Upper secondary school completion and the business cycle

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Abstract

Basic arguments from human capital theory and some empirical evidence suggest that enrolment in post-compulsory education increase (decrease) in cyclical downturns (upturns). However, little evidence exists on whether enrolment is successfully transformed into completed education. This paper adds to the literature by analysing the relationship between completion of upper secondary education and regional unemployment using Norwegian regional panel data on students graduating from compulsory school 1981 to 2004. While more than 90 percent of the students in each cohort enrol into upper secondary school, only around 70 percent have graduated 5 years afterwards. We find robust evidence that completion rates are countercyclical. Our results suggest that poor labor market conditions when starting upper secondary have a lasting effect and motivate students to stay in school and exert effort sufficient to graduate.

Key words: school completion, business cycles

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1. Introduction

Policymakers in many countries are concerned that a significant proportion of youth does not complete upper secondary education. To take an example, while 95 % of the student cohort in Norway finishing compulsory schooling in spring 2002 enrolled in upper secondary school the same fall, less than 70 % had completed upper secondary education five years after enrolment. In addition to possible detrimental effects on economic growth, high dropout rate affects income distribution as completion of upper secondary school in most countries is a prerequisite for further studies at universities and other higher education institutions. Further, unemployment incidence is high among dropouts. On this background, it is important to understand the forces affecting students' propensity to complete upper secondary education or not.

Some previous UK and U.S studies have found that the decision of young people to enroll in post-compulsory education is countercyclical, i.e. students are more (less) likely to enroll in periods with weak (strong) labor markets. Countercyclical enrolment have also motivated the use of regional unemployment rates at time of leaving compulsory school as instruments for schooling in studies of the returns to education as in Arkes (2010) and Carneiro et al (2011).

However, since the quantitative importance of the cyclical conditions varies a lot across studies and evidence is mostly based on UK and US data, separate studies of the relationship between post-compulsory schooling decisions and cyclical conditions in Scandinavian countries are warranted. Scandinavian countries are quite different from the UK and US in terms of labor market institutions and income distribution. First, wage bargaining is highly centralized with typically limited variation in wage rates across regions for similar workers. Accordingly, regional shocks are likely to generate variations in regional unemployment rather than variations in regional wages. Second, return to education is found to be much lower in Scandinavian countries than in UK and US.[1] Further, there is a significant amount of social transfers to people outside the labor market in the Scandinavian welfare states. The combination of small income differences, low returns to education and generous benefit levels may suggest that student educational choices are not driven by relative wage movements. On

[1] Trostel et al. (2002) report in their Table 1 returns to education for men equal to 0.07 and 0.13 in US and UK, while comparable numbers for Norway and Sweden is 0.02.

the other hand, limited regional wage flexibility may imply that quantity signals in terms of changes in unemployment are important, and the differences in institutional setup motivates for a separate investigation of the cyclical response in education choices in Scandinavian countries.

While most previous research has considered the relationship between local labor market conditions and enrolment in upper secondary education, this paper also adds to the literature by investigating to what extent business cycle conditions affect students' propensity to complete upper secondary education. Business cycles may affect completion rate if the composition of students entering upper secondary education in terms of ability and motivation varies cyclically. If rising participation during recessions increases enrolment of students with systematic lower cognitive and non-cognitive ability and weaker school motivation, the effect on completion rates might be low. However, business cycles might affect educational outcomes through at least two other channels. First, higher unemployment may act as a disciplining device and stimulate student effort as the potential costs of not completing given participation, is higher in a downturn than in an upturn[2]. Second, higher unemployment might increase teacher quality if high quality teachers leave (return to) teaching in business cycle upturns (downturns). Thus, if student performance responds to teacher quality, a countercyclical pattern in graduation propensity may occur even if participation is constant. In this paper we estimate the impact of unemployment on the propensity to complete upper secondary education using Norwegian register based regional panel data on cohorts of students graduating from compulsory school from 1981 to 2004. Thus, we analyze the impact of the regional labor market conditions at the time of finishing compulsory school on completion 5 years after.

A concern in Norway is the particular low completion rates among students enrolled in vocational tracks. In most of these tracks, commercial work in firms through an apprentice system is included in the two last years of the education program. Some commentators and politicians argue that lack of apprentice-training places is an important reason why completion rates are low among vocational students. As availability of apprentice-training places is likely to vary pro cyclically, this story suggests a negative association between

[2] This argument is similar to the positive relationship between work effort and unemployment assumed in standard efficiency wage models.

completion and unemployment for vocational students[3]. In particular, it suggests that unemployment rates during the second or third year after enrolling in vocational track would have a negative effect on the propensity to complete within expected time. Separate analysis of students enrolled in vocational and academic tracks enables us to investigate the empirical importance of this mechanism.

On the methodological side, our paper addresses the possibility that regional unemployment and education choices are jointly determined and also estimate model versions using the IV-method. The identification strategy explores the fact that Norway is heavily dependent on petroleum production located at the continental shelf outside the coast. We use movements in national petroleum investments interacted with exogenous variation in natural conditions for petroleum related activity combined with initial regional manufacturing employment share as instrument for the unemployment rate.

The period we use is well suited for an analysis of business cycle effects as the unemployment rate in Norway varied quite substantially during the 80's and 90's. Further, the variation in unemployment was not uniform across the country which enables us to use the within regional variation in unemployment to obtain credible estimates on the impact of business cycles on post-compulsory educational choices and outcomes.

The paper is organized as follows: Section 2 reviews the literature while Section 3 presents the institutional setup in Norwegian upper secondary education. Section 4 lay out the theoretical framework and empirical strategy. Empirical results follow in section 5. Section 6 concludes.

2. Previous literature on cyclical education decisions

Several studies examine the impact of business cycle conditions on post-compulsory education decisions. This section reviews this literature and is divided into three parts. The first part concentrate on studies of upper secondary school enrolment and the second part contains studies of higher education enrolment. The third part reviews related studies of the impact of business cycle effects at time of graduation on future labor market outcomes.

[3] Evidence in Askildsen and Nilsen (2005) and Høst et. al (2008) suggest that recruitment of apprenticeships in Norway is procyclical; i. e. increasing (decreasing) in periods with low (high) unemployment.

Upper-secondary education

Rice (1999), Card and Lemieux (2000), Black, McKinnish and Sanders (2005) and Clark (2011) examines the role played by labor market conditions in the decision of young people to invest in additional schooling. Taken together, their results suggest that young people's decisions to invest in post-compulsory education are countercyclical. Controlling for individual and family characteristics, Rice (1999) finds that a higher level of unemployment increases the probability of undertaking further education using data from England and Wales. Card and Lemieux (2000) and Clark (2011) using data from US states and English regions respectively, estimate regional panel data models to study the impact of labor market conditions. While Clark finds that youth unemployment has strong positive effects on enrolment in upper secondary education, Card and Lemieux (2000) find only a modest effect. Black, McKinnish and Sanders (2005) investigate the relationship between county enrolment and local labor market conditions in Kentucky and Pennsylvania using an IV approach. Using long term changes in the value of regional coal reserves as an instrument for county earnings in manufacturing industry, they obtain a negative and highly significant relationship between earnings of low skilled workers and upper secondary education enrolment.

Higher education

There are also related papers focusing on higher education, e.g. Fredriksson (1997), Dellas and Sakellaris (2003) and Bedard and Herman (2008). Fredriksson (1997) studies demand for university education in Sweden using aggregate time-series data. Using both aggregate unemployment and the unemployment rate for white-collar workers, Fredriksson (1997) finds a positive relationship between enrolment in universities and aggregate unemployment and a negative relationship between enrolment in universities and white-collar workers[4]. Dellas and Sakellaris (2003) study the cyclical behavior of college enrollment decisions in the US and uses the October supplement of the CPS to construct a time series of cross sections of 18-22-year-olds high school graduates. Controlling for individual specific characteristics, they find that the college enrolment decision follows a clear countercyclical pattern. Using state-specific unemployment instead of national gives the same result. Thus, their evidence suggests that the decision to enroll in college is strongly related to both the local and aggregate labor market conditions. While these studies analyze cyclical patterns in college

[4] Fredriksson (1997) uses the proportion of unemployed members of white-collar unemployment benefit funds to represent the employment probability of university graduates. The reason for this is that data on unemployment by education is likely to consist of measurement errors.

enrolment decisions generally, Bedard and Herman examine the impact of fluctuations in entry-level labor market conditions on graduate school enrolment decisions of newly minted undergraduate degree holders. Their results indicate that male PhD enrolment is countercyclical, male master degree enrolment is procyclical. Furthermore, their findings suggest that the cyclical responses differ between students within groups.

Other related studies

The present paper is also related to studies of the impact of labor market conditions at the time of labor market entry. Of special interest is a paper by Raaum and Rød (2006) using Norwegian register data. They find that a depressed local labor market when graduating from secondary schooling (age 16-19) have persistent negative and significant effects on labor market participation in adult life. They use a structural discrete choice panel data model to separate this net reduced form effect between the impact on education choices and the impact of direct entry experiences. They find no impact on educational attainment, while they find that high unemployment at age 16-19 cause students to delay graduation.

Using Canadian data, Oreopoulos et al (2008) find that graduating from college in a cyclical downturn has persistent but not permanent negative effects on future earnings. Kahn (2010) finds large and persistent negative wage effects of college graduation in a recession. Genda et al (2010) estimate the effect of entering labour market during a recession using data for men in Japan and the US. They find persistent negative effects on subsequent employment and earnings for low educated Japanese men, while the effect for low educated US men is only temporary. High educated men are less affected in both countries, and suggest that business cycle conditions at labor market entry affect income differences.

The overall impression from the studies reviewed is that enrolment in post-secondary schooling is countercyclical, but the quantitative importance of the cyclical variation varies a lot between studies. Moreover, evidence on the impact on completion rates is scarce and motivates our study of the impact of cyclical conditions on upper secondary completion rates in Norway.

3. Institutional background

The Norwegian educational system consists of compulsory seven year primary and three year lower secondary education. After finishing lower secondary education the students can either choose to leave education or enroll into different study tracks in upper secondary education. After completing the education program in one of these tracks, students get an upper secondary education diploma qualifying for further studies or certifying for work in a number of occupations.

