)	0.0765 (0.066)
2009	-0.0087 (0.013)	-0.0661 (0.052)	0.0201 (0.047)
2010	-0.0033 (0.020)	-0.0581 (0.072)	0.0617 (0.053)
R-squared	0.11	0.33	0.29
Observations	36,764	18,169	36,764

Notes: Huber-White standard errors, that allow for arbitrary correlation in individual errors within age-year cells, are in parentheses; coefficients followed by +, *, and ** are significantly different from zero at the 10%, 5% and 1% level respectively. All specifications are estimated by OLS. The specifications in panel (A) include the same set of control variables as in the specification in Table 4, column (7), including age-specific and year-specific effects; while the specifications in panel (B), age-specific business cycle effects captured by age-specific interactions with the adult unemployment rate.

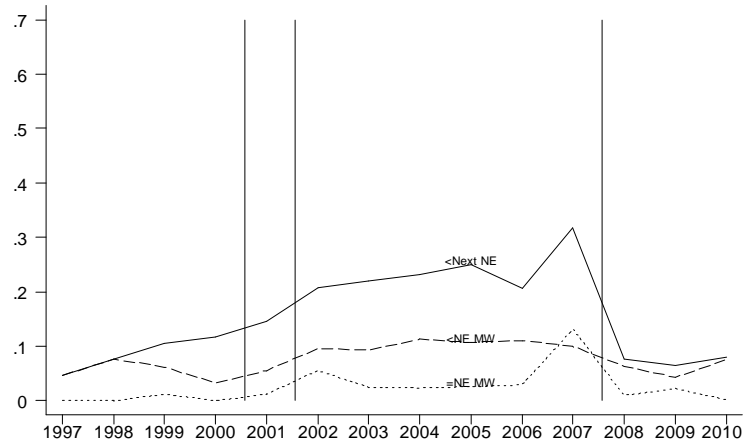
Figure 1: Real minimum wage (2006 \$s), by Age group



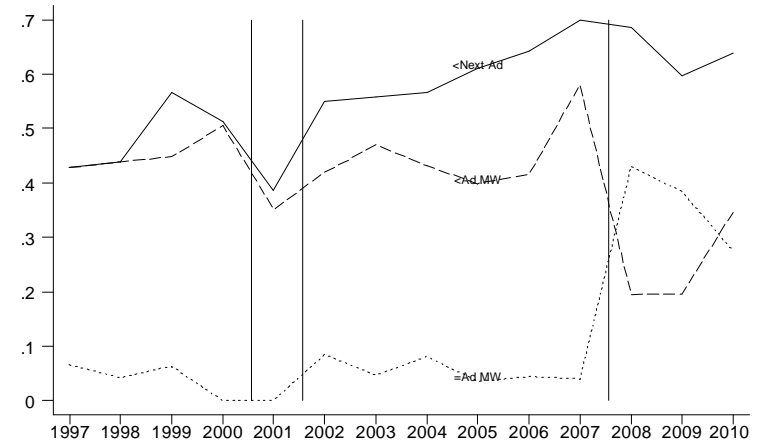
Notes: Vertical lines correspond to dates of the 2001, 2002, and 2008 youth minimum wage reforms.

Figure 2: 16-17 year-old wage trends

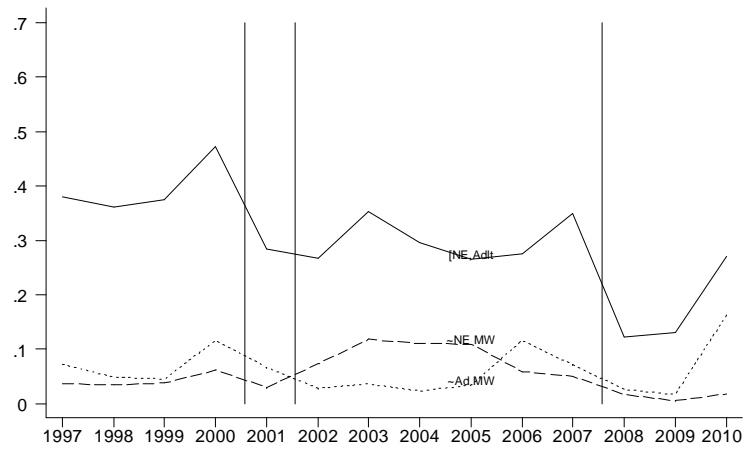
(a) FRACTION $< & =$ CURRENT, AND $<$ NEXT NEW ENTRANT MINIMUM WAGE



