A lost generation? The wage, employment and demographic effects of graduating during a recession

Working paper

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Abstract

We estimate the labour market and demographic effects of graduating in a recession for highly educated graduates in the Netherlands between 1995 and 2012. We find that graduates on average suffer a 9.3% lower wage in a typical recession in their first year, but that the wage loss fades out four years after graduation. Effects on employment are very small. We find stronger effects for women than for men. Poor entry conditions are associated with lower quality jobs and a higher probability of mismatch. External mobility is the primary mechanism through which graduates catch up to their luckier counterparts. Increased insecurity on the labour market also affects important personal decisions. We show that a higher unemployment rate at graduation is associated with lower fertility and partnership rates up to four years after graduation that persist even if we take into account lower wages and employment rates.

Keywords: Entry conditions, Unemployment, Mismatch, Fertility
JEL codes: J22 J23 J31 I26

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1 Introduction

Youth unemployment is a cause for concern in many countries. Especially in the Great Recession, with youth unemployment rates rising quickly in many OECD countries, there have been widespread worries about unemployment disrupting young people's lives and giving them a false start on the labour market. While short-term negative effects of entering the labour market in a recession are to be expected, some worry that young people will suffer long-lasting negative effects. If true, this type of hysteresis could lead to a lost generation of young workers who will be stuck in mismatches and low-paying jobs.

In this paper we estimate the effect of labour market conditions at the moment of graduation on future labour market and demographic outcomes for high educated graduates in the Netherlands. We use administrative matched employer-employee data on graduates from 1995 to 2012. Our data allow us to follow graduates on the labour market for up to eight years. We include both graduates from universities and higher professional education, who take a more vocationally oriented track. The advantage of using only higher educated graduates is that most of them enter the labour market after graduation, so there is relatively little selection bias. This contrasts with lower educated graduates, who frequently pursue a degree at a higher level and this decision could be correlated with the labour market conditions at graduation. Moreover, sufficient data on lower educated graduates are lacking for the Netherlands.

We have to take into account that the timing of labour market entry could be endogenous. Students could for example take up an internship, travel abroad or do an additional study instead of entering the labour market. Similarly, students could leave their studies earlier because they already received a job offer in a tight labour market. We deal with this possible source of endogeneity in three ways. First, we estimate a duration model relating the duration of the study to the labour market conditions. We find no evidence that students postpone graduation in a bad labour market. Second, we employ an instrumental variables strategy where we use the labour market conditions at the expected date of graduation as an instrument for the actual labour market conditions. The resulting IV estimates are similar to the OLS estimates, although less strong. Third, we show that students are not more likely to obtain a higher degree if they graduated in a bad labour market.

We find that students who graduate during a recession on average suffer an initial wage penalty of 3.1% per percentage point increase in the unemployment rate at graduation. In a typical recession, the unemployment rate increases by about 3 percentage points compared to the lowest point in a typical boom. This means that graduates entering at the height of a recession suffer a 9.3% lower wage in their first year compared to their luckier counterparts. The penalty quickly declines to around 0.5% in the fourth year after graduation and fades out to zero after that period. Increased economic insecurity due to graduating in a recession also affects important personal decisions. We find that the probability to be in a partnership (cohabitation or marriage) declines in the first few years after graduation, as well as the probability to have a child and the number of children. These effects remain even if we control for wage and employment status, so they are not solely driven by income effects. There don't seem to be any long-term effects on demographic outcomes.

The mechanism behind the initial losses and rather quick catch-up seems to be the low quality of initial employers and external job mobility. We find that students who graduate during a recession

more frequently start working at employers who pay lower wages and in mismatched jobs. External job mobility to higher paying employers and sectors leads to a relatively fast recovery.

This paper is related to a recent and growing literature on cohort differences in labour market outcomes. Several papers find relatively long lasting effects of graduating during a recession. Kahn (2010) finds significant negative effects up to twenty years after graduation for male college graduates during the 1980s recession in the US. Oreopoulos et al. (2012) also find strong results for Canada for male college graduates between 1976 and 1995, with negative effects fading out after ten years. Brunner and Kuhn (2014) show strong negative effects of entering the labour market during a recession for low and middle educated workers in Austria, lasting up to twenty years. However, some of the more recent literature find results that are more in line with our findings of relatively short-lasting negative effects. For example, Altonji et al. (2016), using data for the US from 1974 to 2011, find that college-educated males only suffer negative effects for about three years. Genda et al. (2010) similarly show that low educated workers in Japan face stronger negative effects than high educated workers. Moreover, they find effects that fade after 3 years for both low and high educated workers in the US for the period 1983 - 2003. Two European studies find similar short-lasting effects. Liu et al. (2016), using data from Norway, find that negative effects fade out after about three years on the labour market. Cockx and Ghirelli (2016), find no effects for low educated workers in Belgium, but increasing negative effects for high educated workers at least up to ten years after entering the labour market.

We also contribute to the literature on the relation between unemployment and fertility and other demographic outcomes. While the standard microeconomic model predicts that fertility is counter-cyclical, since the opportunity costs of children are lower in times of high unemployment (Willis, 1973; Butz and Ward, 1979), both aggregate and micro-evidence show that fertility is pro-cyclical. In times of high unemployment, fertility rates are lower than in times of low unemployment. The mechanism behind this regularity seems to be the increased economic insecurity resulting from unemployment, mismatch or the increased probability for one of the partners to become unemployed (Chevalier and Marie, 2014).[1]

The literature on labour market conditions at graduation and family outcomes is sparse however.[2] The paper most related to our study is Maclean et al. (2016), who examine the effects of graduating during a recession in the US on demographic outcomes at the age of 45 and find negative effects for men on the probability to have children and be married. They find positive effects on fertility for high-educated women. Another related study is Hashimoto and Kondo (2012), who find lower fertility rates for low-skilled women who graduate in a recession and higher fertility rates for high-skilled women in Japan. However, while both studies provide valuable insights, they are also limited in several respects. Maclean et al. (2016) only look at one cohort (the NLSY79) in the US and investigates outcomes at age 45. It is unclear whether the results from this cohort translate to other cohorts and countries,

[1] Del Bono et al. (2015) examine the effect of displacement on fertility and show that it is not so much the incidence of unemployment that reduces fertility, but rather the loss of a career-oriented job.

[2] Some studies look at cohort effects from labour market conditions on family outcomes, but they don't consider the moment of school-leaving. Currie and Schwandt (2014) examine the effects of unemployment rates for different cohorts of US women at different age groups on fertility rates. They find that a higher unemployment rate at age 20-24 reduces fertility. Similarly, Kondo (2012) examines the effect of the unemployment rate at the moment women enter the marriage market. She finds only short-term effects on several demographic outcomes.

and it would be interesting to see how family outcomes at earlier ages are affected.[3] Hashimoto and Kondo (2012) only look at Japanese women, and given the differences in labour market institutions, it is unclear how their results translate to the European context.

Our contribution to this literature is threefold. First, we add to the literature on the broader personal impacts of graduating during a recession using data for a European country. We show that the unemployment rate at graduation is associated with lower fertility rates in the first years on the labour market and lower probabilities of cohabitating. This effect is not solely driven by a lower income or higher probability of unemployment at the start of the career. Second, our administrative data allow us to examine in detail the mechanisms that lead to short-term losses and the rather quick catch-up of students graduating in a recession in the Netherlands. One question is whether those who graduated during a recession work in similar jobs as those who graduated in a boom, but at a lower wage or, whether they work more often in low quality jobs. We show that they are more likely to work in sectors that pay lower wages and at employers who pay less. They catch up to their luckier counterparts with higher job mobility to better paying sectors and employers. Third, we provide extensive heterogeneity analyses. While most of the literature focuses on male graduates, we show that women suffer much stronger losses than men, even when controlling for major. Since women are in many countries, including the Netherlands, currently the largest group of graduates from higher education, this is an important finding. Moreover, the peculiarities of the Dutch higher education system allow us to show that graduates from a vocational track suffer more than graduates from an academic track.

The paper proceeds as follows. In section 2 we discuss the Dutch education system, our data, the selections we make on the sample and the variables we use. In section 3 we present our empirical strategy. Results on labour market outcomes are presented in section 4 and results on household outcomes follow in section 5. We present results on possible sources of selection bias in section 6 and section 7 concludes.

2 Data and sample selection

In this section we discuss the Dutch education system, our data sources, the selections we make to create a homogeneous sample and descriptive statistics for our sample.