Students enrol in two broad categories of study tracks: Academic tracks and vocational tracks. The general academic study track is the largest track and in recent years it has included about 40 percent of the total number of enrolled students. The academic study tracks are three year programs. Vocational study tracks include, e.g., industrial design, health and social work, mechanics, electrical trades and certify for work in a number of jobs, such as carpenter and electrician. These are three or four year programs and most of them include an apprentice system in the third and fourth year, where the training is combined with commercial work in firms. Most upper secondary schools, offer both vocational and academic study programs.

Municipalities are responsible for compulsory education. The municipalities are multi-purpose authorities, where compulsory education accounts for about 25 percent of the budget. Provision of upper secondary education is a county responsibility. Upper secondary education is the main service provided by the 19 counties in the country, and accounts for over 50 percent of total county spending. The counties are financed by grants from the central government and income taxes through the revenue sharing national tax system.

A potentially important reform was implemented in 1994, denoted “Reform 1994”, when youths were given a statutory right to enroll in upper secondary education in one out of three individually ranked study tracks, a rule that has been followed without exceptions by each county since then. Students have the right to five consecutive years of upper secondary education. Before this change, the students had no guarantee that they could enroll into upper secondary education. In addition, the reform implied that the general education content of vocational courses was increased in order to give students more possibilities to switch between vocational and academic tracks.

4. Theoretical background and empirical strategy

4.1 Theoretical background

A natural point of departure to understand education decisions is the standard theory on investment in human capital as originally formulated by Becker (1964) and Ben-Porath (1967). An updated discussion related to school dropout is given in Bradley and Lenton (2007) and Clark (2011). We therefore only sketch the main arguments and the implications for our empirical work.

Given perfect credit markets, the human capital model predicts that students choose to graduate from upper secondary school if the expected benefits are higher than the expected costs. The benefits are represented by the expected increase in lifetime income (wage premium), while costs consist of the expected foregone earnings when studying, direct costs in terms of tuition, transport and school material, the effort required to get a diploma, and the risk of failure. Expected wage premium and foregone earnings will depend on the likelihood of getting an unskilled job and the unskilled wage. In particular the less likely to get an unskilled job and the lower the unskilled wage, the higher is the expected wage premium and the lower is the foregone earnings related to further education. Thus, students are more likely to invest in further education in a recession than in a boom. This effect will be strong if the students are myopic or heavily discount the future, as the evidence in Oreopoulos (2007) suggests. In addition to this opportunity cost effect, education choices depend on other cost and benefit components and the information available on these costs and benefits. Information available at the time of decision making might depend on parental characteristics. In addition, high prior achievement is likely related to relatively high expected benefits and low expected costs.

While basic human capital theory suggests that investment in post-compulsory education is countercyclical due to the impact on students opportunity cost, allowing for imperfect credit markets imply that some families may become credit constrained in a downturn. To the extent that such constraints are not captured by other variables in the model, this partially implies a negative impact from total unemployment on the propensity to invest in further schooling. The impact of unemployment within the human capital framework is therefore ambiguous as it may also capture the effect of credit constraints. Because of this, some authors, including Clark (2011) suggest using the youth unemployment rate to identify the impact of business

cycle conditions on student enrolment choices. The choice of business cycle indicators is further discussed below.

While the standard human capital model offers a basic understanding of the relationship between business cycle conditions and school completion, at least two other mechanisms are potentially relevant. First, students' effort might respond to unemployment in the same way as workers effort increase with unemployment in conventional efficiency wage models. Empirical evidence supporting the positive worker effort-unemployment relationship is provided in Rebitzer (1987), Ackum Agell (1994) and Agell and Lundborg (1995). In our setting, higher unemployment may make students more "grateful" to be in school and thus increase students work morale and effort norms leading to increased propensity to complete upper secondary school.

Second, higher unemployment might increase teacher quality if high quality teachers leave (return to) teaching in business cycle upturns (downturns). Thus, if student performance responds to teacher quality, a countercyclical pattern in graduation propensity may occur even if participation is constant. Johansen, Falch and Strøm (2009) provide empirical support for countercyclical patterns in teacher shortages in lower secondary school in Norway in a system with completely centralized teacher pay scales. Evidence from other public sectors also suggests that centralized pay systems implies substantial variation across regions and over time in the quality of public workers. Carrell (2008) find that turnover of military personnel in US air force vary counter cyclically. Recent evidence from the UK health sector in Propper and Van Reenen (2010) suggest that hospital production falls as local labor market opportunities for nurses improves as the hospitals need to rely on lower quality personnel.

As far as we know, direct evidence on the impact of unemployment on student effort does not exist. Several studies summarized in Hanushek (2006) show that student performance depend heavily on teacher quality, but the literature does not present robust evidence to what extent teacher quality can be related to formal and observable teacher qualifications and characteristics. The US evidence may suggest that formal teacher education is a poor measure of teacher quality, but some recent analyses indicate that teacher credentials have an important impact on student achievement, see for example Clotfelter et al. (2007, 2009), Goldhaber (2007), and Goldhaber and Anthony (2007). Controlling for initial student performance in enrolment equations should to some extent account for both student effort and

teacher quality effects in addition to general changes in school quality. Clark (2011) finds that the estimated impact of regional unemployment on enrolment in England is very similar in specifications with and without controlling for initial academic achievement. These results give some evidence that cyclical movements in school and teacher quality and student effort is not able to explain the countercyclical pattern in enrolment decision.

4.2 Empirical strategy

To investigate business cycle impacts on upper secondary school completion, we aggregate individual data on graduation, student and family characteristics of the cohorts leaving compulsory school in year t into regional averages and combine these regional aggregates with information on regional unemployment rates and other regional characteristics. To be specific, we formulate a linear model (1), where $\overline{G}_{j,t+5}$ is the share of students in region j that have graduated from upper secondary 5 years after finishing compulsory school. Defining the completion rate in this way allow us to analyze the combined effect of labor market conditions when leaving compulsory school on immediate enrolment and subsequent successful transition through upper secondary school. The variable of interest is UN_{jt}, the regional unemployment rate the year the students finish compulsory school. $\overline{X}_{jt}$ is a vector of average regional family and student characteristics of the same cohort with corresponding coefficient vector b_2 while Z_{jt} is a vector of other region specific variables that may affect the graduation propensity with corresponding coefficients b_1. c_j and d_t are region and cohort fixed effects that capture permanent differences in completion propensity across regions, and cohort specific changes, respectively and ε_{jt+5} is a random error term.

(1) $$\overline{G}_{jt+5} = aUN_{jt} + Z'_{jt}b_1 + \overline{X}'_{jt}b_2 + c_j + d_t + \varepsilon_{jt+5}$$

To the extent that regional business cycles are serially correlated, the estimated impact of unemployment when leaving compulsory school may capture the impact of labour market conditions after enrolling into upper secondary. To capture this possibility, we also estimate

model versions extended with regional unemployment rates three subsequent periods after leaving compulsory school, i.e. we extend (1) into: [5]

$$(2)\ \overline{G}_{jt+5} = aUN_{jt} + a_1 UN_{jt+1} + ... + a_3 UN_{jt+3} + Z'_{jt} b_1 + \overline{X}'_{jt} b_2 + c_j + d_t + \varepsilon_{jt+5}$$

In this version, the estimated impact of unemployment when leaving compulsory school on education outcome 5 years later is net of the effect of persistent labor market conditions.

The inclusion of cohort effects is important in models (1) and (2) as they capture the impact of national trends and changes in national regulations of upper secondary education, as the reform in 1994 (discussed in more detail in section 3 above). Further, inclusion of fixed regional effects is crucial to obtain credible evidence on the effect of unemployment. If unemployment tends to be high in areas where youth's investment in education is permanently low for some geographical or other unobserved reason, estimating the models without fixed effects would generate a negative spurious impact of unemployment on the probability to complete upper secondary education. To account for smooth regional specific changes in the dependent variable, we also extend the models with linear regional trends.

So far, we have assumed that business cycle conditions have symmetric impact on school completion, i.e. the impact in absolute value of an unemployment increase is equal to the impact of an unemployment decrease. An interesting question is whether the impact differs in magnitude between downturns and upturns. To answer this question, we formulate a simple extension of the model in equation (1).

$$(3)\quad \overline{G}_{jt+5} = a_1 UN_{jt}^{+} + a_2 UN_{jt}^{-} + + b_1 Z'_{jt} + b_2 \overline{X}'_{jt} + c_j + d_t + \varepsilon_{jt+5}$$

where

$$UN_{jt}^{+} = \begin{cases} U_{jt} \text{ if } UN_{jt} \geq UN_{jt-1} \\ 0 \quad \text{if } UN_{jt} < UN_{jt-1} \end{cases}$$

$$UN_{jt}^{-} = \begin{cases} U_{jt} \text{ if } UN_{jt} < UN_{jt-1} \\ 0 \quad \text{if } UN_{jt} \geq UN_{jt-1} \end{cases}$$

[5] Oreopoulos et al (2008) use the same procedure in their analysis of the impact of unemployment at college graduation on labour market performance up to 10 years later.

In this model the conditional mean of the completion rate is allowed to follow different paths depending on whether unemployment is decreasing (UN_{jt}^{-}) or increasing (UN_{jt}^{+})[6]. In this formulation a_1 is interpreted as the impact on completion of an unemployment increase, while a_2 is the impact of an unemployment reduction. The formulation contains the symmetric response as a special case with the restriction $a_1 = a_2$, which can easily be tested.

A causal interpretation of unemployment effects in models with regional and cohort fixed effects requires that within region unemployment fluctuations, eventually net of linear regional trends, are uncorrelated with the idiosyncratic error term in the model. This may be a too restrictive assumption. It is often argued that youth unemployment rates should be used in analysis of business cycle effects on educational outcomes since total unemployment might capture a negative relationship between unemployment and enrolment resulting from more students being credit constrained in the education market, see Clark (2011). While the youth unemployment rate may be more likely to isolate the opportunity cost of schooling, it is also likely to introduce a simultaneity problem as more students leaving after compulsory school may increase youth unemployment and give a biased estimate on the relationship between completion and youth unemployment. Further, the extent of measurement error may be more important for the youth unemployment rate than for total unemployment. Thus, the choice between total unemployment rate and youth unemployment as our business cycle variable is not obvious and we present model results using both measures in the result section.