(b) FRACTION $< & =$ CURRENT, AND $<$ NEXT ADULT MINIMUM WAGE



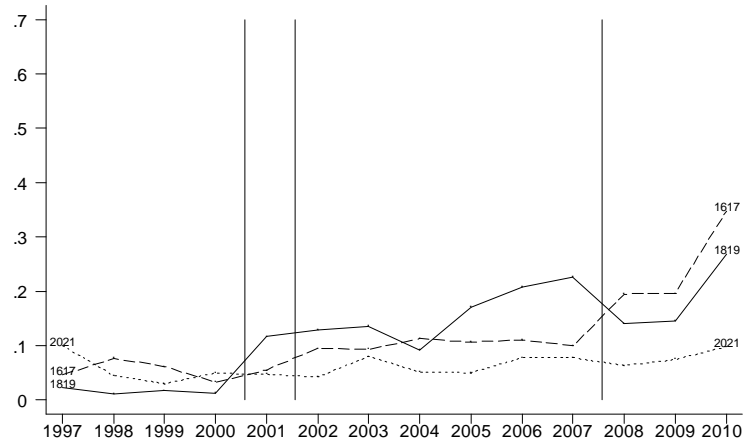
(c) FRACTIONS BETWEEN CURRENT NEW ENTRANT & ADULT MINIMUM WAGES



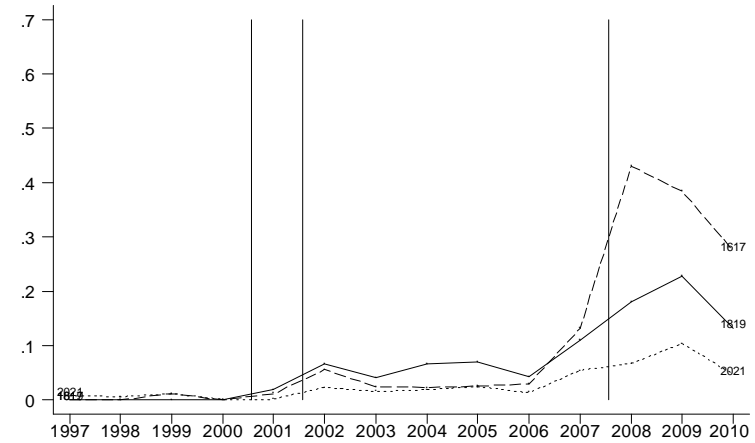
Notes: Vertical lines correspond to dates of the 2001, 2002, and 2008 youth minimum wage reforms.

Figure 3: Real wages (2006\$\$s) and the minimum wage, by Age group

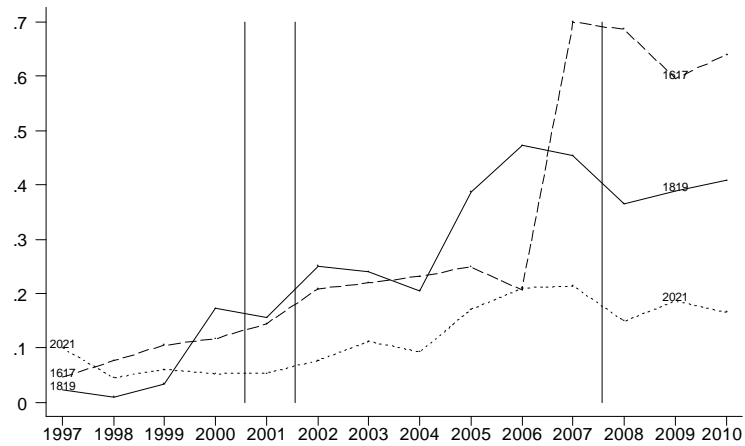
(a) FRACTION BELOW CURRENT MINIMUM WAGE



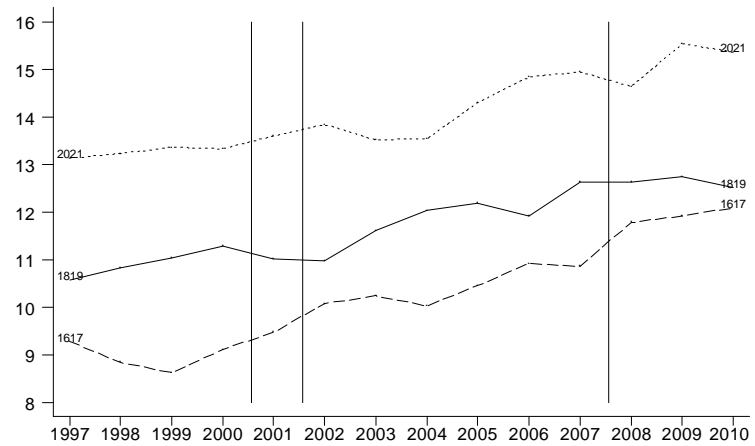
(b) FRACTION EXACTLY AT CURRENT MINIMUM WAGE