2.1 The Dutch education system

At the start of high school, Dutch students are tracked in three levels. Only the highest two give direct access to higher education. The second track (HAVO) takes five years and gives direct access to higher vocational education (*hoger beroepsonderwijs*, HBO).[4] The highest high school track (VWO) takes six years and gives direct access to university. HBO studies typically take four years to complete,

[3] The NLSY79 cohort seems to show very strong negative and long-lasting labour market effects of graduating in a recession in comparison to other studies for the US and comparable countries (Kahn, 2010). This could be related to the fact that most of them graduated in the strong recession in the 1980s.

[4] Students in the lowest track in high school have the opportunity to go to HBO if they finish their vocational degree (MBO) first. This takes a total of seven or eight years. We exclude these students from our analysis, so we won't discuss them here.

while university studies take four to six years, depending on the field of study. Contrary to the US, Dutch students immediately choose a field of study when they start higher education. About 90% of both HBO and university graduates enter the labour market after finishing their degree. About 10% of HBO graduates pursue a university degree.[5]

There are two main differences between HBO and university. First, HBO has a strong vocational component, while university has a strong academic component. Common jobs that require an HBO degree are teachers at the primary or secondary level and nurses. Second, HBO students finish with a bachelor's degree, while most university students finish with a master's degree. While it is possible for university students to enter the labour market after obtaining their bachelor's degree, this rarely happens. A minority of HBO students continue to university to obtain a master's degree, usually after taking a bridge year to catch up with their academic skills.

2.2 Data sources

We use administrative data from Statistics Netherlands on enrolment and graduation for all students in higher education since 1995. The data contain detailed information on the type of programme followed - field of study and level - and the exact date of enrolment and graduation. There is no information on grades.

These data can be merged at the individual level to other datasets using a coded social security number.[6] We merge administrative data on labour market status from 1999 to 2014 obtained from tax filings of employers. These contain the yearly gross wage and the number of days worked, which allows us to calculate the gross daily wage, our main dependent variable. They also contain information on sector and an employer identifier, which we use to calculate several measures of "employer quality", such as the median wage an employer pays. We obtain demographic characteristics by merging our data with municipal registries (GBA), which are available from 1995 onwards. These include personal characteristics, such as age, gender and ethnicity, and household characteristics, such as the number of children and whether people are cohabitating or married. We also add information on social security claims and whether graduates work as self-employed (also available from 1999 - 2014). We don't have information on the level of the social security claims or the income earned as self-employed. Finally, we add national unemployment rates for each year since 1995 from the official employment statistics of Statistics Netherlands as our indicator of the state of the labour market. Table 11 in the Appendix shows a detailed list of the variables we use.

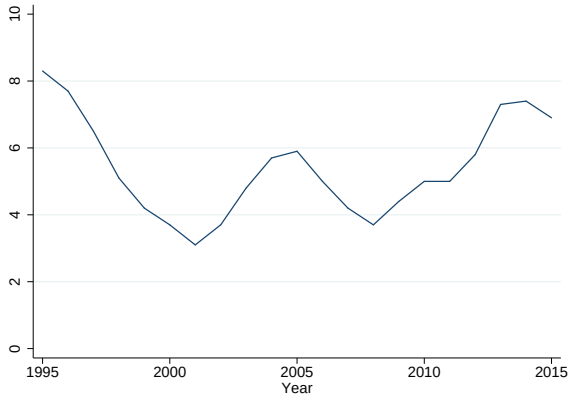
2.3 Sample selection

To prevent selection bias due to students adjusting their timing of graduation and to obtain a sample of typical students, we restrict our sample in the following ways. First, we exclude students who first obtained a vocational (MBO) degree or a foreign degree before starting their higher education career. Second, we only include bachelor's, master's and equivalent degrees. This means we exclude PhD's and other postgraduate degrees. Third, we exclude everyone who graduated before the age of 20 or

[5] These numbers are based on public data from Statistics Netherlands.

[6] The data are available via a secure connection to Statistics Netherlands for researchers who sign a confidentiality agreement.

Figure 1: Unemployment rate in the Netherlands for our sample period.



Source: Eurostat.

after the age of 28. Fourth, we exclude everyone who took shorter than three years or longer than seven years to obtain their degree or those who hold more than 1 master's degree. Finally, we assume that students enter the labour market if they haven't been enrolled for at least 400 days.

2.4 Descriptives

Table 1 gives descriptive statistics for our outcome and control variables. The sample consists of almost 5 million observations of 615,378 unique individuals. Since we have 18 cohorts, this amounts to an average of 34,187 individuals per cohort. 62% of the sample consists of HBO graduates, and 38% are university graduates. The average age at graduation is slightly above 23 years and 60% is female. There are relatively few immigrants or people with immigrant parents in the sample. Finally, 39% of the sample has graduated in social sciences, business and law. Health and education are the other two large fields of study.

Figure 1 shows the unemployment rate in the Netherlands for the two decades we use in our study. Our data start at the end of a downturn in the early 90s. We furthermore use variation introduced by a smaller recession around 2000 and the Great Recession around 2009.

Figure 2 show the experience profiles for our cohorts up to 10 years on the labour market. As is clear from the graph, starting wages differ quite strongly in line with the business cycle (the dotted black line). At five years, the differences are much smaller and wages converge.

3 Empirical approach

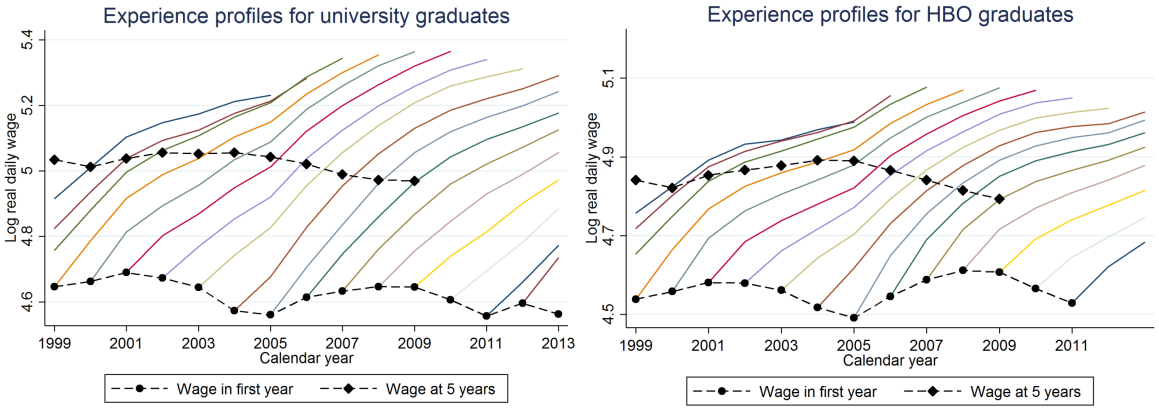
In this section we describe our empirical approach to identify the effects of graduating during a recession on both short- and long-term labour market and other outcomes. We follow the recent literature and use the unemployment rate at graduation as our proxy for labour market conditions (Kahn, 2010; Oreopoulos et al., 2012; Brunner and Kuhn, 2014). The relationship we are interested

Table 1: Descriptive statistics for all outcome and control variables.

	Mean	SD
Panel A. Outcome variables		
Labour market		
ln(daily wage)	4.74	0.45
Employed	0.62	0.49
Self-employed	0.01	0.09
On benefits	0.01	0.09
Change employer	0.28	0.45
Change sector	0.24	0.43
Leave first employer	0.12	0.32
Leave first sector	0.11	0.31
Median ln(daily wage) of employer	4.84	0.27
Median ln(daily wage) of sector	4.84	0.18
Household		
Live together	0.54	0.50
Child (conditional on living together)	0.20	0.40
Panel B. Control variables		
Demographics		
Age at graduation	23.59	1.65
Female	0.60	0.49
HBO level	0.62	0.48
Native	0.96	0.19
Western immigrant	0.01	0.12
Non-western immigrant	0.02	0.15
Field of study		
Education	0.15	0.36
Language, history and art	0.05	0.22
Social sciences, business and law	0.39	0.49
Science	0.06	0.23
Industry and construction	0.09	0.29
Agriculture and veterinary	0.01	0.12
Health	0.18	0.38
Personal services, transport and safety	0.07	0.25
Number of unique persons	615,378	
Number of observations	4,902,753	

Source: Own calculations based on registration data from Statistics Netherlands.

Figure 2: Experience profiles in earnings for recent graduates and mature workers.