Leaving aside the choice of youth versus total unemployment, other mechanisms may suggest that completion have a negative effect on unemployment. For instance, decreasing educational quality in terms of lower completion rate in a region may lead businesses to move activity and investments away from that region and thus create higher unemployment. This would generate a downward bias in the estimated impact of unemployment on education attainment even in models with fixed regional and cohort effects.

An attractive solution is to use an instrumental variable approach. Since pure exogenous regional shocks are rarely available, another approach is to use nationwide variables interacted with initial regional conditions as instrumental variables. This is based on the

[6] The same modeling approach is used in Mocan and Bali (2010) in their investigation of asymmetric responses of crime to changes in regional unemployment

simple idea that macroeconomic shocks can have very different impact in different regions, see Blanchard and Katz (1992). IV-strategies based on such arguments have recently been applied in studies of the impact of regional unemployment on criminal activity as in Gould et al. (2002), Öster and Agell (2007) and Lin (2008).

A special feature of the Norwegian economy is the role played by the petroleum sector. In addition to the contribution to national revenue in terms of government income, the petroleum sector has a substantial direct effect on domestic demand for labor and other inputs[7]. Since the start of the petroleum activities on the Norwegian continental shelf in late 1960's, vast amounts have been invested in exploration, field development, transport infrastructure and onshore facilities. Investment in the petroleum sector is considered a key determinant of aggregate demand fluctuations. We exploit the fact that some parts of the country are more likely to be affected by aggregate changes in petroleum investments than others. As all Norwegian oil and gas resources are located at the continental shelf, most firms supplying goods to the petroleum sector is located by the coast. As an example, during the last 30 years, regions initially concentrating on shipbuilding and related activity has shifted towards supplying investment goods to the petroleum sector.

Based on these arguments we estimate models where we instrument the regional unemployment rate by national investment in field development interacted with the length of the costal line in the region multiplied by employment share in manufacturing industry in 1980. We also take into account the fact that different parts at the Norwegian coast was exposed to petroleum investments at different points in time, by including dummy variables that describes in what periods different parts of Norway have been exposed to petroleum activity. The intuition for the instrument is that an increase (decrease) in petroleum investments means a larger decrease (increase) in unemployment in regions with a long coastal line and a high intial share of employment in industries relevant for production of investment goods to the petroleum sector. Our approach shares similarities to the use of national movements in coal prices interacted with county differences in coal reserves as instruments for county movements in long term return to high school education in Black, McKinnish and Sanders (2005). The idea that some regions are more exposed to exogenously driven movements in oil production also motivates Acemoglu et al. (2009) to use initial

[7] See Dyrstad (1987) for an interesting early study of the impact of petroleum activity on labor market performance in Norway.

regional oil resources interacted with national oil price movements as instrument for regional income in a study of the impact of income on US health expenditure.

The identifying assumption is that in the absence of movements in petroleum investments, the development of upper secondary school completion in regions with varying initial exposition to petroleum activity would be equal conditional on other exogenous variables. Any permanent differences and different trends in completion rates between areas with different initial conditions would be captured by the regional fixed effects and linear trends.

A tricky, but often overlooked issue in studies of schooling decisions is the role of supply constraints. Supply constraints (study places) may have been binding and determining the share of students enrolling and subsequently completing upper secondary school. Thus, to some extent an estimated relationship between education outcomes and unemployment may reflect variation in supply constraints rather than student choices if the extent of regional supply constraints is correlated with regional unemployment. Inclusion of cohort size is one way to control for possible confounding effects of supply constraints. Another approach to address the problem with supply constraints is to estimate the model using the cohorts graduating from compulsory school 1994-2004, i.e. using only the cohorts who had a statutory right to enroll into upper secondary education. A drawback of this approach is that it drastically shortens the available series in the time dimension, thus giving limited possibilities to identify effects of unemployment when leaving compulsory school and at the same time controlling for regional trends and the full labor market history in the region.

The model described in (1) and (2) captures the combined effect of unemployment on completion through the initial enrolment decision and subsequent decisions to continue in upper secondary school and finally graduating and obtain a diploma. An interesting issue is to what extent business cycle conditions when leaving compulsory school works through the enrolment decision or whether such conditions have impact on subsequent continuing and graduation. To isolate the impact of business cycle conditions conditional on being enrolled, we therefore estimate models for the completion rates for those students that actually enrolled into upper secondary schools the same year they finished compulsory school and consider possible differences between students initially enrolled in academic and vocational tracks.

Separate analysis of students enrolled in vocational tracks enables us to investigate whether lack of apprentice training places contributes to the low completion rates of vocational students.

4.3. Data

The student data are based on register data obtained from Statistics Norway and consist of individual information of all students finishing compulsory lower secondary education in the period 1981-2004. The student information is matched with information of their parents, and includes identifiers of students' residence region at age 16. We focus on the individuals graduating from lower secondary school at normal age, i.e. those graduating in the year they are 16 years old, which comprise more than 95 % of the total population. The individual data is aggregated to the regional level. Based on worker commuting statistics, Statistics Norway has classified 90 different labor market regions consisting of 4.8 municipalities on average. We use these regions as our geographical units instead of municipalities since it is likely that local labor market areas go beyond municipal borders, especially since many Norwegian municipalities are small with a population below 5000 inhabitants. Detailed definitions of variables and details on the data reduction are shown in Appendix 1. Table 1 presents descriptive statistics of the sample used in the analyses.

Our main outcome variable is the completion rate, i.e. percentage share of students living in economic region j when finishing compulsory school that have graduated from upper secondary school 5 years later. Subsequently, we also use as dependent variable the completion rate for the students that actually enrolled in upper secondary school the same fall they finish compulsory school.

Regional unemployment

Total unemployment rate is defined as the number of registered persons registered at the employment offices (NAV) as unemployed divided by the number of inhabitants 16-66 years of age living in the economic region in year t. We also construct a youth unemployment series defined as the number registered unemployed 20-24 years old divided by the number of inhabitants 20-24 years old.

Control variables

There is a substantial literature documenting the effect of individual characteristics and family background variables on individual education outcomes. To capture the impact of such characteristics, we include the share of girls, the shares of students with parental highest education at the upper secondary level, short higher education and long higher education, respectively and the shares of first and second generation immigrants. We expect that parental education has a positive effect on enrolment and completion in upper secondary education. Although Falch and Strøm (2011) find that this variable has a significant impact on student progression in Norway, they show that the effect size depends on whether prior ability is included in the model, consistent with the findings in Belley and Lochner (2007). Falch and Strøm (2011) find that 2. generation immigrants are more likely to have expected progression in upper secondary school than native students. This result is consistent with the finding in Belley and Lochner (2007) and Cameron and Heckman (2003) that minorities are less likely to drop out, and they aquire more schooling.

We further include the total population as well as the share of young people (16-24 years old) in a region to account for possible impacts of demographic shifts in the regions. The expected sign of the impacts of these variables are not easy to determine a priori. One possible mechanism is that population growth in the region implies more competition for jobs. Thus, if total population or the share of young people in a region increases, job competition increase and increase the attractivity to continue in school. However, a growth in total population or population share of young people in a region, may also indicate in migration of people because more jobs are available and thus decrease incentives to invest in further education.

We also include cohort size at regional level. The reason for this is that shifts in cohort size may affect the per student supply of education resources, and ultimately the amount of education acquired by members of smaller versus larger cohorts. This variable may account for the possibility that students in larger cohorts are 'crowed out' of upper secondary school if the capacity of the education system or the resources spent on education does not expand as rapidly as the student-age population[8].

[8] Card and Lemieux (2001) and Bound and Turner (2007) find that larger cohort sizes in US states leads to lower educational attainment, consistent with the "cohort crowding" hypothesis.

Figures 1 shows the development in upper secondary completion rates for the cohorts finishing lower secondary school 1981-2004 and the total unemployment rate. It shows an increasing trend in completion towards the early 1990's, starting at a rate around 50% for the 1981-cohort and approaching 65% for the 1993 cohort and fluctuating around that level in the remaining period. While we observe a slight fall in the completion rate in the period 1993-1995, when there was a sharp fall in the unemployment rate, the national fluctuations does not reveal any clear association between unemployment and upper secondary school completion. However, national trends may to some extent reflect the national policy to expand post-compulsory education culminating in the formal reform in 1994 giving all youth statutory right to enroll in an upper secondary school program. Using regional unemployment rates enables us to control for such national events by cohort fixed effects.

Table 1 gives further descriptive statistics for the variables. Of special interest is the variation in completion rates and the unemployment rates. The final column shows the standard deviation that remains after netting out the impact of fixed regional effects and cohort effects. Average completion rate equals 64%, but the rates vary substantially in the sample with a minimum of 28% and a maximum of 87%. The table also shows that approximately16 % of the total variation in completion rates remains after accounting for fixed region and cohort effects. Average total unemployment (youth unemployment) is 2.6% (5.3%) and varies quite substantially with minimums of 0.15% (0.88%) and maximum of 6.9% (13.1%). After netting out fixed regional effects and fixed cohort effects, 19% and 14% of the total variation (squares of the reported standard deviations) in total and youth unemployment rates, respectively, remains.

5. Empirical results

In this section we present results for the relationship between upper secondary education completion and business cycle conditions using a number of empirical specifications. The models estimated in Sections 5.1 and 5.2 uses as dependent variable the percentage share of all students living in economic region j and leaving compulsory school in spring year t that have graduated from upper secondary school 5 years afterwards. To isolate the impact of business cycle conditions conditional on being enrolled, we estimate in Section 5.3 models for the completion rates for those students that actually enrolled into upper secondary schools the

same year they finished compulsory school. We also allow the effects to differ between students enrolled in academic and vocational tracks.