(c) FRACTION BELOW NEXT YEAR'S MINIMUM WAGE

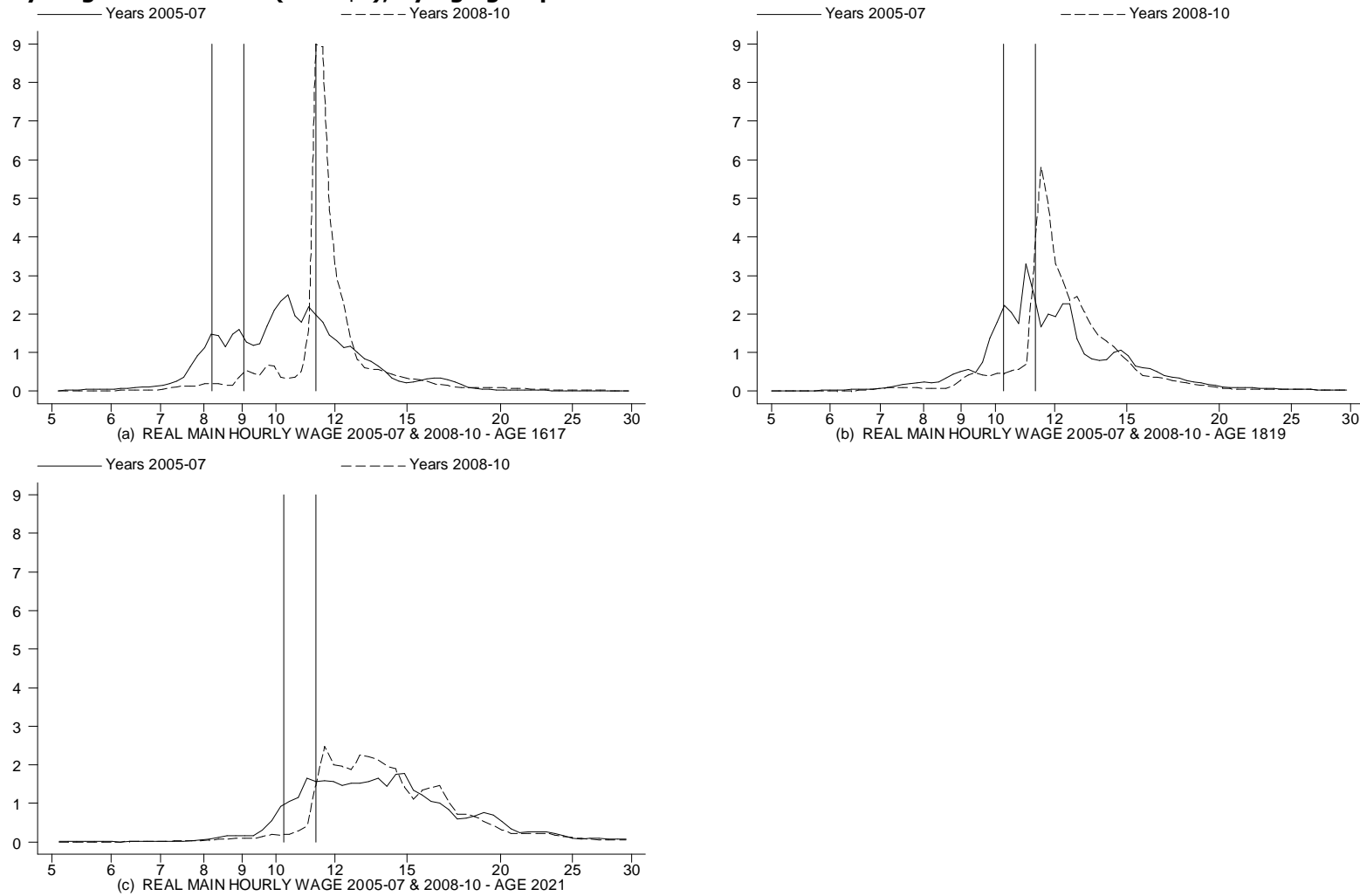


(d) AVERAGE REAL HOURLY WAGE AT MAIN JOB



Notes: Vertical lines correspond to dates of the 2001, 2002, and 2008 youth minimum wage reforms.