(a) University graduates

(b) Hbo graduates

Source: Own calculations based on registration data from Statistics Netherlands.

in can be written as

$$Y_{itc} = \beta_e e_{it} * u_c + \delta X_i + \theta_e + \phi_c + \tau_t + \epsilon_{it}, \tag{1}$$

where Y is the outcome variable (wage, employment status or some other outcome) for individual i observed in year t who graduated in cohort c. We control for several individual controls X, a full set of experience fixed effects θ, a cohort trend ϕ and year fixed effects τ. The coefficients of interest are the β_e's which describe the change in the experience profiles caused by a one percentage point change in the national unemployment rate u_c at graduation. We allow the effect to differ across the first eight years of potential experience (e_{it}), which is defined as years since graduation. We take the moment of graduation of a student's highest degree as their point of entry into the labour market. If students haven't been enrolled for at least a full year before obtaining their highest degree, we assume they entered the labour market after obtaining their previous degree (see section 2.3). Our experience fixed effects pick up any average increases in wage with experience in a very flexible way. The year fixed effects pick up any variation in labour market conditions or other year effects that might affect wages apart from the unemployment rate at graduation or experience. Finally, the cohort trend is included to control for changes at the cohort level that are unrelated to the labour market conditions at graduation.[7] We specify the cohort trend as a flexible step function that is allowed to vary at ten points. This means that we effectively use biannual cohort dummies.[8]

Our main effects are identified using variation in the national unemployment rate. In an ideal research setting we would like to compare two identical individuals, where one graduates during a recession and the other doesn't. In effect, we would prefer random allocation of recessions at graduation. Of course, this is impossible, so we have to compare people who graduate at different

[7]Since cohort, potential experience and year fixed effects can't be identified at the same time, we have to impose another restriction. We follow the literature and impose that one additional year effect is zero (Oreopoulos et al., 2012; Cockx and Ghirelli, 2016).

[8]We can't include a full set of cohort fixed effects, since we don't have multiple observations per cohort. We have also experimented with a linear or quadratic cohort trend. The results remain similar.

points in time to have variation in the unemployment rate at graduation.

Variation in the timing of graduation could result from people who enter college at the same time, but graduate at different moments. Using this group could introduce selection bias, however, since people could deliberately choose to stay in school to prevent graduating during a bad time and therefore graduate at a different moment. Another source of variation arises from people who started their studies at different points in time - so who were effectively born at different points in time - but studied for a similar length of time. OLS estimation of equation 1 includes both groups. This could lead to biased estimates if students deliberately postpone their moment of graduation or graduate earlier in good times. In section 6 we employ an instrumental variables strategy that only uses the second group and we show that our results are not driven by selective timing of graduation. One way to approach this would be to compare people who enter college at the same time, but who graduate at different moments. This could introduce selection bias,

To take into account that individuals from the same cohort might have experienced similar shocks - e.g. changes in the education system - we cluster standard errors at the level of the graduation cohort. Since our main sample consists of cohorts graduating between 1995 and 2012, this leaves us with a relatively small number of clusters. In the Appendix we present several robustness analyses using different methods designed to deal with this problem. First, we estimate the results at the cohort level (as recommend by Angrist and Pischke (2009)). Second, we apply the wild bootstrap (as recommended by Cameron et al. (2008)). The results remain similar. In our main analyses we simply apply Stata's *cluster* option, which uses a $(G-1)$ distribution for the t-statistics. This is recommended as a minimum when dealing with a small number of clusters by Cameron and Miller (2015).

Many papers in the literature use variation in the unemployment rate at a regional level, such as states in the US (Kahn, 2010) or provinces in Canada, Austria or Belgium (Oreopoulos et al., 2012; Brunner and Kuhn, 2014; Cockx and Ghirelli, 2016) instead of variation at the national level. This helps in two ways. First, it is possible to include a full set of cohort fixed effects instead of a cohort trend since there are multiple observations per cohort. Second, the number of clusters increases.[9] However, the Netherlands is a small country and the labour market for graduates is primarily a national labour market (with most graduates working in the Randstad area around Amsterdam - The Hague - Rotterdam), so we don't think such a strategy is warranted in this case.[10]

4 Labour market effects of graduating during a recession

We begin this section by presenting the short and long-term effects of graduating in a recession on labour market outcomes in the Netherlands. We then continue to examine the heterogeneity of the effects. Finally, we show that most of the wage loss is due to graduates working in lower quality jobs with an increased probability of mismatch. Most of the recovery from the wage loss is driven by external mobility.

[9] Although there could be doubts whether the region-cohort level is actually the proper clustering level for many countries.

[10] We show in section A.3 in the Appendix that if we do adopt this approach, our results are qualitatively similar, but weaker. This is expected, because the variation in regional unemployment rates is very low.

4.1 Main results

Table 2 reports the main results with log daily wage as the outcome variable. Column (1) shows the β_e coefficients resulting from estimating the main equation using OLS where we only include year fixed effects. The estimates show that in the year of graduation (experience year 0) a one percentage point increase in the unemployment rate leads to a 2.8% decline in the daily wage. After one year the effect is still 1.5% and it becomes statistically insignificant from the second year on the labour market onwards. In column (2) we include biannual cohort dummies to capture any changes at the cohort level that might affect our estimates. The estimates become somewhat larger, and are now also significant for year 2. These estimates suggest that correlation between cohort-level changes and unemployment rates are not driving our results. In columns (3) and (4) we subsequently add demographic (age at graduation, gender and ethnicity) and education (level and 1-digit major dummies) controls, while also keeping our cohort dummies. Including the controls leads to stronger negative effects for years 3 and 4, while the other coefficients remain very similar. The controls effectively pick up changes at the cohort level as well, such as the increased participation rate of women in higher education.

Our preferred specification is column (4), with all the controls and biannual cohort dummies included. Our preferred estimates show that graduates suffer a 3.1% decline in their daily wage for each percentage point increase in the unemployment rate in the graduation year. This rather quickly declines to about 0.7% in year 3 and a barely significant 0.5% in year 4, after which the effects become smaller and statistically insignificant. In a typical recession, the unemployment rate increases by about 3 percentage points compared to the low point in a boom. This means that the initial effect is about -9.3% and declines to -1.5% in year 4.

Since not everyone finds a job, the effects on wages might be an underestimate of the actual effect. It is therefore instructive to also consider effects on employment and other labour market outcomes. Table 3 shows estimates from the same model for regular employment, self-employment and the probability to receive unemployment benefits, welfare or sickness benefits. The first column shows small negative effects on the probability to be employed for the first seven years on the labour market, although most of them are not or only barely statistically significant. An alternative source of income could be obtained from self-employment. The second column shows that, with a higher unemployment rate, the probability to be self-employed is actually somewhat smaller. The final column shows that the effect on the probability to receive benefits is actually negative in the first year, but close to zero or positive after that.

The results show two key findings. First, there are short-term negative effects of graduating during a recession on wage, but they fade out after about four years. Second, people who graduate during a recession also have lower employment chances and a higher probability to be on benefits. These effects are small however.

4.2 Heterogeneous effects

We continue with some heterogeneity analyses. We look at different effects on wages and employment by education level (the vocational track versus the academic track) and by gender. Figure 3 graphs the estimated coefficients. Colored points are statistically significant at the 5% level, while white

Table 2: Main estimation results of the effect of the unemployment rate at graduation on log daily wage.

	(1)	(2)	(3)	(4)
Effect Year 0	-0.0280^{***}	-0.0283^{***}	-0.0313^{***}	-0.0312^{***}
	(0.0055)	(0.0042)	(0.0043)	(0.0041)
Effect Year 1	-0.0154^{***}	-0.0181^{***}	-0.0215^{***}	-0.0216^{***}
	(0.0039)	(0.0032)	(0.0032)	(0.0032)
Effect Year 2	-0.0067	-0.0113^{***}	-0.0152^{***}	-0.0153^{***}
	(0.0044)	(0.0023)	(0.0023)	(0.0023)
Effect Year 3	-0.0047	-0.0027	-0.0068^{**}	-0.0072^{***}
	(0.0041)	(0.0027)	(0.0025)	(0.0024)
Effect Year 4	-0.0064^{*}	-0.0012	-0.0047^{*}	-0.0046^{*}
	(0.0034)	(0.0027)	(0.0025)	(0.0025)
Effect Year 5	-0.0057	0.0005	-0.0030	-0.0029
	(0.0045)	(0.0028)	(0.0026)	(0.0025)
Effect Year 6	-0.0057	0.0007	-0.0028	-0.0027
	(0.0054)	(0.0033)	(0.0031)	(0.0030)
Effect Year 7	-0.0042	0.0021	-0.0013	-0.0013
	(0.0062)	(0.0043)	(0.0039)	(0.0038)

Notes: Number of observations is 3,331,000. Standard errors clustered at the level of graduation cohort are in parentheses. Significance levels: * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.
Source: Own calculations based on registration data from Statistics Netherlands.

Table 3: Effects of the unemployment rate at graduation on employment status, self-employment and benefit status.