5.1 Completion rate

Total unemployment as business cycle indicator

Table 2 presents estimation results for equation (1) when we use total unemployment as the variable of interest. For comparison purposes, column (1) shows the estimates when controlling for student composition and regional variables, and cohort effects, but without regional fixed effects. This simple specification produces a highly significant and negative unemployment effect. However, excluding fixed regional effects would probably generate a spurious relationship because of unobserved time-invariant regional factors affecting both regional unemployment and the probability to complete upper secondary education.

Column (2) reports estimates from a model that includes regional fixed effects. In this specification the effect of unemployment is significant and positive. We also estimate a version with linear regional trends to account for secular regional specific changes in the completion rate with results presented in column (3). The unemployment effect is a bit higher than in the model without linear regional trends and significant at a one percent level. According to the result in column (3) a one percentage point increase in unemployment increases the completion rate by approximately one percentage point, implying an elasticity of 0.04 evaluated at sample means of the variables.

A possible problem with the specifications so far is that unemployment when finishing compulsory school may capture the impact of unemployment in later periods to the extent that unemployment rates are serially correlated. Thus, column (4) shows the estimates corresponding to equation (2) which controls for subsequent regional unemployment rates, while column (5) adds linear regional trends to this specification. However, these specification changes do not substantially change the estimated impact of unemployment in the year of finishing lower secondary school. The estimated effects are still positive and significant at the five percent level. The model specification used in column (5) indicates that a one percentage point increase in the regional unemployment rate in the year the students finish compulsory school increases the regional completion rate by nearly 0.9 percentage points implying an elasticity approximately equal to 0.04. This is a small effect compared to

the elasticity of 0.3 found in Clark (2011) for England, but more comparable in size to studies from US.

A possible concern is the role of migration. If families with different education and school motivation differ systematically in their locational responses to regional labor market shocks, this could bias our estimates. For instance, if high educated and highly school motivated families are more likely than other families to move out of the region in response to a negative labor market shock, this could generate a partial negative relationship between completion and regional unemployment. To address this issue, we also estimated models equal to model (1) and (2) in section 4 aggregated to the 19 counties in Norway. This aggregation will remove the potential migration bias to the extent that migration occurs between regions within counties. The numerical effects of unemployment on completion did not change very much using this specification although the estimates lose precision due to the large reduction in observations. We take this as evidence that the migration issue is of little importance [9].

Youth unemployment as business cycle indicator

As noted in section 4.2, it has been argued that youth unemployment is a better indicator of the opportunity cost effect for student decisions than total unemployment and we also estimate equation (1) using youth unemployment as the variable of interest. The estimation results for this model specification are reported in Table 3. Unfortunately, we only have data for youth unemployment for the period 1990-2004. When we estimate a model that includes cohort effects and region effects (column 2 in Table 3), the youth unemployment effect is positive and significant at a five percent level. The estimated coefficient implies that a one percentage point increase in youth unemployment increases the regional completion rate by 0.4 percentage points. The coefficient is about one half of the coefficient obtained when using total unemployment, but since the youth unemployment is on average almost twice as large as total unemployment, the implied elasticity evaluated at sample means is quite similar to that found for total unemployment.

[9] Estimating models at county level gives us the following estimates on the effect of unemployment on completion of upper secondary education, 0.596 (0.669), 0.802 (0.628), 0.640 (0.789) and 0.784 (0.733) corresponding to the models presented in column (2), (3), (4) and (5) in Table 2, respectively. Estimated standard errors adjusted for clustering at county level are in parenthesis.

When we include subsequent regional unemployment rates in column (3), and a linear regional trend in column (4), the effect of youth unemployment on the regional completion rate still becomes positive but is no longer significant. This is not surprising since the time period (1990-2004) is short relatively to the large amount of variation in data required to isolate the impact of unemployment in the year finishing compulsory school in these model versions. Further, it is likely that the measurement error is more important in youth than in total unemployment rate and the resulting bias towards zero in the estimated coefficient may be large, especially in specifications with regional specific trends.

Asymmetries and teacher quality effects

Table 4, column (1) and (2) reports the results from estimating models allowing for different impacts of increasing and decreasing unemployment rates corresponding to equation (3) above. The estimated coefficients for the two unemployment terms are very similar to the earlier estimated effects and the null-hypothesis of symmetric response cannot be rejected (p-value 0.47 and 0.66 in the specification without and with linear regional trends respectively).

Above, we also argued that cyclical enrolment and graduation patterns may capture the impact of teacher quality to the extent that teacher turnover respond to business cycle conditions. As a simple way to investigate this hypothesis we include a teacher shortage variable measured by the percentage share of non-certified teachers in compulsory school in the region, see Johansen, Falch and Strøm (2009) for detailed definition of this shortage variable[10]. This variable is available for the period 1981-2002 and the results are shown in column (3). It turns out that the direct effect of unemployment on completion rate is qualitatively the same, although somewhat lower numerically and less precisely estimated. Further, the separate impact of teacher shortages is negative and significant at the 10-percent level and the point estimate implies that 1% point increase in the share of non-certified teachers in compulsory school decrease the share of students completing upper secondary by 0.13 % points. However, we conclude that although teacher shortages appear to have a separate effect on completion, it does not seem to explain much of the business cycle pattern in completion.

[10] Ideally, we should control for teacher shortages in upper secondary schools, but unfortunately this information is not available. However, if teachers supply behavior over the cycle is similar in different school types, our variable should capture variation in teacher quality in upper secondary schools.

Pre and post-reform results

A potential problem with the interpretation of our unemployment effects is the role of rationing of study places in upper secondary school. After 1994, all students 16-19 years old are given a legal right to be enrolled into one out of three individually ranked study tracks in a county, thus potential rationing of study places should be less of a problem from 1994 on. We therefore estimate separate models for the cohorts leaving compulsory school between 1981 and 1993 and for the cohorts leaving between 1994 and 2004 and the results are presented in Table 5. The effects before and after the reform are quite similar, although the numerical effect is a bit higher during the last period (0.81 and 1.17, respectively). However, evaluated at sample means in the two periods, the elasticity of completion with respect to unemployment equals 0.04 in both periods[11] .

Summing up, the baseline results show that completion of upper secondary education seems to be counter-cyclical although the quantitative effect is moderate. A one percentage point increase in the total unemployment rate increases the regional completion rate by approximately 0.7 percentage points. To put this result in context, the total regional unemployment rate standard deviation is 1.13 percentage points. Thus, one standard deviation increase in unemployment implies a 0.8 percentage points increase in the regional completion rate. The mean regional completion rate is 64 percent, so this result translates into a 1.25 percent increase in the regional completion rate.

5.2 Completion rate. IV-results

Above, we argued that joint determination of education outcomes and regional unemployment is likely to give a downward bias in estimated unemployment effect on upper secondary completion and proposed an IV-strategy. To construct our instrumental variables we use data for the length of the coastal line (measured in kilometers) in each region and the share of employment in manufacturing industry in 1980. Thus we specify an instrumental variable defined as total national investment in field development multiplied by the share of manufacturing employment in 1980 interacted with the coastline share of total area in the region. To take into account the fact that exposure to petroleum activity evolved in a certain pattern over time we define instruments which are interactions between the basic instrument

[11] For the period 1981-1993, the average percentage completion and unemployment rates are 60.07 and 2.61, respectively. For the period 1994-2004 the corresponding numbers are 69.40 and 3.13

and dummy variables for when different parts of the country were exposed to petroleum activity. Initially, petroleum exploration were concentrated to the south-western part of the country and hence we define a dummy variable "Southwest80" equal to 1 in the whole period 1980-2004 for the counties Rogaland, Hordaland and Sogn og Fjordane to indicate that this region was exposed to petroleum activity in the whole period. We define a dummy denoted "Northwest90's"for the period 1990-2004 for the counties Møre og Romsdal, Sør-Trøndelag, Nord-Trøndelag and the southern part of Nordland to indicate that the coast outside these counties were exposed for petroleum activity from 1990[12]. This procedure gives us the following set of instrumental variables.

$$Instrument1 = \left(manufact\ industry_{j1980} \times \frac{Coastline_j}{acreage_j} \times Investment\ field\ development_t \right) \times Southwest80$$

$$Instrument2 = \left(manufact\ industry_{j1980} \times \frac{Coastline_j}{acreage_j} \times Investment\ field\ development_t \right) \times Northwest90$$

Table 6 shows the estimates obtained when instrumenting the unemployment rate with interactions between initial petroleum exposure and movements in national petroleum investments. The first stage results in column (1) suggest that the instruments do a fairly good job to explain unemployment fluctuations with an F-value equal to 13.4. The estimated unemployment coefficient in the second stage is much larger than our previous estimates, although it is less precisely estimated. The point estimate implies that a 1% point increase in unemployment leads to around 3% point increase in completion rates. This translates into an elasticity of completion with respect to unemployment equal to 0.12 evaluated at sample means. These results suggest that the previous estimates may be interpreted as lower bounds on the causal effect of unemployment on completion.

5.3. Completion conditional on enrolment

Table 7 reports results from completion equations estimated on the sample of students that actually enrolled in upper secondary school the same year as they finished compulsory school.

[12] Figure 1 in the appendix shows which regions in Norway that is included in the Southwest80 and Northwest90, respectively.

Column (1) shows the results for the total sample of these students, while column (2) and (3) shows results from separate models estimated for students enrolled in academic and vocational track, respectively. We first note that the unemployment effect in year t in Column (1) is significantly positive and the coefficient of 0.79 is very similar in magnitude to that estimated in previous models with all students finishing compulsory school in year t. This indicates that the impact of unemployment in year t does not work through the enrolment channel. Second, the positive impact of unemployment in the same year as enrolling into upper secondary school is clearly most important for students enrolled in vocational track with an estimated coefficient equal to 1.06 and highly significant (column (3)). The effect is numerically small and not significantly different from zero for students in academic track.

The finding of a relatively strong positive effect in vocational track combined with no effects from unemployment rates during the subsequent years suggest that availability of apprentice-training places during the vocational study programs is of little importance for completion or not. Rather it suggests that poor labor market conditions when starting upper secondary have a lasting effect and motivates students to stay in school and exert effort sufficient to graduate. The implied elasticity of completion with respect to unemployment for vocational track students equals 0.05, evaluated at sample means. The stronger effect of unemployment on completion rates for students in vocational track is consistent with the hypothesis that the disciplining effect of labor market opportunities is most important for those students most likely to be on the margin of continuing or dropping out.