Figure 4: Hourly wage distributions (2006\$\$s), by Age group



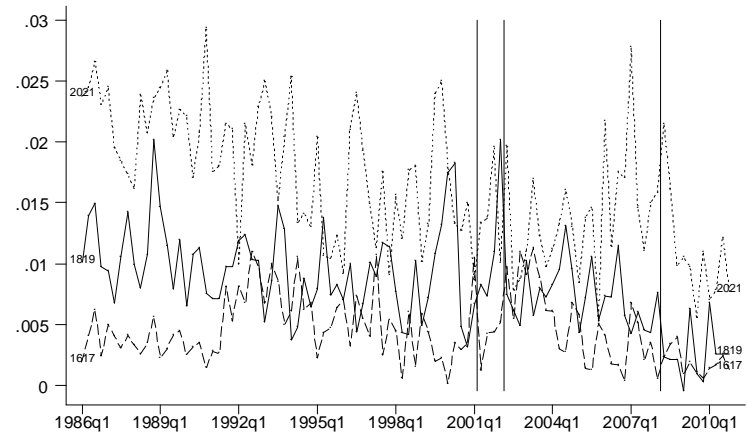
Notes: Vertical lines in (a) at 2006 youth minimum, and 2008 new entrants and adult minimum wages; in (b) and (c) at 2006 and 2008 adult minimum wages.