	(1) Employed	(2) Self-employed	(3) On benefits
Effect Year 0	-0.0027	-0.0011^{**}	-0.0017^{**}
	(0.0040)	(0.0005)	(0.0007)
Effect Year 1	-0.0075^{**}	-0.0006	0.0007^{*}
	(0.0033)	(0.0005)	(0.0003)
Effect Year 2	-0.0021	-0.0006	-0.0001
	(0.0044)	(0.0003)	(0.0004)
Effect Year 3	-0.0012	-0.0007^{**}	-0.0001
	(0.0030)	(0.0003)	(0.0003)
Effect Year 4	-0.0037^{*}	-0.0006^{**}	-0.0001
	(0.0021)	(0.0003)	(0.0002)
Effect Year 5	-0.0046^{*}	-0.0006^{**}	0.0005^{**}
	(0.0022)	(0.0002)	(0.0002)
Effect Year 6	-0.0037	-0.0008^{***}	0.0008^{***}
	(0.0023)	(0.0002)	(0.0002)
Effect Year 7	-0.0017	-0.0011^{***}	0.0005^{**}
	(0.0024)	(0.0003)	(0.0002)

Notes: Number of observations is 3,622,667. Standard errors clustered at the level of graduation cohort are in parentheses. Significance levels: * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.
Source: Own calculations based on registration data from Statistics Netherlands.

Figure 3: Heterogeneous effects by gender and education level.

Notes: Colored points are significant at the 5% level. White points are not significant at 5%. The estimates are the result of running our main specification (column (5) in Table 2 and column (1) in Table 3) seperately for the groups indicated. Full estimation results are presented in the Appendix.
Source: Own calculations based on registration data from Statistics Netherlands.

points are not. The two left graphs show the effects on wage and employment seperately for males and females, while the two right graphs show the effects for (higher vocational) HBO and university graduates separately. The top-left graph shows that while both men and women suffer short-term losses from graduating during a recession, the losses for women are more substantial than for men. They also last up to five years for women, while they already fade out in the third year for men. For both men and women we find no short-term effects on employment, but in the long run we see that primarily women show negative effects on their employment rates. This could be driven by family considerations (see section 5). On the right-hand side we see that wage losses are more substantial for HBO graduates in the short run, but that there are no long-run differences. For employment the first two years show divergent patterns for HBO and university graduates. University graduates even show a small, albeit insignificant, increase in the employment probability in the first year. After the first few years the fortunes reverse and university graduates suffer stronger negative effects on their employment probabilities. In the long-run HBO graduates again have somewhat lower employment rates. Again, the effects on employment are very small.

4.3 Mechanisms

Above we showed that people who graduate during a recession suffer negative wage effects for the first four years on the labour market. In this subsection we show that initial employer quality, as measured by the median wage paid by an employer, is strongly associated with the wage losses. External mobility to better paying employers seems to be the primary mechanism of recovery.

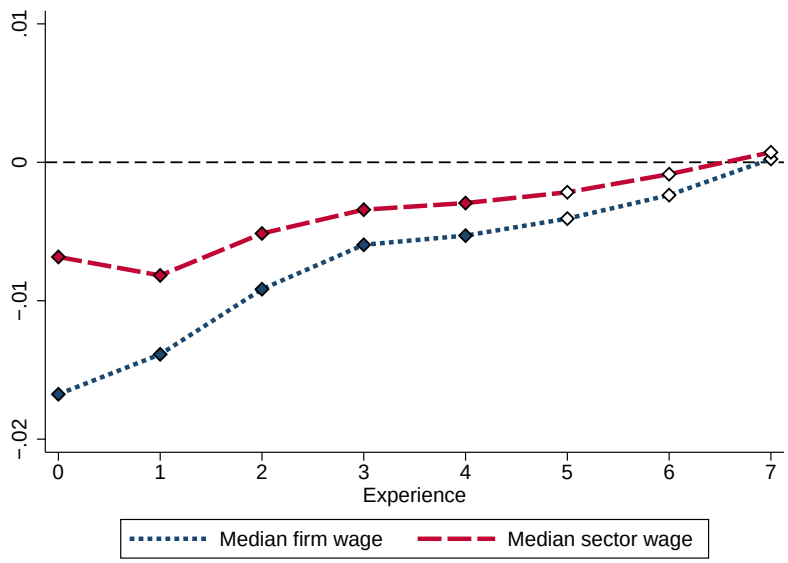
Previous papers have identified the importance of the first employer as a source of the initial losses (Oreopoulos et al., 2012; Brunner and Kuhn, 2014; Liu et al., 2016). There are several reasons for why the first employer could be important. First, during a boom people might find jobs of higher quality. If they specialize in the tasks required for these jobs, they will learn skills that are rewarded more highly (Gibbons and Waldman, 2004). Second, if people obtain a better match during a boom, they will have a higher productivity in this job. Hence, they are less likely to switch jobs and lose job-specific human capital. This ensures that they have a long-term advantage compared to people who started in a worse match. Third, the initial job could be a signal for productivity, and hence could lead to a stigma for people who started in a low-paying job (Waldman, 1984; Oyer, 2006). Finally, risk-averse workers who start during a recession could accept long-term contracts with lower wages than they would have done in a boom. In a world with search frictions, this could lead to procyclical wage effects (Beaudry and DiNardo, 1991).

Figure 4 shows the effect of graduating during a recession on several dimensions of the quality of the job. The figures show results from regressions similar to our main specification, with the outcome variable as stated. The dotted line shows the effects on the median wage of a firm (measured over the full time period and sample). This measures the quality of employers that people work at. There are clear and strong negative effects of the unemployment rate at graduation on the median wage paid at the firm. The negative effect remains statistically significant up to four years and converges to zero after that period. The dashed line shows the effect on the median sector wage. The effect is smaller than for employers, indicating that most of the loss is driven by jobs at lower quality firms within an industry, rather than graduates shifting industries. It converges to zero after about four years on the labour market.[11]

We continue to examine how workers recover from the initial wage losses. In principle there are two mechanisms through which catch-up might happen: internal or external mobility. With our data it is not possible to explicitly look at internal mobility, because we don't know an individual's rank or function within a firm. Previous evidence on the US and Sweden shows that cohort effects in promotions are are procyclical. This suggests that internal mobility, if anything, works against catching up in terms of wages, since those who start during a boom are more likely to be promoted than those who start during a recession (Kwon et al., 2010). Figure 5 presents the results on external mobility. The left figure shows the effect of the unemployment rate at graduation on the probability to leave the first employer and the first sector. Since both are of lower quality for students who graduated during a recession, we would expect them to be more likely to search for a job at another employer or sector and leave than people who graduate during a boom. This is indeed what we find, with overall positive effects over the first four years on the labour market and negative effects for later

[11] We have also tried the measure of match quality as defined by Liu et al. (2016), where the quality of a match is defined as the wage premium a given major earns in a sector. This measure gives very similar results to the other two.

Figure 4: Effect of the unemployment rate at graduation on indicators for job quality.



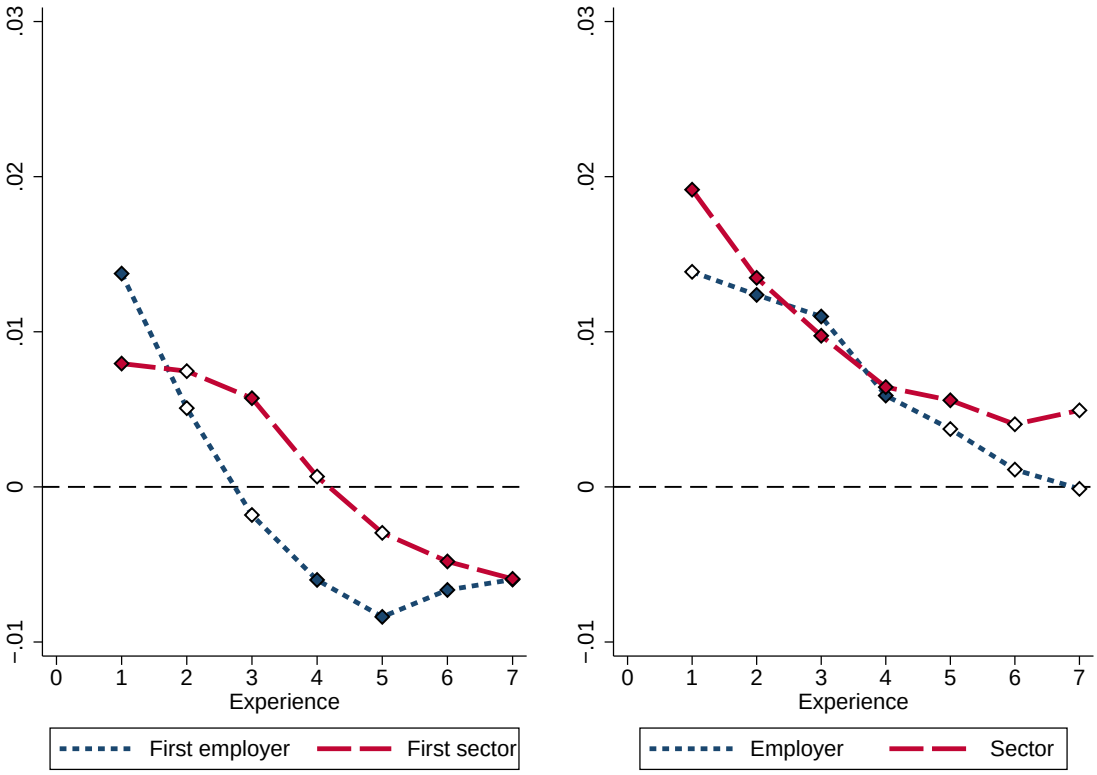
Source: Own calculations based on registration data from Statistics Netherlands.