6. Concluding remarks

Previous studies from US and UK suggest a countercyclical pattern in enrolment into upper secondary education. However, little is known whether such enrolment patterns translate into countercyclical patterns in completed upper secondary education. The paper estimates the impact of business cycles on student's propensity to graduate from upper secondary school using regional panel data 1981-2004 from Norway. We find that students finishing compulsory school in a downturn are more likely to have completed upper secondary school five years afterwards. While this result holds in a number of specifications and using different time periods, the estimated magnitude of the response is relatively moderate in most models. The estimates from baseline models controlling for fixed regional and cohort effects suggest

an elasticity of completion with respect to regional unemployment around 0.04. This should however be interpreted as a lower bound on the causal effect since our instrumental variable estimates suggest an elasticity equal to 0.12. Estimates using only students enrolled into upper secondary the same year they finished compulsory school gives a very similar pattern. Further, the positive impact on completion is most prevalent among students enrolled in vocational tracks. The results suggest that unemployment is of little importance for the initial enrolment decision. Rather they suggest that poor labor market conditions when starting upper secondary have lasting effects and motivate students at the margin of dropping out to stay in school and exert effort sufficient to graduate.

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Data definitions and sources.

Dependent variables:
Completion rate: % share of students finishing compulsory school in spring year t living in region j and 16 years old that have graduated from upper secondary school 5 years later. Source: Data supplied by Statistics Norway and aggregated by authors

Enrolment rate: % share of students finishing compulsory school in spring year t registered as students in upper secondary school in autumn year t.
Source: Individual data supplied by Statistics Norway and aggregated by authors.

Explanatory variables:
Percent regional unemployment rate: The average number of unemployed persons registered at the employment offices each year divided by the number of persons aged 16-66 31. December each year from 1981 to 2004. Source: NSD.

Percent regional youth unemployment rate: The average number of unemployed persons aged 20-24 registered at the employment offices each year divided by the number of persons aged 20-24 31. December each year from 1990 to 2004. Source: NSD.

Percent of regional population aged 15-24: The average number of 15-24-years-old in a region divided by the total regional population 31. December each year 1981-2004. Source: NSD

Population: The total population in each region measured at 31. December each year 1981-2004. Source: NSD

Teacher quality: The number of teachers without approved education divided by the total number of teachers in primary and lower secondary schools in each region. Registration date is 1. October each year. Source: NSD

Student characteristics:
Share of High School Education: Share of students with at least one parent with a high school degree as their highest education. Source: Individual data supplied by Statistics Norway and aggregated by authors.

Share of Bachelor Degree: Share of students with at least one parent with a bachelor degree as their highest education level.
Source: Individual data supplied by Statistics Norway and aggregated by authors.

Share of Master or Doctoral Degree: Share of students with at least one parent with a master or doctoral degree as their highest education level. Source: Individual data supplied by Statistics Norway and aggregated by authors.

Share of Girls: Share of female students. Source: Individual data supplied by Statistics Norway and aggregated by authors.

Share of Immigrants, first generation: Share of students born abroad with both parents born in country outside Norway. Source: Individual data supplied by Statistics Norway and aggregated by authors.

Share of Immigrants, second generation:
Share of students born in Norway, with both both parents born in country outside Norway. Source: Individual data supplied by Statistics Norway and aggregated by authors.

Instrumental variables:
The instrumental variables consists of the three following components.

Percent employment in manufacturing industries 1980:
The average number of persons employed in manufacturing industries divided by the number of persons aged 16-66 31. December 1980. Source: NSD

Measure of coastline: Number of kilometers coastline on mainland and islands divided by acreage in each region. 2003. Source: NSD

Investment in field development: Total investments in field developments each year 1981-2004 measured in Norwegian currency. Source: Statistics Norway.

Table 1. Descriptive Statistics for the aggregate regional panel data set

Variables	Obs	Min	Max	Mean	S.D	S.D. net of Fixed Effects
Regional completion (Percent)	2160	27.84	86.70	64.35	10.05	4.22
Subsamples:						
Completion rate for students enroled year t	2160	36.45	88.26	68.86	7.73	4.41
Completion rate for students enroled year t, academic	2160	29.70	100	85.53	7.60	5.51
Completion rate for students enroled year t, vocational	2160	16.22	84.78	54.41	10.57	5.76
Regional unemployment rate:						
Total unemployment rate (16-66) pct	2160	0.16	6.89	2.64	1.13	0.49
Youth unemployment (20-24) pct years 1990-2004	1350	0.81	13.06	5.26	2.15	0.81
Share of inhabitants 15-24 years old	2160	10.32	19.61	14.37	1.79	0.61
# of inhabitants	2160	5562	521886	47809	67839	4289
Cohort Size	2160	46	4846	609.78	731.80	74.36
Teacher shortage	1980	0	33.78	5.31	4.33	2.28
Parents' highest education level:						
High School share	2160	0.25	0.78	0.56	0.07	0.04
Bachelor Degree share	2160	0.03	0.42	0.20	0.06	0.03
Master or Doctoral degree share	2160	0	0.31	0.06	0.04	0.01
First Generation Immigrant share	2160	0	0.14	0.01	0.01	0.008
Second Generation Immigrant share	2160	0	0.14	0.003	0.009	0.006
Girl	2160	0.36	0.62	0.49	0.03	0.03
Instrumental variables:						
Instrument 1	2160	0	1195.99	28.89	105.57	
Instrument 2	2160	0	2379.08	44.36	191.25	

Notes: Sample period is 1981-2004, unless otherwise is specified. Standard deviations net of fixed effects is computed by taking standard deviations of residuals from regression of the variable in question on region and cohort fixed effects.

Table 2. Completion results. Regional Panel Data. 1981-2004

VARIABLES	(1) Completion	(2) Completion	(3) Completion	(4) Completion	(5) Completion
Total unemployment	-0.861***	0.655**	0.964***	0.696**	0.882***
	(0.303)	(0.301)	(0.318)	(0.314)	(0.331)
Control variables	Yes	Yes	Yes	Yes	Yes
Cohort fixed effects	Yes	Yes	Yes	Yes	Yes
Regional fixed effects	No	Yes	Yes	Yes	Yes
Linear regional trends	No	No	Yes	No	Yes
Control for subsequent unemployment	No	No	No	Yes	Yes
Observations	2,160	2,160	2,160	2,160	2,160
R-squared	0.707	0.834	0.854	0.835	0.855

Note: Robust standard errors adjusting for clustering at regional level in parentheses.
*** p<0.01, ** p<0.05, * p<0.1

Table 3. Completion results. Youth unemployment. Regional Panel Data. 1990-2004

	(1)	(2)	(3)	(4)	(5)
VARIABLES	Completion	Completion	Completion	Completion	Completion
Youth unemloyment	-0.562***	0.422**	0.112	0.331	0.129
	(0.203)	(0.201)	(0.226)	(0.209)	(0.248)
Control variables	Yes	Yes	Yes	Yes	Yes
Cohort fixed effects	Yes	Yes	Yes	Yes	Yes
Regional fixed effects	Yes	Yes	Yes	Yes	Yes
Linear regional trends	No	No	Yes	No	Yes
Control for subsequent unemployment	No	No	No	Yes	Yes
Observations	1,350	1,350	1,350	1,350	1,350
R-squared	0.410	0.701	0.738	0.702	0.738

Note: Robust standard errors adjusting for clustering at regional level in parentheses.
*** p<0.01, ** p<0.05, * p<0.1

Table 4. Completion results allowing for assymmetric unemployment effects and teacher effects. Regional Panel Data. 1981-2004

VARIABLES	(1) Completion	(2) Completion	(3) Completion	(4) Completion
Total unemployment (incr)	0.669**	0.979***	-	-
	(0.295)	(0.311)		
Total unemployment (decr)	0.744**	1.061***	-	-
	(0.321)	(0.332)		
Total unemployment	-	-	0.511	0.618*
			(0.313)	(0.335)
Teacher shortages	-	-	-0.0933	-0.129*
			(0.0661)	(0.0733)
Control variables	Yes	Yes	Yes	Yes
Cohort fixed effects	Yes	Yes	Yes	Yes
Regional fixed effects	Yes	Yes	Yes	Yes
Linear regional trends	No	Yes	No	Yes
Controlling for subsequent unemployment	No	No	No	No
Observations	2,160	2,160	1,980	1,980
F-statistics (p-value)	0.52 (0.4726)	0.66 (0.4194)	-	-

Note: Robust standard errors adjusting for clustering at regional level in parentheses.
*** p<0.01, ** p<0.05, * p<0.1

Table 5. Completion results. Regional Panel Data. 1981-1993 and 1994-2004.

VARIABLES	(1) Completion 1981-1993	(2) Completion 1994-2004
Total unemploymemt	0.811**	1.167**
	(0.375)	(0.458)
Control variables	Yes	Yes
Cohort fixed effects	Yes	Yes
Regional fixed effects	Yes	Yes
Linear regional trends	No	No
Controlling for subsequent unemployment	No	No
Observations	1,170	990
R-squared	0.864	0.731

Note: Robust standard errors adjusting for clustering at regional level in parentheses.
*** p<0.01, ** p<0.05, * p<0.1

Table 6. Completion results. IV-method. Total unemployment. Regional panel data 1981-2004.