Figure 5: Employment and hours worked, by Age group

(a) WAGE AND SALARY EMPLOYMENT



(b) SELF EMPLOYMENT

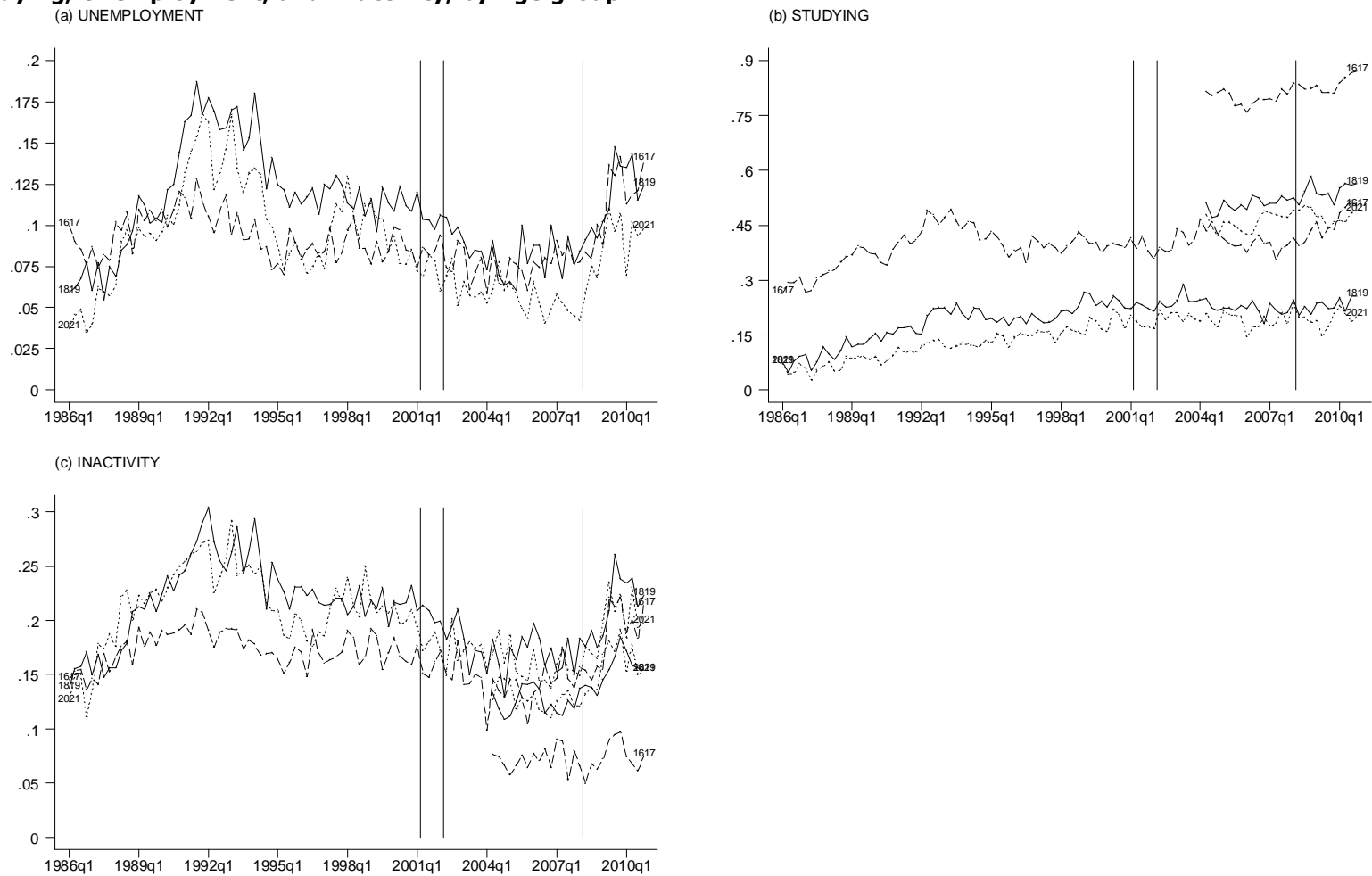


(c) ACTUAL MAIN HOURS | W&S EMPLOYMENT



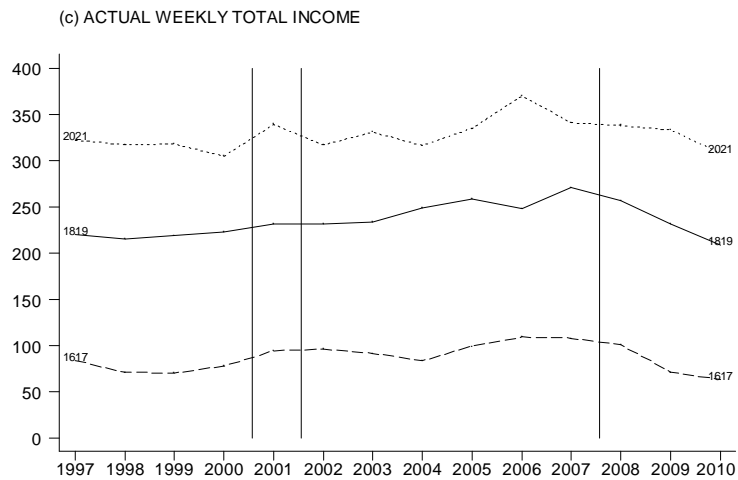
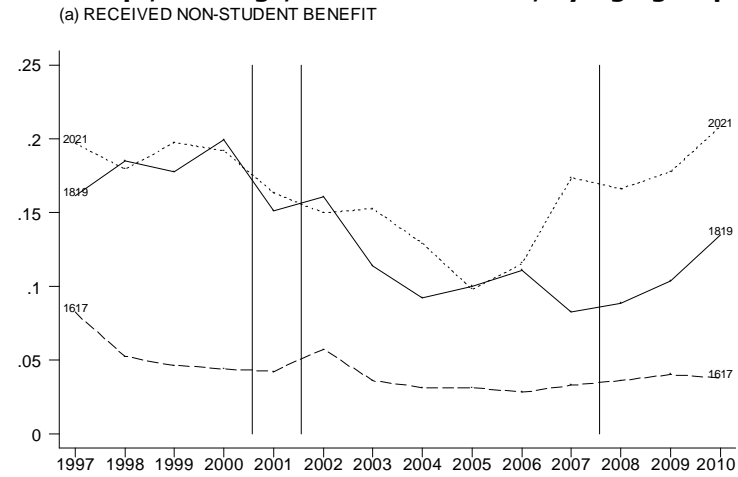
Notes: Vertical lines correspond to dates of the 2001, 2002, and 2008 youth minimum wage reforms.

Figure 6: Studying, Unemployment, and Inactivity, by Age group



Notes: Vertical lines correspond to dates of the 2001, 2002, and 2008 youth minimum wage reforms.

Figure 7: Benefit receipt, Earnings, and Total income, by Age group



Notes: Vertical lines correspond to dates of the 2001, 2002, and 2008 youth minimum wage reforms.