years when they already switched jobs. People who graduate during a boom are more likely to stay at their first employer for a couple of years before moving on. The figure on the right-hand side shows effects on the probability to leave any employer or sector, including the first. The results suggest that external mobility is higher for people who graduated during a recession up to about 5 years on the labour market. This is in line with the results on wages, which show that the wage loss is recovered after about 4 years on the labour market. These results, together with the ones on employer quality, thus suggest that external mobility to better paying employers is the key mechanism in the recovery from graduating during a recession.

5 Demographic effects of graduating during a recession

There is a substantial literature on the relation between unemployment and important personal decisions, for instance regarding fertility and family. Standard microeconomic theory predicts that in times of high unemployment fertility is higher, because the opportunity costs of having children are lower (Willis, 1973; Butz and Ward, 1979). The recent literature however shows that fertility is actually procyclical (Bettio and Villa, 1998; Ahn and Mira, 2002; Adsera, 2011; Del Bono et al., 2015). Unemployment, or, more generally, economic insecurity, causes women to have fewer children. As we have shown above, graduating during a recession leads to more economic insecurity for the first few years on the labour market. People have lower employment chances, and if they do find a job, they more frequently end up working in mismatched, low-paying jobs. A natural question therefore is whether graduating during a recession also affects fertility and other family decisions. In this section we examine whether this is the case. We continue to look at heterogeneity and possible mechanisms

Figure 5: Effect of the unemployment rate at graduation on the probability to leave the first employer or sector (left) and the probability to leave any employer or sector (right).



Source: Own calculations based on registration data from Statistics Netherlands.

driving our results.

5.1 Main effects

Table 4 reports the effects of graduating during a recession on the probability of being in a partnership (either marriage or cohabitation), having a child and the number of children.[12] Column (1) shows the effect of the unemployment rate at graduation on the probability to be in a partnership. We find statistically significant negative effects for years 1 to 4 on the labour market, but no effects for later years. The effects show that the partnership rate is about 1.5% ($3 * 0.005$) lower for people who graduated in a typical recession compared to people who graduated in a boom for the first years. This means that some graduates postpone living together until they have a higher and more stable income. Column (2) shows that the probability to have a child, conditional on being a couple, also declines in the first five years after graduation if students graduated in a recession. The effects start at about a 1.8% lower probability for those graduating in a typical recession and declines to about 1% in year four. In the long-run the effects are close to zero. Column (3) shows similar results for the number of children. In the short run the number of children is smaller, while in the long run there are barely any effects. We have two key findings. First, people who graduate during a recession postpone cohabitating or marrying. Second, graduating during a recession leads people to have a smaller number of children for at least the first six years of their working life. There don't seem to be any long-term effects, so they eventually catch-up to their luckier counterparts.

5.2 Heterogeneity

Figure 6 shows heterogeneous effects for household outcomes, similar to the ones on labour market outcomes. At the top-left we see that both men and women behave similarly in the first few years after graduation, but that women have a lower probability of being in a partnership in the longer run. Both men and women have lower probabilities of having children if they graduate during a recession for their first few years after graduation. However, again women show somewhat stronger effects in the longer run, up to year five. This coincides with the stronger effects for women on labour market outcomes. HBO graduates have lower rates of being in a partnership, while the effects on having children are similar for both.

5.3 Mechanisms

Our previous analyses showed negative effects on labour market outcomes for the first few years on the labour market and negative effects on household outcomes for the same period. This suggests that economic uncertainty in the first few years on the labour market might lead to worse household outcomes. We examine this by including several indicators for a person's economic situation. We separately include the daily wage and an employment dummy as indicators for labour market status.[13]

[12] We have tried separating marriage and cohabitation. We find no effects on marriage, and results on cohabitation are very similar to being in a partnership.

[13] We also tried several other job quality indicators, such as employer quality, but they showed very similar results.

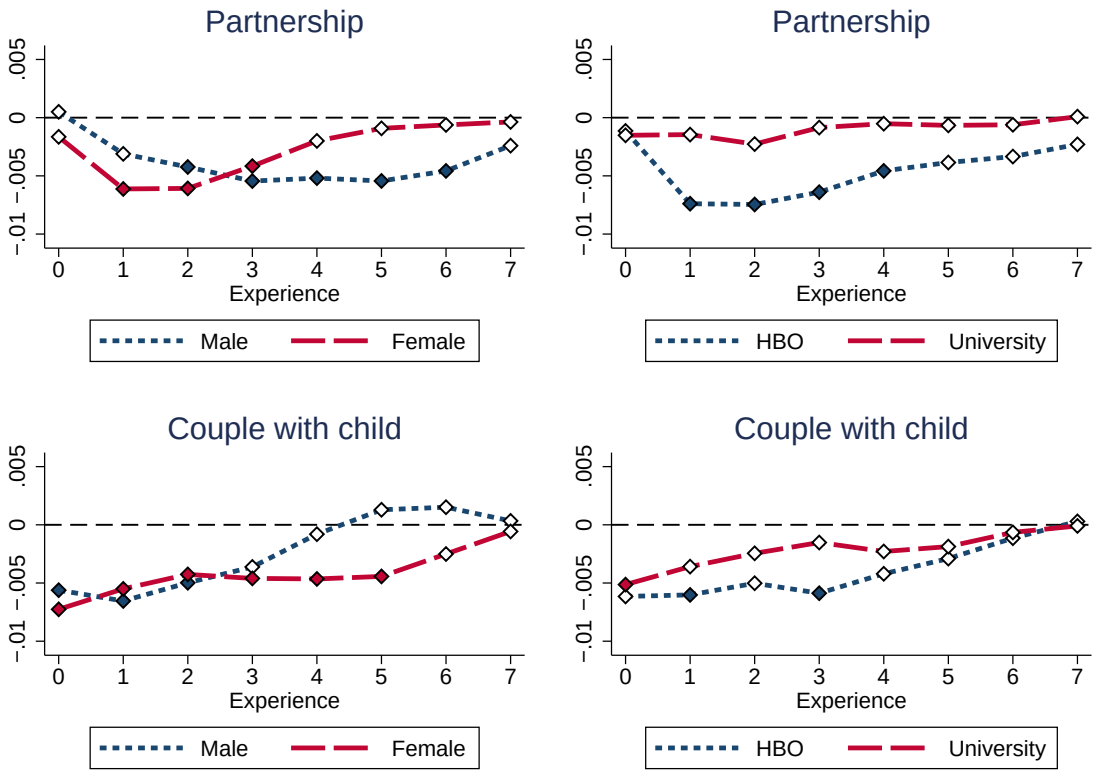
Table 4: Effects of the unemployment rate at graduation on being in a partnership, and, conditional on being in a couple, having a child and the number of children.

	(1) Partnership	(2) Couple with child	(3) Number of children
Effect Year 0	-0.0011	-0.0060^{***}	-0.0072^{**}
	(0.0015)	(0.0018)	(0.0030)
Effect Year 1	-0.0052^{***}	-0.0052^{**}	-0.0067^{**}
	(0.0015)	(0.0020)	(0.0031)
Effect Year 2	-0.0057^{***}	-0.0040^{**}	-0.0060^{**}
	(0.0013)	(0.0016)	(0.0026)
Effect Year 3	-0.0048^{***}	-0.0042^{**}	-0.0058^{*}
	(0.0015)	(0.0019)	(0.0029)
Effect Year 4	-0.0032^{*}	-0.0034^{*}	-0.0050^{*}
	(0.0017)	(0.0019)	(0.0028)
Effect Year 5	-0.0027	-0.0024	-0.0044
	(0.0017)	(0.0019)	(0.0028)
Effect Year 6	-0.0023	-0.0010	-0.0027
	(0.0015)	(0.0018)	(0.0029)
Effect Year 7	-0.0014	0.0001	-0.0004
	(0.0013)	(0.0017)	(0.0030)
N	3,612,740	1,931,237	1,931,237

Notes: Partnership is defined as being married or cohabitating. The estimates for columns (2) and (3) use only people who are already in a partnership. Standard errors clustered at the level of graduation cohort are in parentheses. Significance levels: * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.