VARIABLES	(1) First stage Unemployment	(2) Second stage Completion
Total unemployment		2.976*
		(1.766)
Instrument 1	-0.00108*	
	(0.000589)	
Instrument 2	-0.000469**	
	(0.000236)	
Control variables	Yes	Yes
Cohort fixed effects	Yes	Yes
Regional fixed effects	Yes	Yes
Linear regional trends	Yes	Yes
Controlling for subsequent unemployment	No	No
First stage F-value	13.396	
Observations	2,160	2,160
R-squared	0.868	0.848

Note: Robust standard errors adjusting for clustering at regional level in parentheses.
*** p<0.01, ** p<0.05, * p<0.1

Table 7. Completion results using only students enrolled same year as completing compulsory education. Regional Panel Data. 1981-2004

VARIABLES	(1) Total Completion	(2) Academic Completion	(3) Vocational Completion
Total unemploymemt, t	0.789***	-0.0780	1.063***
	(0.319)	(0.496)	(0.382)
Total unemployment, t+1	-0.166	0.314	-0.155
	(0.412)	(0.548)	(0.434)
Total unemployment, t+2	0.556	0.778	0.149
	(0.351)	(0.473)	(0.504)
Total unemployment, t+3	0.0492	0.0965	0.221
	(0.294)	(0.391)	(0.411)
Control variables	Yes	Yes	Yes
Cohort fixed effects	Yes	Yes	Yes
Regional fixed effects	Yes	Yes	Yes
Linear regional trends	Yes	Yes	Yes
Observations	2,160	2,160	2,160
R-squared	0.740	0.547	0.7

Note: Robust standard errors adjusting for clustering at regional level in parentheses.
*** p<0.01, ** p<0.05, * p<0.1

Appendix A. Complete results

Table A1. Complete results using total unemployment. Regional Panel Data. 1981-2004

	(1)	(2)	(3)	(4)	(5)
VARIABLES	Completion	Completion	Completion	Completion	Completion
Pct regional unemploymemt, t	-0.861***	0.655**	0.964***	0.696**	0.882***
	(0.303)	(0.301)	(0.318)	(0.314)	(0.331)
Pct regional unemployment, t+1				-0.136	-0.0454
				(0.321)	(0.315)
Pct regional unemployment, t+2				0.357	0.405
				(0.294)	(0.307)
Pct regional unemployment, t+3				-0.405	-0.0453
				(0.265)	(0.285)
Pct of regional population aged 15-24	-0.121	1.147***	0.675	1.143***	0.667
	(0.308)	(0.250)	(0.416)	(0.249)	(0.417)
Popualtion	-4.64e-07	1.01e-05	9.92e-05	1.10e-05	0.000104
	(1.12e-05)	(3.38e-05)	(0.000136)	(3.39e-05)	(0.000141)
High school education share	75.74***	23.43***	19.85***	23.17***	19.70***
	(7.577)	(4.502)	(4.427)	(4.501)	(4.446)
Bachelor degree share	50.92***	35.39***	41.40***	35.25***	41.15***
	(6.185)	(6.905)	(6.357)	(6.902)	(6.273)
Master or doctoral degree share	103.9***	49.45***	47.35***	49.03***	47.65***
	(10.03)	(8.325)	(10.09)	(8.444)	(10.14)
First generation immigrants share	-4.029	-13.00	-21.30	-11.95	-21.43
	(27.63)	(15.85)	(18.72)	(15.68)	(18.83)
Second generation immigrants share	36.56	-1.336	19.15	-1.282	20.41
	(33.16)	(22.65)	(34.89)	(22.66)	(35.48)
Girl share	6.747	5.801	5.601	5.899*	5.808
	(4.205)	(3.522)	(3.740)	(3.521)	(3.755)
Cohort size	-0.000414	0.000894	0.00113	0.000941	0.00115
	(0.000917)	(0.00142)	(0.00146)	(0.00139)	(0.00147)
Constant	-2.011	8.970	-1,818***	9.556	-1,874***
	(7.316)	(5.821)	(149.7)	(5.991)	(156.1)
Cohort fixed effects	Yes	Yes	Yes	Yes	Yes
Regional fixed effects	No	Yes	Yes	Yes	Yes
Linear regional trends	No	No	Yes	No	Yes
Observations	2,160	2,160	2,160	2,160	2,160
R-squared	0.707	0.834	0.854	0.835	0.855

Note: Robust standard errors in parentheses *** p<0.01, ** p<0.05, * p<0.1

Table A2. Complete results using youth unemployment. Regional Panel Data. 1981-2004

VARIABLES	(1) Completion	(2) Completion	(3) Completion	(4) Completion	(5) Completion
Pct regional youth unemloyment, t	-0.562***	0.422**	0.112	0.331	0.129
	(0.203)	(0.201)	(0.226)	(0.209)	(0.248)
Pct regional youth unemloyment, t+1				0.00383	-0.0206
				(0.197)	(0.222)
Pct regional youth unemloyment, t+2				0.237	0.225
				(0.218)	(0.241)
Pct regional youth unemloyment, t+3				0.113	-0.00143
				(0.219)	(0.273)
Pct of regional population aged 15-24	0.472	1.350***	1.040	1.311***	1.024
	(0.332)	(0.388)	(0.709)	(0.406)	(0.715)
Popualtion	-1.06e-05	6.59e-05	-0.000357*	6.57e-05	-0.000422*
	(1.09e-05)	(6.25e-05)	(0.000204)	(6.17e-05)	(0.000222)
High school education share	92.12***	17.69***	21.39***	17.69***	21.17***
	(9.276)	(4.955)	(5.529)	(5.008)	(5.591)
Bachelor degree share	60.74***	36.56***	45.85***	36.13***	45.53***
	(7.667)	(6.953)	(7.467)	(6.810)	(7.254)
Master or doctoral degree share	111.8***	39.62***	43.90***	39.85***	43.79***
	(11.48)	(11.98)	(13.07)	(11.95)	(13.07)
First generation immigrants share	27.20	-9.010	-9.226	-8.647	-8.507
	(22.55)	(13.32)	(14.79)	(13.23)	(14.96)
Second generation immigrants share	38.94	6.991	10.41	6.957	8.699
	(26.77)	(36.64)	(41.30)	(35.71)	(41.85)
Girl share	10.21**	4.647	3.687	4.831	3.796
	(4.861)	(4.023)	(4.519)	(3.966)	(4.518)
Cohort size	0.00107	0.000749	-0.000153	0.000409	-0.000384
	(0.000977)	(0.00144)	(0.00153)	(0.00146)	(0.00158)
Constant	-14.63	21.80***	-396.8	20.17***	-599.5
	(9.938)	(6.987)	(373.3)	(6.843)	(515.7)
Cohort fixed effects	Yes	Yes	Yes	Yes	Yes
Regional fixed effects	Yes	Yes	Yes	Yes	Yes
Linear regional trends	No	No	Yes	No	Yes
Observations	1,350	1,350	1,350	1,350	1,350
R-squared	0.410	0.701	0.738	0.702	0.738

Note: Robust standard errors in parentheses *** p<0.01, ** p<0.05, * p<0.1

Table A3. Complete estimation results using asymmetric unemployment. Regional panel data. Period 1981-2004.

VARIABLES	(1) Regional completion rate
Pct regional unemployment (high), t	0.669**
	(0.295)
Pct regional unemployment (low), t	0.744**
	(0.321)
Pct of regional population aged 15-24	1.143***
	(0.247)
Population	1.30e-05
	(3.34e-05)
High school education share	23.36***
	(4.412)
Bachelor Degree share	35.45***
	(6.770)
Master or doctoral degree share	49.41***
	(8.138)
First generation immigrants share	-12.54
	(15.43)
Second generation immigrants share	-1.963
	(22.39)
Girl share	5.801*
	(3.454)
Cohort size	0.00127
	(0.00139)
Constant	7.606
	(6.226)
Cohort fixed effects	Yes
Regional fixed effects	Yes
Linear regional trends	No
Observations	2,160
F-statistics (p-value)	0.52 (0.4726)

Note: Robust standard errors in parentheses *** p<0.01, ** p<0.05, * p<0.1

Table A4. Complete results. Regional Panel Data. 1981-1993

	(1)	(2)	(3)	(4)	(5)
VARIABLES	Compeltion	Compeltion	Completion	Completion	Completion
Pct regional unemploymemt, t	-0.0955	0.811**	0.750**	0.819**	0.775**
	(0.318)	(0.375)	(0.288)	(0.378)	(0.378)
Pct regional unemployment, t+1				0.0113	0.137
				(0.387)	(0.398)
Pct regional unemployment, t+2				-0.00997	0.198
				(0.420)	(0.448)
Pct regional unemployment, t+3				-0.211	0.265
				(0.311)	(0.316)
Pct of regional population aged 15-24	-1.365***	-0.0637	-0.154	-0.0671	-0.118
	(0.393)	(0.572)	(0.604)	(0.568)	(0.609)
Popualtion	4.67e-07	-0.000165	6.26e-05	-0.000156	2.54e-05
	(1.12e-05)	(0.000114)	(0.000153)	(0.000115)	(0.000156)
High school education share	64.94***	24.15***	21.55***	23.95***	21.20***
	(6.095)	(6.150)	(5.566)	(6.137)	(5.619)
Bachelor degree share	58.88***	39.40***	42.09***	39.31***	42.12***
	(7.520)	(8.733)	(8.496)	(8.716)	(8.335)
Master or doctoral degree share	95.87***	52.92***	44.76***	52.26***	45.40***
	(9.087)	(12.97)	(13.58)	(13.18)	(13.68)
First generation immigrants share	-154.8**	-76.75*	-10.59	-74.65*	-11.58
	(72.55)	(40.75)	(31.65)	(41.02)	(32.87)
Second generation immigrants share	-15.03	-32.14	-3.381	-31.65	0.627
	(85.53)	(55.80)	(74.35)	(54.98)	(74.53)
Girl share	2.711	2.831	1.227	2.733	1.407
	(4.795)	(4.863)	(5.125)	(4.933)	(5.194)
Cohort size	-0.000625	-0.000274	-0.00246	-0.000305	-0.00273
	(0.000903)	(0.00230)	(0.00189)	(0.00225)	(0.00189)
Constant	23.98***	29.64***	-3,277***	30.43***	-3,299***
	(6.770)	(10.71)	(201.0)	(11.12)	(204.7)
Cohort fixed effects	Yes	Yes	Yes	Yes	Yes
Regional fixed effects	No	Yes	Yes	Yes	Yes
Linear regional trends	No	No	Yes	No	Yes
Observations	1,170	1,170	1,170	1,170	1,170
R-squared	0.763	0.864	0.900	0.864	0.900