APPENDIX 1

Table 8: Estimated impacts on Quarterly outcomes, 1986–2010 samples

	Wage & Salary Employed	Weekly Hours Worked	Self- Employed	Study	Unem- ployed	Inactive
	(1)	(2)	(3)	(4)	(5)	(6)
A: Controlling for Age-specific seasonal factors						
age16_17						
2008	0.0119 (0.019)	-0.772 (0.601)	-0.0032 (0.003)	-0.0111 (0.017)	0.0013 (0.008)	0.0033 (0.010)
2009	-0.0337* (0.016)	-2.293** (0.421)	0.0023 (0.002)	0.0113 (0.011)	0.0168* (0.008)	0.0189 (0.012)
2010	-0.0552** (0.017)	-2.146** (0.631)	0.0002 (0.003)	0.0461** (0.012)	0.0129 (0.012)	0.0102 (0.012)
age18_19						
2008	0.0400* (0.018)	-0.0137 (0.440)	-0.0070** (0.002)	-0.0313* (0.012)	0.0021 (0.010)	0.0006 (0.012)
2009	-0.011 (0.015)	-1.342** (0.444)	0.00076 (0.003)	0.0008 (0.013)	0.0046 (0.009)	0.0089 (0.012)
2010	0.0057 (0.019)	-2.807** (0.699)	-0.00095 (0.003)	-0.013 (0.015)	0.0075 (0.014)	0.0099 (0.009)
R-squared	0.11	0.19	0.01	0.15	0.03	0.07
B: Controlling for Age-specific business cycle factors						
age16_17						
2008	0.0108 (0.018)	-0.762 (0.564)	-0.0034 (0.003)	-0.0077 (0.017)	-0.0006 (0.008)	0.0012 (0.010)
2009	-0.0279+ (0.016)	-1.672** (0.453)	0.0037 (0.002)	-0.0053 (0.012)	0.0261** (0.008)	0.0285* (0.012)
2010	-0.0503** (0.017)	-1.554* (0.653)	0.0016 (0.003)	0.0327** (0.013)	0.0201 (0.012)	0.0175 (0.012)
age18_19						
2008	0.0390* (0.016)	-0.0696 (0.442)	-0.0072** (0.002)	-0.0277* (0.012)	-0.0002 (0.010)	-0.0020 (0.012)
2009	-0.0074 (0.015)	-0.964* (0.479)	0.0024 (0.003)	-0.0026 (0.013)	0.0035 (0.009)	0.0068 (0.013)
2010	0.0109 (0.019)	-2.337** (0.739)	0.0011 (0.003)	-0.020 (0.015)	0.0081 (0.014)	0.0095 (0.010)
R-squared	0.11	0.19	0.01	0.15	0.03	0.07
Observations	249,304	125,560	249,304	249,304	249,304	249,304

Notes: Huber-White standard errors, that allow for arbitrary correlation in individual errors within age-quarter cells, are in parentheses; coefficients followed by +, *, and ** are significantly different from zero at the 10%, 5% and 1% level respectively. All specifications are estimated by OLS and include the same set of control variables, including age-specific quarterly seasonal effects (panel A), and age-specific business cycle effects (panel B), as in the specifications in Table 4, columns (7) and (8).

Table 9A: Estimated impacts on Quarterly outcomes, 2004–2010 samples

	Wage & Salary Employed (1)	Weekly Hours Worked (2)	Self-Employed (3)	Studied		Unemployed (6)	Inactive	
				All Sources (4)	Standard Questions (5)		All Sources (7)	Standard Questions (8)
age16_17								
2008	0.0206 (0.017)	-0.608 (0.644)	-0.0025 (0.002)	-0.0163 (0.016)	-0.0102 (0.016)	-0.0036 (0.008)	-0.0202** (0.006)	-0.0072 (0.009)
2009	-0.0264 (0.018)	-2.270** (0.462)	0.0031 (0.003)	0.0013 (0.011)	0.0138 (0.013)	0.0112 (0.007)	-0.0321** (0.008)	0.0077 (0.010)
2010	-0.0483* (0.020)	-2.689** (0.660)	0.0018 (0.003)	0.0313** (0.012)	0.0530** (0.015)	0.0034 (0.014)	-0.0430** (0.008)	-0.0066 (0.014)
age18_19								
2008	0.0401* (0.018)	-0.130 (0.444)	-0.0083** (0.002)	-0.0045 (0.019)	-0.0233+ (0.013)	-0.0023 (0.010)	-0.0011 (0.008)	-0.0066 (0.013)
2009	-0.013 (0.014)	-1.449** (0.409)	-0.0003 (0.003)	0.0069 (0.011)	0.0092 (0.013)	0.0019 (0.008)	-0.0091 (0.008)	0.0032 (0.011)
2010	0.0062 (0.019)	-3.203** (0.690)	-0.0020 (0.003)	0.0295* (0.014)	-0.0114 (0.016)	0.0083 (0.015)	-0.0009 (0.007)	0.0082 (0.011)
R-squared	0.12	0.21	0.01	0.21	0.15	0.02	0.08	0.06
Observations	77,101	39,663	77,101	77,101	77,101	77,101	77,101	77,101

Notes: Huber-White standard errors, that allow for arbitrary correlation in individual errors within age-quarter cells, are in parentheses; coefficients followed by +, *, and ** are significantly different from zero at the 10%, 5% and 1% level respectively. All specifications are estimated by OLS and include the same set of control variables, including age-specific quarterly seasonal effects, as in the specification in Table 4, column (7).