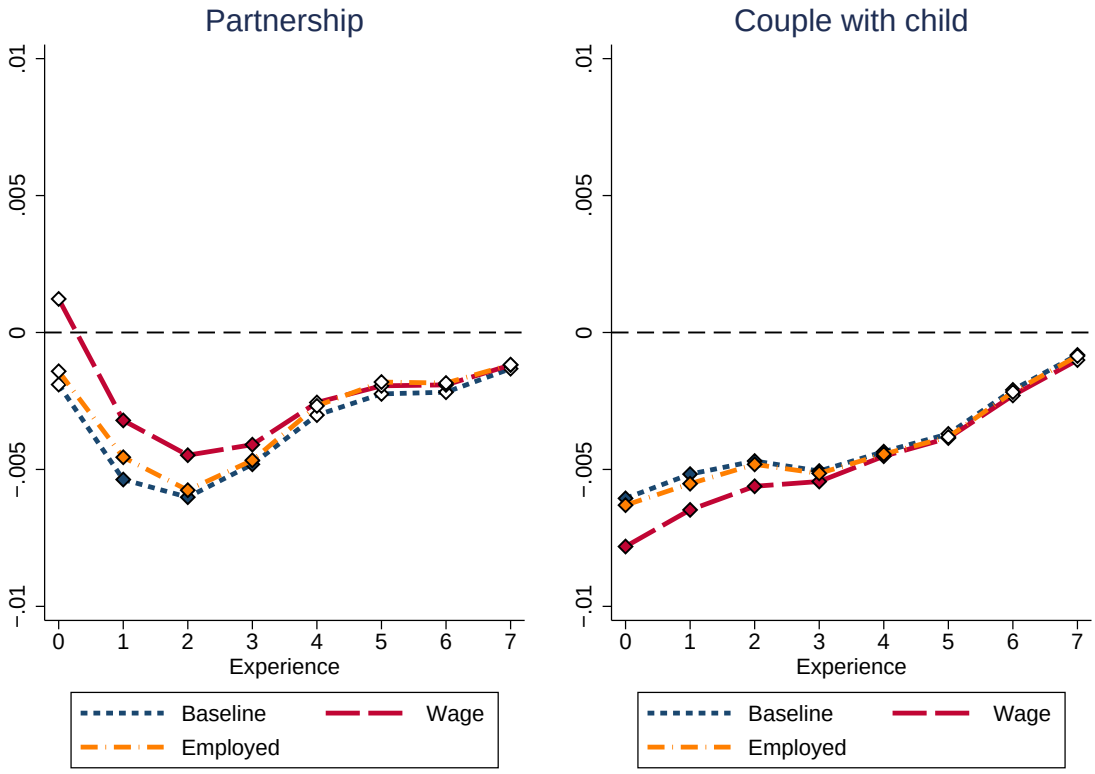
Source: Own calculations based on registration data from Statistics Netherlands.

Figure 6: Heterogeneous demographic effects by gender and education level.



Note: Colored points are significant at the 5% level. White points are not significant at 5%. The estimates are the result of running our main specification (columns (1) and (2) in Table 4) seperately for the groups indicated. Full estimation results are presented in the Appendix.
Source: Own calculations based on registration data from Statistics Netherlands.

Figure 7: Effects of the unemployment rate at graduation on being in a partnership and having a child while controlling for employment status and wage.



Source: Own calculations based on registration data from Statistics Netherlands.

We augment our main equation with these indicators, and include interactions with experience fixed effects.

Figure 7 shows the estimation results. Both figures show that controlling for employment status hardly affects the negative estimates on the probability to be in a partnership or to have a child. Controlling for the wage somewhat attenuates the estimates for being in a partnership, but actually leads to somewhat stronger effects of the unemployment rate at graduation on having a child. This suggests that the effects we find on demographic outcomes are not solely driven by income effects due to graduating at a bad time. There might still be some insecurity regarding the economic situation of the household that is not captured by wage or employment status. Both partners could for example have a fixed-term contract. Unfortunately, our data don't allow us to say anything about other possible mechanisms.

6 Selection

In section 3 we mentioned that our OLS results might be biased if students adjust their timing of graduation to the labour market conditions. In this section we use several methods to examine whether this is the case. First, we follow the recent literature and use an instrumental variables strategy (Oreopoulos et al., 2012). As an instrument we take the unemployment rate at the expected year of graduation rather than the actual year. Second, we examine whether the unemployment rate at graduation affects the probability that students obtain a higher degree. In section A.1 in the appendix we show the results from estimating duration models that directly investigate the link between the unemployment rate and study duration. The results from all three methods point in the same direction. Students don't seem to adjust their timing of graduation to labour market conditions.

6.1 Instrumental variables

As an instrument for the unemployment rate at graduation we follow Oreopoulos et al. (2012) and use the unemployment rate at the predicted year of graduation. In this IV strategy we only use the variation introduced by people whose study duration is the same, but who started at different points in time. This contrasts with the OLS estimates where we also use the variation introduced by people who started at the same time, but graduate at different points in time. It is precisely this group that could introduce selection bias if they adjust their timing of graduation to the labour market conditions. The unemployment rate in the predicted year of graduation is a valid instrument if it is not related to labour market outcomes, except through the actual year of graduation. The instrument would be invalid if, at entry, students are able to predict the state of the labour market at their expected graduation date. Given the difficulty of predicting unemployment rates, this seems a plausible exclusion restriction.

The predicted year of graduation is calculated using both the average and nominal duration of a particular study across the full sample from 1995 to 2012. Both the average and the nominal duration have their advantages if used as the basis for our instrument.[14] The nominal duration is arguably the most exogenous measure, since it doesn't depend on the endogenous choices of students as the average duration does. On the other hand, the average duration is a better predictor for the actual time students spend on their studies in the Netherlands. This also shows up in our first-stage estimates, which are weaker for the nominal duration. Second, the difference between the nominal duration and the average duration could introduce selection bias if students who follow a more difficult study (e.g. a technical study) take consistently longer than the nominal duration, but also earn more.[15] We define a 'study' as a completed program in a particular field, such as a bachelor's in engineering or a master's in philosophy. If a student takes both a bachelor's and a master's, the total average duration of her study is the sum of the average duration of the respective bachelor's and master's program. We distinguish between 239 different studies.

Table 5 gives the estimation results. Column (1) reproduces the main OLS estimates. Column

[14] Note that Oreopoulos et al. (2012) only use the nominal duration.

[15] Yearly reports on the average time students take to complete their studies show for example that students in the humanities and in technical studies at the university level consistently take much longer than the nominal duration (Van der Werff and Berkhout, 2015).

Table 5: Results from IV estimates of the unemployment rate at graduation on ln(daily wage).

	(1) OLS	(2) IV with average duration	(3) IV with nominal duration
First stage coefficient		0.7485***	0.6678***
		(0.0741)	(0.0917)
Effect Year 0	-0.0312***	-0.0324*	-0.0346*
	(0.0041)	(0.0186)	(0.0177)
Effect Year 1	-0.0216***	-0.0127***	-0.0163***
	(0.0032)	(0.0044)	(0.0062)
Effect Year 2	-0.0153***	-0.0074	-0.0065
	(0.0023)	(0.0046)	(0.0054)
Effect Year 3	-0.0072***	-0.0070	-0.0017
	(0.0024)	(0.0053)	(0.0040)
Effect Year 4	-0.0046*	-0.0093*	-0.0015
	(0.0025)	(0.0052)	(0.0036)
Effect Year 5	-0.0029	-0.00105*	-0.0003
	(0.0025)	(0.0055)	(0.0045)
Effect Year 6	-0.0027	-0.0110*	-0.0000
	(0.0030)	(0.0057)	(0.0054)
Effect Year 7	-0.0013	-0.0095	0.0012
	(0.0038)	(0.0059)	(0.0063)

Notes: Number of observations is 3,331,000. Estimation method is indicated above each column. Standard errors clustered at the level of graduation cohort are in parentheses. Significance levels: * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.
Source: Own calculations based on registration data from Statistics Netherlands.