Note: Robust standard errors in parentheses *** p<0.01, ** p<0.05, * p<0.1

Table A5. Complete results. Regional Panel Data. 1994-2004

	(1)	(2)	(3)	(4)	(5)
VARIABLES	Compeltion	Compeltion	Completion	Completion	Completion
Pct regional unemploymemt, t	-1.684***	1.167**	0.0729	0.846	0.295
	(0.458)	(0.458)	(0.516)	(0.518)	(0.610)
Pct regional unemployment, t+1				-0.0773	-0.815
				(0.479)	(0.550)
Pct regional unemployment, t+2				1.202*	0.632
				(0.627)	(0.632)
Pct regional unemployment, t+3				0.242	-0.796
				(0.696)	(0.744)
Pct of regional population aged 15-24	0.981***	2.194**	2.046	2.025**	2.203
	(0.349)	(0.842)	(1.349)	(0.806)	(1.377)
Popualtion	-5.94e-06	-2.48e-05	0.000365	-4.45e-05	0.000388
	(1.33e-05)	(9.44e-05)	(0.000416)	(9.29e-05)	(0.000435)
High school education share	90.41***	19.69***	17.75**	18.69**	17.73**
	(8.437)	(7.249)	(7.233)	(7.156)	(7.252)
Bachelor degree share	60.81***	40.69***	38.51***	40.29***	38.50***
	(8.725)	(8.679)	(8.419)	(8.240)	(8.507)
Master or doctoral degree share	108.0***	36.66**	41.41***	35.94**	41.85***
	(11.05)	(14.10)	(14.31)	(13.99)	(14.31)
First generation immigrants share	59.11***	-7.154	0.569	-7.824	0.0584
	(21.50)	(13.85)	(15.23)	(13.68)	(15.30)
Second generation immigrants share	27.11	-50.09	-39.57	-54.88	-40.03
	(24.08)	(38.19)	(48.57)	(38.40)	(48.58)
Girl share	11.28*	10.84**	14.74***	11.68**	15.42***
	(5.866)	(4.596)	(4.601)	(4.519)	(4.577)
Cohort size	0.000873	0.00435*	0.00447	0.00485*	0.00449
	(0.00115)	(0.00258)	(0.00309)	(0.00260)	(0.00310)
Constant	-17.48*	8.931	878.8	8.444	993.0
	(9.276)	(11.62)	(660.8)	(11.01)	(684.5)
Cohort fixed effects	Yes	Yes	Yes	Yes	Yes
Regional fixed effects	No	Yes	Yes	Yes	Yes
Linear regional trends	No	No	Yes	No	Yes
Observations	990	990	990	990	990
R-squared	0.442	0.731	0.780	0.734	0.781

Note: Robust standard errors in parentheses *** p<0.01, ** p<0.05, * p<0.1

Table A6. Complete results using students enrolled autumn after completing compulsory schooling. Regional Panel Data. 1981-2004

	(1)	(2)	(3)	(4)	(5)	(6)
VARIABLES	Completion	Completion	Completion	Completion	Completion	Completion
Pct regional unemploymemt, t	-0.755**	0.636**	0.845***	0.671**	0.788**	0.789**
	(0.302)	(0.303)	(0.319)	(0.333)	(0.340)	(0.341)
Pct regional unemployment, t+1				-0.227	-0.177	-0.166
				(0.428)	(0.410)	(0.412)
Pct regional unemployment, t+2				0.304	0.596*	0.556
				(0.307)	(0.334)	(0.351)
Pct regional unemployment, t+3						0.0492
						(0.294)
Pct of regional population aged 15-24	0.204	1.369***	0.800*	1.377***	0.786*	0.786*
	(0.314)	(0.233)	(0.416)	(0.235)	(0.418)	(0.418)
Popualtion	-1.41e-05	-6.74e-06	2.82e-05	-7.88e-06	3.56e-05	3.60e-05
	(1.06e-05)	(3.87e-05)	(0.000112)	(3.88e-05)	(0.000119)	(0.000119)
High school education share	68.14***	22.52***	20.60***	22.63***	20.41***	20.41***
	(7.279)	(4.464)	(4.504)	(4.475)	(4.589)	(4.583)
Bachelor degree share	42.51***	35.42***	43.09***	35.37***	42.75***	42.75***
	(6.659)	(6.224)	(5.978)	(6.207)	(5.896)	(5.898)
Master or doctoral degree share	91.13***	53.74***	50.44***	53.98***	50.78***	50.81***
	(9.344)	(8.796)	(10.01)	(8.797)	(10.03)	(10.03)
First generation immigrants share	11.14	11.73	-7.712	11.10	-8.074	-8.209
	(28.11)	(14.82)	(18.03)	(15.05)	(18.30)	(18.32)
Second generation immigrants share	42.06	15.44	8.583	14.85	10.86	11.04
	(33.96)	(26.08)	(33.50)	(26.22)	(34.44)	(34.61)
Girl share	10.95**	4.331	5.712	4.375	5.832	5.823
	(4.333)	(3.420)	(3.644)	(3.453)	(3.658)	(3.656)
Cohort size	0.00110	0.00375***	0.00265**	0.00373***	0.00268**	0.00268**
	(0.000933)	(0.00120)	(0.00132)	(0.00121)	(0.00134)	(0.00134)
Constant	4.453	14.90**	-1,215***	14.21**	-1,306***	-1,310***
	(7.238)	(5.802)	(149.2)	(5.949)	(155.6)	(156.1)
Cohort fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Regional fixed effects	No	Yes	Yes	Yes	Yes	Yes
Linear regional trends	No	No	Yes	No	Yes	Yes
Observations	2,160	2,160	2,160	2,160	2,160	2,160
R-squared	0.507	0.699	0.739	0.699	0.740	0.740

Note: Robust standard errors in parentheses *** p<0.01, ** p<0.05, * p<0.1

Table A7. Complete results using students enrolled in academic study tracks. Regional Panel Data. 1981-2004

VARIABLES	(1) Completion	(2) Completion	(3) Completion	(4) Completion	(5) Completion	(6) Completion
Pct regional unemploymemt, t	-0.640*	0.225	0.350	-0.192	-0.0793	-0.0780
	(0.334)	(0.328)	(0.413)	(0.455)	(0.496)	(0.496)
Pct regional unemployment, t+1				0.190	0.294	0.314
				(0.547)	(0.544)	(0.548)
Pct regional unemployment, t+2				0.683**	0.856**	0.778
				(0.332)	(0.372)	(0.473)
Pct regional unemployment, t+3						0.0965
						(0.391)
Pct of regional population aged 15-24	-0.0680	0.741**	0.553	0.775**	0.528	0.527
	(0.389)	(0.326)	(0.612)	(0.332)	(0.610)	(0.610)
Popualtion	-2.31e-05**	-7.39e-07	-1.69e-05	-8.16e-06	-8.45e-07	2.30e-07
	(9.75e-06)	(3.80e-05)	(0.000105)	(3.92e-05)	(0.000119)	(0.000120)
High school education share	60.90***	22.92***	19.53***	23.44***	19.69***	19.72***
	(7.974)	(3.918)	(3.917)	(3.883)	(3.891)	(3.860)
Bachelor degree share	56.12***	34.91***	34.04***	35.19***	33.88***	33.90***
	(6.743)	(5.502)	(5.253)	(5.487)	(5.238)	(5.221)
Master or doctoral degree share	70.69***	41.52***	37.07***	42.45***	37.52***	37.55***
	(9.121)	(5.916)	(6.353)	(5.956)	(6.347)	(6.339)
First generation immigrants share	27.05	28.17**	16.38	27.88**	16.58	16.40
	(18.35)	(11.37)	(13.20)	(11.63)	(13.58)	(13.43)
Second generation immigrants share	32.41	21.31	-0.992	19.35	1.176	1.239
	(30.14)	(20.56)	(26.34)	(20.74)	(27.56)	(27.57)
Girl share	11.67***	8.089***	7.192***	8.149***	7.236***	7.221***
	(3.258)	(2.470)	(2.489)	(2.487)	(2.505)	(2.511)
Cohort size	0.00107	0.00285	0.00230	0.00278	0.00232	0.00231
	(0.000901)	(0.00186)	(0.00191)	(0.00187)	(0.00195)	(0.00195)
Constant	33.16***	52.34***	740.4***	49.59***	580.4***	571.1***
	(7.970)	(6.171)	(216.8)	(6.383)	(210.5)	(214.0)
Cohort fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Regional fixed effects	No	Yes	Yes	Yes	Yes	Yes
Linear regional trends	No	No	Yes	No	Yes	Yes
Observations	2,160	2,160	2,160	2,160	2,160	2,160
R-squared	0.284	0.503	0.545	0.505	0.547	0.547

Note: Robust standard errors in parentheses *** p<0.01, ** p<0.05, * p<0.1

Table A8. Complete results using students enrolled in vocational study tracks. Regional Panel Data. 1981-2004