Table 9B: Estimated impacts on Quarterly outcomes, 2004–2010 samples

	Wage & Salary Employed (1)	Weekly Hours Worked (2)	Self-Employed (3)	Studied		Unemployed (6)	Inactive	
				All Sources (4)	Standard Questions (5)		All Sources (7)	Standard Questions (8)
age16_17								
2008	0.0262 (0.017)	-0.429 (0.664)	-0.0022 (0.002)	-0.0196 (0.016)	-0.0123 (0.016)	-0.0059 (0.008)	-0.0199** (0.005)	-0.0113 (0.009)
2009	0.0279 (0.026)	-1.756+ (0.945)	0.0066* (0.003)	-0.0190 (0.018)	-0.0231 (0.020)	-0.0061 (0.011)	-0.0149 (0.010)	-0.0149 (0.013)
2010	0.0127 (0.030)	-1.970 (1.206)	0.0056 (0.004)	0.0086 (0.021)	0.0122 (0.022)	-0.0154 (0.016)	-0.0248* (0.010)	-0.0325+ (0.017)
age18_19								
2008	0.0406* (0.017)	0.278 (0.459)	-0.0086** (0.002)	-0.0053 (0.019)	-0.0209+ (0.013)	-0.0025 (0.010)	-0.0041 (0.007)	-0.0094 (0.012)
2009	0.0164 (0.013)	0.989 (0.662)	-0.0004 (0.003)	-0.0054 (0.016)	0.0043 (0.014)	-0.0065 (0.012)	-0.0182+ (0.009)	-0.0228+ (0.012)
2010	0.0424* (0.019)	-0.240 (0.923)	-0.0017 (0.004)	0.0138 (0.021)	-0.0187 (0.018)	-0.0012 (0.016)	-0.0107 (0.010)	-0.0228+ (0.013)
R-squared	0.12	0.21	0.01	0.21	0.15	0.02	0.08	0.06
Observations	77,101	39,663	77,101	77,101	77,101	77,101	77,101	77,101