(2) gives the IV estimates where we instrument for the unemployment rate at graduation with the unemployment rate at the expected year of graduation using the average duration per study. The estimates for the first year are very similar to the OLS results, but starting from year one they are a little weaker. On the long-run, we find slightly stronger negative effects, although they are barely significant. As expected, the first stage is highly significant and strongly predicts the unemployment rate at graduation. In column (3) we present results using the nominal duration. Similarly to the average duration, we find slightly weaker effects for the short-term. The later years are very similar to the main OLS results. The first stage estimates are somewaht smaller than for the average duration, reflecting the weaker correlation between the nominal and actual study duration. The results suggest that recovery from graduating during a recession might even be a little quicker than our OLS results show. Nevertheless, the point estimates for each year of potential experience in the three models are well within each other's confidence interval, so the differences are quite small. See section A.4 for IV estimates for our other main outcomes. Overall, the IV results are quite similar to the OLS estimates, which means that selection bias is a small problem for our sample. If anything, we slightly underestimate the negative effects of graduating during a recession.

Table 6: Effect of the unemployment rate on the probability to obtain an additional or higher degree.

	(1) HBO to HBO	(2) HBO to university	(3) University to university
Unemployment rate	0.0031	-0.0006	0.0013
	(0.0034)	(0.0098)	(0.0025)
N	407,941	407,941	189,910

Notes: Standard errors clustered at the level of graduation cohort are in parentheses. Significance levels: * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.
Source: Own calculations based on registration data from Statistics Netherlands.

6.2 Do students who graduate in a recession more often obtain a higher degree?

Another way in which students might select themselves onto the labour market is in their choice of obtaining a higher or additional degree. Students who graduate during a recession might face lower opportunity costs of staying in school and thus are more likely to obtain an additional degree. Table 6 shows the estimated relation between the unemployment rate at graduation (the first level mentioned in each column) and the probability to obtain an additional degree (the second level mentioned). We estimate a simple linear probability model that relates a dummy variable indicating whether a student pursued a higher degree to the unemployment rate measured at graduation of the first level and the same set of demographic and education control variables as included in our other specifications. Note that students at the HBO level can pursue a master's degree at the HBO level, an additional bachelor's degree at the HBO level or a bachelor's or master's degree at the university level. University students can typically pursue an additional master's degree. We find no significant effect between the unemployment rate at graduation and the probability to obtain a higher degree. Columns (1) and (3) have the right sign, but they are small and statistically insignificant. This means that there is no relation between the unemployment rate at graduation and the probability to obtain a higher or additional degree.

7 Discussion and conclusion

In this paper we examined the labour market and household effect of graduating in a recession using a sample of Dutch higher education graduates from 1995 to 2012. We find negative effects on wages which last up to three years after graduation, while small negative effects on employment last up to six years after graduation. We show that increased labour market insecurity also affects the probability to start living together and having children for four to six years after graduation. However, we find no long-term negative effects. External mobility to better paying employers is an important mechanism that leads to recovery of the wage losses. We also find that women suffer stronger losses than men.

Our approach has some limitations. Most points apply to other papers in this literature as well. First, to circumvent issues related to selection bias as much as possible and the lack of good data, we only look at higher educated graduates. This is only half of the graduate population in the Netherlands. The sparse literature that compares higher educated with lower educated graduates

finds that higher educated graduates lose more in terms of wages from graduating during a recession, but that lower educated have lower job probabilities (Genda et al., 2010; Cockx and Ghirelli, 2016). Second, and related to the previous point, our estimates do not take into account general equilibrium effects. It is for example possible that the effects on employment are small because higher educated graduates take jobs that are typically held by lower educated graduates. Indeed, the lower job quality is one of the drivers of the initial wage loss. This means that, by extension, lower educated graduates could be hurt in their employment chances. Third, while we provide extensive robustness analyses that show our results remain similar, we can't fully exclude other cohort effects affecting our results.

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Table 7: Effect of the unemployment rate on the exit rate out of higher education.

	(1)
Unemployment rate	-0.0619
	(0.1149)
Year 3	0.1091
	(0.4959)
Year 4	0.1830
	(0.6423)
Year 5	0.7175
	(0.5749)
Year 6	2.4682***
	(0.5009)
Year 7	2.6093***
	(0.5272)
Year 8	3.0458***
	(0.5478)
Year 9	5.3568***
	(0.5467)
N	2,223,915

Notes: Standard errors clustered at the level of starting cohort are in parentheses. Significance levels: * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.
Source: Own calculations based on registration data from Statistics Netherlands.

A Appendix

A.1 Do students postpone graduation if the unemployment rate is high?

Bad labour market conditions might induce people to stay in school longer than they would have been if labour market conditions had been better. We apply duration analysis to directly examine this question. We estimate a discrete time duration model, where we assume that students decide each year whether they will enroll for the next year or enter the labour market (see Cockx and Ghirelli (2016) for a similar application). We apply a complementary log-log specification. The exit rate out of higher education is modeled as follows

$$\theta(t|x, u_y) = 1 - \exp(-\exp(x'\beta + u_y'\gamma) \tag{2}$$

where t is the time spent in higher education, counted in years from the first enrollment, x is a set of individual observable characteristics (the same as used in the main specification) and u_y is the unemployment rate in year y. We include dummies for each year in education to model the baseline hazard. Table 7 shows the results. We find no statistically significant effect of the unemployment rate on the exit rate out of graduation. The coefficient, while it has the expected sign, is very small.

Table 8: Effects of the unemployment rate at graduation ln(daily wage) using different methods to deal with a small number of clusters.

	(1) Baseline	(2) Collapsed data	(3) Wild bootstrap
Effect Year 0	-0.0312^{***}	-0.0287^{***}	-0.0312^{**}
	(0.0041)	(0.0037)	
Effect Year 1	-0.0216^{***}	-0.0187^{***}	-0.0216^{**}
	(0.0032)	(0.0033)	
Effect Year 2	-0.0153^{***}	-0.0148^{***}	-0.0153^{**}
	(0.0023)	(0.0028)	
Effect Year 3	-0.0072^{***}	-0.0059^{*}	-0.0072^{**}
	(0.0024)	(0.0029)	
Effect Year 4	-0.0046^{*}	-0.0016	-0.0046
	(0.0025)	(0.0023)	
Effect Year 5	-0.0029	0.0002	-0.0029
	(0.0025)	(0.0026)	
Effect Year 6	-0.0027	0.0000	-0.0027
	(0.0030)	(0.0025)	
Effect Year 7	-0.0013	0.0011	-0.0013
	(0.0038)	(0.0031)	
N	3,331,000	119	3,331,000

Notes: Standard errors clustered at the level of graduation cohort are in parentheses. The wild bootstrap method doesn't provide standard errors. Significance levels: * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.
Source: Own calculations based on registration data from Statistics Netherlands.

A.2 Small number of clusters

We use data on graduation cohorts from 1995 to 2012. Since we cluster on the level of the graduation cohort, we only have 18 clusters. This could lead us to underestimate our standard errors. There is no definitive way of dealing with this problem, so we provide results from two ways to address it. Both show similar results. First, we follow Angrist and Pischke (2009) and estimate the same equation at the cohort level. This means that we collapse our data to the cohort level and run our regression with this dataset. Second, we follow Cameron et al. (2008) and apply the wild bootstrap. This method doesn't provide us with standard errors, but it does give us significance levels. Table 8 shows the results. Column (1) reproduces the main results. Column (2) gives the results using the collapsed data. The results are quite similar. The coefficients are somewhat smaller, but show the same pattern. Column (3) gives the results using the wild bootstrap. We generally lose some level of significance, but the main results remain significant at conventional levels of 5%. While this isn't an exhaustive list of methods to deal with a small number of clusters, they provide reassurance that our main results are not driven by a small cluster problem. Finally, note that our standard errors in the main analysis would have to increase by a factor of 2 to 3 for the main results (years 0 - 3) to lose significance at 5%.

Table 9: Effects of the national (baseline) and regional unemployment rate at graduation on ln(daily wage).

	(1) Baseline	(2) Regional	(3) Regional with fixed effects
Effect Year 0	-0.0312***	-0.0456***	-0.0190***
	(0.0041)	(0.0050)	(0.0038)
Effect Year 1	-0.0216***	-0.0336***	-0.0073**
	(0.0032)	(0.0045)	(0.0035)
Effect Year 2	-0.0153***	-0.0285***	-0.0036
	(0.0023)	(0.0044)	(0.0032)
Effect Year 3	-0.0072***	-0.0249***	-0.0002
	(0.0024)	(0.0050)	(0.0029)
Effect Year 4	-0.0046*	-0.0243***	0.0012
	(0.0025)	(0.0051)	(0.0029)
Effect Year 5	-0.0029	-0.0244***	0.0009
	(0.0025)	(0.0052)	(0.0028)
Effect Year 6	-0.0027	-0.0248***	0.0003
	(0.0030)	(0.0053)	(0.0028)
Effect Year 7	-0.0013	-0.0240***	0.0009
	(0.0038)	(0.0058)	(0.0029)
Number of clusters	18	72	72
N	3,331,000	3,329,898	3,329,898

Notes: Standard errors clustered at the level of graduation cohort (baseline) and region-cohort (columns (2) and (3) are in parentheses. Significance levels: * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.
Source: Own calculations based on registration data from Statistics Netherlands.