VARIABLES	(1) Completion	(2) Completion	(3) Completion	(4) Completion	(5) Completion	(6) Completion
Pct regional unemploymemt, t	-1.305***	0.476	1.025**	0.729**	1.061***	1.063***
	(0.449)	(0.431)	(0.439)	(0.360)	(0.383)	(0.382)
Pct regional unemployment, t+1				-0.238	-0.202	-0.155
				(0.461)	(0.433)	(0.434)
Pct regional unemployment, t+2				-0.201	0.327	0.149
				(0.431)	(0.465)	(0.504)
Pct regional unemployment, t+3						0.221
						(0.411)
Pct of regional population aged 15-24	0.629*	1.925***	0.532	1.912***	0.523	0.521
	(0.374)	(0.365)	(0.475)	(0.357)	(0.477)	(0.479)
Popualtion	-1.93e-05	5.94e-05	-6.80e-05	6.30e-05	-6.56e-05	-6.40e-05
	(1.98e-05)	(5.91e-05)	(0.000139)	(5.96e-05)	(0.000143)	(0.000143)
High school education share	48.63***	19.90***	17.56***	19.86***	17.48***	17.47***
	(5.760)	(4.143)	(3.627)	(4.188)	(3.596)	(3.604)
Bachelor degree share	24.65***	32.76***	38.72***	32.78***	38.52***	38.49***
	(7.577)	(7.066)	(6.640)	(7.101)	(6.523)	(6.531)
Master or doctoral degree share	71.98***	63.87***	57.86***	63.91***	57.48***	57.50***
	(15.10)	(15.07)	(14.46)	(15.09)	(14.54)	(14.49)
First generation immigrants share	-7.445	-7.686	-13.90	-7.559	-13.94	-14.15
	(25.00)	(13.79)	(15.44)	(13.84)	(15.46)	(15.50)
Second generation immigrants share	28.99	4.639	9.631	5.136	10.81	11.55
	(46.53)	(28.64)	(36.41)	(28.72)	(36.29)	(36.57)
Girl share	6.016	2.883	5.351*	2.975	5.349*	5.331*
	(4.125)	(2.864)	(2.744)	(2.887)	(2.747)	(2.754)
Cohort size	0.00153	0.00121	0.00242	0.00125	0.00245	0.00244
	(0.00157)	(0.00223)	(0.00163)	(0.00223)	(0.00164)	(0.00164)
Constant	-4.423	-12.79*	-2,542***	-11.91*	-2,586***	-2,606***
	(7.148)	(6.537)	(170.6)	(6.635)	(180.4)	(180.2)
Cohort fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Regional fixed effects	No	Yes	Yes	Yes	Yes	Yes
Linear regional trends	No	No	Yes	No	Yes	Yes
Observations	2,160	2,160	2,160	2,160	2,160	2,160
R-squared	0.570	0.724	0.776	0.724	0.776	0.776

Note: Robust standard errors in parentheses *** p<0.01, ** p<0.05, * p<0.1

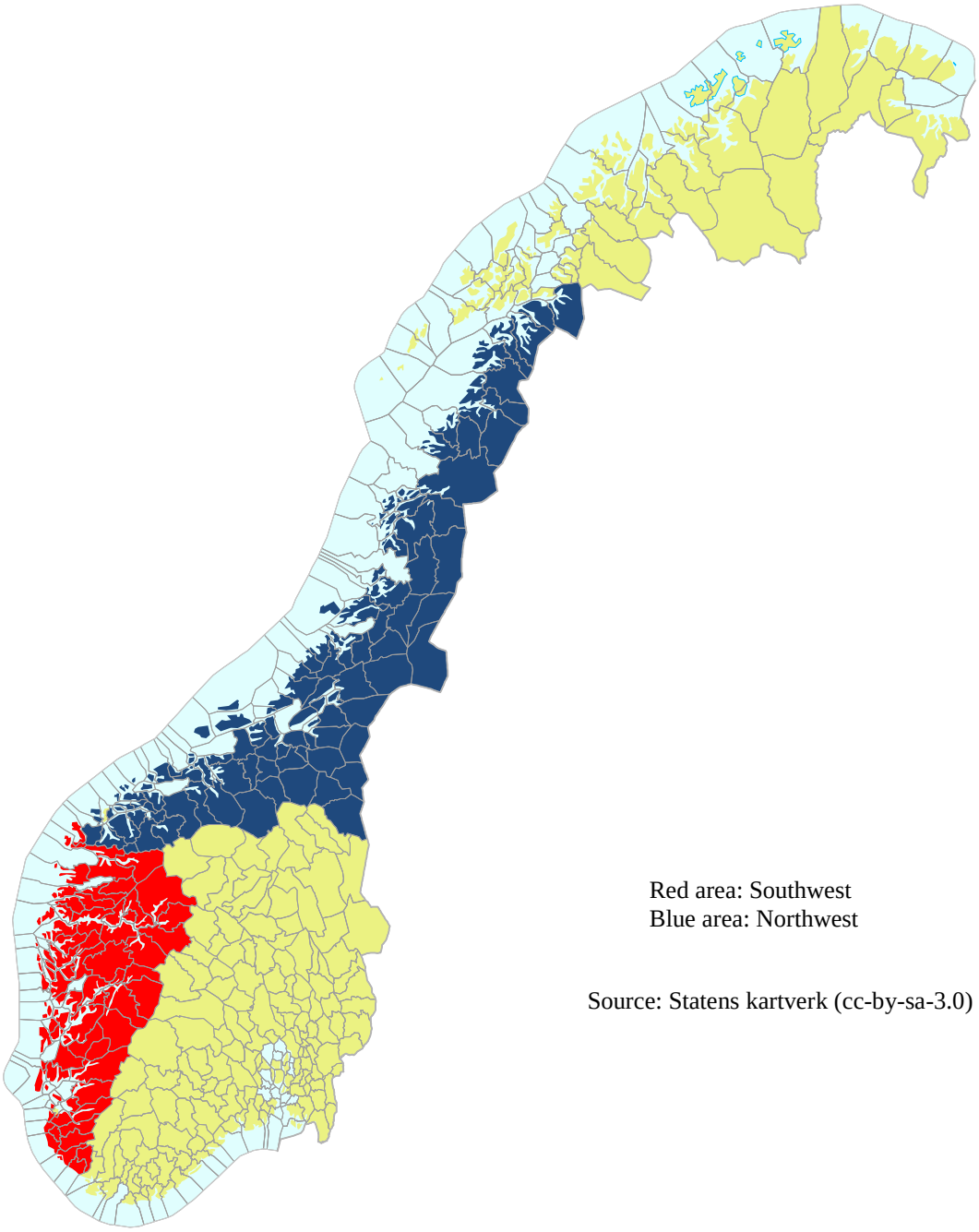

Figure 1: Labor market regions in Norway exposed for investments in petroleum sector. The red area consists of the counties, Rogaland, Hordaland and Sogn –og Fjordane (regions 41-53). Thie red area was exposed for investments in the whole period (1981-2004). The blue area consists of the counties Møre –og Romsdal, Sør-Trøndelag, Nord-Trøndelag, and parts of Nordland (regions 54-79). The blue area was exposed for investments in the period 1990-2004. Source: Norwegian Mapping Authority (cc-by-sa-3.0).

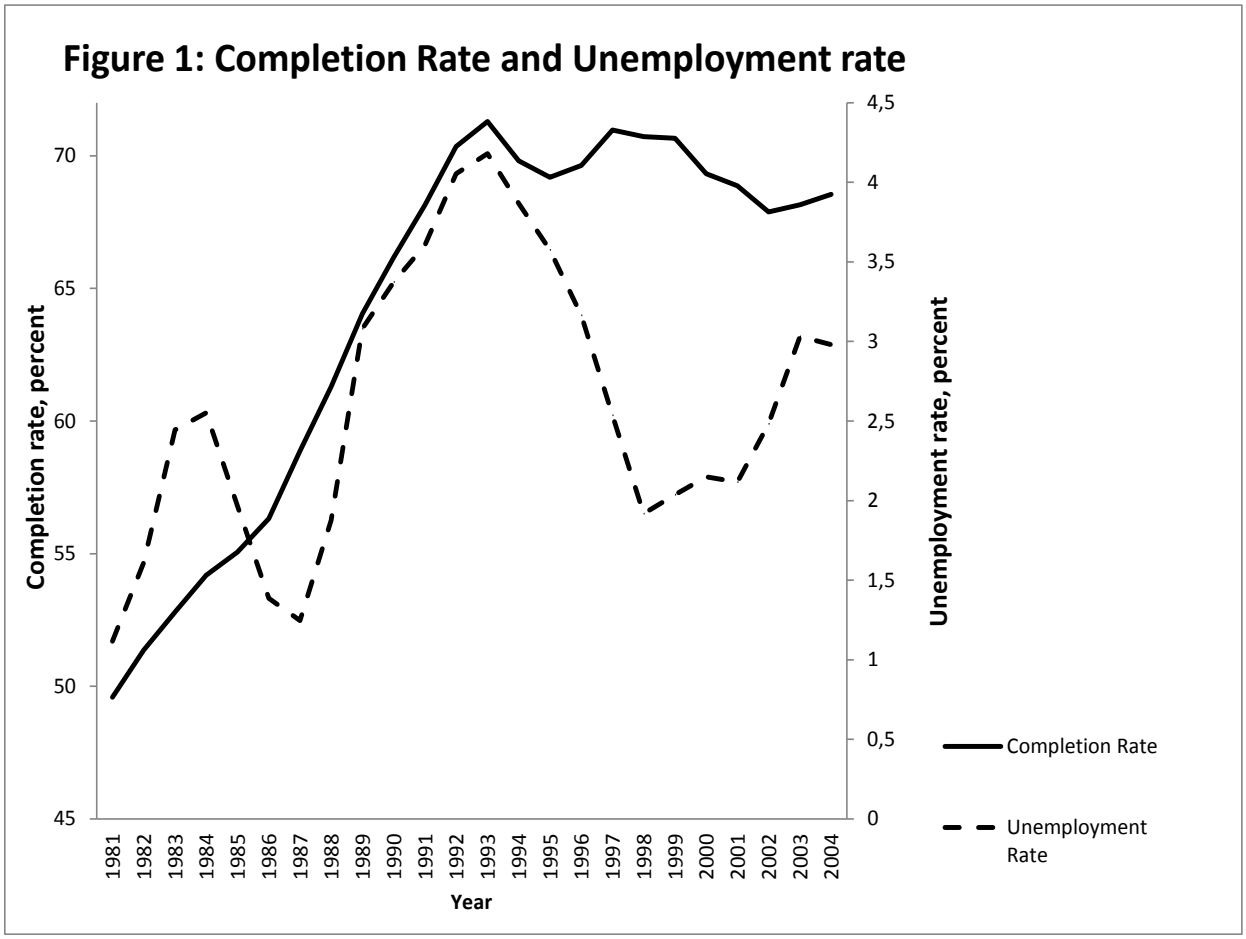
Figure 1: Completion Rate and Unemployment rate
Completion rate, percent
Unemployment rate, percent
Year
Completion Rate
Unemployment Rate
70
65
60
55
50
45
4,5
4
3,5
3
2,5
2
1,5
1
0,5
0
1981
1982
1983
1984
1985
1986
1987
1988
1989
1990
1991
1992
1993
1994
1995
1996
1997
1998
1999
2000
2001
2002
2003
2004