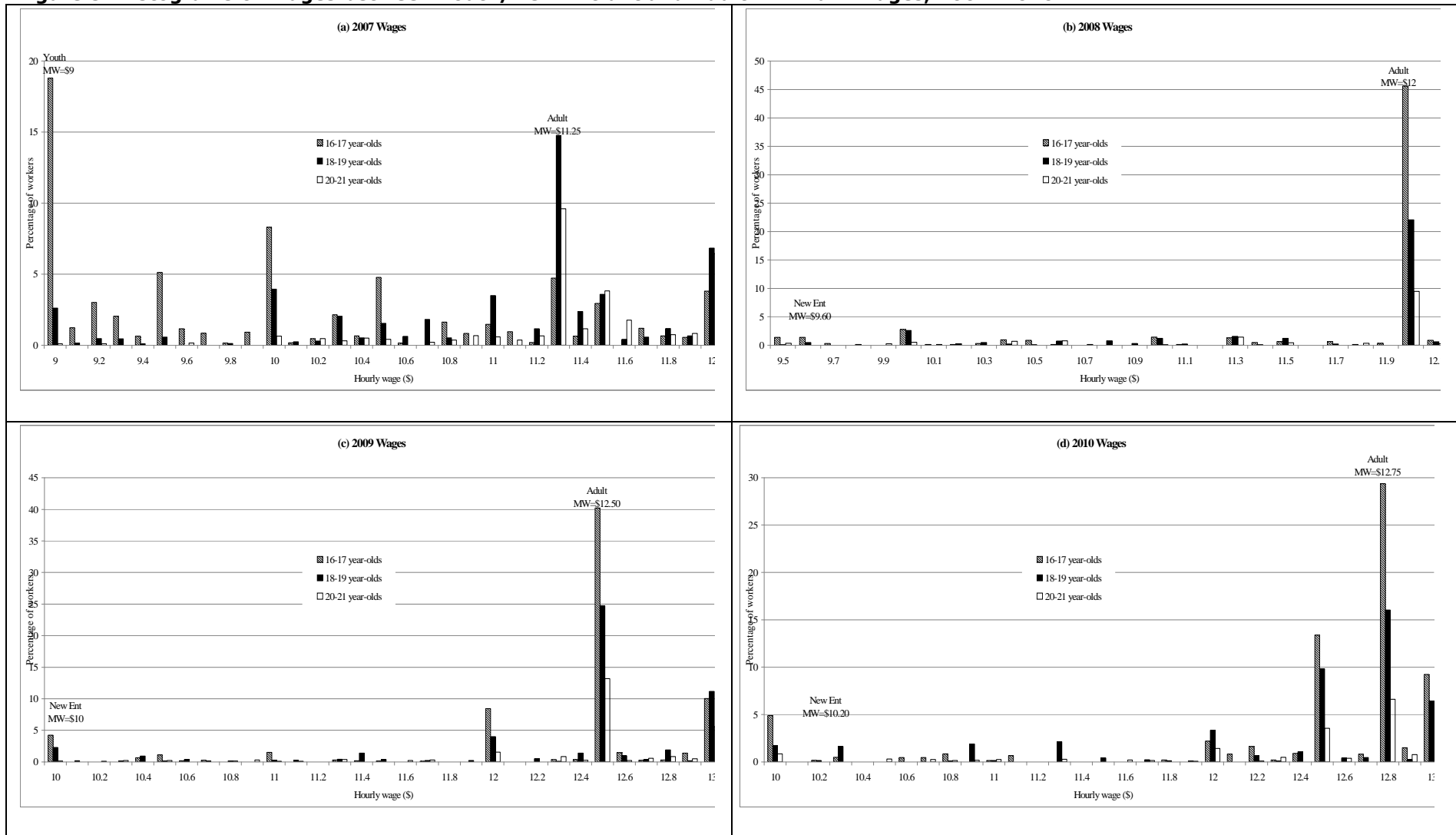
Notes: Huber-White standard errors, that allow for arbitrary correlation in individual errors within age-quarter cells, are in parentheses; coefficients followed by +, *, and ** are significantly different from zero at the 10%, 5% and 1% level respectively. All specifications are estimated by OLS and include the same set of control variables, including age-specific business cycle effects captured by age-specific interactions with the adult unemployment rate, as in the specification in Table 4, column (8).

Table 10: Estimated impacts on Annual outcomes, 2004–2010 samples

	Received Benefits	Log (weekly earnings)	Log (weekly income)
A: Controlling for age-specific and year-specific factors			
age16_17			
2008	-0.0273+ (0.015)	0.0264 (0.044)	0.0391 (0.065)
2009	-0.0302** (0.009)	-0.142** (0.040)	-0.0694 (0.047)
2010	-0.0586** (0.015)	0.132* (0.056)	-0.0947+ (0.056)
age18_19			
2008	-0.0345+ (0.018)	-0.0033 (0.039)	0.0556 (0.065)
2009	-0.0262* (0.010)	-0.105** (0.037)	-0.040 (0.041)
2010	-0.0206* (0.009)	-0.132** (0.049)	-0.0103 (0.041)
R-squared	0.09	0.32	0.29
B: Controlling for age-specific business cycle factors			
age16_17			
2008	-0.0174 (0.016)	0.0664 (0.058)	0.102+ (0.057)
2009	0.0483 (0.059)	0.134 (0.250)	0.386* (0.169)
2010	0.0643 (0.091)	0.550 (0.384)	0.591* (0.263)
age18_19			
2008	-0.023 (0.021)	-0.0639 (0.040)	0.0292 (0.064)
2009	0.0767 (0.087)	-0.497** (0.153)	-0.118 (0.234)
2010	0.139 (0.134)	-0.732** (0.238)	-0.117 (0.367)
R-squared	0.10	0.32	0.29
Observations	17,065	8,413	17,065

Notes: Huber-White standard errors, that allow for arbitrary correlation in individual errors within age-year cells, are in parentheses; coefficients followed by +, *, and ** are significantly different from zero at the 10%, 5% and 1% level respectively. All specifications are estimated by OLS. The specifications in panel (A) include the same set of control variables as in the specification in Table 4, column (7), including age-specific and year-specific effects; while the specifications in panel (B), age-specific business cycle effects captured by age-specific interactions with the adult unemployment rate.

Figure 8: Histograms of Wages between Youth/New Entrant and Adult Minimum Wages, 2007–2010



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