A.3 Regional estimates

In our main analyses we use variation in the unemployment rate at the national level. As discussed in section 3, many papers use variation at some regional level (Kahn, 2010; Oreopoulos et al., 2012; Brunner and Kuhn, 2014; Cockx and Ghirelli, 2016). This allows for the inclusion of cohort fixed effects and increases the number of clusters. While we are not confident that this strategy is warranted for the Netherlands for reasons already discussed, we do explore this strategy in this sensitivity analysis. We use variation in the unemployment rate introduced by four regions (North, South, East, West, the NUTS-1 level). This increases the number of clusters available for estimation from 18 to 72.

Table 9 shows the estimation results for wages. Column (1) reproduces the main estimates from Table 2. Column (2) applies the same model with regional unemployment rates. We actually find significantly stronger effects than for the main sample. However, these could be biased by the lack of region-specific controls. Column (3) includes a full set of region and cohort fixed effects and drops the biannual cohort dummies. This specification is similar to e.g. Oreopoulos et al. (2012). Once we include cohort and region fixed effects, the results remain qualitatively similar to the OLS estimates, but the point estimates become smaller and are no longer significant from year 2 onwards. Part of this is surely driven by the lack of variation in unemployment rates at the regional level. We conclude that our main conclusion - only short-term negative effects of graduating during a recession on wages - remains.

A.4 IV estimates for other outcomes

In section 6.1 we show that our results on wages remain roughly similar when we apply our IV strategy using the unemployment rate in the predicted year of graduation as an instrument for the unemployment rate in the year of graduation. Table 10 shows estimation results from IV estimates for our other main outcome variables. The results from the OLS specification are reproduced to facilitate comparison. The first three columns show the effects on employment. The IV coefficients for both models are similar for the first few years, but about twice as large and more significant for the later years. While it is expected that IV estimates are somewhat larger, the results suggest that our OLS results somewhat underestimate the long-term effect of graduating during a recession on employment.

Columns 4 - 6 present the results for being in a partnership. The IV coefficients are larger for the first few years, but similar for the later years. The pattern is similar. We find short-term negative effects of graduating during a recession for the probability of being in a partnership. For most years the OLS and IV coefficients are well within each other's confidence interval.

Columns 7 - 9 present the results for having a child, conditional on being in a partnership. The coefficients when using the average duration are similar to the OLS coefficients, while they are smaller if we use the nominal duration. Nevertheless, as with living together, they are mostly well within each other's confidence interval.

Overall, the IV results are quite similar to the OLS estimates, which means that selection bias is a small problem for our sample. If anything, the results suggest that we slightly underestimate the negative effects of graduating during a recession.

Table 10: Results from IV estimates for the probability to be employed, to be living together and having children.

	Employed			Partnership			Couple with a child		
	OLS	IV with average duration	IV with nominal duration	OLS	IV with average duration	IV with nominal duration	OLS	IV with average duration	IV with nominal duration
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Effect Year 0	-0.0027	0.005	-0.0045	-0.0011	-0.0017	-0.0061	-0.0060***	-0.053**	-0.0059
	(0.0040)	(0.0129)	(0.0101)	(0.0015)	(0.0053)	(0.0086)	(0.0018)	(0.0026)	(0.0036)
Effect Year 1	-0.0075**	0.0001	0.0054	-0.0052***	-0.0079*	-0.0120**	-0.0052**	-0.0062**	-0.0041
	(0.0033)	(0.0051)	(0.0115)	(0.0015)	(0.0046)	(0.0056)	(0.0020)	(0.0031)	(0.0036)
Effect Year 2	-0.0021	0.0001	0.0063	-0.0057***	-0.0104***	-0.0131***	-0.0040**	-0.0057**	-0.0025
	(0.0044)	(0.0047)	(0.0064)	(0.0013)	(0.0038)	(0.0030)	(0.0016)	(0.0024)	(0.0020)
Effect Year 3	-0.0012	-0.0053	-0.0012	-0.0048***	-0.0053	-0.0076**	-0.0042**	-0.0049**	-0.0025*
	(0.0030)	(0.0047)	(0.0031)	(0.0015)	(0.0035)	(0.0038)	(0.0019)	(0.0021)	(0.0014)
Effect Year 4	-0.0037*	-0.0101***	-0.0069***	-0.0032*	-0.0015	-0.0039	-0.0034*	-0.0040**	-0.0024**
	(0.0021)	(0.0038)	(0.0023)	(0.0017)	(0.0031)	(0.0040)	(0.0019)	(0.0016)	(0.0009)
Effect Year 5	-0.0046*	-0.0121***	-0.0100***	-0.0027	-0.0004	-0.0027	-0.0024	-0.0028*	-0.0013
	(0.0022)	(0.0033)	(0.0025)	(0.0017)	(0.0031)	(0.0039)	(0.0019)	(0.0016)	(0.0011)
Effect Year 6	-0.0037	-0.0110***	-0.0093***	-0.0023	0.0003	-0.0020	-0.0010	-0.0017	-0.0004
	(0.0023)	(0.0026)	(0.0023)	(0.0015)	(0.0025)	(0.0031)	(0.0018)	(0.0014)	(0.0012)
Effect Year 7	-0.0017	-0.0089***	-0.0070***	-0.0014	0.0011	-0.0011	0.0001	-0.0013	-0.0000
	(0.0024)	(0.0024	(0.0022)	(0.0013)	(0.0021)	(0.0025)	(0.0017)	(0.0014)	(0.0012)
N	3,622,667	3,622,667	3,622,667	3,612,740	3,612,740	3,612,740	1,931,237	1,931,237	1,931,237

Notes: Standard errors clustered at the level of graduation cohort are in parentheses. Significance levels: * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.
Source: Own calculations based on registration data from Statistics Netherlands.

A.5 Variables

Table 11: Overview of variables.

Variable	Definition	Period observed	Units	Source
Potential experience	Number of years after graduation.	1995 - 2014	years	Higher education degrees
Unemployment rate	Unemployment according to the ILO definition, percentage of active population.	1995 - 2014	percentage points	Unemployment - LFS adjusted series, Eurostat
Graduation year	Year in which a student finishes his/her study. See section for more extensive discussion.	1995 - 2012	years	Higher education degrees
ln(daily wage)	Log of total yearly earnings divided by days worked.	1999 - 2014	log of euros / day	Tax filings
Being employed	Main income is from being an employee, self-employed, director/major shareholder or otherwise active.	1999 - 2014	0/1 dummy	Socio-economic status
Self-employed	Main income is from entrepeneurship.	1999 - 2014	0/1 dummy	Socio-economic status
On benefits	Main income is from benefits.	1999 - 2014	0/1 dummy	Socio-economic status
Employer sector	Firm sector according to the 2008 Dutch SBI (Standaard Bedrijfsindeling), based on the NACE.	1999 - 2014	Categorical variable	Firm administration
ln(median firm wage)	Log of median daily wage for each firm across all years	1999 - 2014	log of euros / day	Firm administration
ln(median sector wage)	Log of median daily wage for each 5-digit sector across all years	1999 - 2014	log of euros / day	Firm administration
Age at graduation	Age at graduation.	1995 - 2014	in years	Municipal registry
Gender	Dummy if a person is female	1995 - 2014	0/1 dummy	Municipal registry
Ethnicity	Divided in native, western immigrant and non-western immigrant. Non-natives are all people for whom one parent is born in another country than the Netherlands.	1995 - 2014	Categorical variable.	Municipal registry
Living together	Being a part of a married or unmarried couple.	1995 - 2014	0/1 dummy	Municipal registry
Having kids	Being part of a married or unmarried couple with kids.	1995 - 2014	0/1 dummy	Municipal registry
Field of study (major)	Defined as	1995 - 2014	Categorical variable	Higher education degrees
Level of study	HBO (higher vocational education) and WO (university)	1995 - 2014	0/1 dummy	Higher education degrees

Notes: All data, except for the unemployment series, are administrative. The source indicates which data file was used. The higher education degree data consists of two files. One file contains information from 1986 until 2007 (we use 1995 - 1999) and the other one contains information from 2000 - 2014 (we use all years). The socio-economic status data contains an indicator for each person for their most important source of income, as defined by Statistics Netherlands.